

TOSHIBA

PRODUCT GUIDE

General-Purpose Small-Signal Surface-Mount Devices

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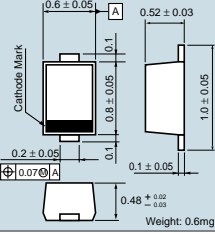
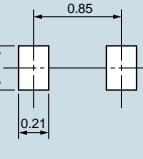
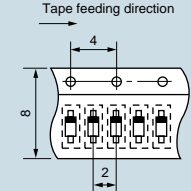
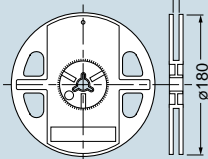

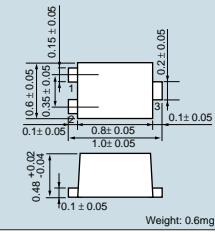
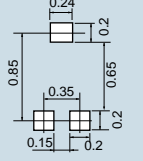
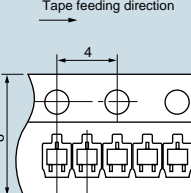
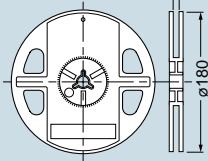

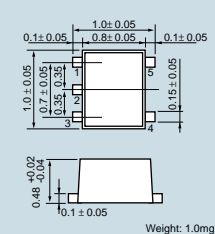
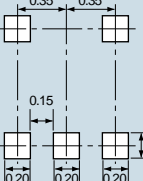
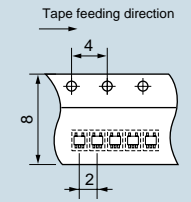
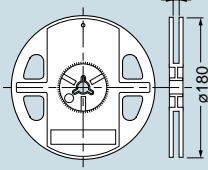

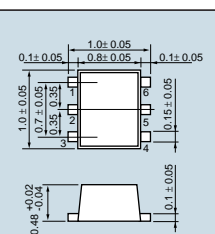
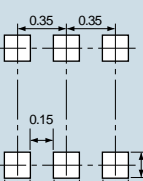
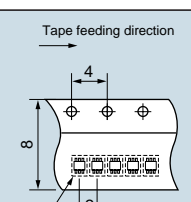
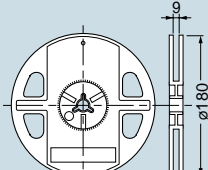

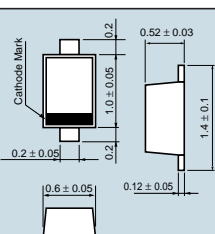
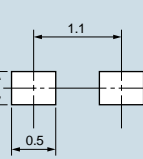
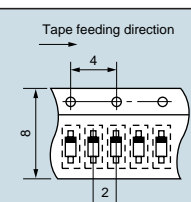
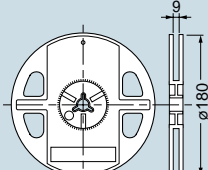

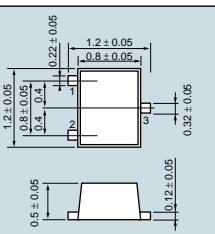
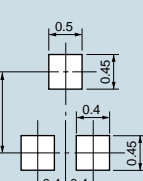
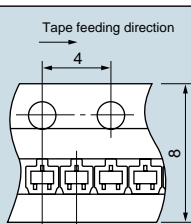
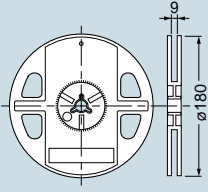
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
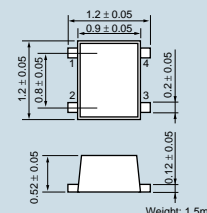
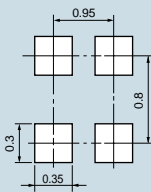
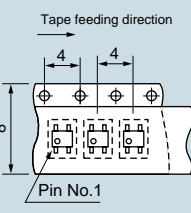
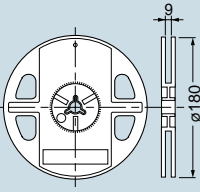

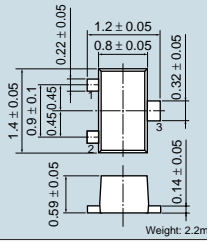
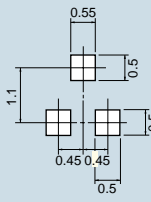
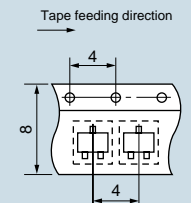
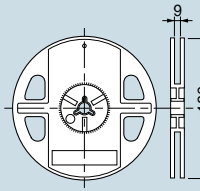

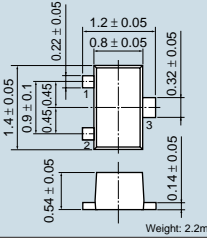
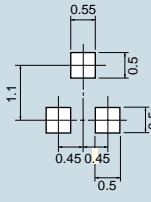
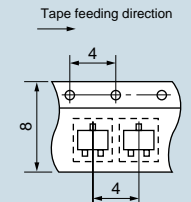
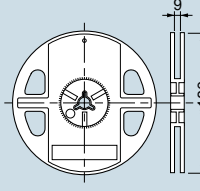

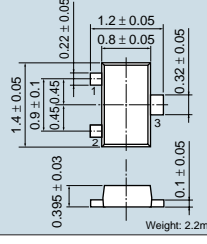
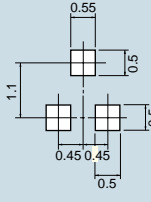
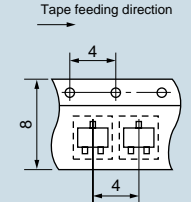
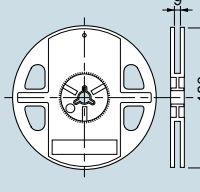

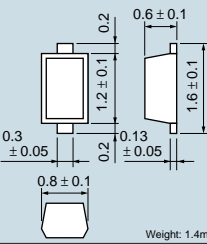
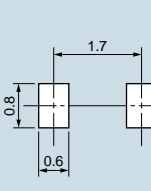
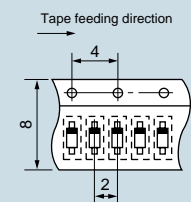
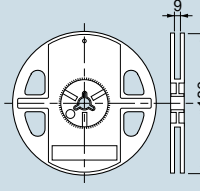

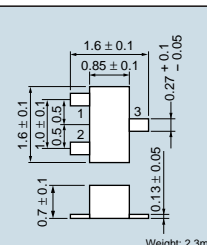
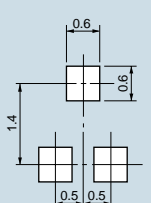
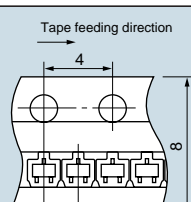
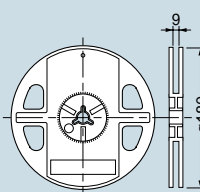
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Package Development for Surface-Mount Devices


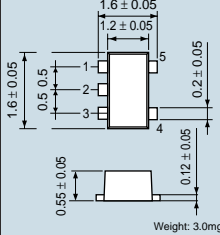
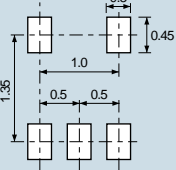
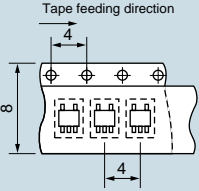
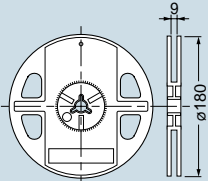

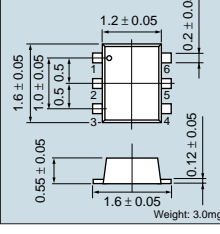
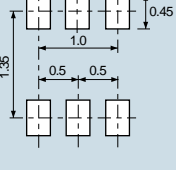
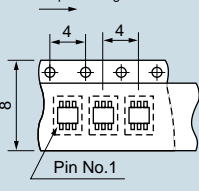
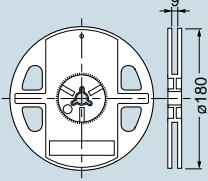

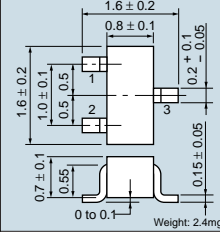
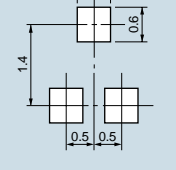
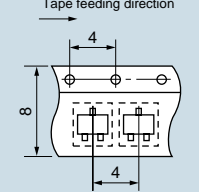
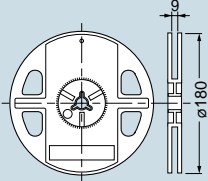

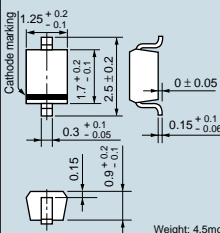
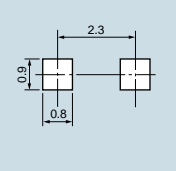
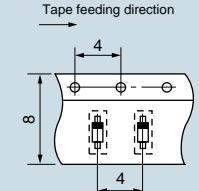
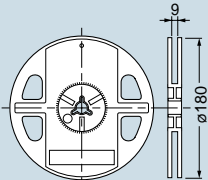

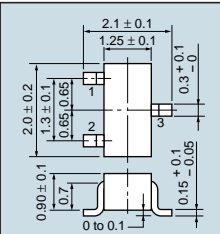
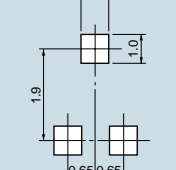
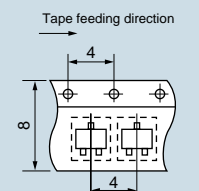
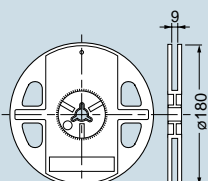

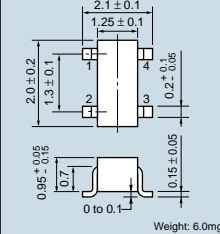
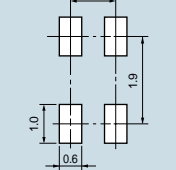
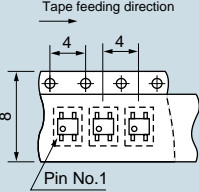
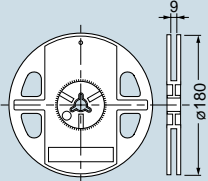



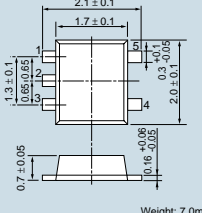
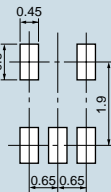
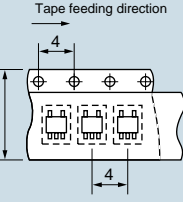
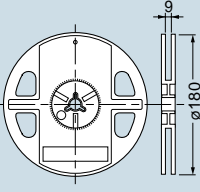

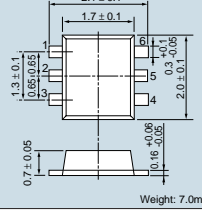
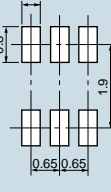
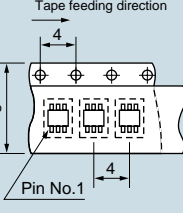
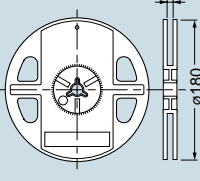

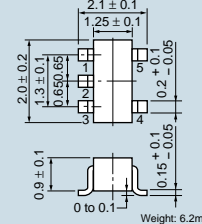
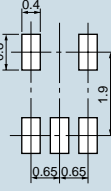
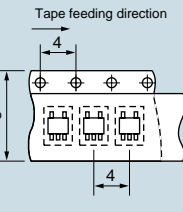
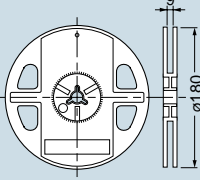

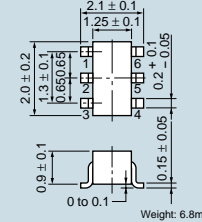
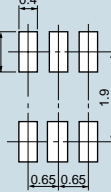
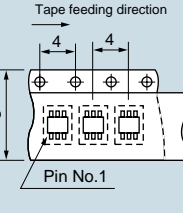
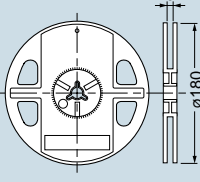

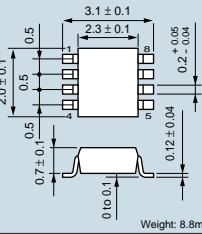
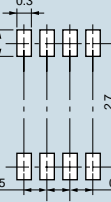
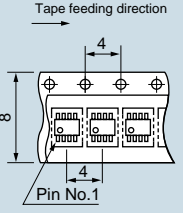
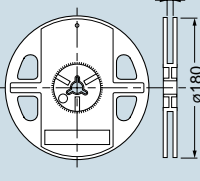

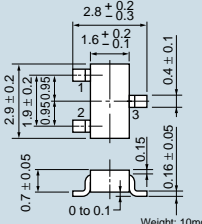
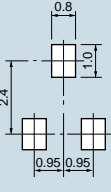
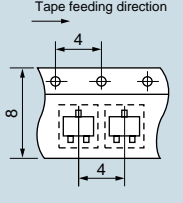
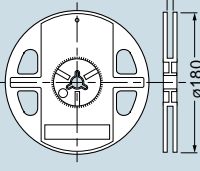
1. Package Information

Toshiba package name	Package Type		Reference pad dimensions	Standard Tape Packing Specifications		
	Appearance	Dimensions		Tape type	Tape dimensions	Reel dimensions
fSC		 <p>Weight: 0.6mg</p>		TPL3		
	Packing quantity		10000/reel			
fSM		 <p>Weight: 0.6mg</p>		TPL3		
	Packing quantity		10000/reel			
fSV		 <p>Weight: 1.0mg</p>		TPL3		
	Packing quantity		10000/reel			
fS6		 <p>Weight: 1.0mg</p>		TPL3	 <p>Pin No.1</p>	
	Packing quantity		10000/reel			
sESC		 <p>Weight: 1.1mg</p>		TPL3		
	Packing quantity		10000/reel			
VESM (SOT-723)		 <p>Weight: 1.5mg</p>		TPL3		
	Packing quantity		8000/reel			


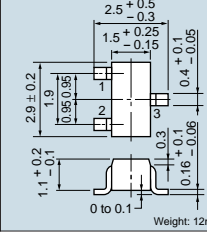
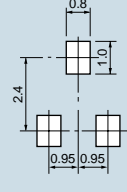
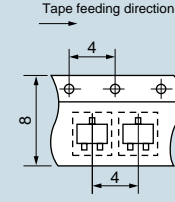
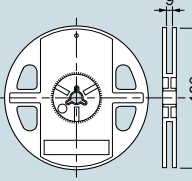
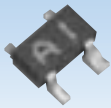
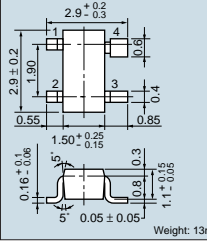
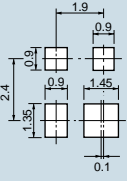
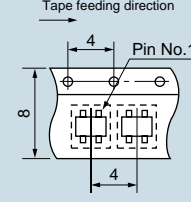
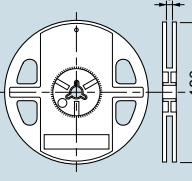

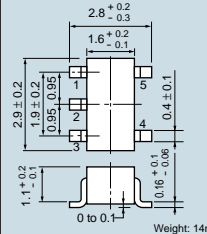
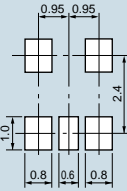
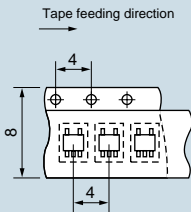
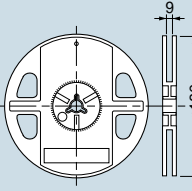

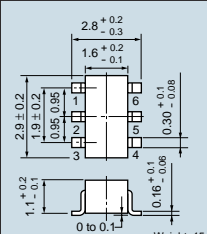
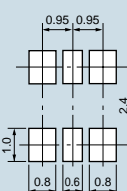
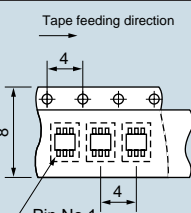
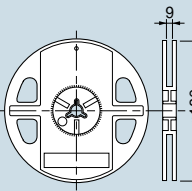
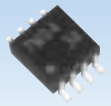
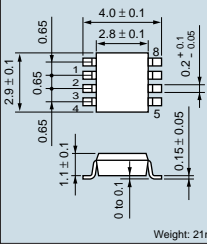
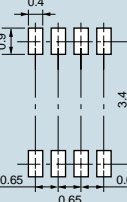
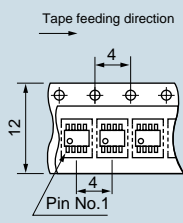
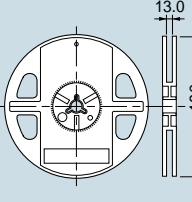
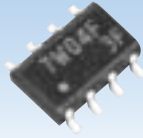
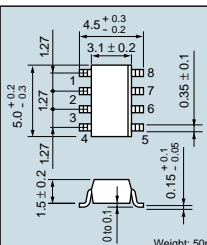
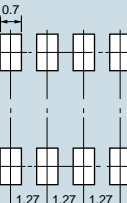
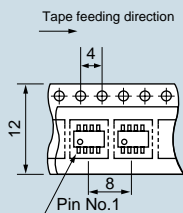
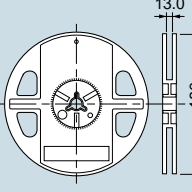
Toshiba package name	Package Type		Reference pad dimensions	Standard Tape Packing Specifications		
	Appearance	Dimensions		Tape type	Tape dimensions	Reel dimensions
TESQ		 Weight: 1.5mg		TE85L	 Pin No.1	
	Packing quantity		3000/reel			
TESM		 Weight: 2.2mg		TE85L		
	Packing quantity		4000/reel			
TESM2		 Weight: 2.2mg		TE85L		
	Packing quantity		4000/reel			
TESM3		 Weight: 2.2mg		TE85L		
	Packing quantity		5000/reel			
ESC (SOD-523)		 Weight: 1.4mg		TPL3		
	Packing quantity		8000/reel			
ESM (SOT-490) (SC-81)		 Weight: 2.3mg		TPL3		
	Packing quantity		8000/reel			

1. Package Information

Toshiba package name	Package Type		Reference pad dimensions	Standard Tape Packing Specifications		
	Appearance	Dimensions		Tape type	Tape dimensions	Reel dimensions
ESV (SOT-553)		 <p>Weight: 3.0mg</p>		TE85L		
	Packing quantity		4000/reel			
ES6 (SOT-563)		 <p>Weight: 3.0mg</p>		TE85L		
	Packing quantity		4000/reel			
SSM (SOT-416) (SC-75)		 <p>Weight: 2.4mg</p>		TE85L		
	Packing quantity		3000/reel			
USC (SOD-323)		 <p>Weight: 4.5mg</p>		TPH3		
	Packing quantity		3000/reel			
USM (SOT-323) (SC-70)		 <p>Weight: 6.0mg</p>		TE85L		
	Packing quantity		3000/reel			
USQ (SOT-343)		 <p>Weight: 6.0mg</p>		TE85L		
	Packing quantity		3000/reel			

Toshiba package name	Package Type		Reference pad dimensions	Standard Tape Packing Specifications		
	Appearance	Dimensions		Tape type	Tape dimensions	Reel dimensions
UFV		 Weight: 7.0mg		TE85L		
	Packing quantity		3000/reel			
UF6		 Weight: 7.0mg		TE85L		
	Packing quantity		3000/reel			
USV (SOT-353) (SC-88A)		 Weight: 6.2mg		TE85L		
	Packing quantity		3000/reel			
US6 (SOT-363) (SC-88)		 Weight: 6.8mg		TE85L		
	Packing quantity		3000/reel			
US8		 Weight: 8.8mg		TE85L		
	Packing quantity		3000/reel			
TSM		 Weight: 10mg		TE85L		
	Packing quantity		3000/reel			

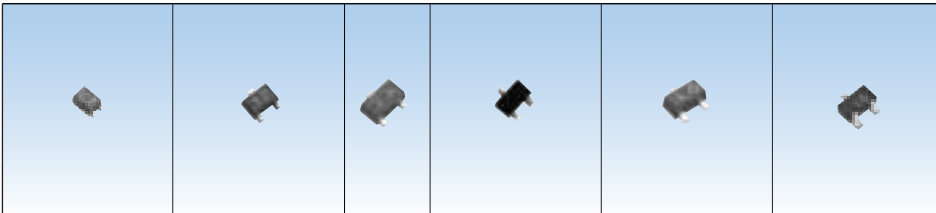
1. Package Information

Toshiba package name	Package Type		Reference pad dimensions	Standard Tape Packing Specifications		
	Appearance	Dimensions		Tape type	Tape dimensions	Reel dimensions
S-MINI (SOT-346) (SC-59)		 Weight: 12mg		TE85L		
	Packing quantity		3000/reel			
SMQ (SOT-24) (SC-61)		 Weight: 13mg		TE85L		
	Packing quantity		3000/reel			
SMV (SOT-25) (SC-74A)		 Weight: 14mg		TE85L		
	Packing quantity		3000/reel			
SM6 (SOT-26) (SC-74)		 Weight: 15mg		TE85L		
	Packing quantity		3000/reel			
SM8		 Weight: 21mg		TE12L		
	Packing quantity		3000/reel			
FM8		 Weight: 50mg		TE12L		
	Packing quantity		1000/reel			

2. Small Signal Transistors

2.1 Small-Signal Transistors

Transistors

Classification	V _{CEO} (V)	I _C (mA)	fSM		VESM (SOT-723)		TESM2	TESM		ESM (SOT-490, SC-81)		SSM (SOT-416, SC-75)	
			NPN	PNP	NPN	PNP	NPN	NPN	PNP	NPN	PNP	NPN	PNP
													
General-purpose	50	150	—	—	2SC4738FV	2SA1832FV	2SC4738TT	2SC4738FT	2SA1832FT	2SC4738F	2SA1832F	2SC4738	2SA1832
	50	100	2SC6026	2SA2154	—	—	—	—	—	—	—	—	—
Low-noise	120	100	—	—	—	—	—	—	—	—	—	—	—
General-purpose	30	500	—	—	—	—	—	—	—	—	—	—	—
	50	500	—	—	—	—	—	—	—	—	—	—	—
Low saturation	12	400	—	—	2SC5376FV	2SA1955FV	—	—	—	2SC5376F	2SA1955F	2SC5376	2SA1955
	12	500	—	—	—	—	—	—	—	—	—	—	—
	15	800	—	—	—	—	—	—	—	—	—	—	—
High current	25	800	—	—	—	—	—	—	—	—	—	—	—
	30	800	—	—	—	—	—	—	—	—	—	—	—
High withstand voltage capability	80	300	—	—	—	—	—	—	—	—	—	—	—
High hFE	50	150	—	—	—	—	—	—	—	—	—	—	—
Muting	20	300	—	—	—	—	—	—	—	—	—	—	—
High-speed switching	15	200	—	—	—	—	—	—	—	—	—	—	—
High-speed switching	200	50	—	—	—	—	—	—	—	—	—	—	—
High withstand voltage capability	300	100	—	—	—	—	—	—	—	—	—	—	—
Strobe	10	5000 (3000)	—	—	—	—	—	—	—	—	—	—	—
Package Size			1.0 × 0.6(3 pins) Flat lead		1.2 × 0.8(3 pins) Flat lead		1.4 × 0.8 (3 pins) Flat lead	1.4 × 0.8(3 pins) Flat lead		1.6 × 0.8(3 pins) Flat lead		1.6 × 0.8(3 pins)	

 New product

2. Small Signal Transistors

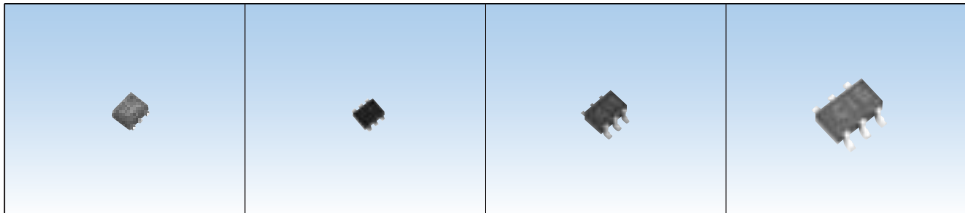
2.1 Small-Signal Transistors

Transistors

Classification	V _{CEO} (V)	I _C (mA)	USM (SOT-323, SC-70)		TSM	S-MINI (SOT-346, SC-59)		ESV (SOT-553)	USV (SOT-353, SC-88A)		SMV (SOT-25, SC-74A)		
			NPN	PNP	NPN	NPN	PNP	PNP + NPN	NPN	PNP	NPN	PNP	PNP + NPN
			General-purpose	50	150	2SC4116	2SA1586	—	2SC2712	2SA1162	△ HN4B01JE	2SC4944	△ 2SA1873 ▲ HN4A56JU
	50	100	—	—	—	—	—	—	—	—	—	—	—
Low-noise	120	100	2SC4117	2SA1587	—	2SC2713	2SA1163	—	—	—	△ HN4C06J	△ HN4A06J	△ HN4B06J
			—	—	—	2SC3324	2SA1312	—	—	—	▲ HN4C51J	▲ HN4A51J	—
General-purpose	30	500	2SC4118	2SA1588	—	2SC2859	2SA1182	—	—	—	—	—	△ HN4B04J
	50	500	—	—	—	2SC3325	2SA1313	—	—	—	—	—	—
Low saturation	12	400	—	—	—	—	—	—	△ HN4C05JU	—	—	—	—
	12	500	2SC5233	2SA1954	—	2SC5232	2SA1953	—	—	—	—	—	—
	15	800	—	—	—	—	2SA1362	—	—	—	—	—	—
High current	25	800	—	—	—	2SC3265	2SA1298	—	—	—	△ HN4C08J	△ HN4A08J	—
	30	800	—	—	—	2SC4210	2SA1621	—	—	—	—	—	—
High withstand voltage capability	80	300	—	—	—	2SC4209	2SA1620	—	—	—	—	—	—
High hFE	50	150	2SC4666	—	—	2SC3295	—	—	—	—	—	—	—
Muting	20	300	2SC4213	—	—	2SC3326	—	—	—	—	—	—	—
High-speed switching	15	200	2SC4667	—	—	2SC3437	—	—	—	—	—	—	—
High-speed switching	200	50	—	—	—	2SC3138	2SA1255	—	—	—	—	—	—
High withstand voltage capability	300	100	—	—	—	2SC4497	2SA1721	—	—	—	—	—	—
Strobe	10	5000 (3000)	—	—	(2SC5766)	—	—	—	—	—	—	—	—
Package Size			2.0 × 1.25 (3 pins)		2.9 × 1.5 (3 pins)	2.9 × 1.5 (3 pins)		1.6 × 1.2 (5 pins) Flat lead	2.0 × 1.25 (5 pins)		2.9 × 1.6 (5 pins)		

