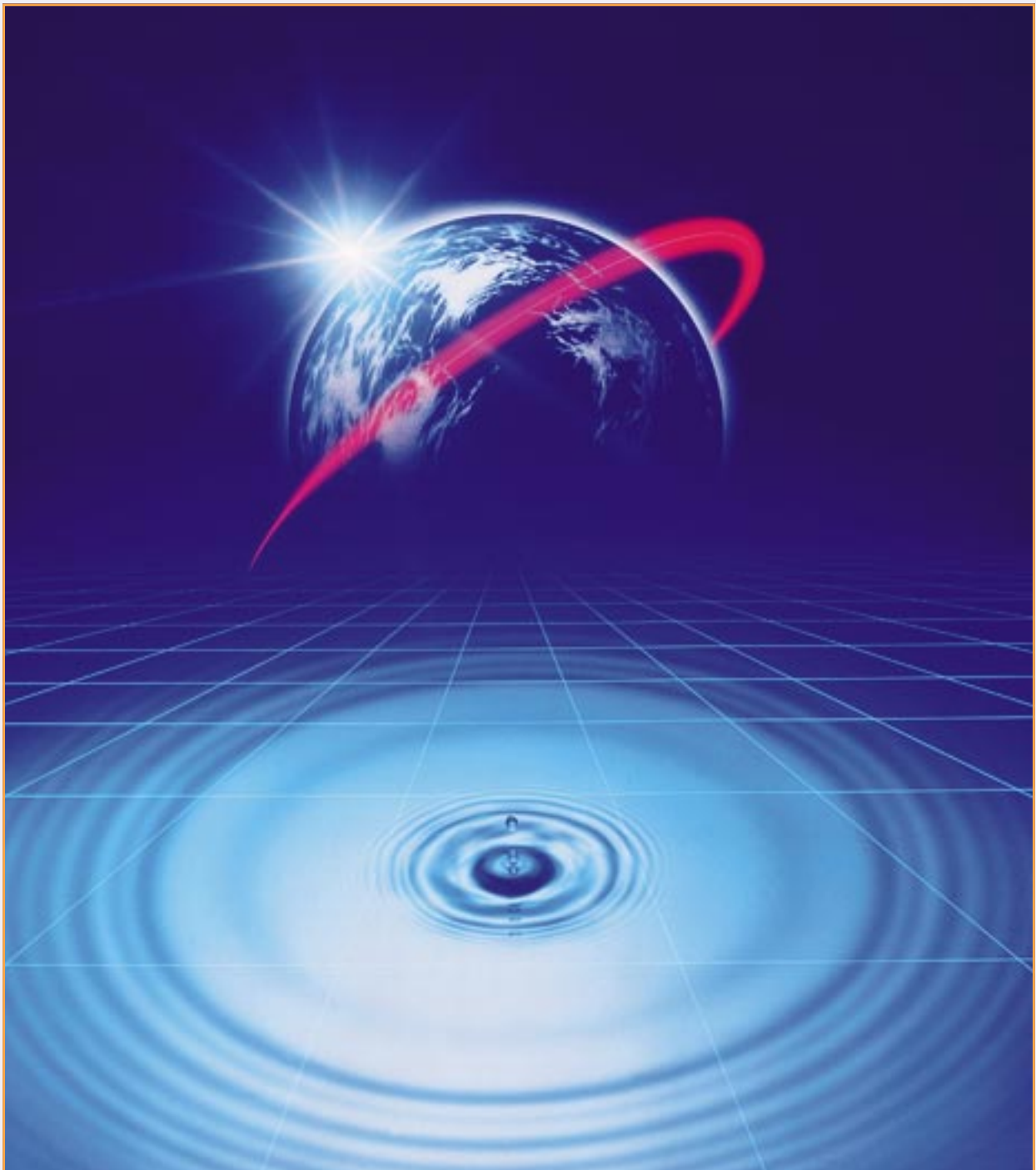


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# SMALL-SIGNAL MOS FET SERIES



# Signal MOS FET

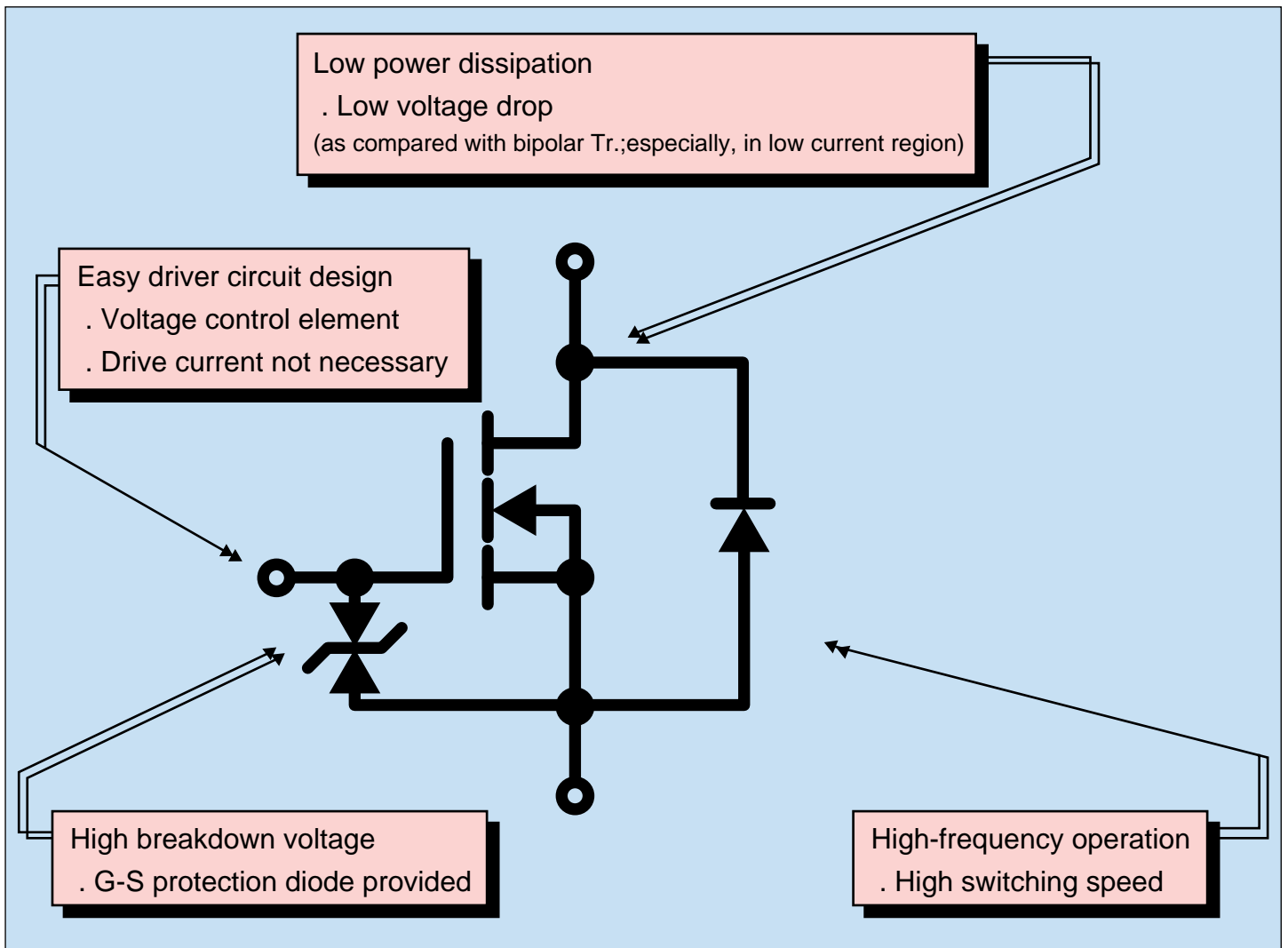
## A wide line-up from small-signal interface applications to semi-power switching applications

Small-signal MOS FETs have been increasingly employed mainly in portable systems as high-performance switching elements that supersede the existing bipolar transistors.

Like power MOS FETs, these small-signal MOS FETs can improve their chip performances and are expected to grow rapidly in future as the market of portable systems expands.

NEC recognized their marketability and started development and marketing of small-signal MOS FETs from the very beginning, and now provide many variations. Use this Selection Guide when you select the one best-suited to your application from these variations.

### FEATURES



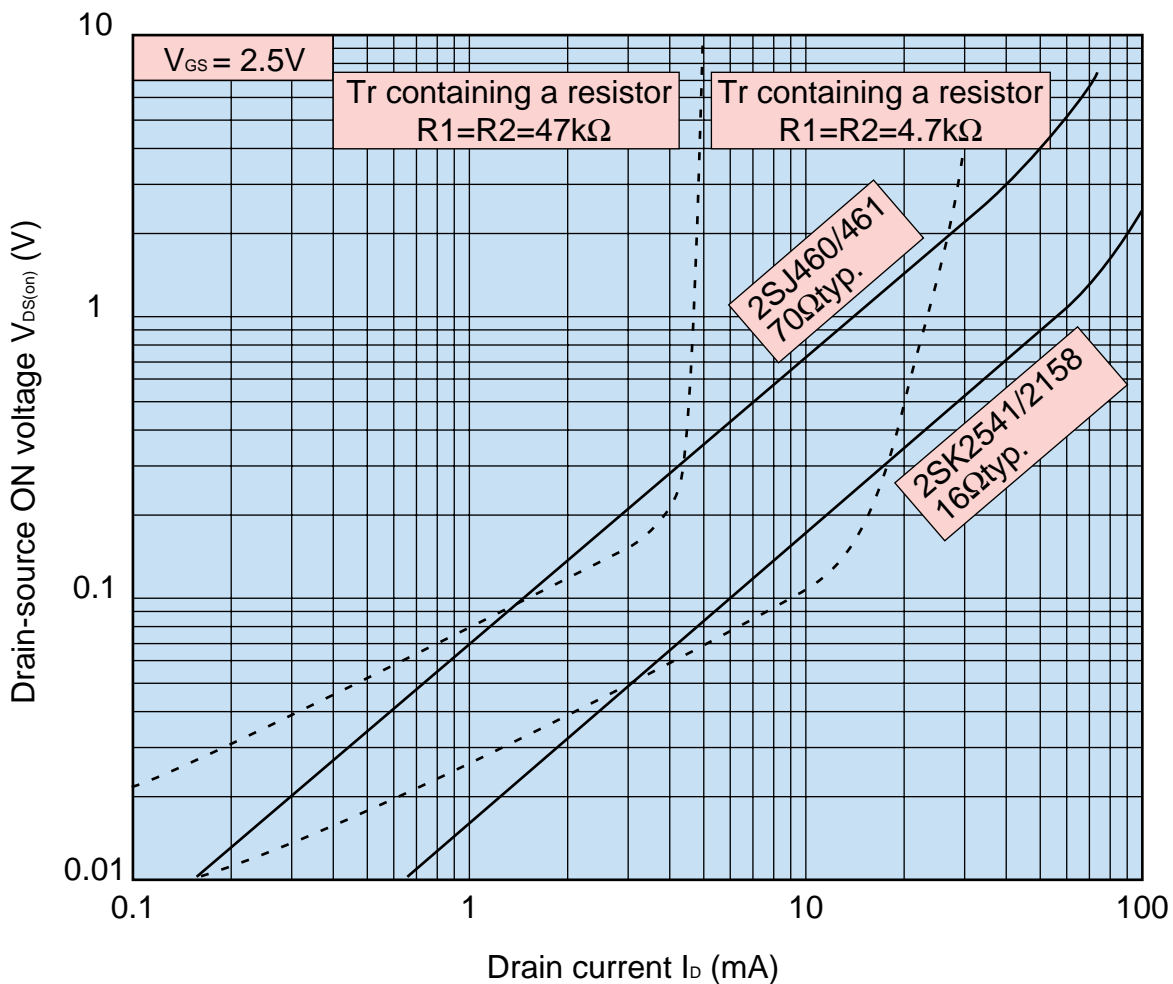
- The protection diode provided between the gate and source protects the MOS FET from the effects of static electricity. If there is a possibility that a voltage higher than that rated will be applied to the MOS FET under the actual operating conditions, provide an external protection circuit.
- A parasitic diode is formed between the drain and source due to the structure of the MOS FET.