- New product
- Independent point symmetry arrangement
- Independent parallel arrangement
- × Cascade arrangement
- △ Emitter common arrangement
- ▲ Base common arrangement

Transistors



Classification	V _{CEO} (V)	I _C (mA)	fS6			ES6 (SOT-563)			US6 (SOT-363, SC-88)			SM6 (SOT-26, SC-74)		
			NPN	PNP	PNP + NPN	NPN	PNP	PNP + NPN	NPN	PNP	PNP + NPN	NPN	PNP	PNP + NPN
General-purpose	50	150	—	—	—	○ HN1C01FE ○ HN2C01FE ○ HN3C67FE	○ HN1A01FE □ HN2A01FE	—	○ HN1C01FU ○ HN2C01FU ○ HN3C56FU	○ HN1A01FU □ HN2A01FU	○ HN1B01FU ○ HN1B04FU ○ HN3B02FU	○ HN1C01F —	○ HN1A01F × HN3A56F	○ HN1B01F × HN3B01F
	50	100	* HN1C26FS * HN2C26FS	* HN1A26FS * HN2A26FS	* HN1B26FS	—	—	—	—	—	—	—	—	—
Low-noise	120	100	—	—	—	—	—	—	—	—	—	× HN3C51F	× HN3A51F	—
			—	—	—	—	—	—	—	—	—	—	—	—
General-purpose	30	500	—	—	—	—	—	—	—	—	—	—	—	○ HN1B04F
	50	500	—	—	—	—	—	—	—	—	—	○ HN1C07F	○ HN1A07F	—
Low saturation	12	400	—	—	—	○ HN1C05FE	—	—	—	—	—	—	—	—
	12	500	—	—	—	—	—	—	—	—	—	—	—	—
	15	800	—	—	—	—	—	—	—	—	—	—	○ HN1A02F	—
High current	25	800	—	—	—	—	—	—	—	—	—	—	—	—
	30	800	—	—	—	—	—	—	—	—	—	—	—	—
High withstand voltage capability	80	300	—	—	—	—	—	—	—	—	—	—	—	—
High hFE	50	150	—	—	—	—	—	—	—	—	—	—	—	—
Muting	20	300	—	—	—	—	—	—	○ HN1C03FU	—	—	○ HN1C03F	—	—
High-speed switching	15	200	—	—	—	—	—	—	× HN3C61FU	—	—	—	—	—
High-speed switching	200	50	—	—	—	—	—	—	—	—	—	—	—	—
High withstand voltage capability	300	100	—	—	—	—	—	—	—	—	—	—	—	—
Strobe	10	5000 (3000)	—	—	—	—	—	—	—	—	—	—	—	—

Package Size	1.0 × 0.8 (6 pins)	1.6 × 1.2 (6 pins)	2.0 × 1.25 (6 pins)	2.9 × 1.6 (6 pins)
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- New product * : Under development
- : Independent point symmetry arrangement
- : Independent parallel arrangement
- × : Cascade arrangement
- △ : Emitter common arrangement
- ▲ : Base common arrangement

2. Small Signal Transistors

2.2 Bias Resistor Built-in Transistors (BRTs)

(NPN/PNP)

		General-Purpose Type																	
Ratings		V _{CEO} (V)		50															
		I _c (mA)		100															
Package		VESM (SOT-723)		TESM		ESM (SOT-490, SC-81)		SSM (SOT-416, SC-75)		USM (SOT-323, SC-70)		S-MINI (SOT-346, SC-59)		ESV (SOT-553)		USV (SOT-353, SC-88A)		SMV (SOT-25, SC-74A)	
Polarity		NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
Internal resistors (kΩ)																			
R1	R2																		
4.7	4.7	RN1101FV	RN2101FV	RN1101FT	RN2101FT	RN1101F	RN2101F	RN1101	RN2101	RN1301	RN2301	RN1401	RN2401	RN1701JE	RN2701JE	RN1701	RN2701	RN1501	RN2501
10	10	RN1102FV	RN2102FV	RN1102FT	RN2102FT	RN1102F	RN2102F	RN1102	RN2102	RN1302	RN2302	RN1402	RN2402	RN1702JE	RN2702JE	RN1702	RN2702	RN1502	RN2502
22	22	RN1103FV	RN2103FV	RN1103FT	RN2103FT	RN1103F	RN2103F	RN1103	RN2103	RN1303	RN2303	RN1403	RN2403	RN1703JE	RN2703JE	RN1703	RN2703	RN1503	RN2503
47	47	RN1104FV	RN2104FV	RN1104FT	RN2104FT	RN1104F	RN2104F	RN1104	RN2104	RN1304	RN2304	RN1404	RN2404	RN1704JE	RN2704JE	RN1704	RN2704	RN1504	RN2504
2.2	47	RN1105FV	RN2105FV	RN1105FT	RN2105FT	RN1105F	RN2105F	RN1105	RN2105	RN1305	RN2305	RN1405	RN2405	RN1705JE	RN2705JE	RN1705	RN2705	RN1505	RN2505
4.7	47	RN1106FV	RN2106FV	RN1106FT	RN2106FT	RN1106F	RN2106F	RN1106	RN2106	RN1306	RN2306	RN1406	RN2406	RN1706JE	RN2706JE	RN1706	RN2706	RN1506	RN2506
10	47	RN1107FV	RN2107FV	RN1107FT	RN2107FT	RN1107F	RN2107F	RN1107	RN2107	RN1307	RN2307	RN1407	RN2407	RN1707JE	RN2707JE	RN1707	RN2707	RN1507	RN2507
22	47	RN1108FV	RN2108FV	RN1108FT	RN2108FT	RN1108F	RN2108F	RN1108	RN2108	RN1308	RN2308	RN1408	RN2408	RN1708JE	RN2708JE	RN1708	RN2708	RN1508	RN2508
47	22	RN1109FV	RN2109FV	RN1109FT	RN2109FT	RN1109F	RN2109F	RN1109	RN2109	RN1309	RN2309	RN1409	RN2409	RN1709JE	RN2709JE	RN1709	RN2709	RN1509	RN2509
4.7	∞	RN1110FV	RN2110FV	RN1110FT	RN2110FT	RN1110F	RN2110F	RN1110	RN2110	RN1310	RN2310	RN1410	RN2410	RN1710JE	RN2710JE	RN1710	RN2710	RN1510	RN2510
10	∞	RN1111FV	RN2111FV	RN1111FT	RN2111FT	RN1111F	RN2111F	RN1111	RN2111	RN1311	RN2311	RN1411	RN2411	RN1711JE	RN2711JE	RN1711	RN2711	RN1511	RN2511
22	∞	RN1112FV	RN2112FV	RN1112FT	RN2112FT	RN1112F	RN2112F	RN1112	RN2112	RN1312	RN2312	RN1412	RN2412		RN2712JE				
47	∞	RN1113FV	RN2113FV	RN1113FT	RN2113FT	RN1113F	RN2113F	RN1113	RN2113	RN1313	RN2313	RN1413	RN2413		RN2713JE				
1	10	RN1114FV	RN2114FV	RN1114FT	RN2114FT	RN1114F	RN2114F	RN1114	RN2114	RN1314	RN2314	RN1414	RN2414				RN2714		
2.2	10	RN1115FV	RN2115FV	RN1115FT	RN2115FT	RN1115F	RN2115F	RN1115	RN2115	RN1315	RN2315	RN1415	RN2415						
4.7	10	RN1116FV	RN2116FV	RN1116FT	RN2116FT	RN1116F	RN2116F	RN1116	RN2116	RN1316	RN2316	RN1416	RN2416						
10	4.7	RN1117FV	RN2117FV	RN1117FT	RN2117FT	RN1117F	RN2117F	RN1117	RN2117	RN1317	RN2317	RN1417	RN2417						
47	10	RN1118FV	RN2118FV	RN1118FT	RN2118FT	RN1118F	RN2118F	RN1118	RN2118	RN1318	RN2318	RN1418	RN2418						
1	∞	RN1119FV	RN2119FV																
100	100	RN1130FV	RN2130FV	RN1130FT	RN2130FT	RN1130F	RN2130F												
100	∞	RN1131FV	RN2131FV	RN1131FT	RN2131FT	RN1131F	RN2131F												
200	∞	RN1132FV	RN2132FV	RN1132FT	RN2132FT	RN1132F	RN2132F												

■ New product

		Low Saturation Type							
Rating		V _{CEO} (V)		20					
		I _c (mA)		50					
Package Name		fSM				fS6			
Polarity		NPN	PNP	NPN x 2	PNP x 2	NPN x 2	PNP x 2	NPN + PNP	
Resistor(kΩ)									
R1	R2								
4.7	4.7	RN1101FS	RN2101FS	RN1961FS	RN2961FS	RN1901FS	RN2901FS	RN4981FS	
10	10	RN1102FS	RN2102FS	RN1962FS	RN2962FS	RN1902FS	RN2902FS	RN4982FS	
22	22	RN1103FS	RN2103FS	RN1963FS	RN2963FS	RN1903FS	RN2903FS	RN4983FS	
47	47	RN1104FS	RN2104FS	RN1964FS	RN2964FS	RN1904FS	RN2904FS	RN4984FS	
2.2	47	RN1105FS	RN2105FS	RN1965FS	RN2965FS	RN1905FS	RN2905FS	RN4985FS	
4.7	47	RN1106FS	RN2106FS	RN1966FS	RN2966FS	RN1906FS	RN2906FS	RN4986FS	
10	47	RN1107FS	RN2107FS	RN1967FS	RN2967FS	RN1907FS	RN2907FS	RN4987FS	
22	47	RN1108FS	RN2108FS	RN1968FS	RN2968FS	RN1908FS	RN2908FS	RN4988FS	
47	22	RN1109FS	RN2109FS	RN1969FS	RN2969FS	RN1909FS	RN2909FS	RN4989FS	
4.7	∞	RN1110FS	RN2110FS	RN1970FS	RN2970FS	RN1910FS	RN2910FS	RN4990FS	
10	∞	RN1111FS	RN2111FS	RN1971FS	RN2971FS	RN1911FS	RN2911FS	RN4991FS	
22	∞	RN1112FS	RN2112FS	RN1972FS	RN2972FS	RN1912FS	RN2912FS	RN4992FS	
47	∞	RN1113FS	RN2113FS	RN1973FS	RN2973FS	RN1913FS	RN2913FS	RN4993FS	

■ New product

(NPN/PNP)

		General-Purpose Type																					
Ratings	V _{CEO} (V)	50																					
	I _c (mA)	100																					
Package		ES6 (SOT-563)						US6 (SOT-363, SC-88)						SM6 (SOT-26, SC-74)									
Polarity		PNP × 2		PNP + NPN	NPN + PNP	NPN × 2		PNP × 2		NPN		PNP		PNP + NPN		NPN + PNP		NPN		PNP		PNP + NPN	
Internal resistors (kΩ)																							
R1	R2	(Point-symmetrical array type)		(Point-symmetrical array type)	(Point-symmetrical array type)	(Mirror-image array type)		(Point-symmetrical array type)						(Mirror-image array type)		(Point-symmetrical array type)							
4.7	4.7	RN1901FE	RN2901FE	RN4901FE	RN4981FE	RN1961FE	RN2961FE	RN1901	RN2901	RN1961	RN2961	RN4901	RN4981			RN1601	RN2601	RN4601					
10	10	RN1902FE	RN2902FE	RN4902FE	RN4982FE	RN1962FE	RN2962FE	RN1902	RN2902	RN1962	RN2962	RN4902	RN4982			RN1602	RN2602	RN4602					
22	22	RN1903FE	RN2903FE	RN4903FE	RN4983FE	RN1963FE	RN2963FE	RN1903	RN2903	RN1963	RN2963	RN4903	RN4983			RN1603	RN2603	RN4603					
47	47	RN1904FE	RN2904FE	RN4904FE	RN4984FE	RN1964FE	RN2964FE	RN1904	RN2904	RN1964	RN2964	RN4904	RN4984			RN1604	RN2604	RN4604					
2.2	47	RN1905FE	RN2905FE	RN4905FE	RN4985FE	RN1965FE	RN2965FE	RN1905	RN2905	RN1965	RN2965	RN4905	RN4985			RN1605	RN2605	RN4605					
4.7	47	RN1906FE	RN2906FE	RN4906FE	RN4986FE	RN1966FE	RN2966FE	RN1906	RN2906	RN1966	RN2966	RN4906	RN4986			RN1606	RN2606	RN4606					
10	47	RN1907FE	RN2907FE	RN4907FE	RN4987FE	RN1967FE	RN2967FE	RN1907	RN2907	RN1967	RN2967	RN4907	RN4987			RN1607	RN2607	RN4607					
22	47	RN1908FE	RN2908FE	RN4908FE	RN4988FE	RN1968FE	RN2968FE	RN1908	RN2908	RN1968	RN2968	RN4908	RN4988			RN1608	RN2608	RN4608					
47	22	RN1909FE	RN2909FE	RN4909FE	RN4989FE	RN1969FE	RN2969FE	RN1909	RN2909	RN1969	RN2969	RN4909	RN4989			RN1609	RN2609	RN4609					
4.7	∞	RN1910FE	RN2910FE	RN4910FE	RN4990FE	RN1970FE	RN2970FE	RN1910	RN2910	RN1970	RN2970	RN4910	RN4990			RN1610	RN2610	RN4610					
10	∞	RN1911FE	RN2911FE	RN4911FE	RN4991FE	RN1971FE	RN2971FE	RN1911	RN2911	RN1971	RN2971	RN4911	RN4991			RN1611	RN2611	RN4611					
22	∞																						RN4612
47	∞									RN1973					RN1673								
1	10																						
2.2	10										RN2975												
4.7	10																						
10	4.7																						
47	10																						
100	100																						
100	∞																						
200	∞																						

■ New products

(NPN/PNP)

		High Current						Muting			
Ratings	V _{CEO} (V)	12			50			20			
	I _c (mA)	500			800			300			
Package		USM (SOT-323, SC-70)			MINI		S-MINI (SOT-346, SC-59)		MINI	S-MINI (SOT-346, SC-59)	
Polarity		NPN		PNP	NPN	PNP	NPN	PNP	NPN	NPN	
Internal resistors (kΩ)											
R1	R2										
1	1	RN1321A	RN2321A	RN1221	RN2221	RN1421	RN2421				
2.2	2.2	RN1322A	RN2322A	RN1222	RN2222	RN1422	RN2422				
4.7	4.7	RN1323A	RN2323A	RN1223	RN2223	RN1423	RN2423				
10	10	RN1324A	RN2324A	RN1224	RN2224	RN1424	RN2424				
0.47	10	RN1325A	RN2325A	RN1225	RN2225	RN1425	RN2425				
1	10	RN1326A	RN2326A	RN1226	RN2226	RN1426	RN2426				
2.2	10	RN1327A	RN2327A	RN1227	RN2227	RN1427	RN2427				
5.6	∞							RN1241	RN1441		
10	∞							RN1242	RN1442		
22	∞							RN1243	RN1443		
2.2	∞							RN1244	RN1444		

■ New product

Muting Switch Type

		High Current	
Ratings	V _{CEO} (V)	20	
	I _c (mA)	300	
Package		SMV	
Polarity		NPN × 2	
Internal resistors (kΩ)			
R1	R2		
2.2	∞	RN1544	

High hFE Type

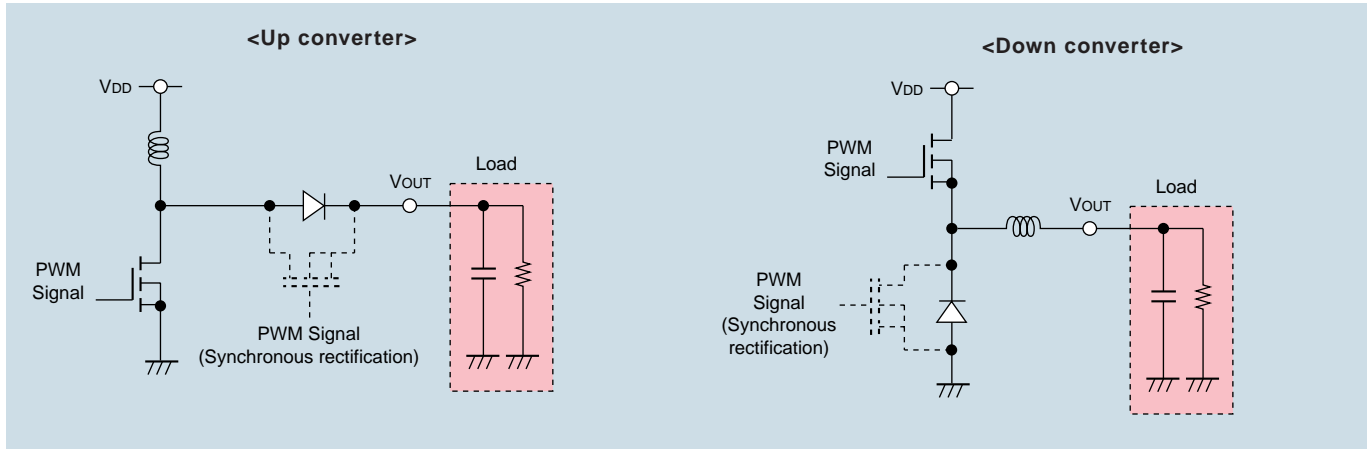
		High Current		
Ratings	V _{CEO} (V)	40/-30		
	I _c (mA)	100/-100		
Package		ES6		
Polarity		NPN × 2	PNP × 2	NPN + PNP
Internal resistors (kΩ)				
R1	R2	(Mirror-image array type)		(Point-symmetrical array type)
4.7	∞	RN1970HFE	RN2970HFE	RN4990HFE
10	∞	RN1971HFE	RN2971HFE	RN4991HFE
22	∞	RN1972HFE	RN2972HFE	RN4992HFE

3. Very Small Package FETs

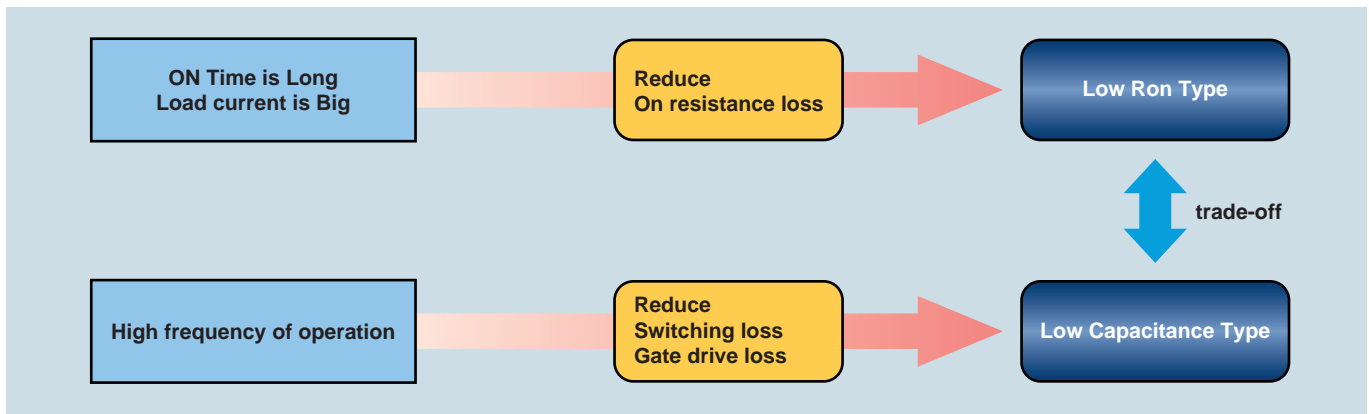
3.1 MOSFETs for DC-DC Converter (Under 3 W class) Applications

Toshiba has developed very small package MOSFETs suitable to make small DC-DC converter for portable equipment. We offer various new products to meet customer needs.

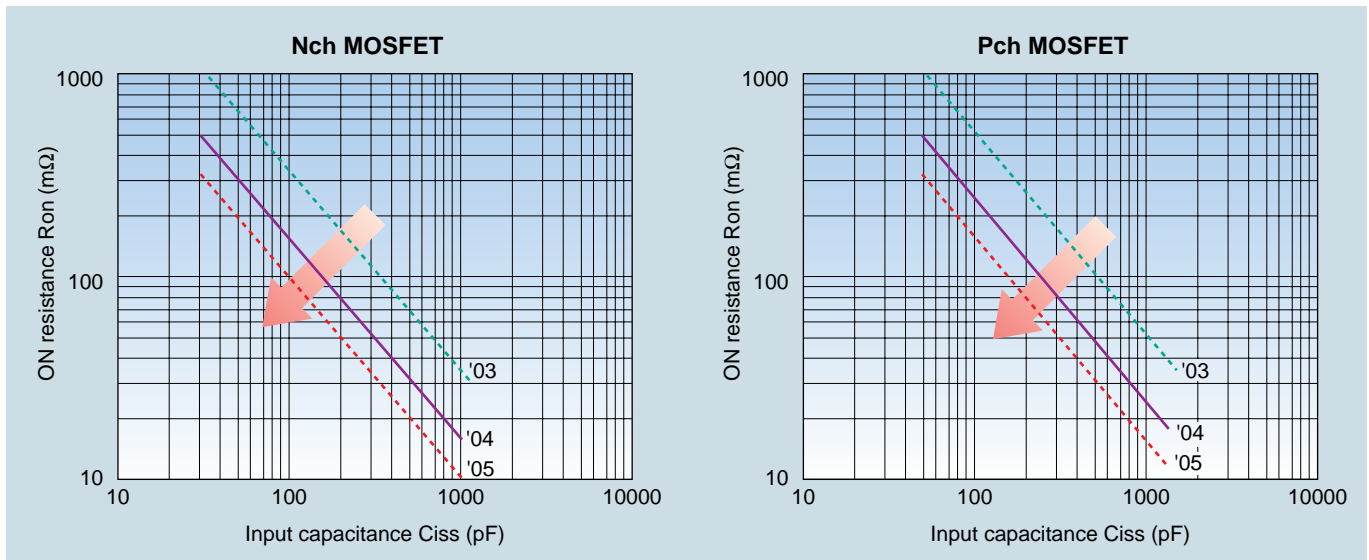
General DC-DC converter circuit



Device characteristics required to improve efficiency



Load Map of development (~To offer the products suitable for the various operating condition)



Line-up

Very Low ON-Resistance Devices

Fabricated with Toshiba's submicron process technology, the devices achieve low ON-resistance of 100 mΩ or less in an SC-88 (SOT-363) package.

Part Number	Package	Pd (W)	Polarity	Vbss (V)	Id (A)	MOSFET			Ciss (pF) Typ. Vds=10 V(15 V)
						RDS(ON) (mΩ) Max			
						VGS=4.0 V	VGS=2.5 V	VGS=2.0V	
SSM6K18TU	UF6	0.5	N-ch	20	4.0	40	54	–	1100
SSM3K14T	TSM	0.7		30	4.0	67	–	–	(460)
*SSM6J21TU	UF6	0.5	P-ch	-12	-3.0	50	88	–	1300
*SSM6J50TU	UF6	0.5		-20	-2.5	64	100	205	800
SSM3J13T	TSM	0.7		-12	-3.0	70	95	180	890

*: New product

Fast Switching Devices

The devices exhibit fast switching speed with improved trade-off between ON-resistance and Gate switch charge.

Part Number	Package	Pd (W)	Polarity	Vdss (V)	Id (A)	MOSFET			SBD		
						RDS(ON) (mΩ) Max		Ciss (pF) Typ. VDS=10 V(15 V)	VR (V)	Io (A)	VF (V) Max IF=0.5 A (0.3 A)
						VGS=4.0 V	VGS=2.5 V				
SSM6K08FU	US6 SOT-363/SC-88	0.3	N-ch	20	1.6	105	140	306	25	0.7	0.41
*TCP8AA1	PS8	1.0		20	1.6	105	140	306			
SSM3K01T	TSM	0.7		30	3.2	120	150	152	12	0.5	0.43
*SSM5H05TU	UFV	0.5		20	1.5	160	220	125			
*SSM5H08TU	UFV	0.5		20	1.5	160	220	125	20	0.5	(0.45)
*SSM6K22FE	ES6 SOT-563	0.5		20	1.4	170	230	125	12	0.5	0.43
SSM6K30FE	ES6 SOT-563	0.5		20	1.2	430	–	60			
*SSM6K31FE	ES6 SOT-563	0.5		20	1.2	550	–	36	12	0.5	0.43
**SSM5H07TU	UFV	0.5		20	1.2	550	–	36			
SSM3K12T	TSM	0.7		30	3.0	175	–	(120)	20	0.5	(0.45)
SSM3K02T	TSM	0.7		30	2.5	200	250	115			
SSM6K07FU	US6 SOT-363/SC-88	0.3		30	1.5	220	–	(102)	20	0.5	(0.45)
SSM5H01TU	UFV	0.5	30	1.4	450	–	(106)				
SSM3J14T	TSM	0.7	-30	-2.7	170	–	(413)	12	0.5	0.43	
*SSM5G09TU	UFV	0.5	-12	-1.5	130	200	550				
SSM5G02TU	UFV	0.5	-12	-1.0	160	240	310	12	0.5	0.43	
*SSM6J23FE	ES6 SOT-563	0.5	-12	-1.2	182	260	550	12	0.5	0.43	
SSM5G04TU	UFV	0.5	-12	-1.0	240	420	170				
*TCP8BA1	PS8	1.0	-20	-1.3	180	260	370	25	0.7	0.41	
SSM6J08FU	US6 SOT-363/SC-88	0.3	-20	-1.3	180	260	370	20	0.5	(0.45)	
SSM6J06FU	US6 SOT-363/SC-88	0.3	-20	-0.65	500	700	160				
SSM3J01T	TSM	0.7	-30	-1.7	400	600	240	20	0.5	(0.45)	
SSM3J02T	TSM	0.7	-30	-1.5	500	700	150				
SSM5G01TU	UFV	0.5	-30	-1.0	800	–	(86)	20	0.5	(0.45)	
SSM6J07FU	US6 SOT-363/SC-88	0.3	-30	-0.8	800	–	(130)				

*: New product, **: Under development

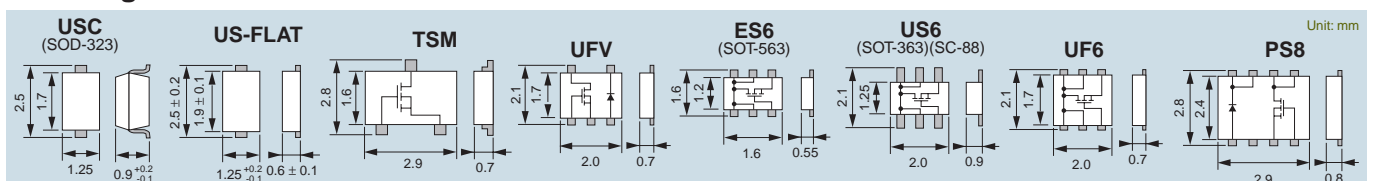
Toshiba offers Schottky barrier diodes suitable for your applications, along with MOSFETs.

Single Schottky Barrier Diode

Low VF devices are offered in a small package.

Part Number	Package	VR (V)	Io (A)	VF (V) Max		
				IF=0.3 A	IF=0.5 A	IF=0.7 A
1SS404	USC SOD-323	20	0.3	0.45	–	–
CUS01	US-FLAT	30	1.0	–	–	0.37
CUS02	US-FLAT	30	1.0	–	–	0.45

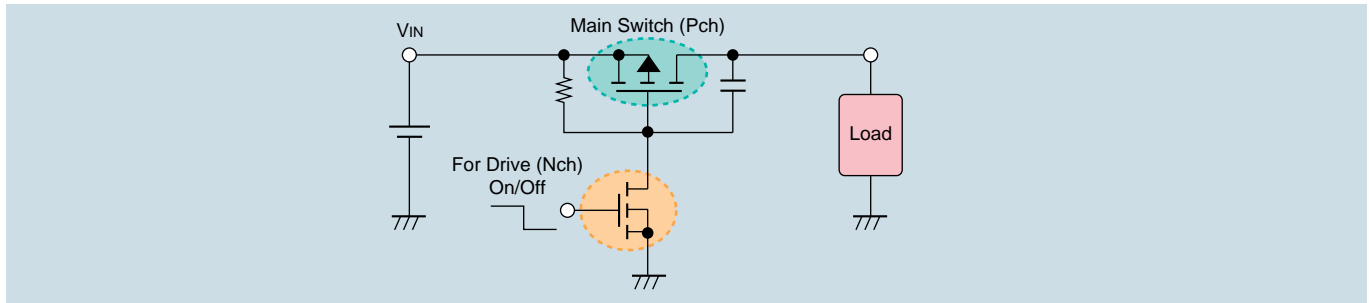
Package Dimensions



3. Very Small Package FETs

3.2 MOSFETs for Power Management Applications

Load Switch Application Circuit Example

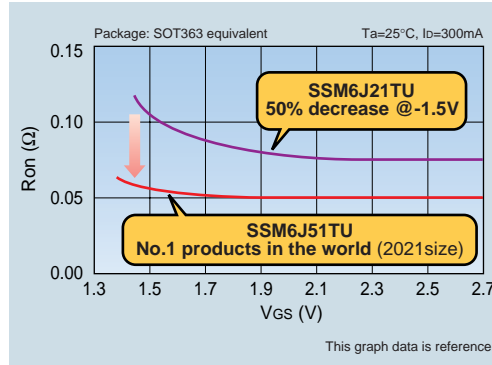


New Products **SSM6J51TU**

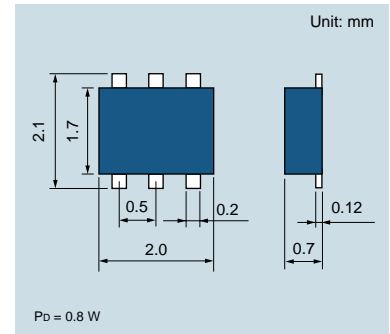
Very low ON-resistance and low voltage gate driving for load switch application

■ Features

- Low on resistance
 - Ron = 54 mΩmax @-2.5 V
 - Ron = 68 mΩmax @-1.8 V
- Low voltage gate drive
 - Ron = 150 mΩmax @Vgs = -1.5 V



■ Package Dimensions



■ Line-up

<Single Type> P-ch MOSFETs (for Main Switch)

Part Number	Package	Pd (W)	Polarity	Vdss (V)	Id (A)	RDS(ON) Max (mΩ)		
						VGS = -4 V (4.5 V)	VGS = 2.5 V	VGS = -1.5 V (1.8 V)
SSM6J07FU	US6	0.3	P-ch	-30	-0.8	800	(1600)	-
SSM3J14T	TSM	0.7		-30	-2.6	(145)	-	-
SSM3J01T				-30	-1.7	400	600	-
SSM3J02T	VS6	2.2		-30	-1.5	500	700	-
TPC6102	VS6	2.2		-30	-2.7	(110)	160	(300)
TPCF8104	VS8	2.5		-30	-6	(38)	-	-
*SSM6J26FE	ES6(SOT-563)	0.5		-20	-0.5	230	330	(980)
*SSM6J25FE				-20	-0.5	260	430	-
SSM6J50TU	UF6	0.5		-20	-2.5	(64)	100	-
SSM6J06FU	US6	0.3		-20	-0.65	500	700	-
SSM6J08FU				-20	-1.3	180	260	-
TPC6105	VS6	2.2		-20	-2.7	(110)	160	(300)
TPC6101				-20	-4.5	(60)	100	-
TPC6104				-20	-5.5	(40)	60	(120)
TPCF8103				VS8	1.0	-20	-2.7	(110)
TPCF8102	-20	-6				(30)	41	(90)
*SSM6J23FE	ES6(SOT-563)	0.5		-12	-1.2	210	140	-
*SSM6J51TU	UF6	0.5		-12	-4.0	-	54	180
*SSM6J21TU				-12	-3.0	50	88	-
SSM3J13T	TSM	0.7		-12	-3.0	70	95	-
TPC6103	VS6	2.2		-12	-5.5	(35)	55	(90)
TPCF8101	VS8	2.5		-12	-6	(28)	40	(85)

*: New products

<2in1 Type> P-ch x 2 MOSFETs

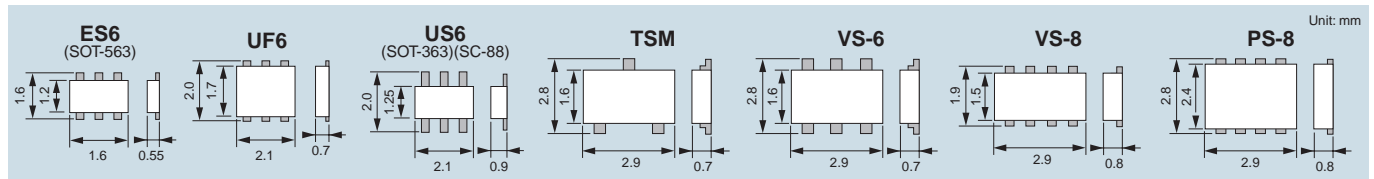
Part Number	Package	Pd (W)	Polarity	VdSS (V)	Id (A)	RDS(ON) Max (mΩ)		
						VGS = -4 V (4.5 V)	VGS = 2.5 V	VGS = 1.8 V
SSM6P26FU	UF6	0.5	P-ch x 2	-20	-0.5	230	330	980
SSM6P25FU				-20	-0.5	260	430	—
TPCF8301	VS6	2.2		-20	-2.7	(110)	160	300
TPCF8302				-20	-3	(59)	95	—
TPCF8303			-20	-3	(58)	87	250	

<2in1 Type> P-ch/N-ch MOSFETs

Part Number	Package	Pd (W)	Polarity	VdSS (V)	Id (A)	RDS(ON) Max		RDS(ON) Max		RDS(ON) Max	
						(Ω)	VGS (V)	(Ω)	VGS (V)	(Ω)	VGS (V)
**SSM6E02TU	UF6	0.5	P-ch + N-ch Load Switch	-20	-0.5	0.15	-4.0	0.22	-2.5	0.39	-1.8
				20	0.05	—	4.0	10	2.5	—	—
SSM6E01TU				-12	-1.0	0.16	-4.0	0.24	-2.5	—	—
				20	0.05	—	4.0	10	2.5	—	—
TPCP8401	PS8	1.0		-12	-5.5	0.038	-4.0	0.058	-2.5	0.103	-1.8
				20	0.1	3	4.0	4	2.5	—	—
TPCF8402	VS8	2.5	P-ch	-30	-3.2	0.072	-4.0	0.105	-2.5	—	—
			N-ch	30	4	0.05	4.0	0.077	2.5	—	—
TPCP8402	PS8	0.5	P-ch	-30	-3.4	0.072	-4.0	0.105	-2.5	—	—
			N-ch	30	4.2	0.05	4.0	0.077	2.5	—	—
*SSM6L12TU	UF6	0.5	P-ch	-20	-0.5	260	-4.0	430	-2.5	—	—
			N-ch	30	0.5	145	4.5	180	2.5	—	—
*SSM6L10TU	UF6	0.5	P-ch	-20	-0.5	230	-4.0	330	-2.5	980	-1.8
			N-ch	20	0.5	145	4.0	190	2.5	395	1.8
*SSM6L11TU	UF6	0.5	P-ch	-20	-0.5	260	-4.0	430	-2.5	—	—
			N-ch	20	0.5	145	4.0	190	2.5	395	1.8

*: New products **: Under development

■ Package Dimensions

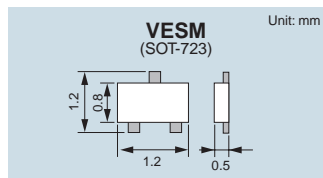


■ N-ch MOSFET Line-up

<Single Type> N-ch MOSFETs (for Drive)

Part Number	Package	VdSS (V)	VgSS (V)	Id (A)	Vth (V)	RDS(ON) Max (Ω)			Ciss Typ (pF)
						VGS = 4 V	VGS = 2.5 V	VGS = 1.5 V	
SSM3K15FV	VESM (SOT-723)	30	±20	0.1	0.8 to 1.5	4	7	—	7.8
SSM3K16FV		20	±10	0.1	0.6 to 1.1	3	4	15	9.3
SSM3K04FV		20	10	0.1	0.7 to 1.3	—	12	—	11.0

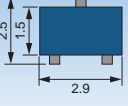
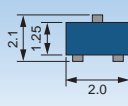
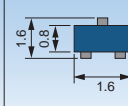
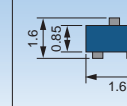
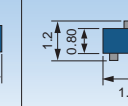
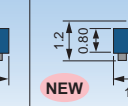
■ Package Dimensions



3. Very Small Package FETs

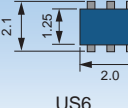
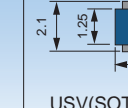
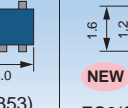
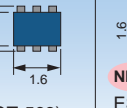
3.3 Standard Series (Under 500 mA type)

Single type

Polarity	Maximum Ratings			Package					Unit: mm		Vth (V)	RDS(ON) Typ.(Max)	
	Vbss (V)	Vgss (V)	Id (mA)							(Ω)		@ VGS (V)	
N-ch	20	10	100	-	-	-	SSM3K03FE	SSM3K03TE	SSM3K03FV	0.7 to 1.3	4(12)	2.5	
	20	10	100	-	**SSM3K04FU	**SSM3K04FS	**SSM3K04FE	-	**SSM3K04FV	0.7 to 1.3	4(12)	2.5	
	20	±10	100	-	SSM3K16FU	SSM3K16FS	-	SSM3K16TE	SSM3K16FV	0.6 to 1.1	2.2(5)	2.5	
	20	±12	400	-	SSM3K05FU	-	-	-	-	0.6 to 1.1	0.85(1.2)	2.5	
	30	±20	100	SSM3K15F	SSM3K15FU	SSM3K15FS	-	SSM3K15TE	SSM3K15FV	0.8 to 1.5	4(7)	2.5	
	30	±20	200	2SK2009	-	-	-	-	-	0.5 to 1.5	1.2(2.0)	2.5	
	30	±20	400	-	SSM3K09FU	-	-	-	-	1.1 to 1.8	0.8(1.2)	4	
	50	±7	100	-	SSM3K17FU	-	-	-	-	0.9 to 1.5	22(40)	2.5	
	50	10	50	2SK1826	2SK1827	-	-	-	-	0.8 to 2.5	20(50)	4	
	60	±20	200	2SK1062	-	-	-	-	-	2.0 to 3.5	0.6(1.0)	10	
60	±20	200	-	SSM3K7002FU	-	-	-	-	1.0 to 2.5	2.2(3.3)	4.5		
P-ch	-20	±10	-100	-	SSM3J16FU	SSM3J16FS	-	SSM3J16TE	SSM3J16FV	-0.6 to -1.1	8(12)	-2.5	
	-20	±12	-200	-	SSM3J05FU	-	-	-	-	-0.6 to -1.1	3.2(4.0)	-2.5	
	-30	±20	-100	SSM3J15F	SSM3J15FU	SSM3J15FS	-	SSM3J15TE	SSM3J15FV	-1.1 to -1.7	1.4(32)	-2.5	
	-30	±20	-200	2SJ305	-	-	-	-	-	-0.5 to -1.5	2.4(4)	-2.5	
	-30	±20	-200	-	SSM3J09FU	-	-	-	-	-1.1 to -1.8	3.3(4.2)	-4	
	-50	±7	-50	2SJ343	2SJ344	-	-	-	-	-0.8 to -2.5	20(50)	-4	
-60	±20	-200	2SJ168	-	-	-	-	-	-2.0 to -3.5	1.8(2)	-10		

** : Built-in 1-MΩ gate-source resistor

2-in-1 type

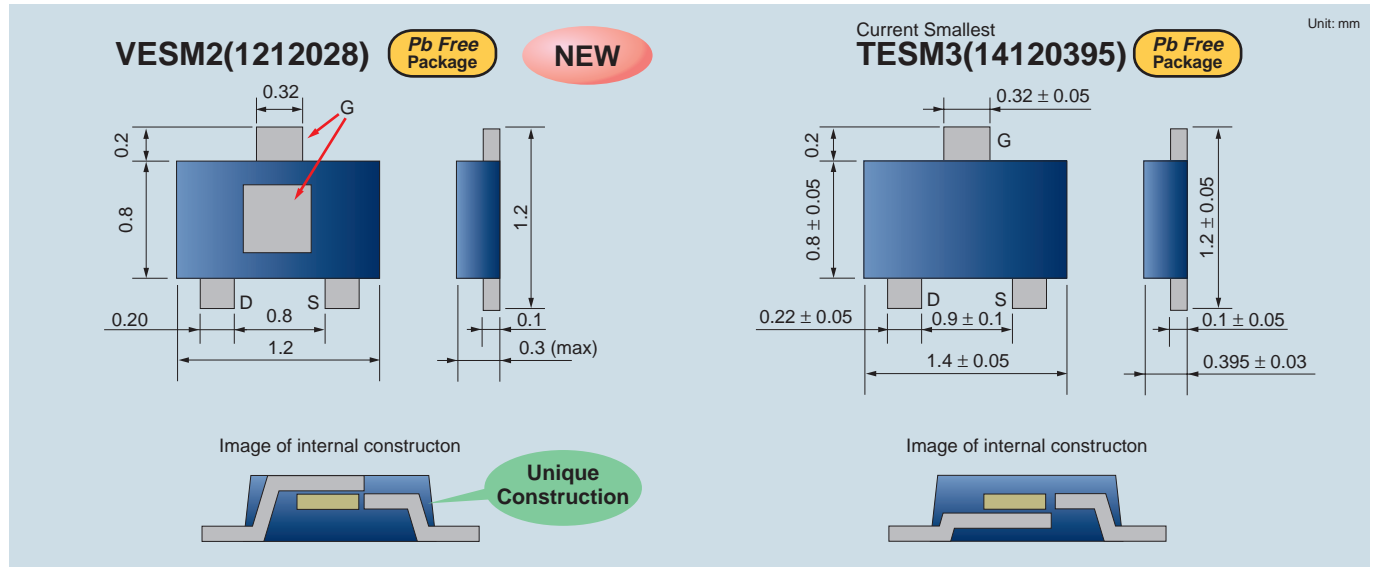
Polarity	Maximum Ratings			Package				Unit: mm		Vth (V)	RDS(ON) Typ.(Max)		Component Devices
	Vbss (V)	Vgss (V)	Id (mA)					(Ω)	@ VGS (V)				
N-ch	50	10	50	HN1K04FU	-	-	-	0.8 to 2.5	20(50)	4	2SK1827x2		
	20	10	100	-	-	SSM6N03FE	SSM5N03FE	0.7 to 1.3	4(12)	2.5	SSM3K03FEx2		
	20	10	100	**SSM6N04FU	-	-	-	0.7 to 1.3	4(12)	2.5	SSM3K04FUx2		
	20	10	100	HN1K06FU	-	-	-	0.5 to 1.5	3.5(6.0)	2.5	2SK2037x2		
	20	±10	100	SSM6N16FU	SSM5N16FU	SSM6N16FE	SSM5N16FE	0.6 to 1.1	2.2(5)	2.5	SSM3K16FUx2		
	30	±20	100	SSM6N15FU	SSM5N15FU	SSM6N15FE	SSM5N15FE	0.8 to 1.5	4(7)	2.5	SSM3K15FUx2		
	50	±7	100	SSM6N17FU	-	-	-	0.9 to 1.5	22(40)	2.5	SSM3K17FUx2		
	60	±20	200	SSM6N7002FU	-	-	-	1.0 to 2.5	2.2(3.3)	4.5	SSM3K7002FUx2		
	20	±12	400	SSM6N05FU	SSM5N05FU	-	-	0.6 to 1.1	0.85(1.2)	2.5	SSM3K05FUx2		
	30	±20	400	SSM6N09FU	-	-	-	1.1 to 1.8	0.8(1.2)	4	SSM3K09FUx2		
P-ch	-20	±10	-100	SSM6P16FU	SSM5P16FU	SSM6P16FE	SSM5P16FE	-0.6 to -1.1	8(12)	-2.5	SSM3J16FUx2		
	-20	±12	-200	SSM6P05FU	SSM5P05FU	-	-	-0.6 to -1.1	3.2(4.0)	2.5	SSM3J05FUx2		
	-30	-	-100	SSM6P15FU	SSM5P15FU	SSM6P15FE	SSM5P15FE	-1.1 to -1.7	14(32)	-2.5	SSM3J15FUx2		
	-30	±20	-200	SSM6P09FU	-	-	-	-1.1 to -1.8	3.3(4.2)	4	SSM3J09FUx2		
	50	10	50	HN1L03FU	-	-	-	0.8 to 2.5	20(50)	4	2SK1827		
	-20	-7	-50	-	-	-	-	-0.5 to -1.5	20(40)	-2.5	+2SJ346		
	20	±12	400	SSM6L05FU	-	-	-	0.6 to 1.1	0.85(1.2)	2.5	SSM3K05FU		
	-20	±12	-200	-	-	-	-	-0.6 to -1.1	3.2(4.0)	-2.5	+SSM3J05FU		
	30	±20	400	SSM6L09FU	-	-	-	1.1 to 1.8	0.8(1.2)	4	SSM3K09FU		
	-30	±20	-200	-	-	-	-	-1.1 to -1.8	3.3(4.2)	4	+SSM3J09FU		
20	±10	100	-	-	SSM6L16FE	-	0.6 to 1.1	2.2(5)	2.5	SSM3K16FS			
-20	±10	-100	-	-	-	-	-0.6 to -1.1	8(12)	-2.5	+SSM3K16FS			

** : Built-in 1-MΩ gate-source resistor

3.4 J-FET for ECM Applications

Toshiba has developed the small package which met the request of the ECM market.

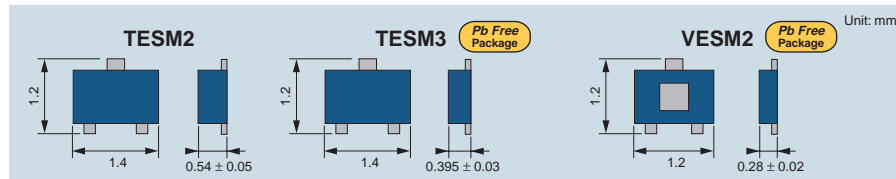
■ New world wide smallest package for very thin ECM



■ Line-up (for ECM applications)

Polarity	Part Number			V _{GD0} (V)	I _{DSS} (μA) Min	Y _{fs} (mS)		C _{iss} (pF)		V _{GD} (V)	f (MHz)		
	TESM2	TESM3	VESM2			V _{DS} (V)	V _{GS} (V)	V _{DS} (V)	V _{GS} (V)				
Nch	2SK3376TT	2SK3376TK	2SK3376TV	-20	80 to 480	2	0	0.7	2	0	5.5	2	0
Nch	2SK3582TT	2SK3582TK	2SK3582TV	-20	80 to 300	2	0	0.55	2	0	3.6	2	0
Nch	2SK3857TT	2SK3857TK	2SK3857TV	-20	140 to 350	2	0	0.9	2	0	3.5	2	0

■ Package Dimensions

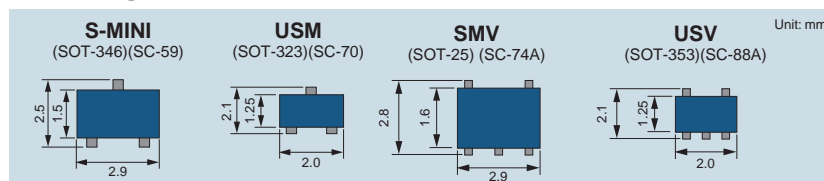


■ Line-up (standard type)

Polarity	S-MINI (SOT-346) (SC-59)	USM (SOT-323) (SC-70)	SMV (SOT-25) (SC-74A)	USV (SOT-353) (SC-88A)	V _{GD5} (V)	I _G (mA)	P _D (mW)	I _{DSS} (mA)	V _{DS} (V)	V _{GS} (V)	Y _{fs} (mS)	V _{DS} (V)	V _{GS} (V)	C _{rss} (pF) (Typ.)		f (MHz)	Marking
	V _{DS} (V)	V _{GS} (V)	V _{DS} (V)	V _{GS} (V)													
Nch	2SK208	2SK879	—	—	-50	10	100	0.3 to 6.5	10	0	1.2 (Min)	10	0	2.6	10	1	J □
Pch	2SJ106	2SJ144	—	—	50	-10	100	-1.2 to -14	-10	0	1 (Min)	-10	0	3.6	-10	1	V □
Nch	2SK209	2SK880	2SK2145	2SK3320	-50	10	100	1.2 to 14	10	0	15 (Typ.)	10	0	3	10	1	X □
Nch	2SK368	—	—	—	-100	10	100	0.6 to 6.5	10	0	4.6 (Typ.)	10	0	3	10	1	KA □

Alphabetic characters of marking prefix indicates I_{DSS} rank.

■ Package Dimensions



4. Small Signal Diodes

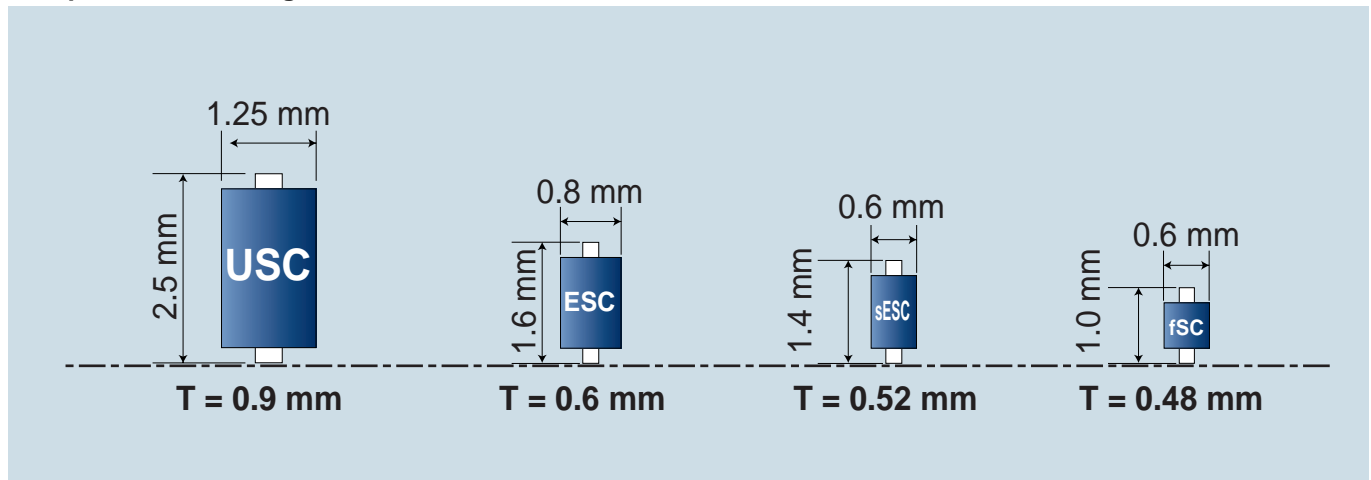
4.1 New Products

Very Small Package Solution for Diodes. fSC / sESC package

Features

- Very small package fSC = 1.0 x 0.6 mm* (* : Include outer lead) sESC = 1.4 x 0.6 mm* (* : Include outer lead)
- Very thin package fSC Height = 0.50 mm max sESC Height = 0.55 mm max

Comparison of Package Size



Schottky Barrier Diodes

Part Number		Rating		Electrical Characteristics			
fSC	sESC	V_R (V)	I_F (A)	V_F (V) Max.	@ I_F (A)	I_R (μ A)	@ V_R (V)
1SS416	1SS418	30	0.1	0.5	0.1	50	30
1SS417	1SS419	40	0.1	0.62	0.1	5	40
1SS413		20	0.05	0.55	0.05	0.5	20

Diode for Protection against ESD

Part Number			V_Z (V)		I_R (μ A)		C_T (pF)	
fSC	sESC		Typ.	@ I_Z (mA)	Max	@ V_R (V)	Typ.	@ V_R (V)
DF2S5.6FS	DF2S5.6S	standard type	5.6	5	10	1	40	0
DF2S6.2FS	DF2S6.2S		6.2	5	1	3	32	0
DF2S6.8FS	DF2S6.8S		6.8	5	0.5	5	25	0
DF2S8.2FS	DF2S8.2S		8.2	5	0.5	6.5	20	0
DF2S12FS	DF2S12S		12	5	0.05	9	15	0
DF2S16FS	DF2S16S		16	5	0.5	12	10	0
DF2S24FS	DF2S24S		24	5	0.5	19	8.5	0

4.2 Switching Diodes

Electrical Characteristics (Ta=25°C)																	
V _R (V)	I _o (mA)	t _{rr} (ns)	ESC (SOD-523)	VESM	ESM (SOT-490, SC-81)	SSM (SOT-416, SC-75)	ESV (SOT-553)	ES6 (SOT-563)	USC (SOD-323)	USM (SOT-323, SC-70)	USQ (SOT-343)	USV (SOT-353)	US6 (SOT-363, SC-88)	S-MINI (SOT-346, SC-59)	SMQ (SOT-24, SC-61)	SMV (SOT-25, SC-74A)	SM6 (SOT-26, SC-74)
30	100	—															
80	100	—															
80	100	1.6 typ.															
80	100	1.6 typ.															
80	100 (80)	1.6 typ.															
80	100 (80)	1.6 typ.															
80	100 (80)	1.6 typ.															
80	100	1.6 typ.															
80	200	7.0 typ.															
80	200	6.0 typ.															
200	100	30 typ.															
400	100	500 typ.															
400	100	500 typ.															


