## Example Comparing Characteristics with a Transistor Containing a Resistor

The ON resistance of a MOS FET is almost independent of the current and shows almost a straight curve in the region lower than the rated current of the MOS FET. Therefore, in applications, such as interfacing small signals, where the MOS FET is used in a low current region, the MOS FET can smoothly replace the existing transistors containing resistors.

The figure below compares the characteristics of a representative transistor containing a resistor with those of a small-signal MOS FET ideal for replacing the transistor. This figure indicates that the characteristics of the signal MOS FET are almost equivalent to those of the transistor containing a resistor in the region below several mA.

### Comparison of ON Voltage between Tr Containing a Resistor and MOS FET



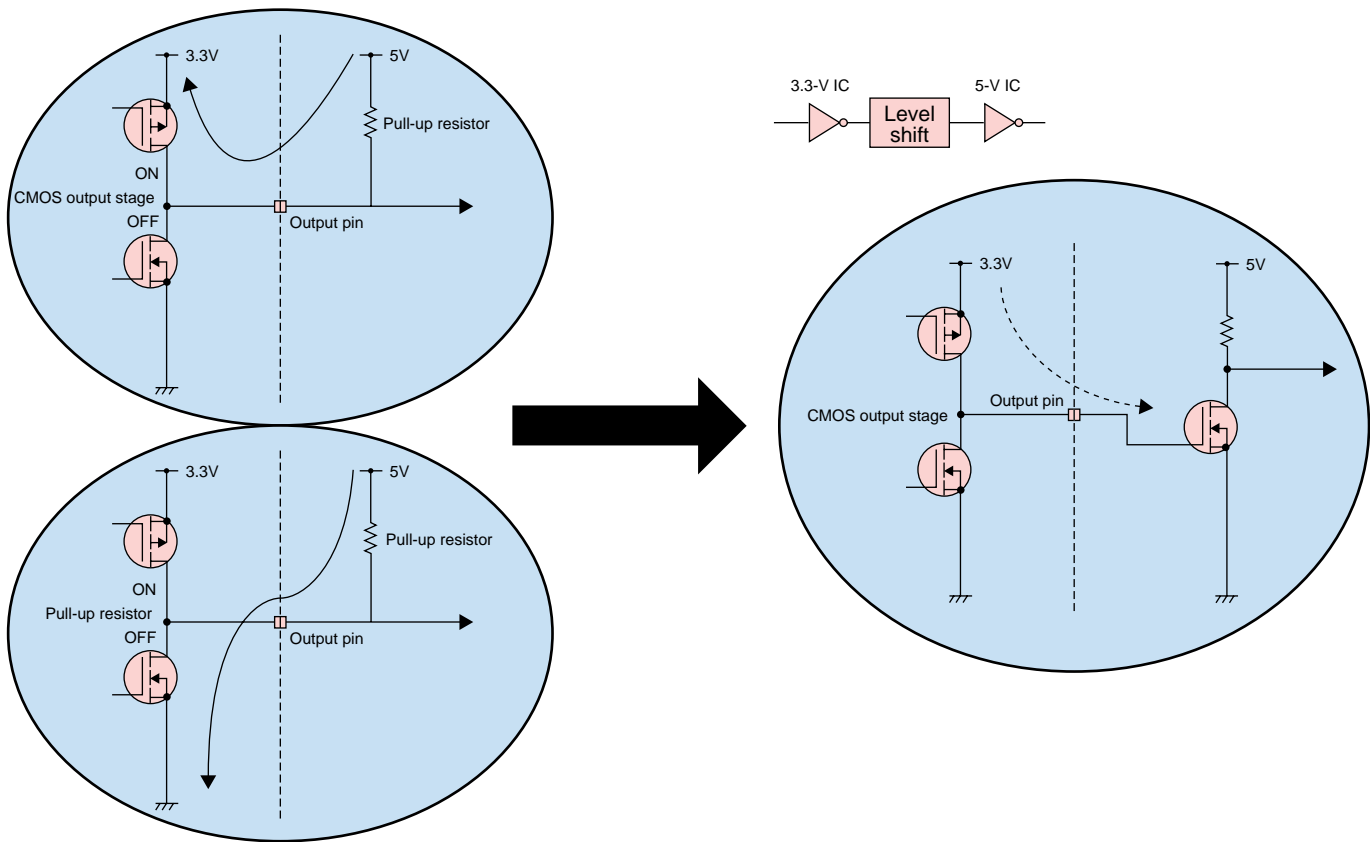
# Signal MOS FET

## Application Example of Small-Signal MOS FET

As an example of an application circuit using the small-signal MOS FET, a level shift circuit where both 3.3-V and 5-V ICs are used together.

In a level shift circuit using only pull-up resistors, the resistance must be set to a high level in order to suppress the current flowing into and out of the CMOS output stage of an IC.

As a result, the switching speed of the next input stage slows down. If a small-signal MOS FET is inserted as a buffer in this case, favorable switching characteristics can be obtained by decreasing the pull-up resistance while suppressing the current of the CMOS output stage.



## Compatibility between Small-Signal Transistor and MOS FET

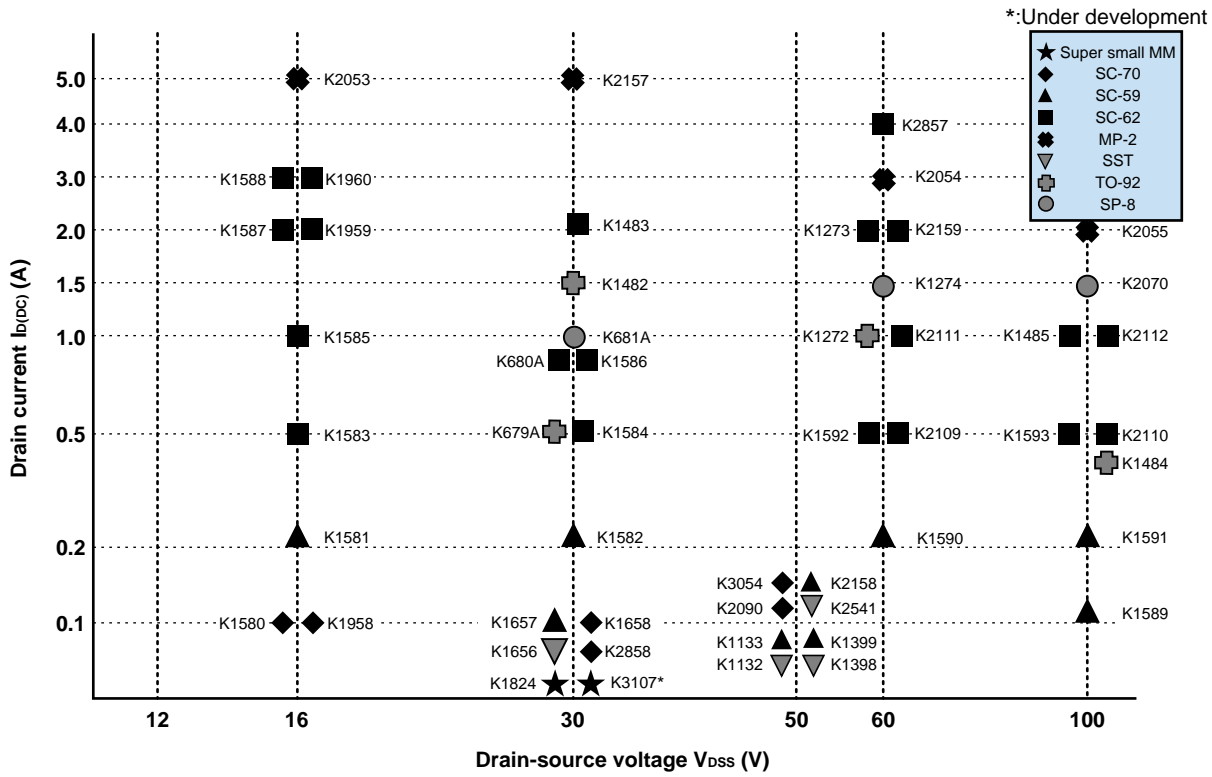
The following table shows the compatibility of the general-purpose type MOS FET that is mainly used for applications, such as small-signal interfacing, and that has basic characteristics and package almost equivalent to those of the bipolar transistor.