New product * Under development


4. Small Signal Diodes

4.3 Schottky Barrier Diodes (SBDs)

Features	Maximum Ratings		Electrical Characteristics (Ta=25°C)				fSC	sESC	ESC (SOD-523)	VESM (SOT-723)	ESM (SOT-490, SC-81)	SSM (SOT-416, SC-75)	TESQ	ESV (SOT-553)	ES6 (SOT-563)		
	VR (V)	Io (mA)	VF (V)		IR (µA)												
			Typ.	Max	@If (mA)	Max @VR (V)											
Low-VF	10	100	0.23	0.3	5	20	10									1SS389 	HN2S01JE
			0.35	0.5	100												
	10	100	0.23	0.3	5	20	10				1SS385FV 	1SS385F 	1SS385 				
			0.35	0.5	100												
10	100	0.23	0.3	5	20	10											
		0.35	0.5	100													
30	100	0.23	—	5	20	10	1SS416 	1SS418 				1SS422 					
		0.38	0.5	100	50	30											
Low-IR, High-speed	20	50	0.33	—	1	0.5	20	1SS413 		1SS405 				HN2S03T 			HN2S03FE
			0.38	—	5												
			0.50	0.55	50												
Low-IR	10	50	0.63	1.0	100	0.5	10										
Standard	40	100	0.54	0.6	100	5	40			1SS388 							HN2S02JE
			0.54	0.6	100	5	40										
	40	100	0.54	0.6	100	5	40										
			0.36	—	10	5	40	1SS417 	1SS419 				1SS423 				
			0.56	0.62	100												
High-VR	80	100	0.56	0.7	100	5	80										
High-Io, Low-VF	20	200	0.23	—	5	5	30			1SS424* 							
			0.42	0.5	200												
	30	200	0.36	—	5	5	30			1SS420 							
			0.52	0.6	200												
20	300	0.16	—	1	50	20											
		0.22	—	10													
High-Io	20	500	0.50	0.55	500	20	10										
			100	20													
	30	700	0.52	0.65	700	25	30										
	20	1000	0.46	0.55	1000	25	30										

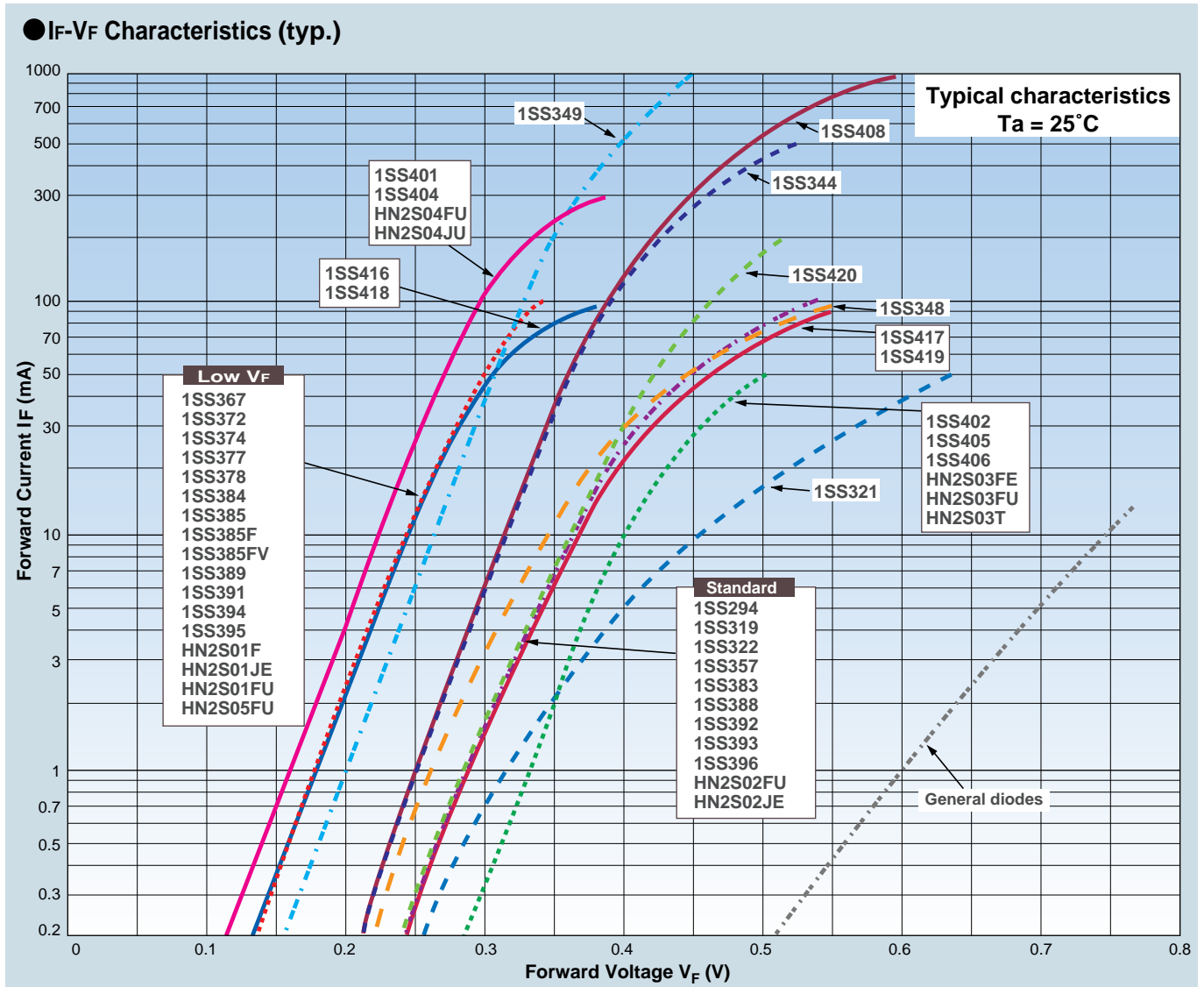
New product Under development

Features	Maximum Ratings		Electrical Characteristics (Ta=25°C)				USC (SOD-323)	USM (SOT-323, SC-70)	USQ (SOT-343)	USV (SOT-353, SC-88A)	US6 (SOT-363, SC-88)	S-MINI (SOT-346, SC-59)	SMQ (SOT-24, SC-61)	SM6 (SOT-26, SC-74)	
	VR (V)	Io (mA)	VF (V)		IR (μA)										
			Typ.	Max	@IF (mA)	Max									@VR (V)
Low-VF	10	100	0.23	0.3	5	20	10	1SS367 	1SS395 	1SS384 		HN2S01FU 	1SS394 	1SS391 	HN2S01F 
			0.35	0.5	100										
	10	100	0.23	0.3	5	20	10		1SS378 			HN2S05FU 	1SS377 		
			0.35	0.5	100										
10	100	0.23	0.3	5	20	10		1SS372 				1SS374 			
		0.35	0.5	100											
30	100	0.23	—	5	20	10									
		0.35	0.5	100			50	30							
Low-IR, High-speed	20	50	0.33	—	1	0.5	20	1SS406 		1SS402 		HN2S03FU 			
			0.38	—	5										
			0.50	0.55	50										
Low-IR	10	50	0.63	1.0	100	0.5	10					1SS321 			
Standard	40	100	0.54	0.6	100	5	40	1SS357 	1SS322 	1SS383 		HN2S02FU 	1SS294 	1SS319 	
				1SS393 							1SS392 				
	40	100	0.54	0.6	100	5	40					1SS396 			
			0.36	—	10			5	40						
	40	100	0.56	0.62	100										
High-VR	80	100	0.56	0.7	100	5	80					1SS348 			
High-Io, Low-VF	20	200	0.23	—	5	5	30								
			0.42	0.5	200										
	30	200	0.36	—	5	5	30								
0.52			0.6	200											
20	300	0.16	—	1	50	20	1SS404 	1SS401 	HN2S04JU 	HN2S04FU 					
		0.22	—	10											
		0.38	0.45	300											
High-Io	20	500	0.50	0.55	500	20	10					1SS344 			
			100	20											
	30	700	0.52	0.65	700	25	30		1SS408 						
20	1000	0.46	0.55	1000	25	30					1SS349 				

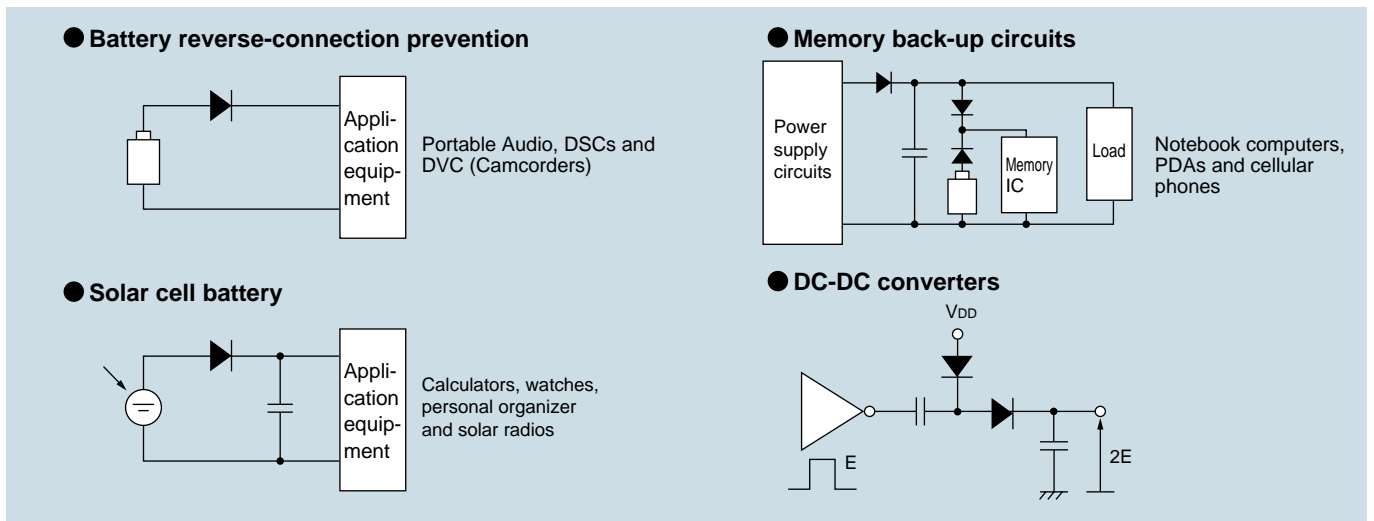
 New product

4. Small Signal Diodes

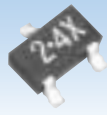
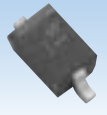

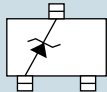


Schottky Barrier Diodes



Application Examples of Schottky Barrier Diodes



4.4 Zener Diodes

Zener Voltage V_z (V)	Package			
	S-MINI (SOT-346, SC-59)	USC (SOD-323)	ESC (SOD-523)	
2.0	02CZ2.0	02DZ2.0	015AZ2.0	
2.2	02CZ2.2	02DZ2.2	015AZ2.2	
2.4	02CZ2.4	02DZ2.4	015AZ2.4	
2.7	02CZ2.7	02DZ2.7	015AZ2.7	
3.0	02CZ3.0	02DZ3.0	015AZ3.0	
3.3	02CZ3.3	02DZ3.3	015AZ3.3	
3.6	02CZ3.6	02DZ3.6	015AZ3.6	
3.9	02CZ3.9	02DZ3.9	015AZ3.9	
4.3	02CZ4.3	02DZ4.3	015AZ4.3	
4.7	02CZ4.7	02DZ4.7	015AZ4.7	
5.1	02CZ5.1	02DZ5.1	015AZ5.1	
5.6	02CZ5.6	02DZ5.6	015AZ5.6	
6.2	02CZ6.2	02DZ6.2	015AZ6.2	
6.8	02CZ6.8	02DZ6.8	015AZ6.8	
7.5	02CZ7.5	02DZ7.5	015AZ7.5	
8.2	02CZ8.2	02DZ8.2	015AZ8.2	
9.1	02CZ9.1	02DZ9.1	015AZ9.1	
10	02CZ10	02DZ10	015AZ10	
11	02CZ11	02DZ11	015AZ11	
12	02CZ12	02DZ12	015AZ12	
13	02CZ13	02DZ13	* 015AZ13	
15	02CZ15	02DZ15	* 015AZ15	
16	02CZ16	02DZ16	* 015AZ16	
18	02CZ18	02DZ18	* 015AZ18	
20	02CZ20	02DZ20	* 015AZ20	
22	02CZ22	02DZ22	* 015AZ22	
24	02CZ24	02DZ24	* 015AZ24	
27	02CZ27			
30	02CZ30			
33	02CZ33			
36	02CZ36			
39	02CZ39			
43	02CZ43			
47	02CZ47			
Pin assignent				
P (mW)	200	200	150	

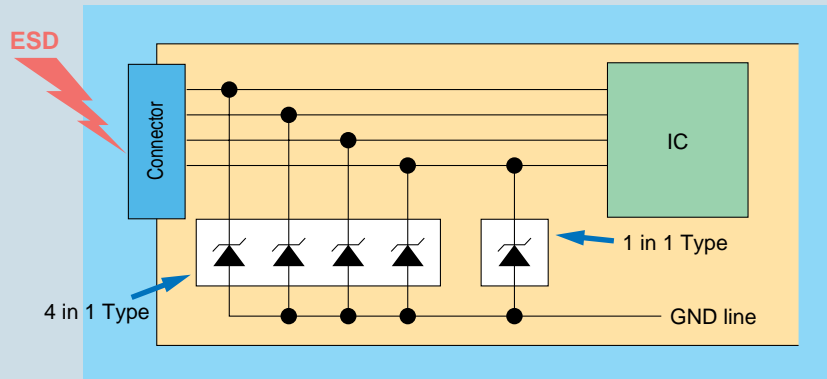
* Under development

4. Small Signal Diodes

4.5 ESD-Protection Diodes

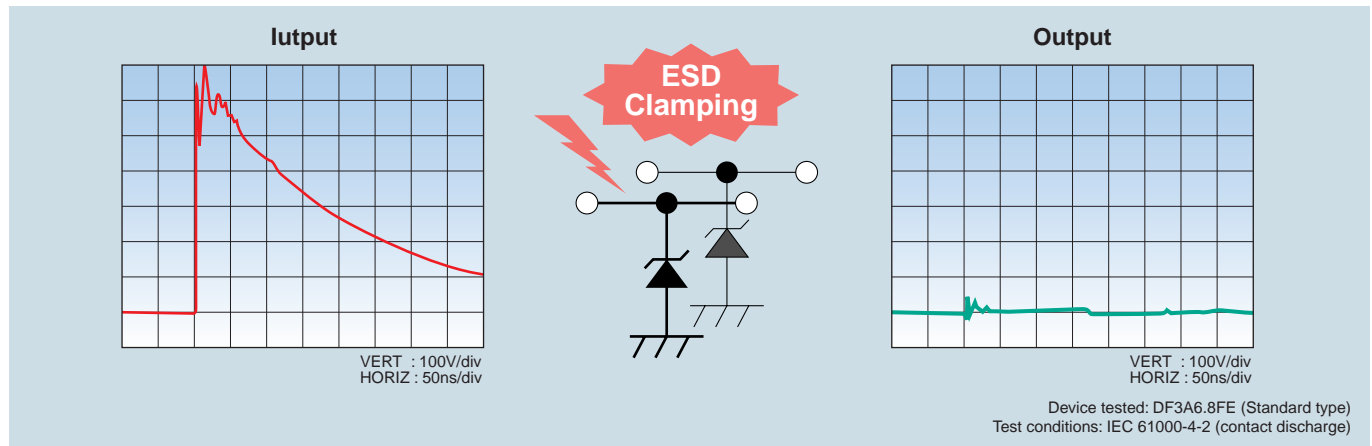
ESD-protection diodes are designed to absorb electrostatic discharge (ESD) energy that is introduced from I/O ports and travels through the connector onto the system board. ESD-protection diodes thus provide protection against ESD-induced system malfunction and/or damage to ICs.

● System Interface Protection

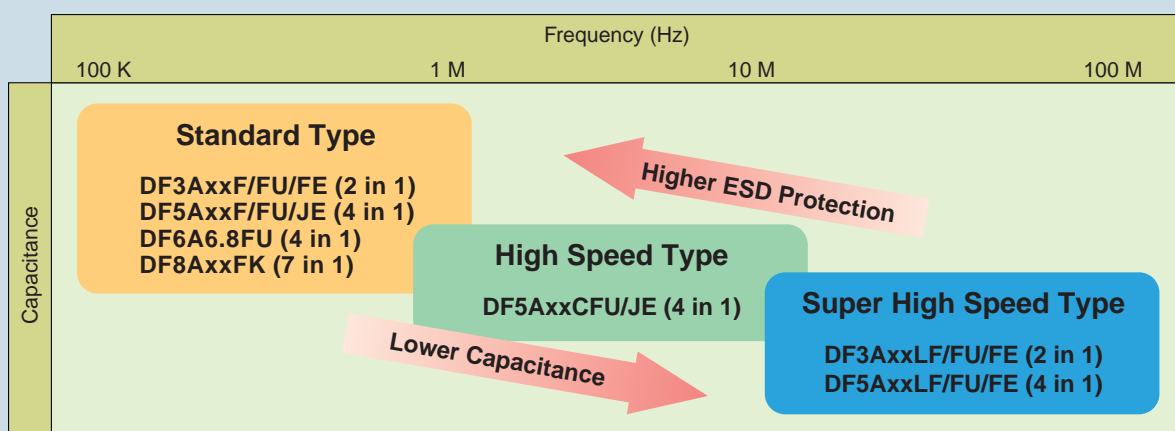


● ESD Clamping Performance

Toshiba's ESD-protection diodes are specifically designed for suppression of ESD-induced transients to protect against system malfunction and/or damage to ESD-sensitive ICs.



● Selection Guide

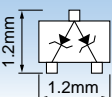
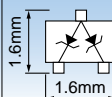
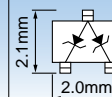
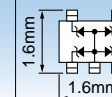
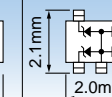
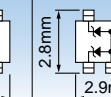
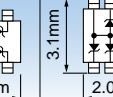


Single Type

Part Number		V_Z (V)		I_R (μ A)		C_T (pF)		
fSC	sESC	USC	Typ.	@ I_Z (mA)	Max	@ V_R (V)	Typ.	@ V_R (V)
DF2S5.6FS	DF2S5.6S		5.6	5	10	1	40	0
DF2S6.2FS	DF2S6.2S		6.2	5	1	3	32	0
DF2S6.8FS	DF2S6.8S		6.8	5	0.5	5	25	0
DF2S8.2FS	DF2S8.2S		8.2	5	0.5	6.5	20	0
DF2S12FS	DF2S12S	DF2S12FU	12	5	0.05	9	15	0
DF2S16FS	DF2S16S		16	5	0.5	12	10	0
DF2S24FS	DF2S24S		24	5	0.5	19	8.5	0

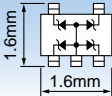
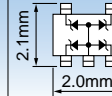
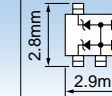
 New product


Standard Type

2-in-1			4-in-1				V_Z (V)		I_R (μ A)		C_T (pF)	
VESM (SOT-723)	ESM (SOT-490)	USM	ESV (SOT-553)	USV	SMV	US8	Typ.	@ I_Z (mA)	Max	@ V_R (V)	Typ.	@ V_R (V)
												
DF3A3.3FV	DF3A3.3FE	DF3A3.3FU	DF5A3.3JE	DF5A3.3FU	DF5A3.3F	–	3.3	5	20	1.0	115	0
DF3A3.6FV	DF3A3.6FE	DF3A3.6FU	DF5A3.6JE	DF5A3.6FU	DF5A3.6F	–	3.6	5	10	1.0	110	0
–	–	DF3A4.3FU	–	–	–	–	4.3	5	10	1.8	100	0
DF3A5.6FV	DF3A5.6FE	DF3A5.6FU	DF5A5.6JE	DF5A5.6FU	DF5A5.6F	DF8A5.6FK	5.6	5	1	2.5	65	0
DF3A6.2FV	DF3A6.2FE	DF3A6.2FU	DF5A6.2JE	DF5A6.2FU	DF5A6.2F	DF8A6.2FK	6.2	5	1	3.0	55	0
DF3A6.8FV	DF3A6.8FE	DF3A6.8FU	DF5A6.8JE	DF5A6.8FU	DF5A6.8F	DF8A6.8FK	6.8	5	0.5	5.0	45	0
DF3A8.2FV	DF3A8.2FE	DF3A8.2FU	DF5A8.2JE	DF5A8.2FU	DF5A8.2F	–	8.2	5	0.5	6.5	38	0

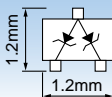
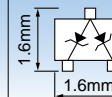
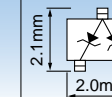
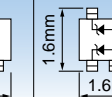
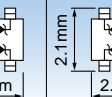
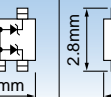
 New product

High Speed Type

4-in-1			V_Z (V)		I_R (μ A)		C_T (pF)	
ESV (SOT-553)	USV	SMV	Typ.	@ I_Z (mA)	Max	@ V_R (V)	Typ.	@ V_R (V)
								
DF5A3.6CJE	DF5A3.6CFU		3.6	5	100	1.8	52	0
DF5A5.6CJE	DF5A5.6CFU		5.6	5	1.0	3.5	29	0
DF5A6.2CJE	DF5A6.2CFU		6.2	5	2.5	5.0	25	0
DF5A6.8CJE	DF5A6.8CFU		6.8	5	0.5	5.0	23	0
DF5A8.2CJE	DF5A8.2CFU		8.2	5	0.5	6.5	18	0

 New product

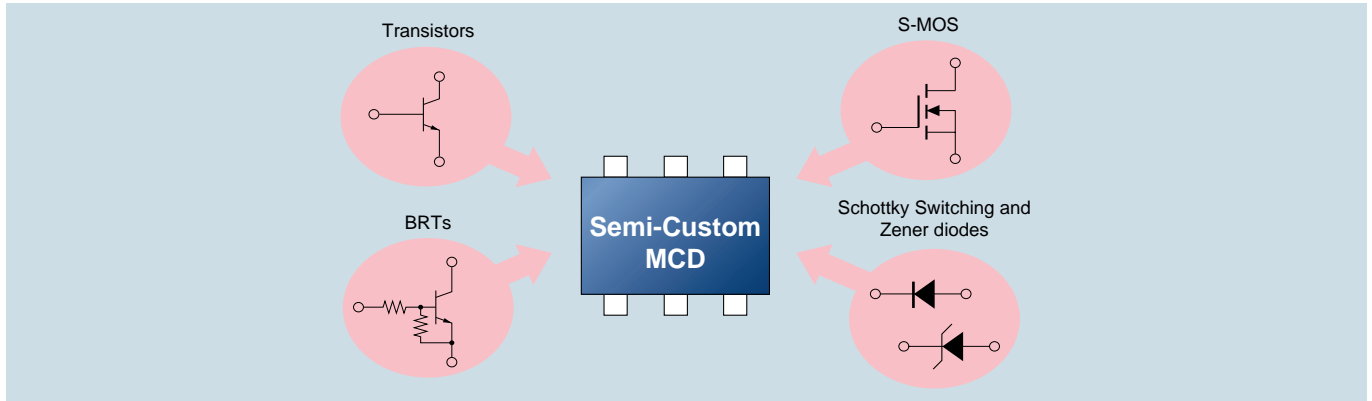
Super High Speed Type

2-in-1			4-in-1			V_Z (V)		I_R (μ A)		C_T (pF)	
VESM (SOT-723)	ESM (SOT-490)	USM	ESV (SOT-553)	USV	SMV	Typ.	@ I_Z (mA)	Max	@ V_R (V)	Typ.	@ V_R (V)
											
DF3A5.6LFV	DF3A5.6LFE	DF3A5.6LFU	DF5A5.6LJE	DF5A5.6LFU		5.6	5	1.0	3.5	8	0
DF3A6.2LFV	DF3A6.2LFE	DF3A6.2LFU	DF5A6.2LJE	DF5A6.2LFU		6.2	5	2.5	5.0	6.5	0
DF3A6.8LFV	DF3A6.8LFE	DF3A6.8LFU	DF5A6.8LJE	DF5A6.8LFU	DF5A6.8LF	6.8	5	0.5	5.0	6	0
DF3A8.2LFV	DF3A8.2LFE	DF3A8.2LFU	DF5A8.2LJE	DF5A8.2LFU	DF5A8.2LF	8.2	5	0.5	6.5	6	0

5. Multi-chip Discrete Device Series

5.1 Multi-chip Discrete Devices

Toshiba offers semi-custom multi-chip devices, which can be tailored to suit your unique needs. This helps to reduce external components, save board space and cut implementation cost.

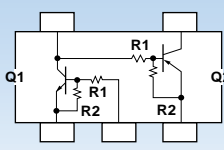


5-pin package (USV, SMV), 6-pin package (ES6, US6, SM6) Line-up

Internal Connection	Part Number					Component Devices	Ratings		Features	
	ES6 (1.6 × 1.6 mm) (SOT-553)	USV (2 × 2.1 mm)	US6 (2 × 2.1 mm)	SMV (2.9 × 2.8 mm)	SM6 (2.9 × 2.8 mm)		Voltage (V)	Current (mA)		
Point symmetrical array PNP + N-ch		HN7G01FE	-	HN7G01FU	-	-	Q1 2SA1954	V _{CEO} -12	I _c -400	PNP low-saturation transistor Suitable for power supply switches 2.5-V gate drive (V _{th} = 1.5 V max) Ron = 20 Ω (typ.)
		-	-	HN7G03FU	-	-	Q1 2SA1954	V _{CEO} -12	I _c -400	
Point symmetrical array PNP(BRT) + N-ch		HN7G02FE	-	HN7G02FU	-	-	Q1 RN2310	V _{CEO} -50	I _c -100	PNP low-saturation transistor Suitable for power supply switches Built-in 1-MΩ gate-source resistor 2.5-V gate drive (V _{th} = 1.3 V max) Ron = 4 Ω (typ.)
		-	-	-	-	-	Q2 2SK1829	V _{DS} 20	I _D 50	
Point symmetrical array PNP + NPN(BRT)		-	-	HN7G04FU	-	-	Q1 2SA1954	V _{CEO} -12	I _c -400	PNP low-saturation transistor Suitable for power supply switches Resistor built-in NPN transistor R1 = 10 kΩ, R2 = 47 kΩ
		-	-	-	-	-	Q2 RN1307	V _{CEO} 50	I _c 100	
Point symmetrical array PNP(BRT) + N-ch		-	-	HN7G05FU	-	-	Q1 RN2101	V _{CEO} -50	I _c -100	Resistor built-in PNP transistor R1 = 4.7 kΩ, R2 = 4.7 kΩ 2.5-V gate drive (V _{th} = 1.5 V max) Ron = 20 Ω (typ.)
		-	-	-	-	-	Q2 2SK1830	V _{DS} 20	I _D 50	
Point symmetrical array PNP + NPN(BRT)		HN7G06FE*	-	HN7G06FU	-	-	Q1 2SA1955F	V _{CEO} -12	I _c -400	PNP low-saturation transistor Suitable for power supply switches Resistor built-in NPN transistor R1 = 47 kΩ, R2 = 47 kΩ
		-	-	-	-	-	Q2 RN1104F	V _{CEO} 50	I _c 100	
Point symmetrical array NPN + NPN(BRT)		-	-	HN7G07FU	-	-	Q1 2SC5376F	V _{CEO} 12	I _c 400	NPN low-saturation transistor Suitable for power supply switches Resistor built-in NPN transistor R1 = 2.2 kΩ, R2 = 10 kΩ
		-	-	-	-	-	Q2 RN1115F	V _{CEO} 50	I _c 100	
Point symmetrical array PNP + NPN(BRT)		HN7G08FE	-	-	-	-	Q1 2SA1954	V _{CEO} -12	I _c -500	PNP low-saturation transistor Suitable for power supply switches Resistor built-in NPN transistor R1 = 4.7 kΩ, R2 = 47 kΩ
		-	-	-	-	-	Q2 RN1306	V _{CEO} 50	I _c 100	
Point symmetrical array NPN(BRT) + N-ch		HN7G09FE	-	-	-	-	Q1 RN1104F	V _{CEO} 50	I _c 100	Resistor built-in NPN transistor R1 = 47 kΩ, R2 = 47 kΩ 2.5-V gate drive (V _{th} = 1.5 V max) Ron = 4 Ω (typ.)
		-	-	-	-	-	Q2 SSM3K15FS	V _{DS} 30	I _D 100	
Point symmetrical array NPN + N-ch		HN7G10FE	-	-	-	-	Q1 2SC5376F	V _{CEO} 12	I _c 400	NPN low-saturation transistor Suitable for power supply switches 2.5-V gate drive (V _{th} = 1.3 V max) Ron = 4 Ω (typ.)
		-	-	-	-	-	Q2 SSM3K03FE	V _{DS} 20	I _D 100	
Emitter common NPN + NPN (BRT)		-	-	-	HN4G01J	-	Q1 2SC2712	V _{CEO} 50	I _c 100	General-purpose NPN transistor Resistor built-in NPN transistor R1 = 22 kΩ, R2 = 22 kΩ
		-	-	-	-	-	Q2 RN1103F	V _{CEO} 50	I _c 100	
Small-signal diode + NPN		-	-	-	-	HN2E01F	Q1 1SS352	V _R 80	I _O 100	General-purpose high-speed switching
		-	-	-	-	HN2E02F	Q2 2SC4666	V _{CEO} 50	I _c 150	
PNP + Small-signal diode		-	-	-	-	HN2E04F	Q1 2SA1587	V _{CEO} -120	I _c -100	High-V _{CEO} PNP transistor General-purpose high-speed switching
		-	-	-	-	-	Q2 1SS352	V _R 80	I _O 100	
BRT(PNP) + Small-signal diode		-	-	-	HN2E05J	-	Q1 RN2304	V _{CEO} -50	I _c -100	Resistor built-in PNP transistor R1 = 47 kΩ, R2 = 47 kΩ General-purpose high-speed switching
		-	-	-	-	-	Q2 1SS352	V _R 80	I _O 100	
Small-signal diode + NPN		-	HN2E06JU*	-	-	-	Q1 1SS352	V _R 80	I _O 100	General-purpose high-speed switching
		-	-	-	-	-	Q2 2SC4116	V _{CEO} 50	I _c 150	

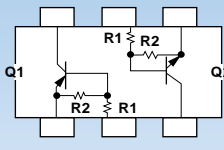
*: Under development

Multi-chip 5-pin packages (C-B Connecting type)

Ratings	V _{CEO} (V)	50 / -50		Component devices		Internal resistor
	I _{CEO} (mA)	100 / -100				
Package		ESV (SOT-533)	USV (SOT-353, SC-88A)			
Internal resistors						
R1 (kΩ)	R2 (kΩ)			Q1		
4.7	—	RN47A1JE	RN47A1	Q2	RN1310	
4.7	—			Q1	RN2310	
22	22	RN47A2JE	RN47A2	Q1	RN1303	
22	22			Q2	RN2303	
10	10	RN47A3JE	RN47A3	Q1	RN1302	
10	10			Q2	RN2302	
47	47	RN47A4JE	RN47A4	Q1	RN1304	
10	47			Q2	RN2307	
47	47	RN47A5JE	RN47A5	Q1	RN1304	
4.7	10			Q2	RN2316	
100	100		RN47A6*	Q1	RN1130F	
100	100			Q2	RN2130F	
10	10	RN47A7JE		Q1	RN1302	
4.7	10			Q2	-12 V / -100 mA Low V _{CE(sat)}	

■ New product * : Under development

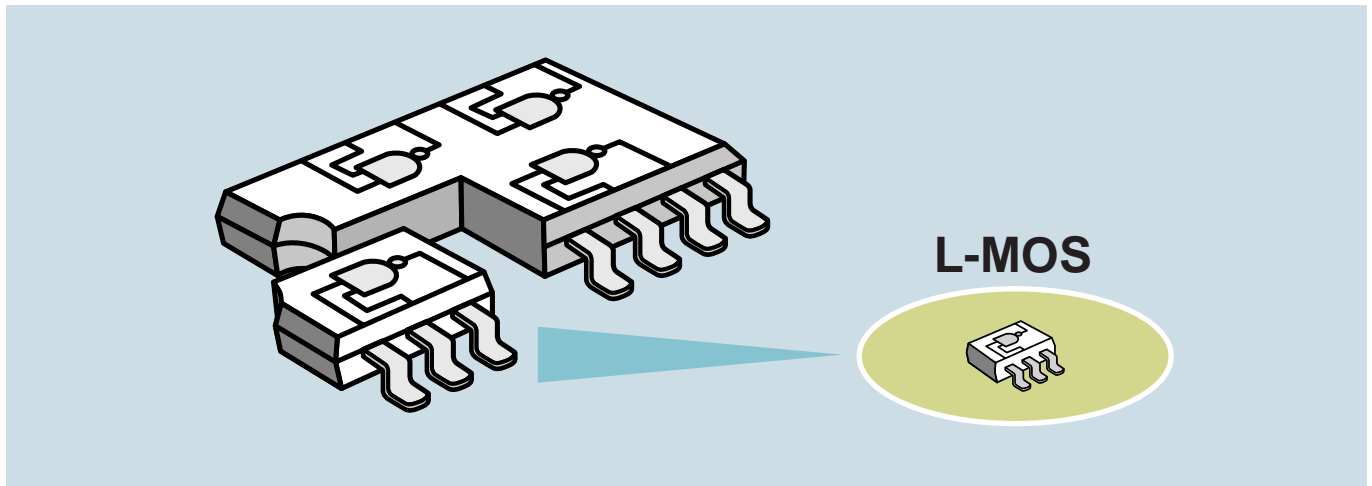
Multi-chip 6-pin packages (Special Combination type)

Ratings	V _{CEO} (V)	-50 / 50			Component devices		Internal resistor
	I _{CEO} (mA)	-100 / 100					
Package		ES6 (SOT-563)	US6 (SOT-363, SC-88)	SM6 (SOT-26, SC-74)			
Internal resistors							
R1 (kΩ)	R2 (kΩ)				Q1		
2.2	47	RN49A1FE	RN49A1		RN2305		
22	47			Q2	RN1308		
22	22			Q1	RN2303		
10	10			Q2	RN1302		
2.2	47		RN49A2	Q1	RN2305		
47	47			Q2	RN1304		
0.47	10	RN49A4FE		Q1	RN2325A		
10	—			Q2	RN1111F		
22	—			Q1	RN2112F		
4.7	—			Q2	RN1970HFE		
10	10		RN49A5	Q1	RN1107F		
2.2	10				Q2	RN2327A	

■ New product * : Under development

6. L-MOS

6.1 Outline of L-MOS



Features

1. Very Small

The latest and smallest package fSV's mounting area is only 1mm square. It is very good for high density mount set. And it is suitable for circuit minor change.

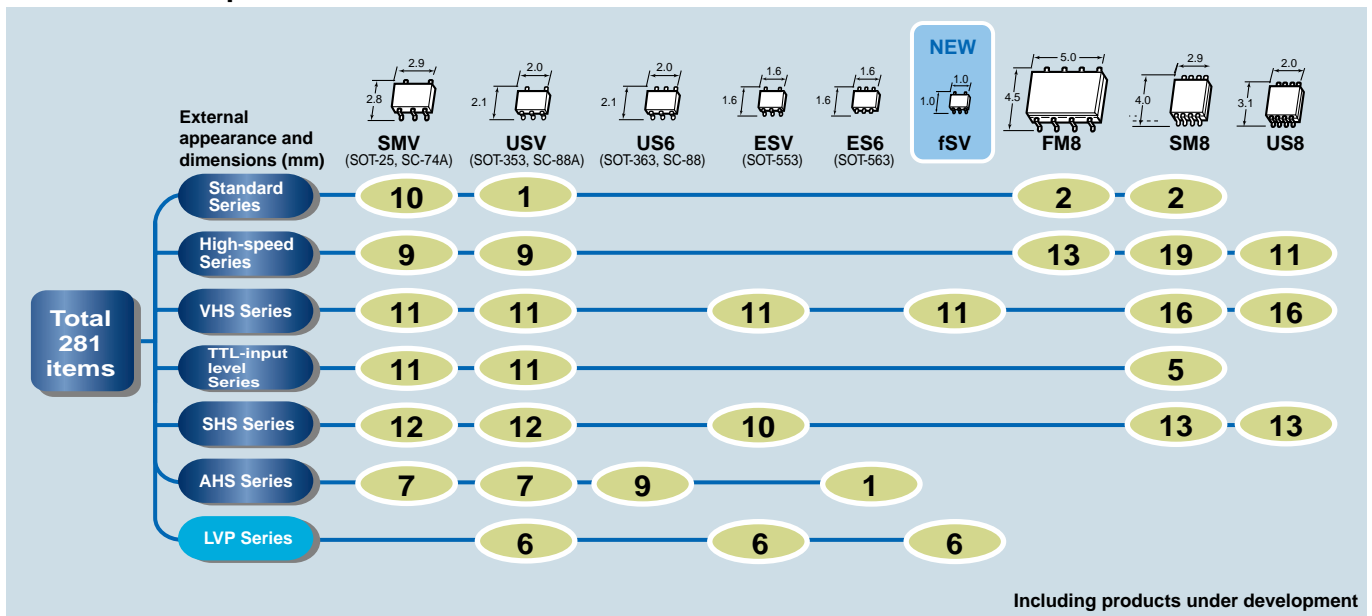
2. Easy Layout Arrangement

L-MOS contain only 1 or 2 circuit in package, so it is very convenience for separate arrangement. This increase the ease of layout and pattern design.

3. Very Thin

The thinnest package fSV is only 0.5mm height. It is convenience for portable set especially for high functional cellular phone.

Products Line-up



Under development

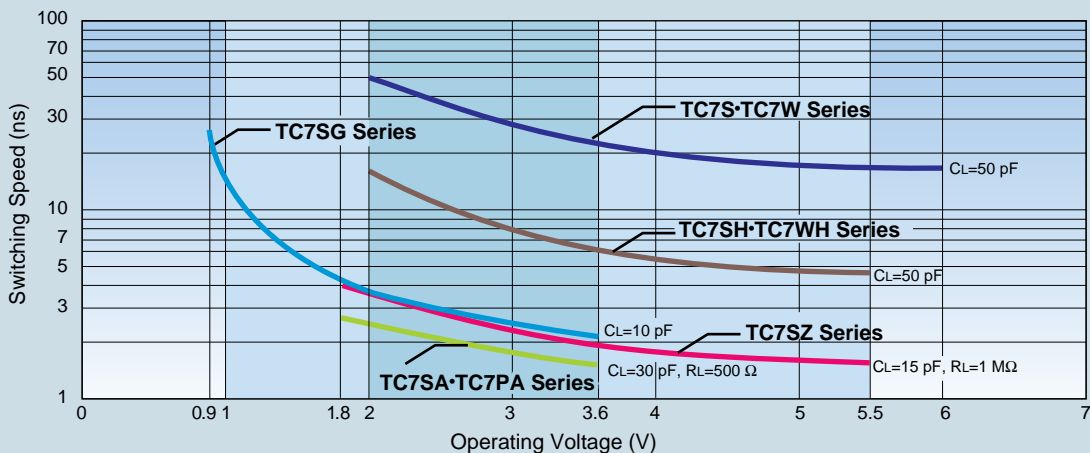
L-MOS Performance Summary

Parameter	Standard Series	High-Speed Series * ₁		Very-High-Speed Series	TTL-Level Input Series		Super-High-Speed Series * ₂	AHS Series	LVP Series	
	TC4S _{xx} F TC4W _{xx} F/FU	TC7S _{xx} F/FU	TC7W _{xx} F/FU/FK TC3W _{xx} F/FU	*TC7SH _{xx} F/ FU/FE/FS TC7WH _{xx} F/ FK	*TC7SET _{xx} F/FU	TC7WT _{xx} FU	TC7SZ _{xx} F/FU TC7SZ _{xx} AFE *TC7WZ _{xx} FU/FK	TC7SA _{xx} F/FU *TC7PA _{xx} F/FU	*TC7SG _{xx} FU/ FE/AFS* ₁	
Propagation delay time (NAND gate)	65 ns typ. @V _{cc} = 5 V C _L = 15 pF Ta=25°C	7 ns typ. @V _{cc} = 5 V C _L = 15 pF Ta=25°C	6 ns typ. @V _{cc} = 5 V C _L = 15 pF Ta=25°C	3.7 ns typ. @V _{cc} = 5 V C _L = 15 pF Ta=25°C	4.2 ns typ. @V _{cc} = 5 V C _L = 15 pF Ta=25°C	10 ns typ. (3state Bu) @V _{cc} = 5.5 V C _L = 15 pF Ta=25°C	2.4 ns typ. @V _{cc} = 3.3 V C _L = 15 pF R _L = 1 MΩ Ta=25°C	2.8 ns max @V _{cc} = 3.3 V C _L = 30 pF R _L = 500 Ω Ta=-40 ~ 85°C	2.5 ns typ. @V _{cc} = 3.3 V C _L = 15 pF Ta=25°C	
Operating voltage range	3 to 18 V	2 to 6 V	2 to 6 V	2 to 5.5 V	4.5 to 5.5 V	4.5 to 5.5 V	1.8 to 5.5 V	1.8 to 3.6 V	0.9 to 3.6 V	
Operating temperature range	-40 to 85°C	-40 to 85°C	-40 to 85°C	-40 to 85°C	-40 to 85°C	-40 to 85°C	-40 to 85°C	-40 to 85°C	-40 to 85°C	
Output current	I _{OH}	0.42 mA min (@V _{cc} = 5 V)	2 mA min (@V _{cc} = 4.5 V)	4 mA min (@V _{cc} = 4.5 V)	8 mA min (@V _{cc} = 4.5 V)	8 mA min (@V _{cc} = 4.5 V)	4 mA min (@V _{cc} = 4.5 V)	24 mA min (@V _{cc} = 3 V)	24 mA min (@V _{cc} = 3 V)	8 mA min (@V _{cc} = 3 V)
	I _{OL}	0.42 mA min (@V _{cc} = 5 V)	2 mA min (@V _{cc} = 4.5 V)	4 mA min (@V _{cc} = 4.5 V)	8 mA min (@V _{cc} = 4.5 V)	8 mA min (@V _{cc} = 4.5 V)	4 mA min (@V _{cc} = 4.5 V)	24 mA min (@V _{cc} = 3 V)	24 mA min (@V _{cc} = 3 V)	8 mA min (@V _{cc} = 3 V)
Electrical characteristics (except for permissible power dissipation rating)	Same as those of the TC4 _{xxx} B series	Output current is 1/2 that of the TC74HC _{xx} A series	Same as those of the TC74HC _{xx} A series	Same as those of the TC74VHC _{xxx} series	Input voltage specification is TTL level. V _{IL} = 0.8 V (max) V _{IH} = 2.0 V (min) The output voltage level is subject to full swings.		Same as those of the TC74LC _{xx} series when operating V _{cc} = 3.3 V	Same as those of the TC74VC _{xx} series	-	

*: Some products are in under development stage.

*₁: TC3W_{xx}F/FU and TC7SG_{xx}FU/FE/AFS are original L-MOS devices and it is not a C²MOS logic IC.

*₂: TC7SZ_{xx}F/FU Series have 5-V tolerant function for input and output same as those of the TC74LC_{xx} Series. TC7SZ_{xx}AFE Series only have 5-V tolerant function for input.

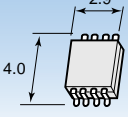


6. L-MOS

6.2 L-MOS Line-up

Package Name	fSV		ESV (SOT-553)			USV (SOT-353, SC-88A)						SMV (SOT-25, SC-74A)			
Appearance Image (mm)															
Function	VHS Series	LVP Series	VHS Series	SHS Series	LVP Series	HS Series	VHS Series	VHS-TTL Series	SHS Series	AHS Series	LVP Series	Standard Series	HS Series	VHS Series	VHS-TTL Series
NAND	TC7SH00FS	TC7SG00AFS	TC7SH00FE	TC7SZ00AFE	TC7SG00FE	TC7S00FU	TC7SH00FU	TC7SET00FU	TC7SZ00FU	TC7SA00FU	*TC7SG00FU	TC4S11F	TC7S00F	TC7SH00FU	TC7SET00F
NAND (unbuffer)												TC4SU11F			
NAND (Open Drain)									TC7SZ38FU						
AND	TC7SH08FS	TC7SG08AFS	TC7SH08FE	TC7SZ08AFE	TC7SG08FE	TC7S08FU	TC7SH08FU	TC7SET08FU	TC7SZ08FU	TC7SA08FU	*TC7SG08FU	TC4S81F	TC7S08F	TC7SH08FU	TC7SET08F
NOR	TC7SH02FS	*TC7SG02AFS	TC7SH02FE	TC7SZ02AFE	*TC7SG02FE	TC7S02FU	TC7SH02FU	TC7SET02FU	TC7SZ02FU		*TC7SG02FU	TC4S01F	TC7S02F	TC7SH02FU	TC7SET02F
OR	TC7SH32FS	*TC7SG32AFS	TC7SH32FE	TC7SZ32AFE	*TC7SG32FE	TC7S32FU	TC7SH32FU	TC7SET32FU	TC7SZ32FU	TC7SA32FU	*TC7SG32FU	TC4S71F	TC7S32F	TC7SH32FU	TC7SET32F
Exclusive-OR	TC7SH86FS	*TC7SG86AFS	TC7SH86FE	TC7SZ86AFE	*TC7SG86FE	TC7S86FU	TC7SH86FU	TC7SET86FU	TC7SZ86FU		*TC7SG86FU	TC4S30F	TC7S86F	TC7SH86FU	TC7SET86F
Inverter	TC7SH04FS	*TC7SG04AFS	TC7SH04FE	TC7SZ04AFE	*TC7SG04FE	TC7S04FU	TC7SH04FU	TC7SET04FU	TC7SZ04FU	TC7SA04FU	*TC7SG04FU	TC4S69F	TC7S04F	TC7SH04FU	TC7SET04F
Inverter (unbuffer)	TC7SHU04FS	*TC7SGU04AFS	TC7SHU04FE	TC7SZU04AFE	*TC7SGU04FE	TC7SU04FU	TC7SHU04FU		TC7SZU04FU	TC7SAU04FU	*TC7SGU04FU	TC4SU69F	TC7SU04F	TC7SHU04FU	
Inverter (open drain)									TC7SZ05FU	TC7SA05FU					
Schmitt inverter	TC7SH14FS		TC7SH14FE	TC7SZ14AFE		TC7S14FU	TC7SH14FU	TC7SET14FU	TC7SZ14FU			TC4S584F	TC7S14F	TC7SH14FU	TC7SET14F
Schmitt buffer								TC7SET17FU							TC7SET17F
Non-Inverter	TC7SH34FS		TC7SH34FE				TC7SH34FU	TC7SET34FU		TC7SA34FU				TC7SH34F	TC7SET34F
Analog switch						TC7S66FU						TC4S66F TC4S66FU(USV)	TC7S66F		
Analog multiplexer															
D-type flip-flop															
D-type flip-flop with clear															
3-state buffer	*TC7SH125FS		TC7SH125FE	TC7SZ125AFE			TC7SH125FU	*TC7SET125FU	TC7SZ125FU					TC7SH125FU	*TC7SET125F
3-state buffer	*TC7SH126FS		TC7SH126FE	TC7SZ126AFE			TC7SH126FU	*TC7SET126FU	TC7SZ126FU					TC7SH126FU	*TC7SET126F
3-state inverting buffer															
3-state buffer															
Bus transceiver															
Bus transceiver with open drain															
Monostable multivibrator															
Digital multiplexer															
1-to-2 decoder															
2-to-4 decoder															
2-to-3 decoder with Enable															
2-to-3 decoder with Enable															
Oscillator & divider															

*: Under development

Package Name	SMV (SOT-25, SC-74A)		ES6 (SOT-563)	US6 (SOT-363, SC-88)	US8			SM8					FM8	
Appearance Image (mm)														
Function	SHS Series	AHS Series	AHS Series	AHS Series	HS Series	VHS Series	SHS Series	Standard Series	HS Series	HS-TTL Series	VHS Series	SHS Series	Standard Series	HS Series
NAND	TC7SZ00F	TC7SA00F			TC7W00FK	TC7WH00FK	TC7WZ00FK		TC7W00FU		TC7WH00FU	TC7WZ00FU		TC7W00F
NAND (unbuffer)														
NAND (Open Drain)	TC7SZ38F						TC7WZ38FK					TC7WZ38FU		
AND	TC7SZ08F	TC7SA08F			TC7W08FK	TC7WH08FK	TC7WZ08FK		TC7W08FU		TC7WH08FU	TC7WZ08FU		TC7W08F
NOR	TC7SZ02F				TC7W02FK	TC7WH02FK	TC7WZ02FK		TC7W02FU		TC7WH02FU	TC7WZ02FU		TC7W02F
OR	TC7SZ32F	TC7SA32F			TC7W32FK	TC7WH32FK	TC7WZ32FK		TC7W32FU		TC7WH32FU	TC7WZ32FU		TC7W32F
Exclusive-OR	TC7SZ86F				TC7W86FK				TC7W86FU					
Inverter	TC7SZ04F	TC7SA04F		TC7PA04FU	TC7W04FK	TC7WH04FK	TC7WZ04FK		TC7W04FU		TC7WH04FU	TC7WZ04FU		TC7W04F
Inverter (unbuffer)	TC7SZU04F	TC7SAU04F		TC7PAU04FU	TC7WU04FK	TC7WHU04FK	TC7WZU04FK		TC7WU04FU		TC7WHU04FU	TC7WZU04FU		TC7WU04F
Inverter (open drain)	TC7SZ05F	TC7SA05F		TC7PA05FU			TC7WZ05FK					TC7WZ05FU		
Schmitt inverter	TC7SZ14F			TC7PA14FU	TC7W14FK	TC7WH14FK	TC7WZ14FK		TC7W14FU		TC7WH14FU	TC7WZ14FU		TC7W14F
Schmitt buffer				TC7PA17FU										
Non-Inverter		TC7SA34F		TC7PA34FU	TC7W34FK	TC7WH34FK	TC7WZ34FK		TC7W34FU		TC7WH34FU	TC7WZ34FU		
Analog switch					TC7W66FK			TC4W66FU	TC7W66FU				TC4W66F	TC7W66F
Analog multiplexer				TC7PA53FU	TC7W53FK			TC4W53FU	TC7W53FU				TC4W53F	TC7W53F
D-type flip-flop					TC7W74FK	TC7WH74FK	TC7WZ74FK		TC7W74FU	TC7WT74FU	TC7WH74FU	TC7WZ74FU		TC7W74F
D-type flip-flop with clear				TC7PA175FU										
3-state buffer	TC7SZ125F					TC7WH125FK			TC7W125FU	TC7WT125FU	TC7WH125FU			
3-state buffer	TC7SZ126F					TC7WH126FK			TC7W126FU	TC7WT126FU	TC7WH126FU			
3-state inverting buffer						TC7WH240FK			TC7W240FU	TC7WT240FU	TC7WH240FU			
3-state buffer						TC7WH241FK			TC7W241FU	TC7WT241FU	TC7WH241FU			
Bus transceiver						TC7WH245FK	TC7WZ245FK				TC7WH245FU	TC7WZ245FU		
Bus transceiver with open drain							TC7WZ246FK					TC7WZ246FU		
Monostable multivibrator						TC7WH123FK					TC7WH123FU			
Digital multiplexer						TC7WH157FK					TC7WH157FU			
1-to-2 decoder			TC7PA19AFE	*TC7PA19AFU										
2-to-4 decoder									TC7W139FU					
2-to-3 decoder with Enable									TC3W01FU					
2-to-3 decoder with Enable									TC3W02FU					
Oscillator & divider									TC3W03FU					

6. L-MOS

6.3 New Series Solution

LVP Series

LVP Low Voltage Low Power Series: TC7SGxxAFS/TC7SGxxFE/TC7SGxxFU

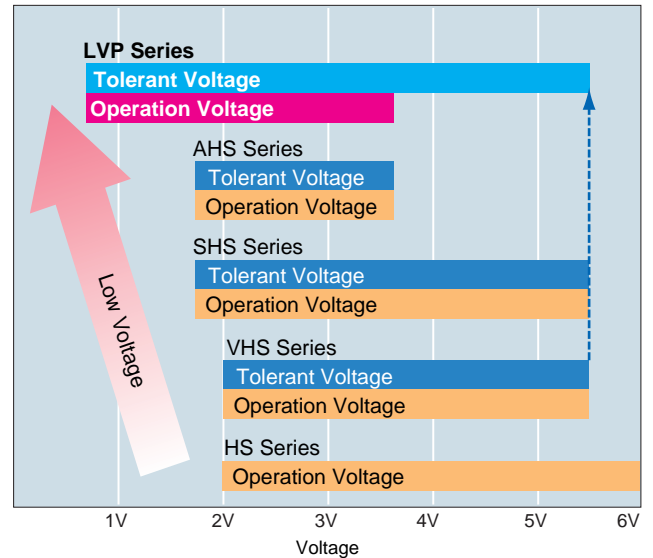
Features

- Low voltage (Operating voltage range) : 0.9 V to 3.6 V
- Low power (Power dissipation capacitance) : 6 pF @Vcc=3.6 V
- 5.0 V Input tolerant/3.6 V* Output power-down protection
- High-output drive : ± 8 mA(min) @Vcc=3.0 V
- Low switching noise
- Propagation delay time : 2.5 ns(typ) @Vcc=3.3 V, CL=15 pF
- Small and thin package : fSV/ESV/USV

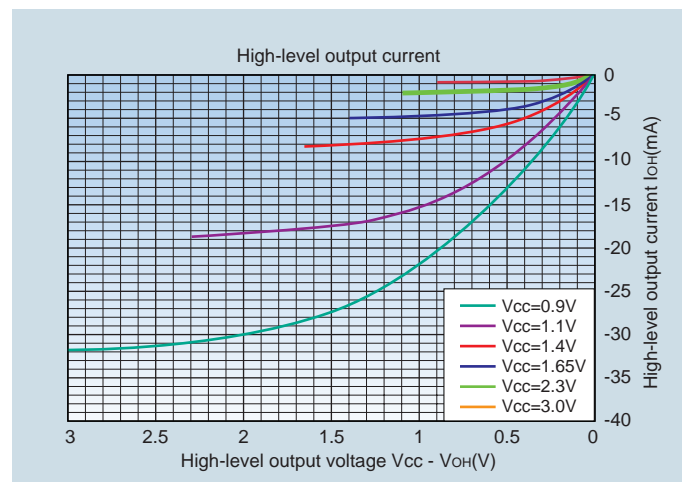
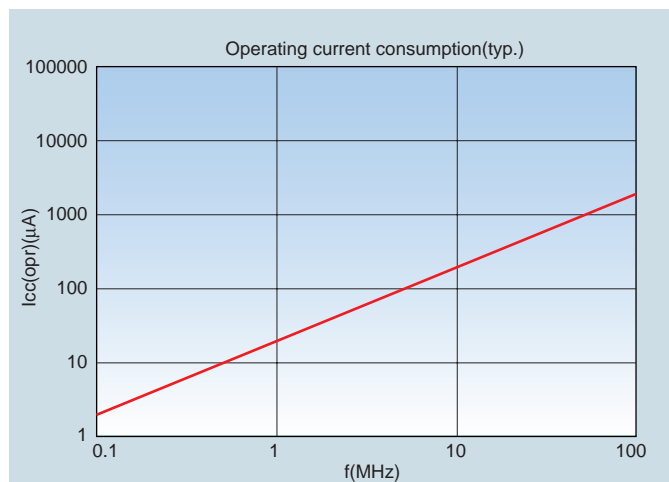
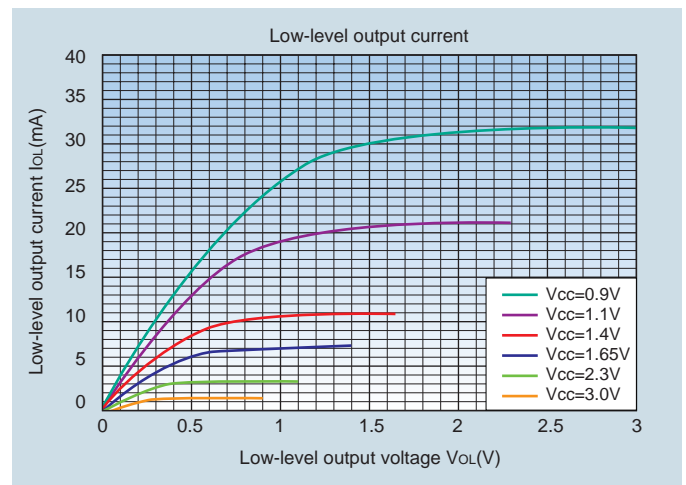
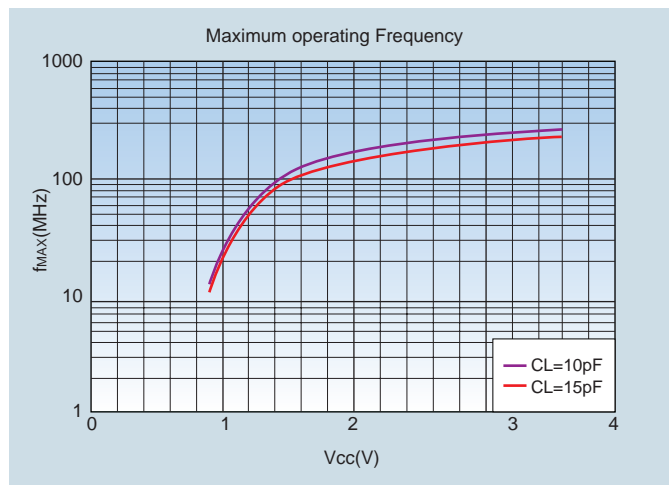
*The output protection for TC7SGxxAFS series is different from that of TC7SGxxFE and TC7SGxxFU series, hence, voltage greater than or equal to Vcc should not be applied to TC7SGxxAFS series.