\*:Under development

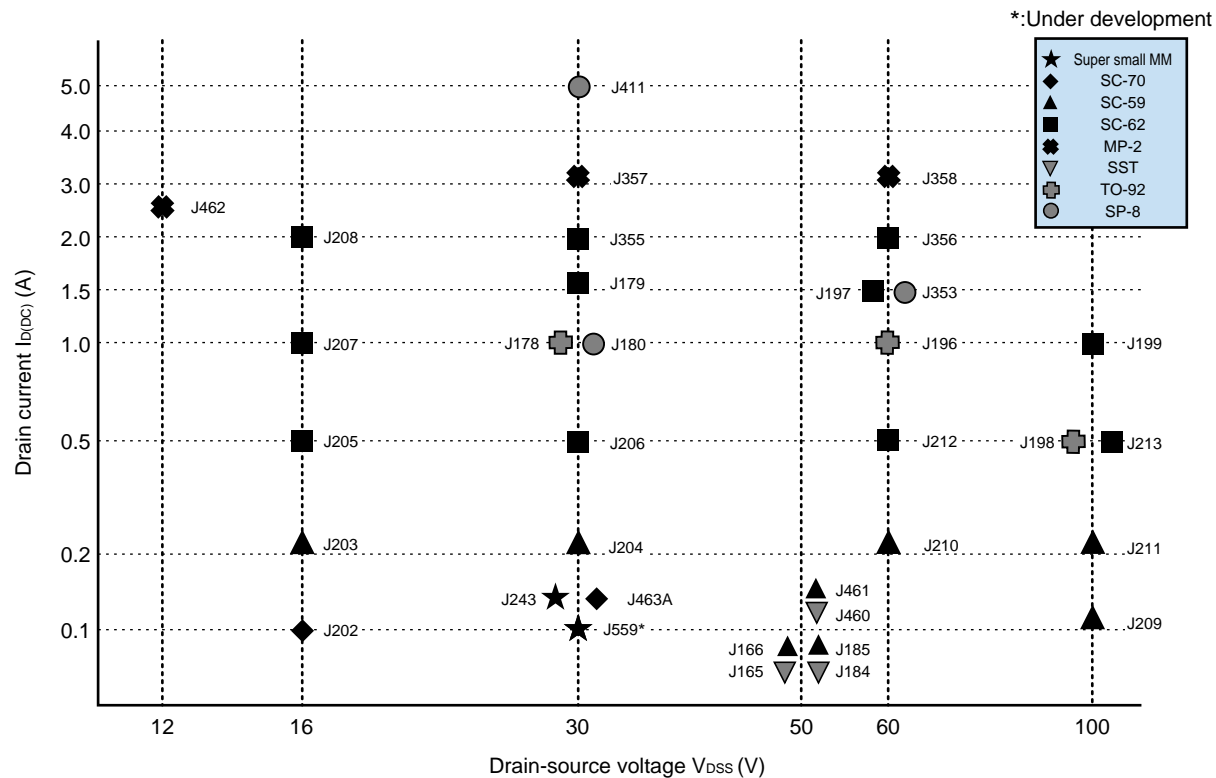
Polarity	Package	Compatible Model		MOS FET	Remark	
		Bip Tr				
		General-purpose Tr	Tr containing a resistor			
NPN Nch	TO-92	2SC945	AA1「J」series	2SK1132		
	SST	2SC2785	BA1「J」series	2SK1398	2.5-V drive type	
				2SK1656	Low leak type	
			2SK2541		2SK2541	1.5-V drive type
	SC-59	2SC1623	FA1「J」series	2SK1133	2.5-V drive type	
				2SK1399	Low leak type	
			2SK1657	1.5-V drive type		
			2SK2158			
SC-70	2SC4177	GA1「J」series	2SK1580	2.5-V drive type		
			2SK1658	Low leak type		
			2SK1958	1.5-V drive type		
			2SK2090	2.5-V drive type		
			2SK2858	2.5-V drive type		
			2SK3054*	2.5-V drive type		
Super small MM	2SC4783	None	2SK1824	2.5-V drive type		
Compound package	μPA500T μPA570T μPA600T/604T μPA670T	None	μPA502T	2.5-V drive type		
			μPA572T			
			μPA602T/606T			
			μPA672T	2.5-V drive type		
PNP Pch	TO-92	2SA733	AN1「J」series	2SJ165		
	SST	2SA1175	BN1「J」series	2SJ184	2.5-V drive type	
				2SJ460	2.5-V drive type	
	SC-59	2SA812	FN1「J」series	2SJ166	2.5-V drive type	
				2SJ185	2.5-V drive type	
				2SJ461	2.5-V drive type	
SC-70	2SA1611	GN1「J」series	2SJ202	2.5-V drive type		
			2SJ463A	2.5-V drive type		
Super small MM	2SA1836	None	2SJ243	2.5-V drive type		
Compound package	μPA501T μPA571T μPA601T/605T μPA671T	None	μPA503T	2.5-V drive type		
			μPA573T			
			μPA603T/607T			
			None			

# Signal MOS FET

## Small-Signal MOS FET Product Map (N-ch type)



## Small-Signal MOS FET Product Map (P-ch type)



# Major Characteristics of Small-Signal MOS-FET (N-ch type)

## ●N-ch type (small-signal system: 0.2 A MAX.)

1: 4-V drive type

Part Number	V <sub>DSS</sub> (V)	V <sub>GSS</sub> (V)	I <sub>D(DC)</sub> (A)	PKG	V <sub>GS(off)</sub> (V)		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =1.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =2.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =4V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =10V		C <sub>iss</sub> (pF)
					MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	
2SK1582	30	20	0.2	SC-59	0.8	1.8					2.2	5	1.4	3	28
2SK1132	50	7	0.1	SST	1.0	2.0					16	50			7
2SK1133	50	7	0.1	SC-59	1.0	2.0					16	50			7
2SK1590	60	20	0.2	SC-59	0.8	1.8					3.2	6	2.4	3	26
2SK1589	100	20	0.1	SC-59	0.8	1.8					19	30	15	25	16
2SK1591	100	20	0.2	SC-59	0.8	1.8					5.8	8	4.8	6.5	25

2: 2.5-V drive type

\*: Under development

Part Number	V <sub>DSS</sub> (V)	V <sub>GSS</sub> (V)	I <sub>D(DC)</sub> (A)	PKG	V <sub>GS(off)</sub> (V)		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =1.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =2.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =4V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =10V		C <sub>iss</sub> (pF)
					MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	
2SK1580	16	16	0.1	SC-70	0.8	1.6			9	15	6	10			18
2SK1581	16	16	0.2	SC-59	0.8	1.6			3.2	5	2.2	3			27
2SK1656	30	7	0.1	SST	0.9	1.5			25	45	18	25			15
2SK2858	30	20	0.1	SC-70	0.8	1.7			5.6	8	3.5	5			10
2SK1657	30	7	0.1	SC-59	0.9	1.5			25	45	18	25			15
2SK1658	30	7	0.1	SC-70	0.9	1.5			25	45	18	25			15
2SK1824	30	7	0.1	Super small MM	0.8	1.5			7	13	5	8			16
2SK1398	50	7	0.1	SST	1.0	2.0			22	40	14	20			8
2SK1399	50	7	0.1	SC-59	1.0	2.0			22	40	14	20			8
2SK2090	50	7	0.1	SC-70	0.7	1.5			20	40	15	20			6
2SK3054	50	7	0.1	SC-70	1.0	2.0			22	40	14	20			8
2SK3107*	30	20	0.1	Super small MM	0.8	1.7			5.6	8	3.5	5			10

3: 1.5-V drive type

Part Number	V <sub>DSS</sub> (V)	V <sub>GSS</sub> (V)	I <sub>D(DC)</sub> (A)	PKG	V <sub>GS(off)</sub> (V)		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =1.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =2.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =4V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =10V		C <sub>iss</sub> (pF)
					MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	
2SK1958	16	7	0.1	SC-70	0.5	1.1	20	50	7	15	5	12			10
2SK2158	50	7	0.1	SC-59	0.5	1.1	32	50	16	20	12	15			6
2SK2541	50	7	0.1	SST	0.5	1.1	32	50	16	20	12	15			6

## ●N-ch type (semi-power system: 0.5 A MIN.)

1: 4-V drive type

Part Number	V <sub>DSS</sub> (V)	V <sub>GSS</sub> (V)	I <sub>D(DC)</sub> (A)	PKG	V <sub>GS(off)</sub> (V)		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =1.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =2.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =4V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =10V		C <sub>iss</sub> (pF)
					MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	
2SK679A	30	20	0.5	TO-92	1.0	2.5					0.6	1	0.4	0.7	130
2SK1584	30	20	0.5	SC-62	1.3	2.5					1.2	2	0.65	1.5	60
2SK681A	30	20	1	SP-8	1.0	2.5					0.6	1	0.4	0.7	130
2SK1586	30	20	1	SC-62	1.3	2.5					0.3	1	0.2	0.6	170
2SK680A	30	20	1	SC-62	1.0	2.5					0.6	1	0.4	0.7	130
2SK1482	30	20	1.5	TO-92	1.3	2.5					0.4	0.8	0.15	0.4	230
2SK1483	30	20	2	SC-62	1.3	2.5					0.4	0.8	0.15	0.4	230
2SK2157	30	20	5	MP-2	1.5	2.5					0.09	0.15	0.06	0.1	650
2SK1592	60	20	0.5	SC-62	0.8	2.0					1.6	2.5	1.2	2	52
2SK2109	60	20	0.5	SC-62	0.8	2.0					0.55	1	0.41	0.8	111
2SK1272	60	20	1	TO-92	1.0	2.5					0.31	1	0.24	0.65	220
2SK2111	60	20	1	SC-62	0.8	2.0					0.32	0.6	0.24	0.45	170
2SK1274	60	20	1.5	SP-8	1.0	2.5					0.31	1	0.24	0.65	220
2SK1273	60	20	2	SC-62	1.0	2.5					0.31	1	0.24	0.65	220
2SK2054	60	20	3	MP-2	0.8	2.0					0.18	0.25	0.15	0.2	530
2SK2857	60	20	4	SC-62	1.0	2.0					0.15	0.22	0.11	0.15	250
2SK1484	100	20	0.5	TO-92	0.8	2.0					0.6	1.2	0.5	0.8	230
2SK1593	100	20	0.5	SC-62	0.8	2.0					4	6	3.4	5	55
2SK2110	100	20	0.5	SC-62	0.8	2.0					0.95	1.5	0.82	1.2	100
2SK1485	100	20	1	SC-62	0.8	2.0					0.6	1.2	0.5	0.8	230
2SK2112	100	20	1	SC-62	0.8	2.0					0.58	1.2	0.5	0.8	178
2SK2070	100	20	1.5	SP-8	0.8	2.0					0.28	0.45	0.24	0.35	530
2SK2055	100	20	2	MP-2	0.8	2.0					0.28	0.45	0.24	0.35	530

2: 2.5-V drive type

Part Number	V <sub>DSS</sub> (V)	V <sub>GSS</sub> (V)	I <sub>D(DC)</sub> (A)	PKG	V <sub>GS(off)</sub> (V)		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =1.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =2.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =4V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =10V		C <sub>iss</sub> (pF)
					MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	
2SK1583	16	16	0.5	SC-62	0.8	1.6			1.8	2	0.8	1.5			60
2SK1585	16	16	1	SC-62	0.8	1.6			0.6	1.2	0.3	1			116
2SK1587	16	16	2	SC-62	0.8	1.6			0.5	0.8	0.3	0.5			180
2SK1588	16	16	3	SC-62	0.8	1.6			0.25	0.5	0.17	0.3			240

3: 1.5-V drive type

Part Number	V <sub>DSS</sub> (V)	V <sub>GSS</sub> (V)	I <sub>D(DC)</sub> (A)	PKG	V <sub>GS(off)</sub> (V)		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =1.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =2.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =4V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =10V		C <sub>iss</sub> (pF)
					MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	
2SK1959	16	7	2	SC-62	0.5	1.1	0.8	3.2	0.36	0.6	0.28	0.5			160
2SK1960	16	7	3	SC-62	0.5	1.1	0.35	0.8	0.17	0.3	0.12	0.2			370
2SK2053	16	7	5	MP-2	0.5	1.1	0.19	0.4	0.08	0.15	0.06	0.12			730
2SK2159	60	14	2	SC-62	0.5	1.1	0.55	0.7	0.27	0.5	0.22	0.3			319