Low Voltage and Tolerant

Operation voltage range and tolerant voltage range(Input)



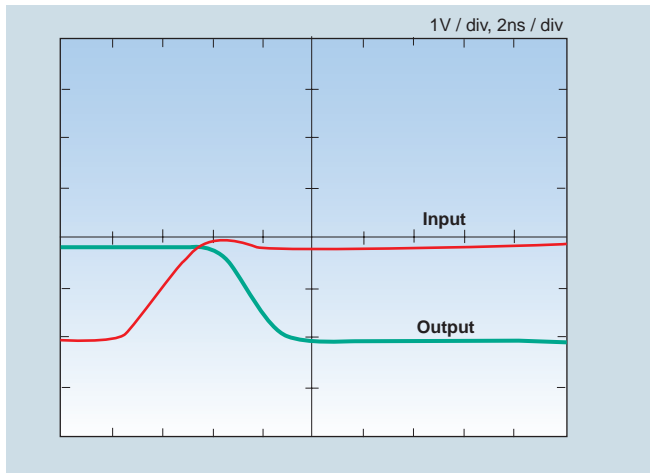
Characteristics



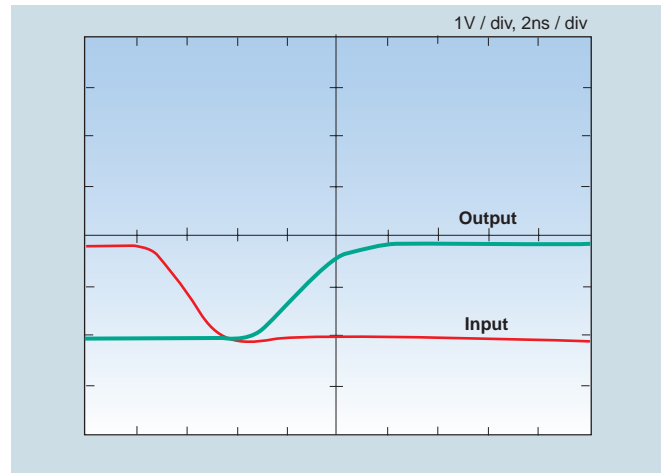
Switching waveform (typ.)

● $V_{CC} = 1.8\text{ V}$, $C_L = 10\text{ pF}$

tpHL



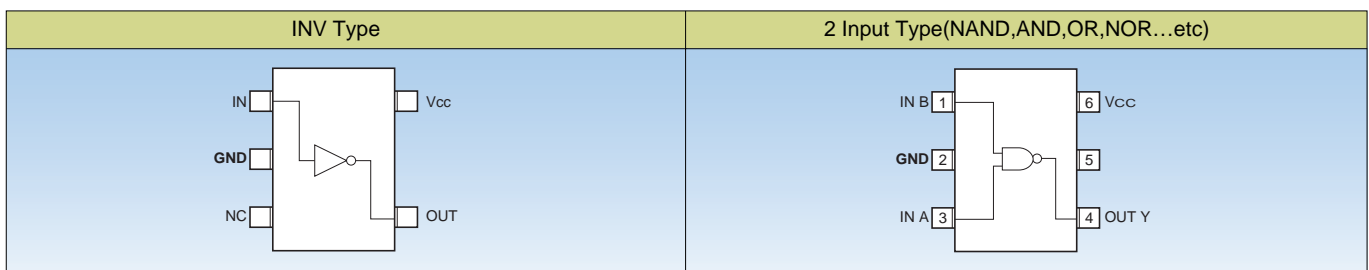
tpLH



Package dimensions and Recommended Land Pattern

TC7SGxxAFS fSV		TC7SGxxFE ESV(SOT-553)		TC7SGxxFU USV (SOT-353, SC-88A)	
Dimensions	Land pattern for reference	Dimensions	Land pattern for reference	Dimensions	Land pattern for reference
Unit: mm	Unit: mm	Unit: mm	Unit: mm	Unit: mm	Unit: mm

Pin Assignment of fSV Packages



Please be careful to design when making new PCB for fSV because of change the position GND terminal.

Product Line-up

fSV Product No.	ESV Product No.	USV Product No.	Function
TC7SG00AFS	TC7SG00FE	*TC7SG00FU	2-Input NAND Gate
*TC7SG02AFS	*TC7SG02FE	*TC7SG02FU	2-Input NOR Gate
*TC7SG04AFS	*TC7SG04FE	*TC7SG04FU	Inverter
*TC7SGU04AFS	*TC7SGU04FE	*TC7SGU04FU	Inverter(Unbuffer)
TC7SG08AFS	TC7SG08FE	*TC7SG08FU	2-Input AND Gate
*TC7SG32AFS	*TC7SG32FE	*TC7SG32FU	2-Input OR Gate

*Under development

6. L-MOS

6.4 New Very Small Package Solution

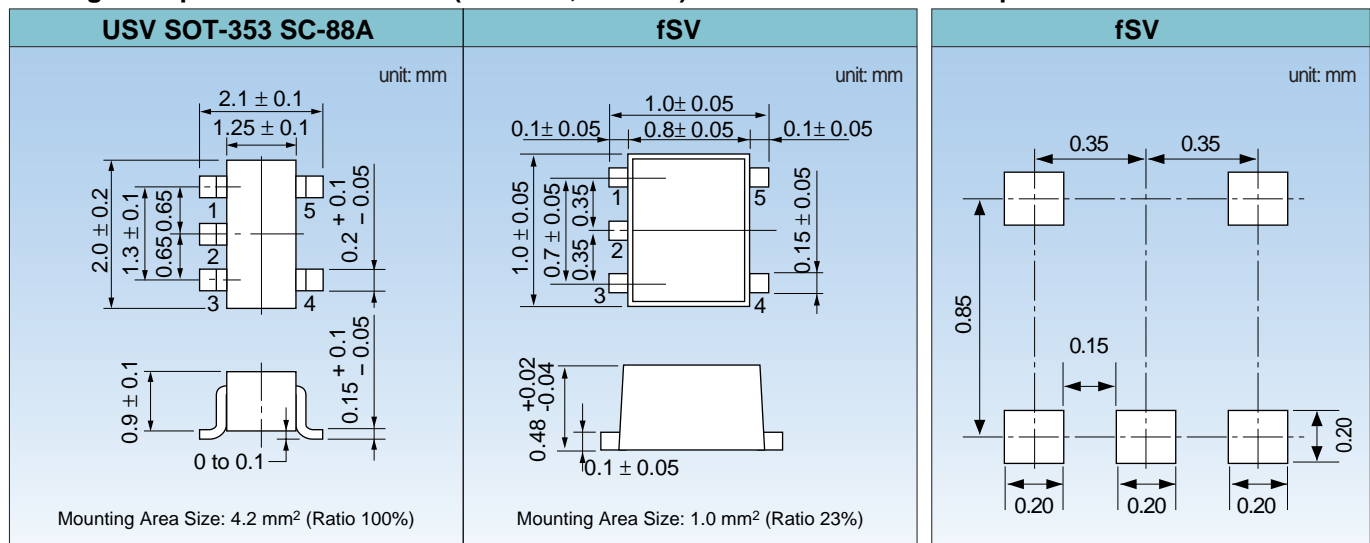
6.4.1 New Smallest fSV(5pin) Package

VHS Series Housed in fSV Package: TC7SHxxFS

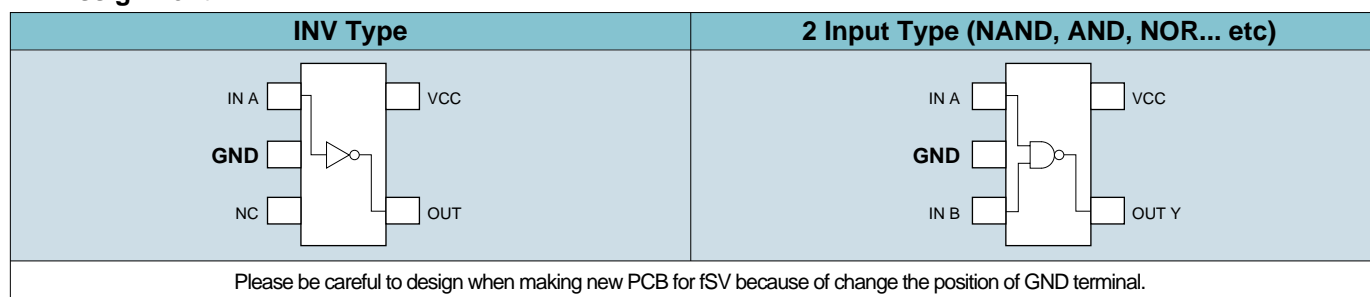
Features

- Package Dimension: 1.0mm × 1.0mm
- Lead pitch: 0.35mm
- Product height: 0.48mm
- fSV are flat-lead package which suitable for use in high-speed and high-density mounting.

Package comparison between USV(SOT-523, SC-88A) and fSV



Pin Assignment



Product Line-up

Part Number	Function
TC7SH00FS	2-Input NAND Gate
TC7SH02FS	2-Input NOR Gate
TC7SH04FS	Inverter
TC7SHU04FS	Inverter(Unbuffer)
TC7SH08FS	2-Input AND Gate
TC7SH14FS	Schmitt Inverter
TC7SH32FS	2-Input OR Gate
TC7SH34FS	Non-Inverter
TC7SH86FS	2-Input EX-OR Gate
*TC7SH125FS	3-State Buffer
*TC7SH126FS	3-State Buffer

Please be careful to design the new PCB.

*: Underdevelopment

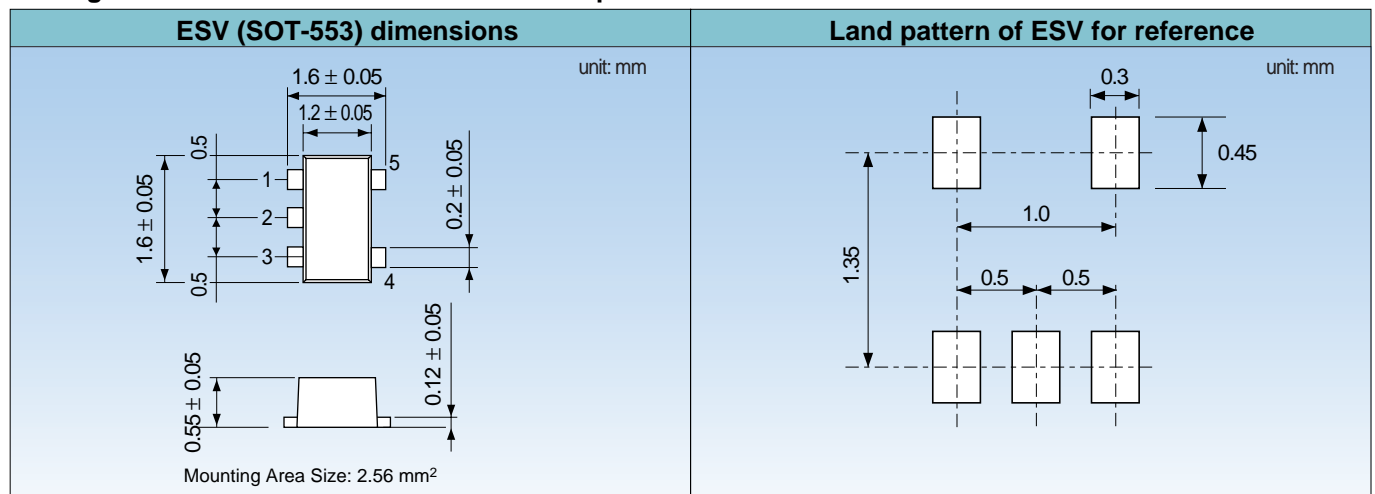
6.4.2 ESV(5pin) Package

VHS/SHS Series Housed in ESV Package: TC7SHxxFE/TC7SZxxAFE

Features

- Package Dimension: 1.6mm × 1.6mm
- Lead pitch: 0.5mm
- Product height: 0.55mm
- ESV are flat-lead package which suitable for use in high-speed and high-density mounting.
- The same pin assignment as USV/SMV package

Package dimensions and Recommended land pattern



New Product Line-up

Part Number	Function
TC7SH00FE	2-Input NAND Gate
TC7SH02FE	2-Input NOR Gate
TC7SH04FE	Inverter
TC7SHU04FE	Inverter(Unbuffer)
TC7SH08FE	2-Input AND Gate
TC7SH14FE	Schmitt Inverter
TC7SH32FE	2-Input OR Gate
TC7SH34FE	Non-Inverter
TC7SH86FE	2-Input EX-OR Gate
*TC7SH125FE	3-State Buffer
*TC7SH126FE	3-State Buffer

*: Underdevelopment

Current Product Line-up

Part Number	Function
TC7SZ00AFE	2-Input NAND Gate
TC7SZ02AFE	2-Input NOR Gate
TC7SZ04AFE	Inverter
TC7SZ04AFE	Inverter(Unbuffer)
TC7SZ08AFE	2-Input AND Gate
TC7SZ32AFE	2-Input OR Gate
TC7SZ125AFE	3-State Buffer
TC7SZ126AFE	3-State Buffer

The output protection function for TC7SZxxAFE Series is different from that of TC74LCxx and TC7SZxxF/FU Series; hence, voltage greater than or equal to V_{CC} should not be applied to TC7SZxxAFE Series.

6. L-MOS

6.5 New Products (Low-voltage logic series)

SHS Series Housed in 8-pin Package: TC7WZxxFU/FK

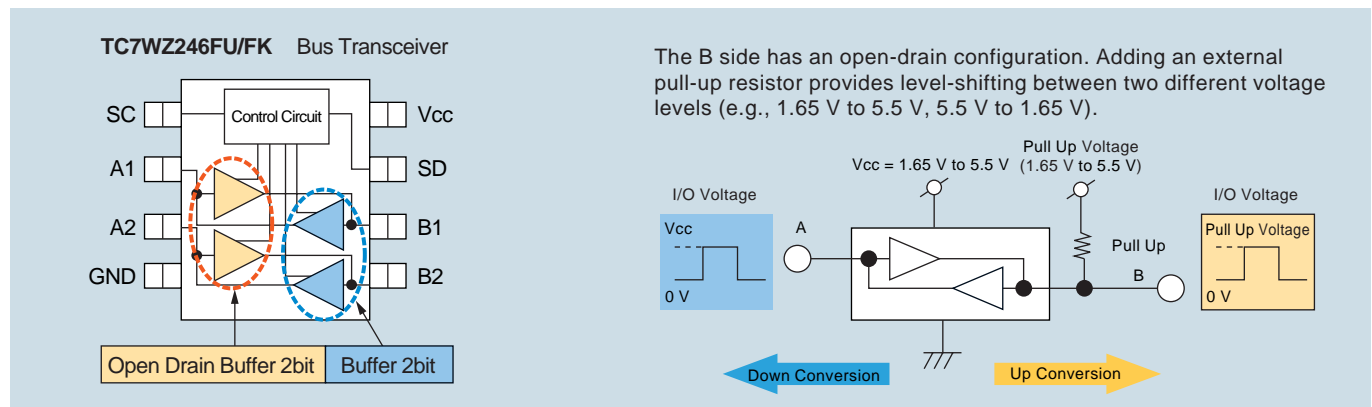
Outline

Two or three circuits of super-high-speed propagation delay time and high drive capability SHS single types are housed in 8-pin packages. Small and thin packages; US8 and SM8 are used.

Features

- High-output drive: ± 24 mA (min) @ $V_{CC} = 3$ V
- Propagation delay time: 2.4 ns (typ.) @ $V_{CC} = 5$ V, $C_L = 50$ pF, $R_L = 500$ Ω
- Operating voltage range
- 5-V input/output tolerant function and power-down protection
- Electrical characteristics when $V_{CC} = 3.3$ V are the same those of TC74LCxx Series.

New Product explanation TC7WZ246FU/FK



Package dimensions

SM8		US8	
Dimensions	Land pattern for reference	Dimensions	Land pattern for reference
<p>Unit: mm</p> <p>Weight: 0.021g</p>	<p>Unit: mm</p>	<p>Unit: mm</p> <p>Weight: 0.01g</p>	<p>Unit: mm</p>

Product line-up

Part Number	Function	Package	Part Number	Function	Package
TC7WZ00FU/FK	Dual 2-input NAND gate	SM8/US8	TC7WZ32FU/FK	Dual 2-input OR gate	SM8/US8
TC7WZ02FU/FK	Dual 2-input NOR gate		TC7WZ34FU/FK	Triple non-inverter	
TC7WZ04FU/FK	Triple inverter		TC7WZ38FU/FK	Dual 2-input NAND gate (open drain output)	
TC7WZU04FU/FK	Triple inverter (unbuffer)		TC7WZ74FU/FK	D-type flip-flop	
TC7WZ05FU/FK	Triple inverter (open drain output)		TC7WZ86FU/FK	Dual 2-input exclusive OR gate	
TC7WZ08FU/FK	Dual 2-input AND gate		TC7WZ245FU/FK	Dual BUS Transceiver	
TC7WZ14FU/FK	Triple schmitt trigger inverter		TC7WZ246FU/FK	Dual BUS Transceiver with open drain	

AHS Series Housed in 6-pin Package: TC7PAxxFU

Outline

One or two circuit of AHS (Advanced High Speed) types are housed in 6-pin package.

There are new function products for L-MOS family.

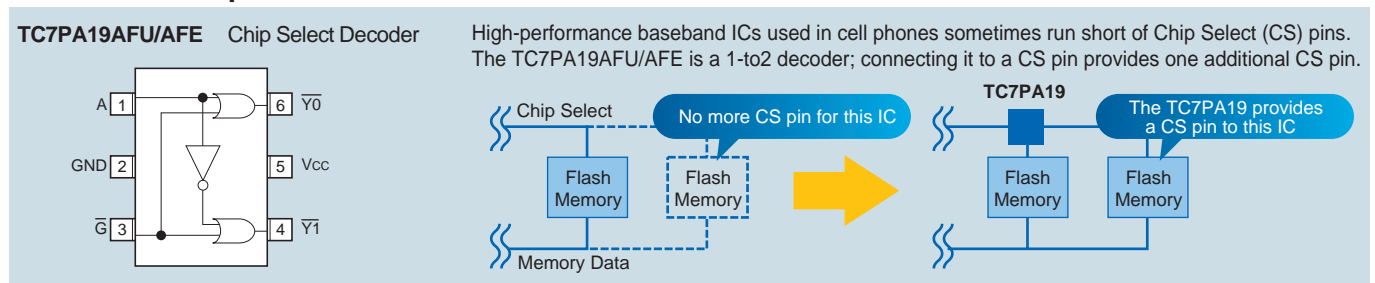
: 19(Chip Select Decoder)

Features

- High-level output drive: $\pm 24 \text{ mA}$ @ $V_{cc} = 3 \text{ V}$
- Propagation delay time: 2.8 ns (max) @ $V_{cc} = 3.3 \text{ V}$, $C_L = 30 \text{ pF}$, $R_L = 500 \Omega$
- Operating voltage range: 1.8 V to 3.6 V (TC7PA19 : 1.4 V to 3.6 V)
- 3.6 V Input Tolerant/ 3.6 V^* Output Power-down Protection

*The output protection for TC7PA19AFU/AFE is different from that of TC7PAxxFU, hence, voltage greater than or equal to V_{cc} should not be applied to TC7PA19AFU/AFE.

New Product explanation TC7PA19AFU/AFE



Package Dimensions

US6 (SOT-363, SC-88)		ES6 (SOT-563)	
Dimensions	Land pattern for reference	Dimensions	Land pattern for reference
<p>Unit: mm</p> <p>US6 (SOT-363, SC-88) Weight: 0.03g</p>	<p>Unit: mm</p>	<p>Unit: mm</p>	<p>Unit: mm</p>

Pin Assignment

Inverter	Analog MPX	D-FLIP FLOP	Chip Select Decoder

Product Line-up

Part Number	Function	Package
TC7PA04FU	Dual inverter	US6
TC7PA05FU	Dual inverter (open drain output)	
TC7PA14FU	Dual schmitt trigger inverter	
TC7PA17FU	Dual schmitt buffer	
TC7PA34FU	Dual buffer	
TC7PA53FU	2-channel Analog Multiplexer/Demultiplexer	
TC7PA175FU	D-type flip-flop with clear	
*TC7PA19AFU	Chip select decoder	
TC7PA19AFE	Chip select decoder	ES6

*Under development

6. L-MOS

AHS/SHS/LVP Interface

Interface performance

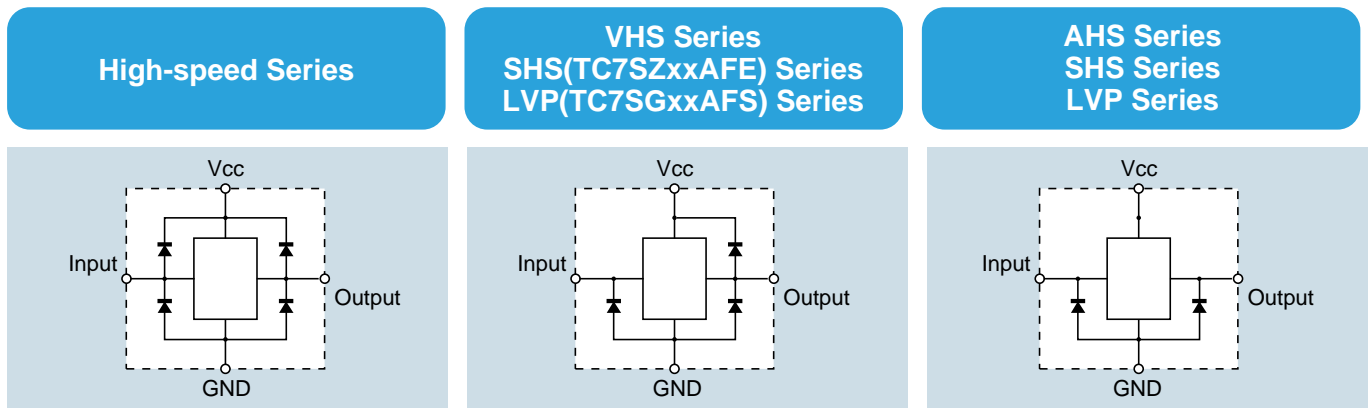
AHS series, SHS series, VHS series, LVP series incorporate a tolerant function and a power-down protection.

- Tolerant function: enable to interface two different power supply voltages (for a back-up circuit)
- Power-down protection: enables to supply power to I/O when power is down (for IC protection)

I/O permissible voltage

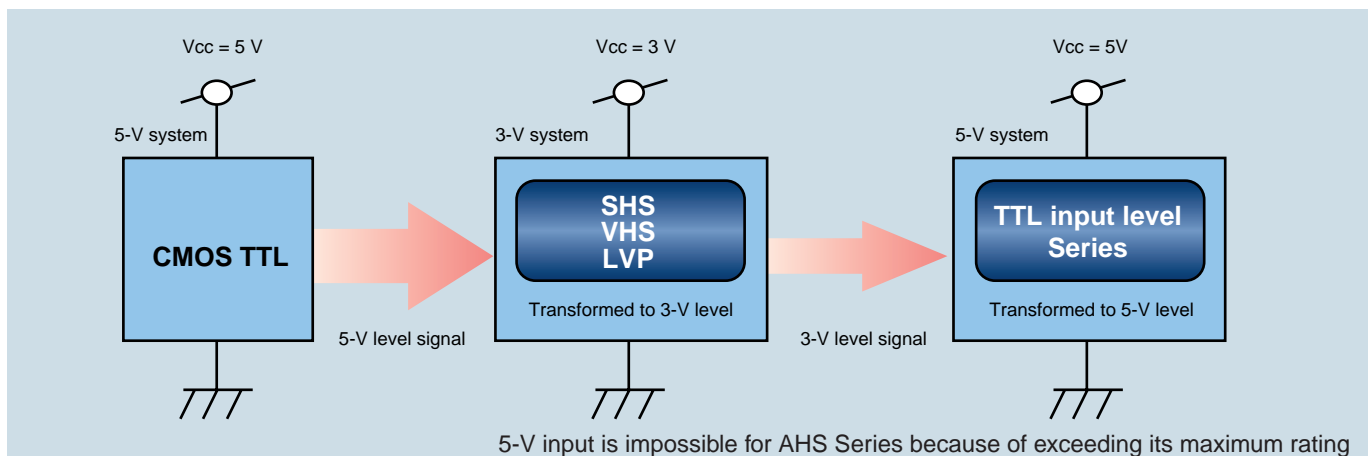
Series		AHS	SHS	VHS	LVP
Input voltage range	During operation	0 to 3.6 V	0 to 5.5 V	0 to 5.5V	0 to 5.5V
	When power-down	0 to 3.6 V	0 to 5.5 V	0 to 5.5V	0 to 5.5V
Output voltage range	When output enable	0 to Vcc	0 to Vcc	0 to Vcc	0 to Vcc
	When output disable	0 to 3.6 V	0 to 5.5 V	0 to Vcc	0 to 3.6 V
	When power-down	0 to 3.6 V	0 to 5.5 V	—	0 to 3.6 V

I/O equivalent circuit diagrams



Direct interfacing between 3-V and 5-V systems

The emergence of 3-V CPUs and memories has led to a transition across to 3-V mains power supply systems. The inclusion of dual 3-V/5-V power capability in commonly-used items of office equipment continues to spread. New L-MOS products can be used in ultra-compact dual power supply interface systems (3-V/5-V).

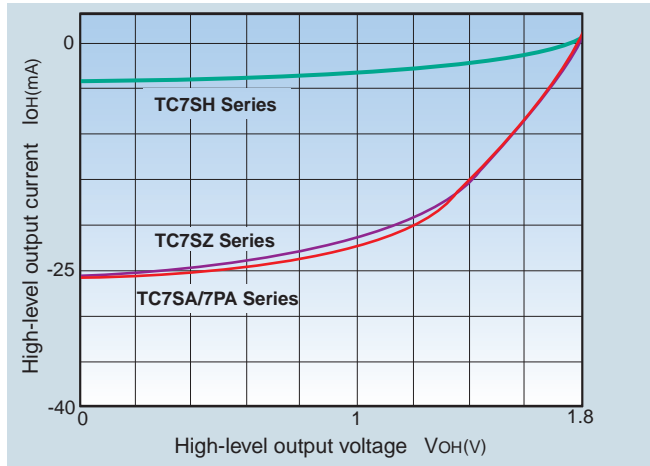


Typical characteristics for Low Voltage logic Series

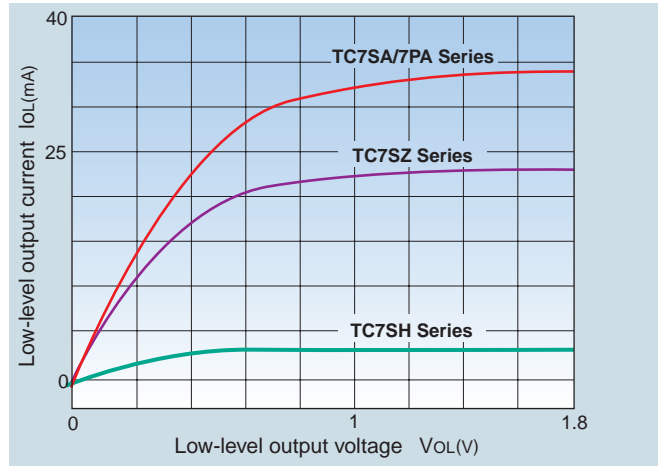
Drive current (typ.)

● $V_{CC} = 1.8\text{ V}$, $T_a = 25\text{ }^\circ\text{C}$

High-level output current

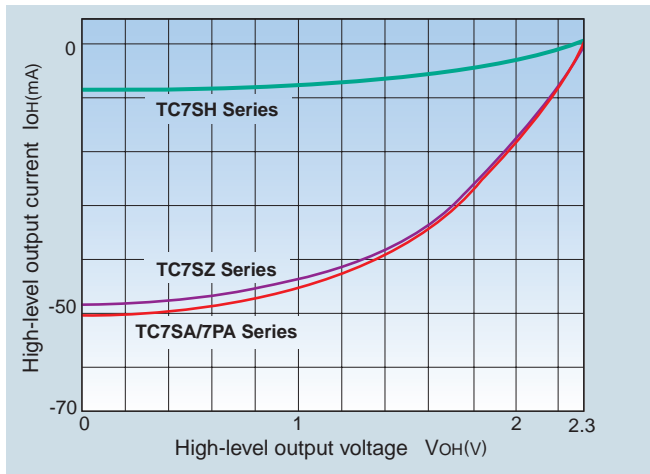


Low-level output current

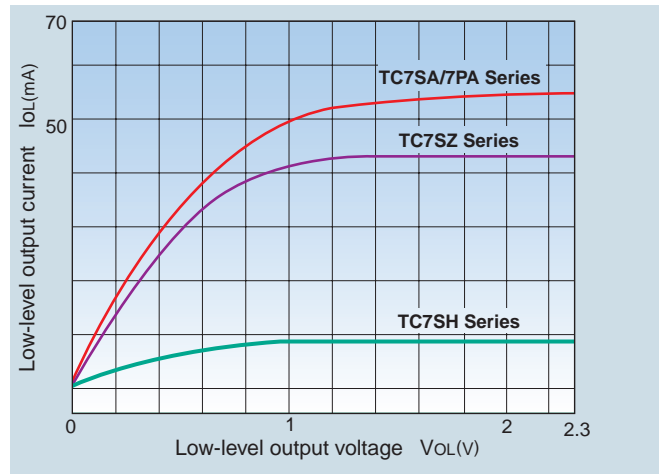


● $V_{CC} = 2.3\text{ V}$, $T_a = 25\text{ }^\circ\text{C}$

High-level output current

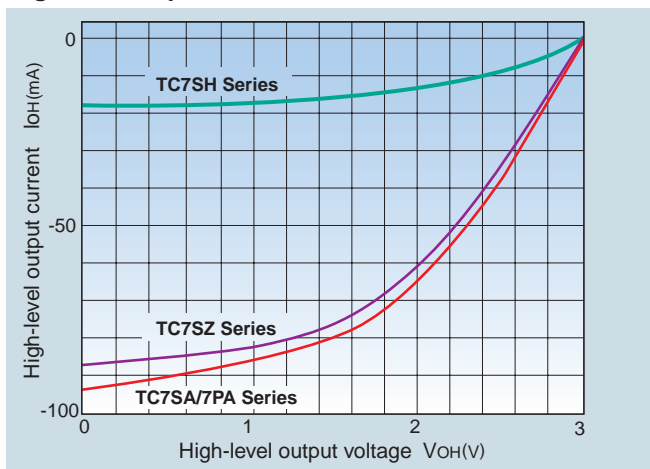


Low-level output current

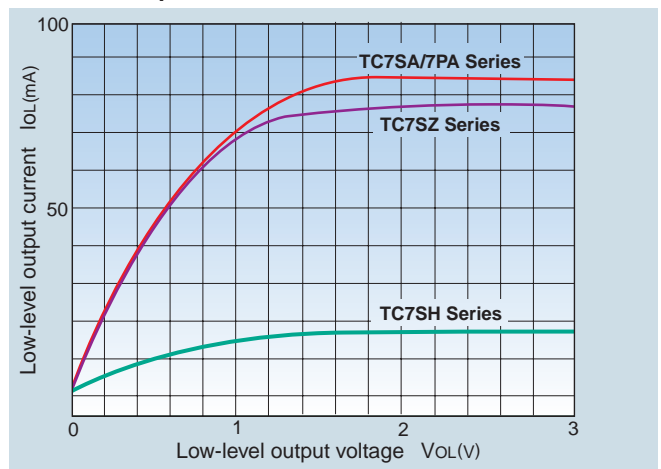


● $V_{CC} = 3.0\text{ V}$, $T_a = 25\text{ }^\circ\text{C}$

High-level output current



Low-level output current



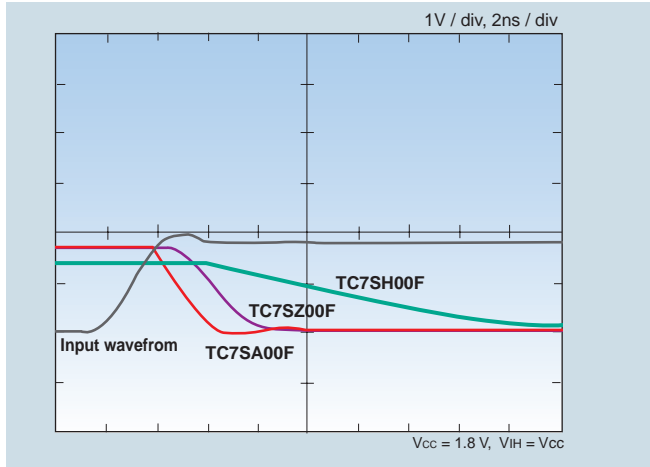
6. L-MOS

Switching waveform (typ.)

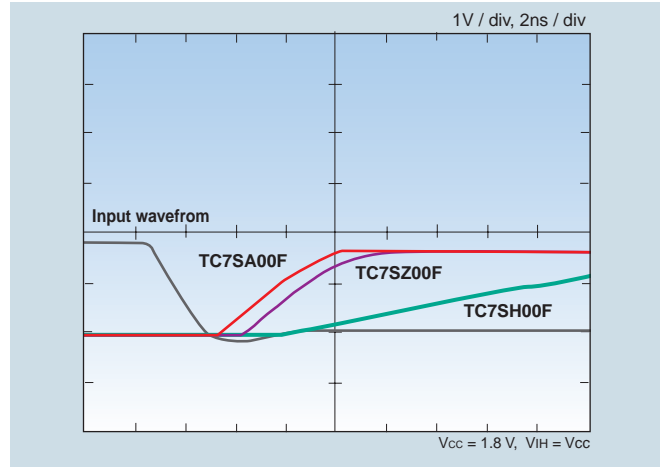
Typical AHS Series characteristics (compared to VHS Series and SHS Series)

● $V_{CC} = 1.8\text{ V}$, $C_L = 30\text{ pF}$, $R_L = 500\ \Omega$

tpHL

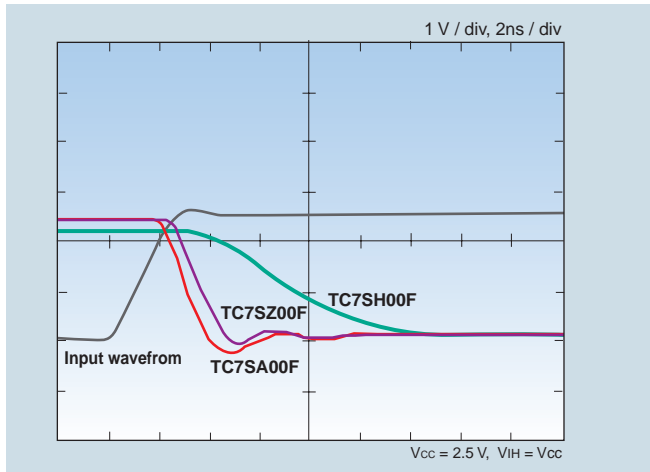


tpLH

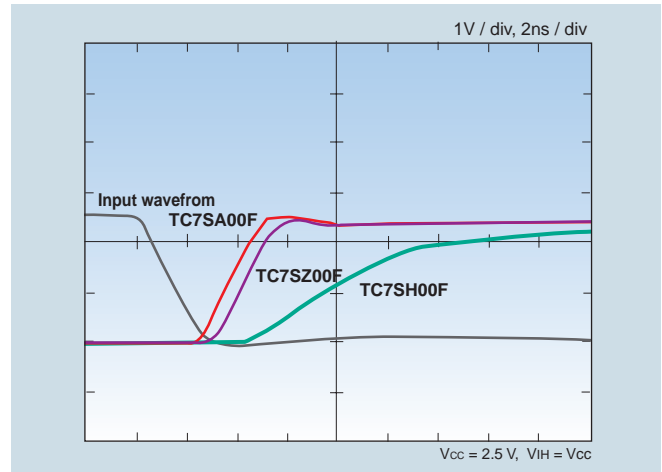


● $V_{CC} = 2.5\text{ V}$, $C_L = 30\text{ pF}$, $R_L = 500\ \Omega$

tpHL

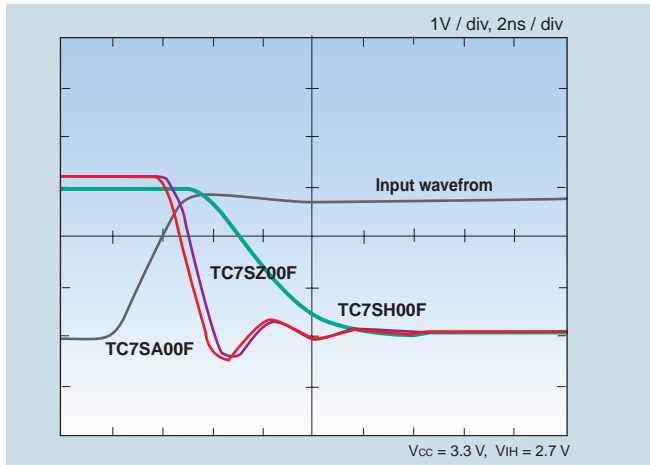


tpLH

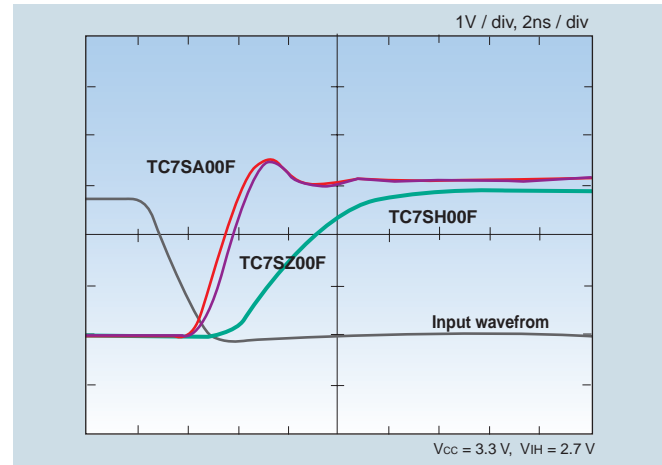


● $V_{CC} = 3.3\text{ V}$, $C_L = 30\text{ pF}$, $R_L = 500\ \Omega$

tpHL

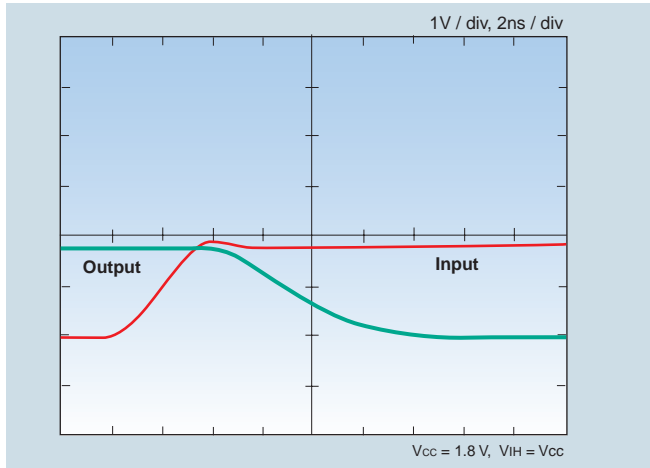


tpLH

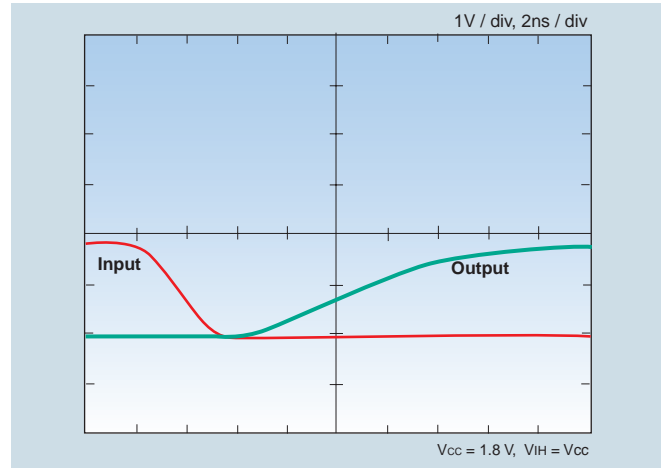


LVP Series

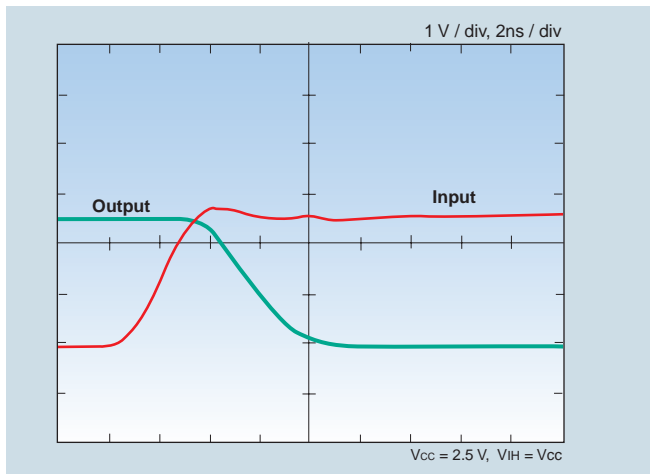
● $V_{CC} = 1.8\text{ V}$, $C_L = 30\text{ pF}$
tpHL



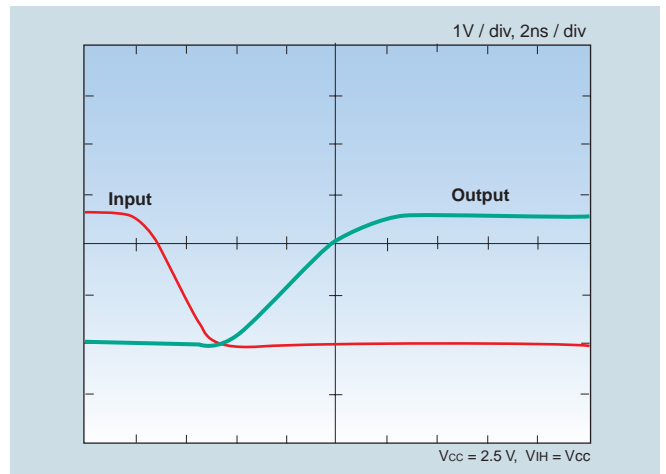
tpLH



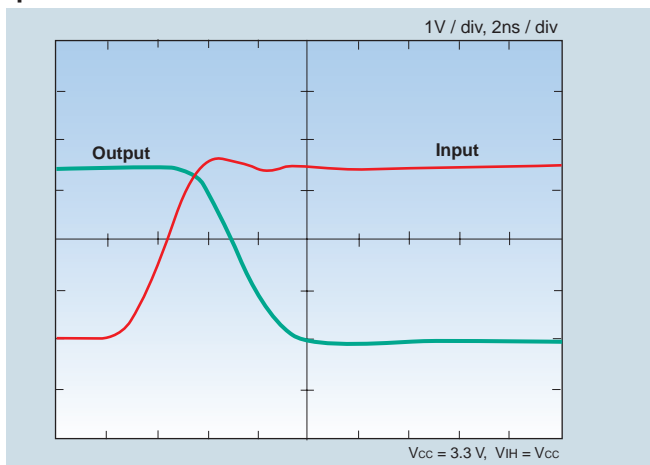
● $V_{CC} = 2.5\text{ V}$, $C_L = 30\text{ pF}$
tpHL



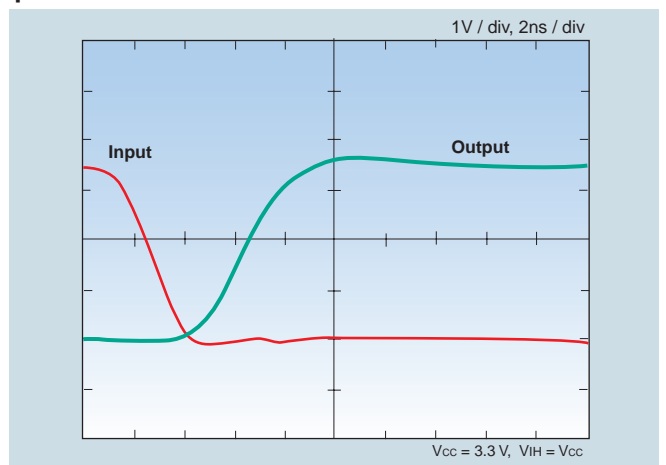
tpLH



● $V_{CC} = 3.3\text{ V}$, $C_L = 30\text{ pF}$
tpHL



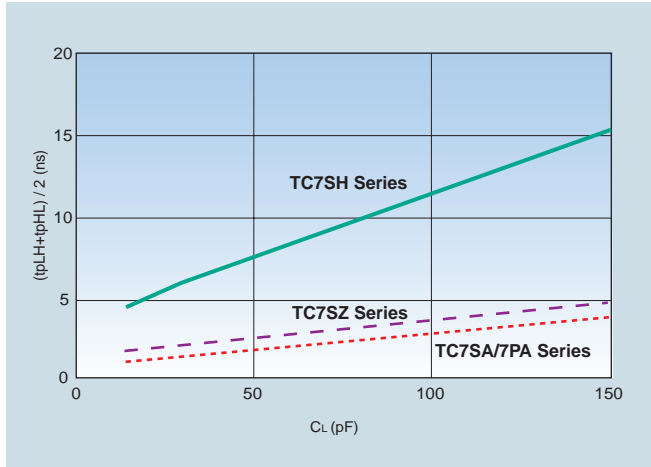
tpLH



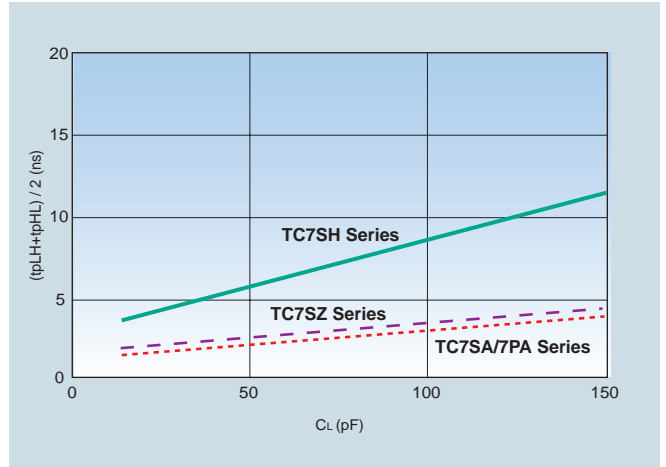
6. L-MOS

Load capacitance dependence (typ.)

● $V_{CC} = 2.5\text{ V}$, $R_L = 500\ \Omega$, $T_a = 25\ ^\circ\text{C}$

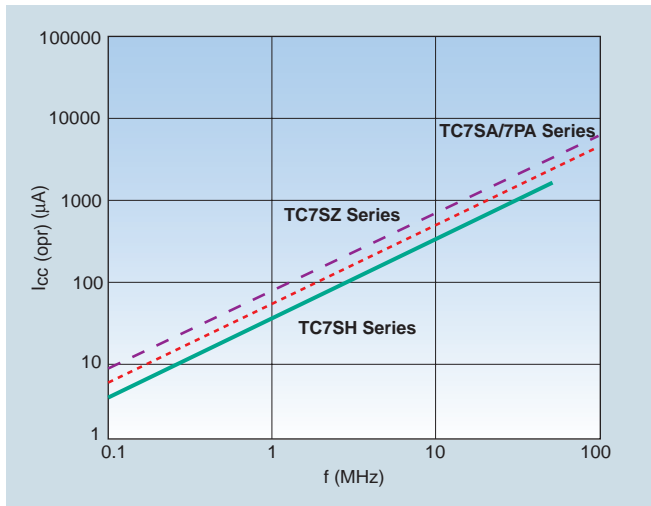


● $V_{CC} = 3.3\text{ V}$, $R_L = 500\ \Omega$, $T_a = 25\ ^\circ\text{C}$



Operating current consumption (typ.)

● $V_{CC} = 3.3\text{ V}$, $T_a = 25\ ^\circ\text{C}$



7. Constant Current Driver (CC-Driver)

7.1 Non Up-convert Type Constant Current Driver (for LCD backlight) TAH8N601K/TAH6N201U

Outline

This IC is including 4-channel or 2-channel constant current driving circuit.

It is possible to set up a driving current with only one resistor. It is suitable for parallel White – LED driving circuit.

Features

- This device compose a system of the non up-converter, so it contribute to making high efficiency.
- Need only one resistor for current setting.
- Because of no oscillation circuits, this device is effective in reduction of EMC noise.