# Signal MOS FET

## Major Characteristics of Small-Signal MOS-FET (P-ch type)

### ●P-ch type (small-signal system: 0.2 A MAX.)

1: 4-V drive type

Part Number	V <sub>DSS</sub> (V)	V <sub>GSS</sub> (V)	I <sub>D(DC)</sub> (A)	PKG	V <sub>GS(off)</sub> (V)		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =1.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =2.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =4V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =10V		C <sub>iss</sub> (pF)
					MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	
2SJ204	30	20	0.2	SC-59	1.4	2.4					8.5	13	5	8	27
2SJ165	50	7	0.1	SST	1.0	3.0					18	50			18
2SJ166	50	7	0.1	SC-59	1.0	3.0					18	50			18
2SJ210	60	20	0.2	SC-59	1.4	2.4					10	15	6	10	27
2SJ209	100	16	0.1	SC-59	1.5	2.5					60	100	37	60	17
2SJ211	100	20	0.2	SC-59	1.4	2.4					15	30	11	20	27

2: 2.5-V drive type

\*: Under development

Part Number	V <sub>DSS</sub> (V)	V <sub>GSS</sub> (V)	I <sub>D(DC)</sub> (A)	PKG	V <sub>GS(off)</sub> (V)		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =1.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =2.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =4V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =10V		C <sub>iss</sub> (pF)
					MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	
2SJ202	16	7	0.1	SC-70	1.1	2.1			70	100	23	30			18
2SJ203	16	7	0.2	SC-59	1.2	2.2			15	23	7	10			28
2SJ463A	30	20	0.1	SC-70	1.0	1.7			26	60	12	23			10
2SJ243	30	7	0.1	Super small MM	1.6	2.3			55	100	20	25			16
2SJ184	50	7	0.1	SST	1.2	2.0			25	40	13	20			22
2SJ460	50	7	0.1	SST	0.7	1.3			46	100	31	50			6
2SJ185	50	7	0.1	SC-59	1.2	2.0			25	40	13	20			22
2SJ461	50	7	0.1	SC-59	0.7	1.3			46	100	31	50			6
2SJ559*	30	20	0.1	Super small MM	1.0	1.7			26	60	12	23			10

### ●P-ch type (semi-power system: 0.5 A MIN.)

1: 4-V drive type

Part Number	V <sub>DSS</sub> (V)	V <sub>GSS</sub> (V)	I <sub>D(DC)</sub> (A)	PKG	V <sub>GS(off)</sub> (V)		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =1.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =2.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =4V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =10V		C <sub>iss</sub> (pF)
					MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	
2SJ206	30	20	0.5	SC-62	1.0	3.0					2	4	0.8	3	100
2SJ178	30	20	1	TO-92	1.0	3.0					0.8	1.5	0.4	1	210
2SJ180	30	20	1	SP-8	1.0	3.0					0.8	1.5	0.4	1	210
2SJ179	30	20	1.5	SC-62	1.0	3.0					0.8	1.5	0.4	1	210
2SJ355	30	20	2	SC-62	1.0	2.0					0.5	0.6	0.26	0.35	300
2SJ357	30	20	3	MP-2	1.0	2.0					0.23	0.35	0.12	0.2	645
2SJ411	30	20	5	SP-8	1.0	2.0					0.18	0.24	0.096	0.11	790
2SJ212	60	20	0.5	SC-62	1.0	3.0					1.5	4	0.8	3	160
2SJ196	60	20	1	TO-92	1.0	3.0					0.9	1.5	0.5	1	220
2SJ197	60	20	1.5	SC-62	1.0	3.0					0.9	1.5	0.5	1	220
2SJ356	60	20	2	SC-62	1.0	2.0					0.65	0.95	0.41	0.5	270
2SJ358	60	20	3	MP-2	1.0	2.0					0.29	0.4	0.18	0.3	600
2SJ353	60	20	1.5	SP-8	1.0	2.0					0.58	0.68	0.33	0.37	320
2SJ198	100	20	0.5	TO-92	1.0	3.0					1.5	2.5	1.1	2	220
2SJ199	100	20	1	SC-62	1.0	3.0					1.5	2.5	1.1	2	220
2SJ213	100	20	0.5	SC-62	1.0	3.0					2.5	5	1.8	4.2	165

2: 2.5-V drive type

Part Number	V <sub>DSS</sub> (V)	V <sub>GSS</sub> (V)	I <sub>D(DC)</sub> (A)	PKG	V <sub>GS(off)</sub> (V)		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =1.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =2.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =4V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =10V		C <sub>iss</sub> (pF)
					MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.	
2SJ462	12	8	2.5	MP-2	0.7	1.3			0.195	0.29	0.135	0.19			940
2SJ205	16	16	0.5	SC-62	1.4	2.4			3	5	1.5	3			105
2SJ207	16	16	1	SC-62	1.4	2.4			2.6	4	0.9	1.5			180
2SJ208	16	16	2	SC-62	1.4	2.4			1.6	3	0.7	1			230

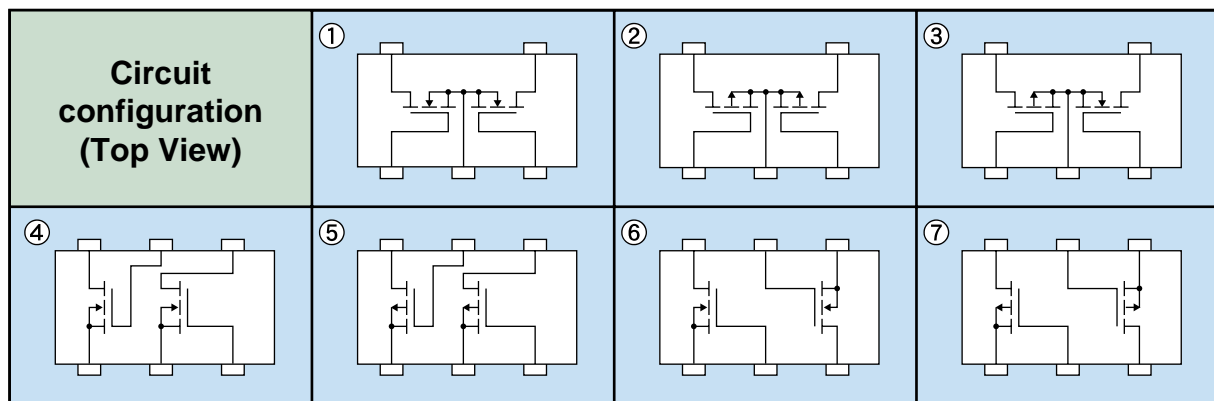


# Major Characteristics of Small-Signal MOS-FET(compound type)

NEC also provides compound package types of MOS FETs that are ideal for portable systems where a high mounting density is a must. These types are best-suited for small systems such as portable tele-phones and lithium-ion battery packs.





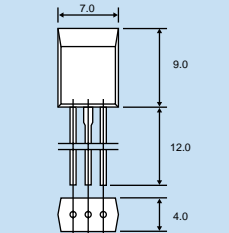
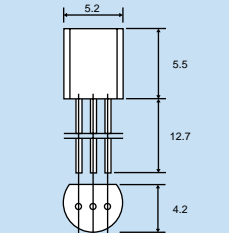
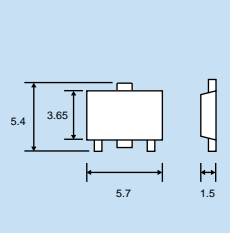
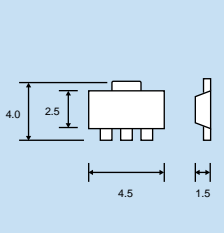




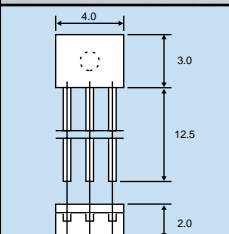
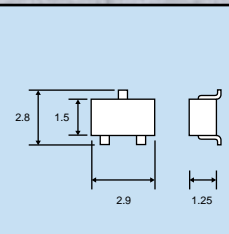
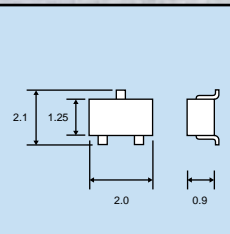
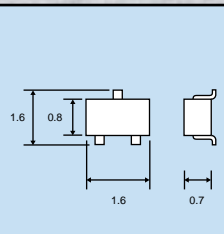




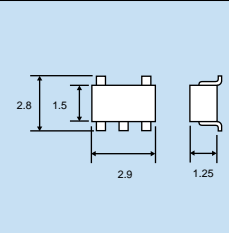
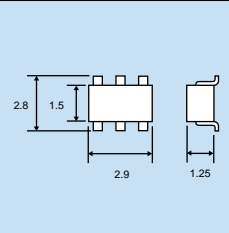
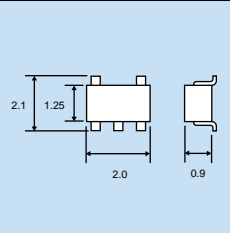
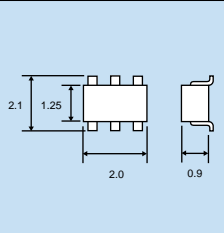
## ●Compound package series

Package	Part Number	V <sub>bss</sub> (V)	V <sub>gss</sub> (V)	I <sub>d(DC)</sub> (A)	V <sub>GS(off)</sub> (V)		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =2.5V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =4V		R <sub>DS(on)</sub> (Ω) @ V <sub>GS</sub> =10V		C <sub>iss</sub> (pF)	Circuit configuration
					MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	TYP.	MAX.		
5-pin mini-mold	μPA502T	50	20	0.1	0.8	1.8			19	30	15	25	16	①
	μPA503T	-50	-16	-0.1	-1.5	-2.5			60	100	40	60	17	②
	μPA505T	50/-50	20/-16	0.1/-0.1	0.8/-1.5	1.8/-2.5			19/60	30/100	15/40	25/60	16/17	③
5-pin small mini-mold	μPA572T	30	7	0.1	0.8	1.5	7	13	5	8			16	①
	μPA573T	-30	-7	-0.1	-1.6	-2.3	55	100	20	25			16	②
6-pin mini-mold	μPA602T	50	20	0.1	0.8	1.8			19	30	15	25	16	④
	μPA603T	-50	-16	-0.1	-1.5	-2.5			60	100	40	60	17	⑤
	μPA606T	50	20	0.1	0.8	1.8			19	30	15	25	16	⑥
	μPA607T	-50	-16	-0.1	-1.5	-2.5			60	100	40	60	17	⑦
	μPA610TA	-50	-20	-0.1	-1	-1.7	26	60	12	23			10	⑤
	μPA611TA	50	20	0.1	0.8	1.7	5.6	8	3.5	5			10	④
6-pin small mini-mold	μPA672T	50	7	0.1	0.7	1.5	20	40	15	20			6	⑥



# Signal MOS FET

## Package Shapes

Package Name	Semi-power model			
	SP-8	TO-92	MP-2	SC-62
Appearance				
Dimensions				
Package Name	Small Signal Type (1-element type)			
	SST	SC-59	SC-70	Super small MM
Appearance				
Dimensions				
Package Name	Small Signal Type (Compound type)			
	5-pin MM	6-pin MM	5-pin small MM	6-pin small MM
Appearance				
Dimensions				

**The information in this document is based on documents issued in August, 1998 at the latest. The information is subject to change without notice. For actual design-in, refer to the latest publications of data sheet, etc., for the most up-to-date specifications of the device.**

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Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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Anti-radioactive design is not implemented in this product.

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