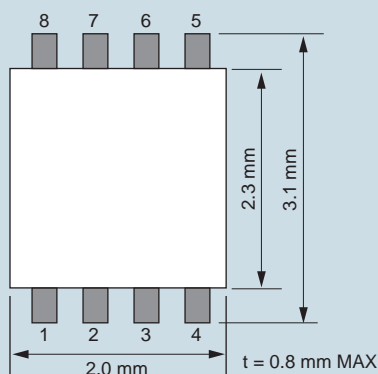
Characteristics

- Recommended operating supply voltage: $V_{cc} = 2.5$ to 4.5 V (Maximum ratings: 7.0 V)
- Including reference voltage for constant current driving (Ref voltage: 1.07 to 1.27 V)
- Recommended driving current: 0 to 20 mA (Maximum ratings: 25 mA)
- Good current pairing performance (Current difference is 2.0 mA(max) @ Drive current = 20 mA)
- Low OFF leak current: 10 μ A

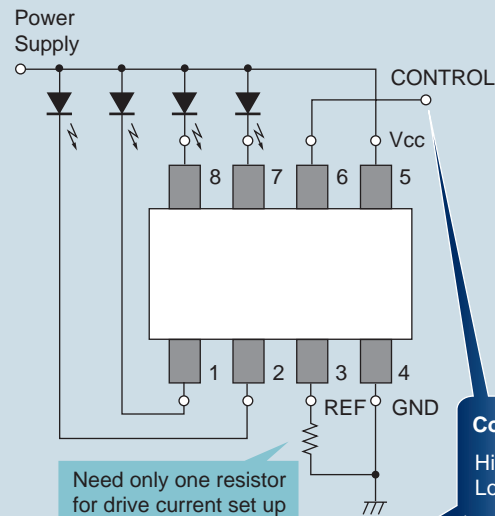
Pin Assignment and Recommended Circuit

TAH8N401K(4ch Driver)

US8



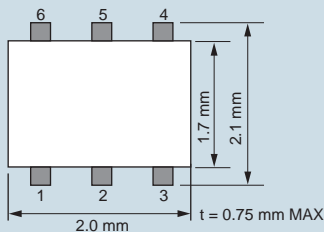
- | | |
|-------------|-------------|
| 1: DRIVE(2) | 5: Vcc |
| 2: DRIVE(1) | 6: CONTROL |
| 3: REF | 7: DRIVE(4) |
| 4: GND | 8: DRIVE(3) |



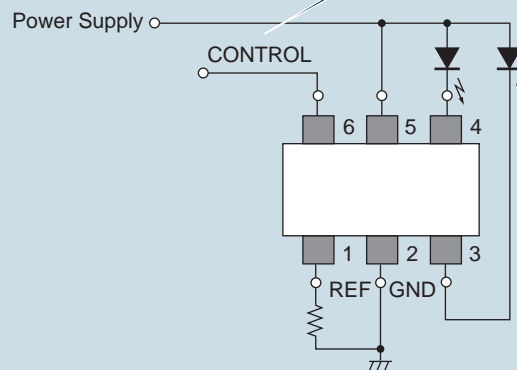
Control Signal
High level: ON
Low level: OFF

TAH6N201U(2ch Driver)

UF6



- | | |
|-------------|-------------|
| 1: REF | 4: DRIVE(2) |
| 2: GND | 5: Vcc |
| 3: DRIVE(1) | 6: CONTROL |



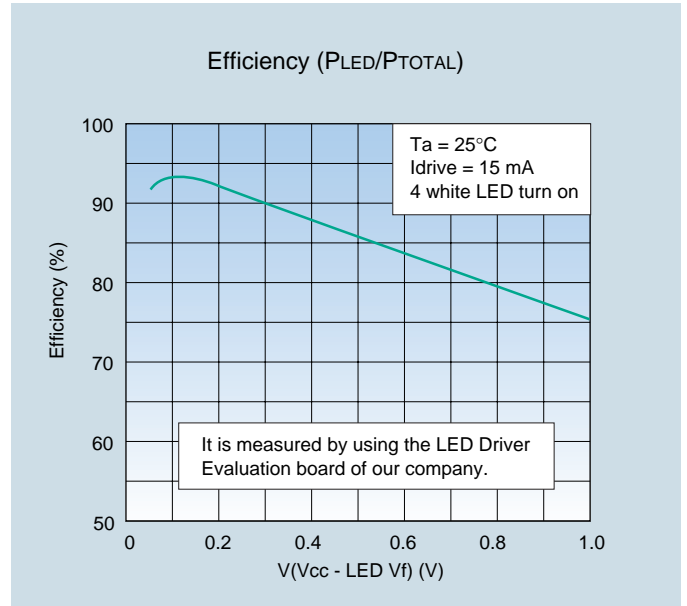
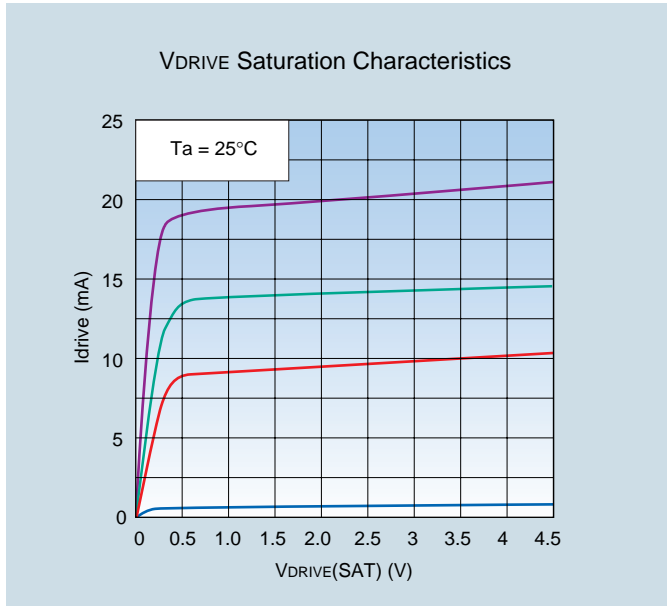
**Simple circuit
Space saving**

External resistor setting

External resistor = V_{REF} terminal voltage / (Drive current / 100)

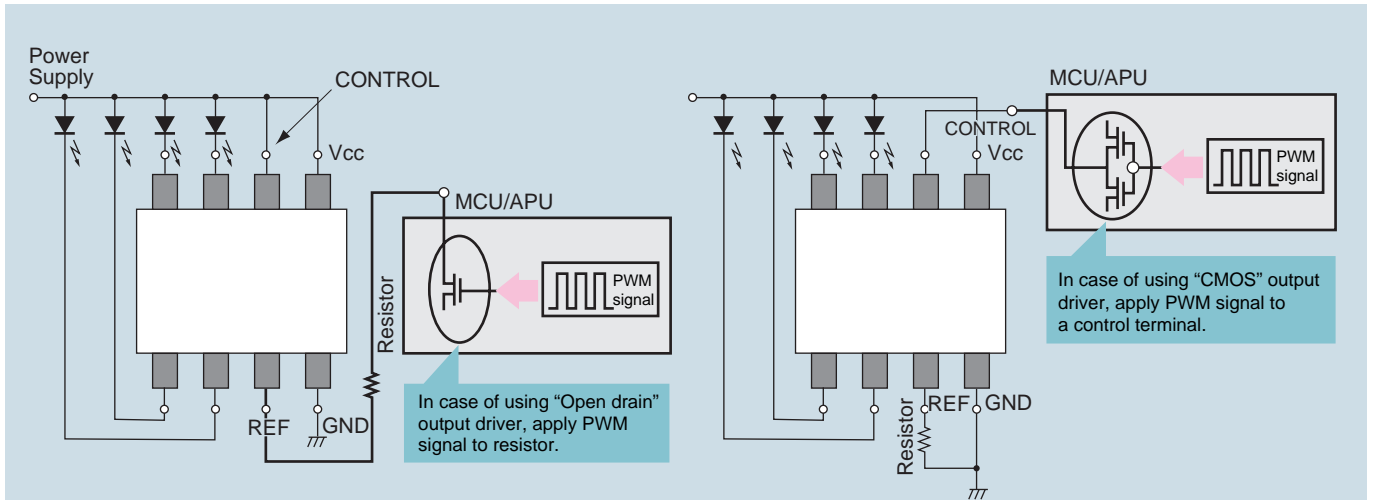
7. Constant Current Driver (CC-Driver)

Typical Operating Characteristics

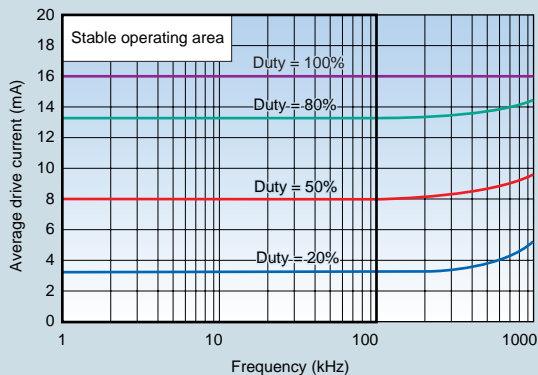


Application Circuit

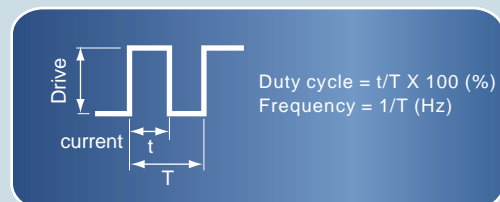
Linear luminosity control with PWM generator



Engineering Information of PWM control



<Condition>
Resistor = 7.2 kΩ
Drive current = 16 mA
Luminosity control can be changed by duty cycle of the PWM
[Average drive current
Drive current X Duty ratio]



8. Point Regulator ICs (Low-Dropout Regulators)

The point regulator series features one or two regulator ICs in a small package. The devices are suitable for use as power supplies in battery-driven mobile phones and portable audio players.

8.1 Single Output type

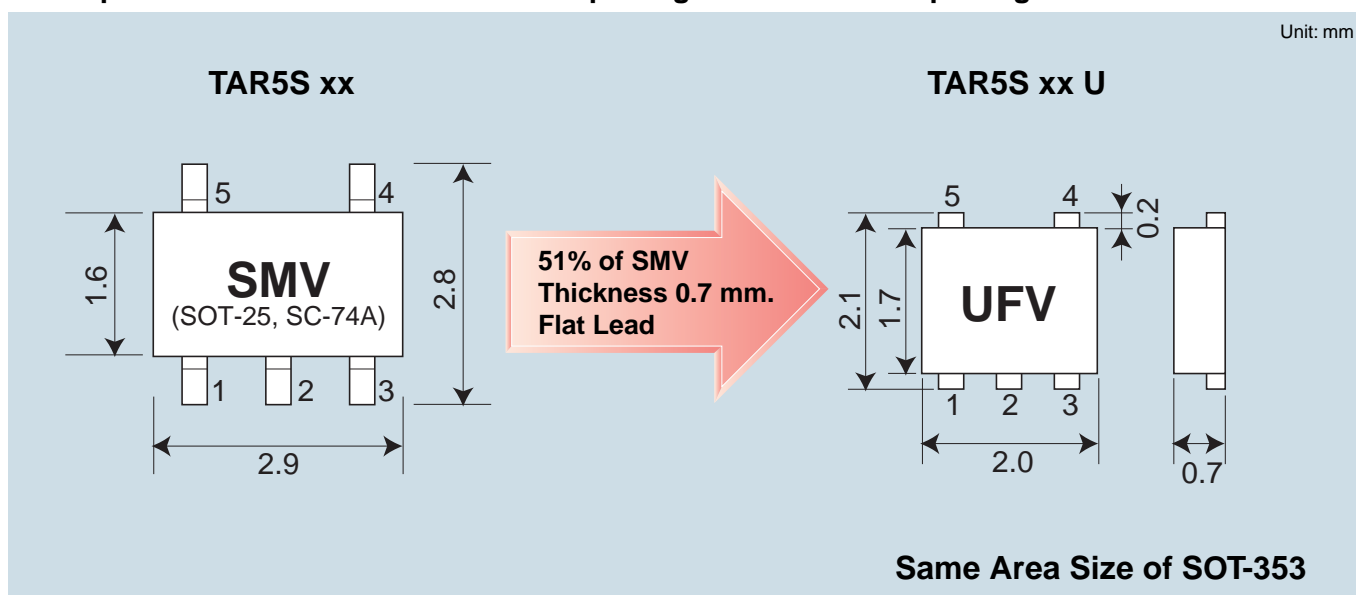
New Products

TAR5S xx U Series(Very Small package Single-output type)

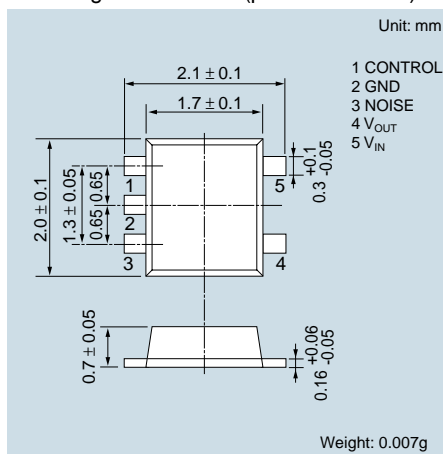
Features

- Very Small package (UFV)
- Dropout voltage 130 mV (typ.), 200 mV (max) @50 mA
- Connection to a noise bypass capacitor realizes low noise of 30 μ Vrms (typ.).
- High performance with ripple rejection of 70 dB (typ. @f = 1 kHz)
- ON/OFF control function (ON at 1.5 V or higher; OFF at 0.4 V or lower)
- Standby current of 0.1 μ A or less (when control OFF)
- Built-in overtemperature and overcurrent protection circuits
- Uses a ceramic capacitor

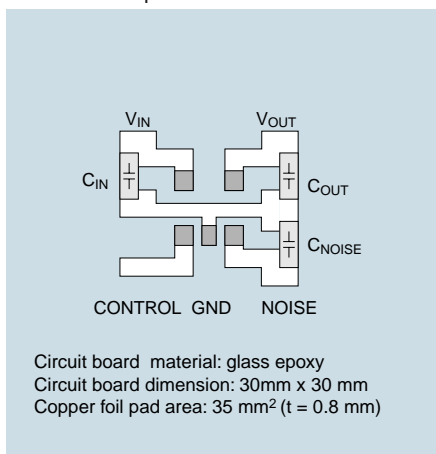
Comparison between Current Standard package and New Small package



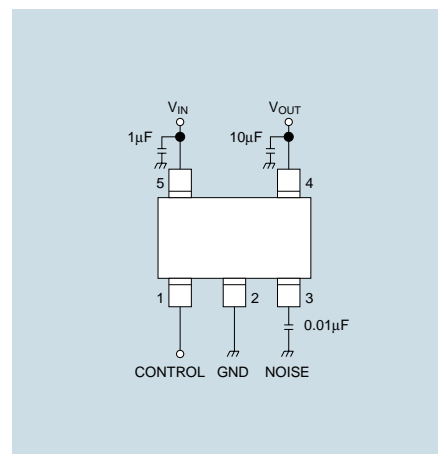
Package dimensions (pin connections)



Power dissipation evaluation board



Recommend circuit



8. Point Regulator ICs (Low-Dropout Regulators)

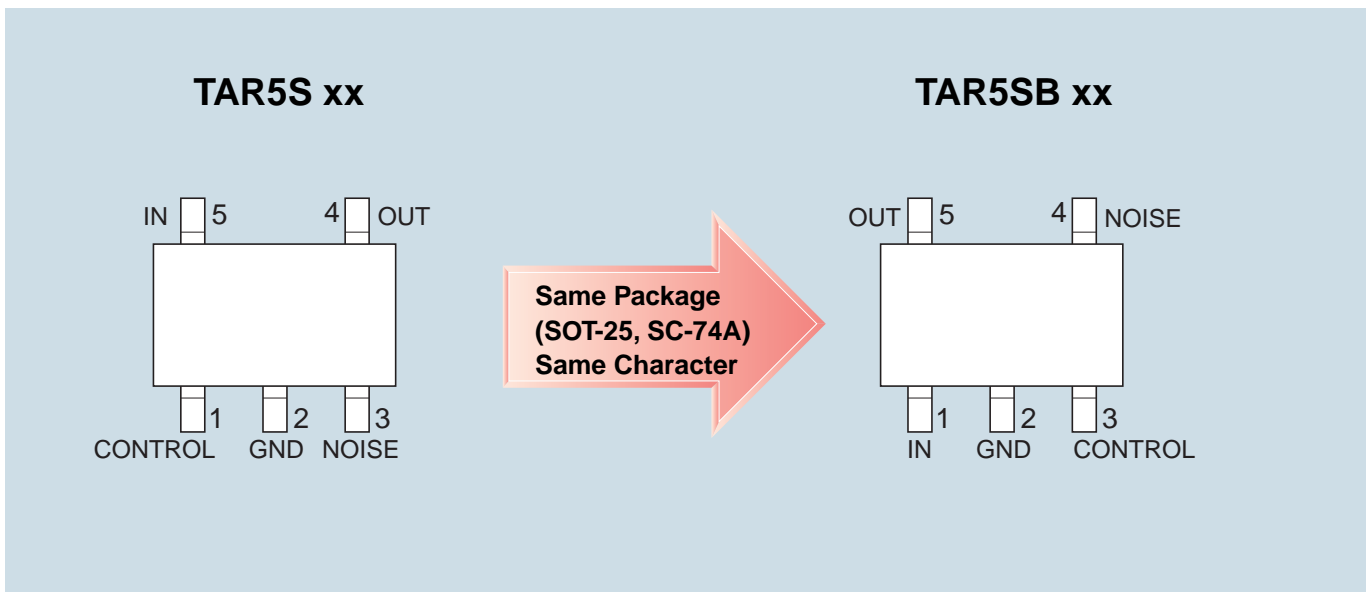
New Products

TAR5SB xx Series (New pin assignment Single-output type)

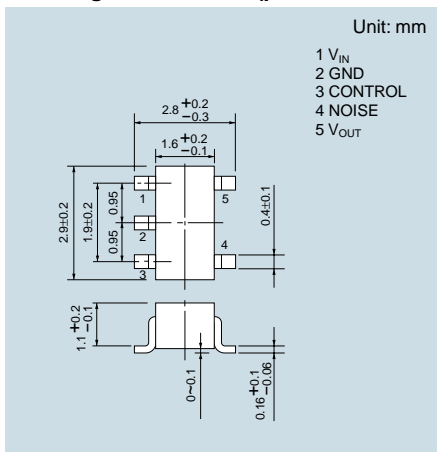
Features

- Small package (SMV: SC-74A, SOT-25)
- Dropout voltage 130 mV (typ.), 200 mV (max) @50 mA
- Connection to a noise bypass capacitor realizes low noise of 30 μ Vrms (typ.).
- High performance with ripple rejection of 70 dB (typ. @f = 1 kHz)
- ON/OFF control function (ON at 1.5 V or higher; OFF at 0.4 V or lower)
- Standby current of 0.1 μ A or less (when control OFF)
- Built-in overtemperature and overcurrent protection circuits
- Uses a ceramic capacitor

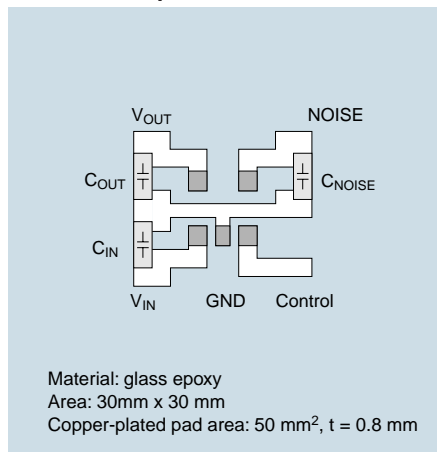
Comparison between Current and New pin assignment



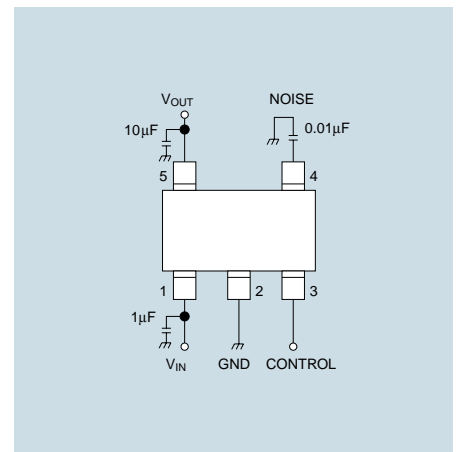
Package dimensions (pin connections)



Power dissipation evaluation board



Recommend circuit

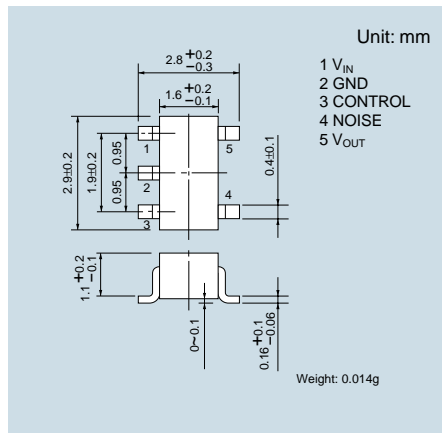


TAR5Sxx Series (single-output type)

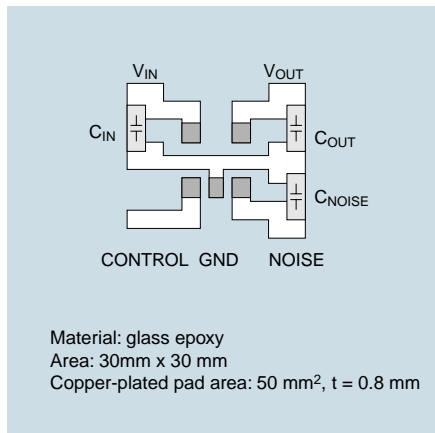
Features

- Small package (SMV: SC-74A, SOT-25)
- Dropout voltage 130 mV (typ.), 200 mV (max) @50 mA
- Connection to a noise bypass capacitor realizes low noise of 30 μ Vrms (typ.).
- High performance with ripple rejection of 70 dB (typ. @f = 1 kHz)
- ON/OFF control function (ON at 1.5 V or higher; OFF at 0.4 V or lower)
- Standby current of 0.1 μ A or less (when control OFF)
- Built-in overtemperature and overcurrent protection circuits
- Uses a ceramic capacitor

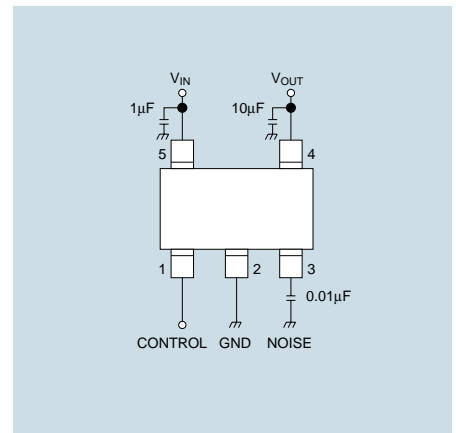
Package dimensions (pin connections)



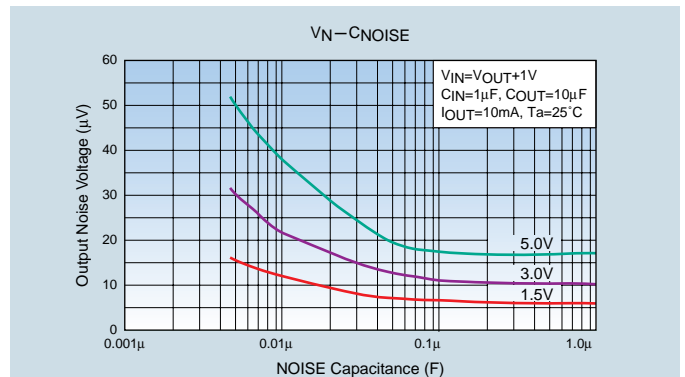
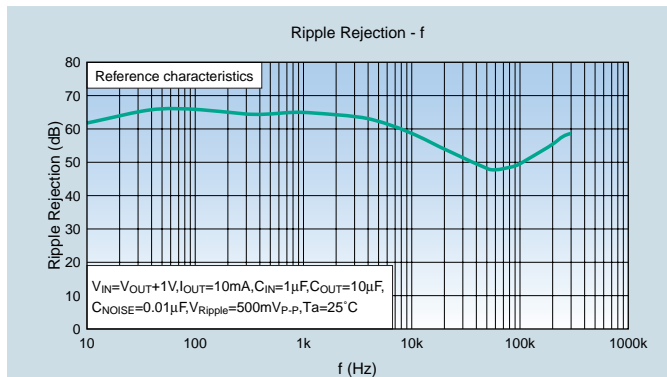
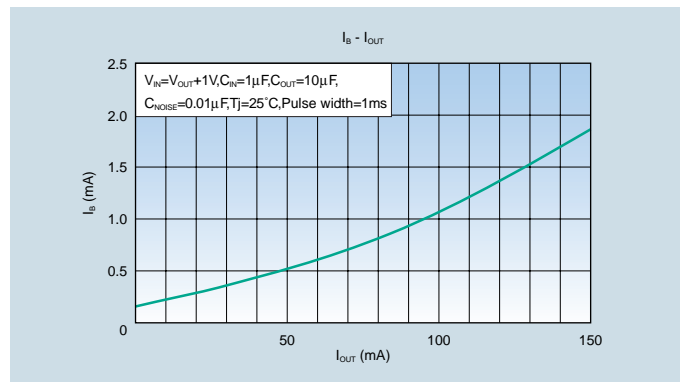
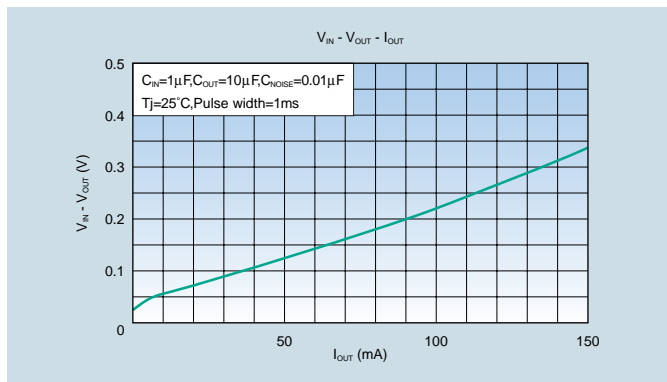
Power dissipation evaluation board



Recommend circuit



TAR5S xx U/TAR5SB xx/TAR5S xx series Typical characteristic curves



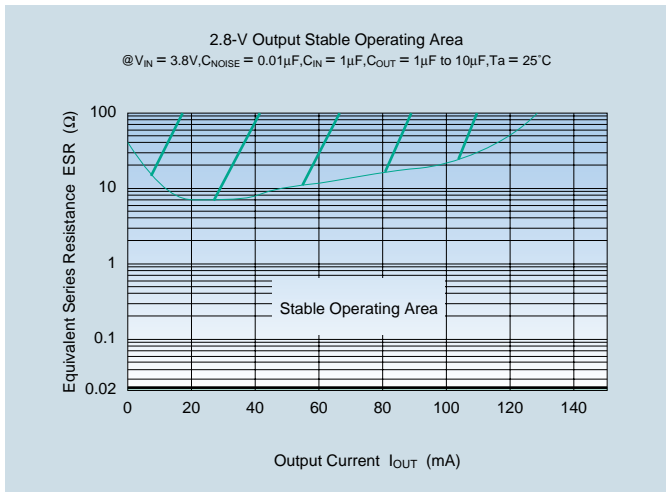
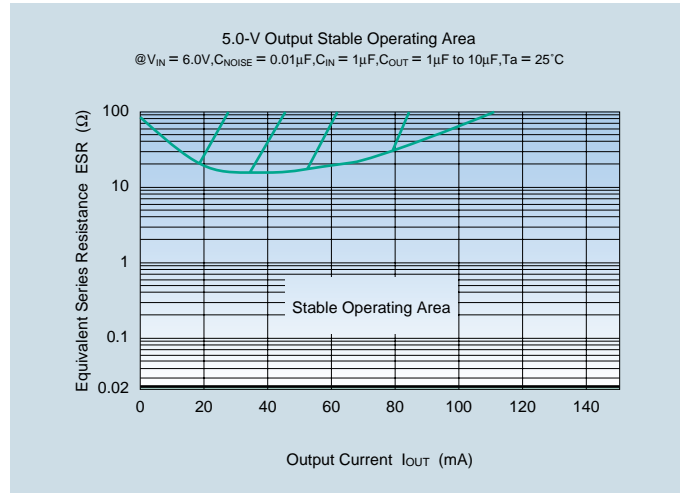
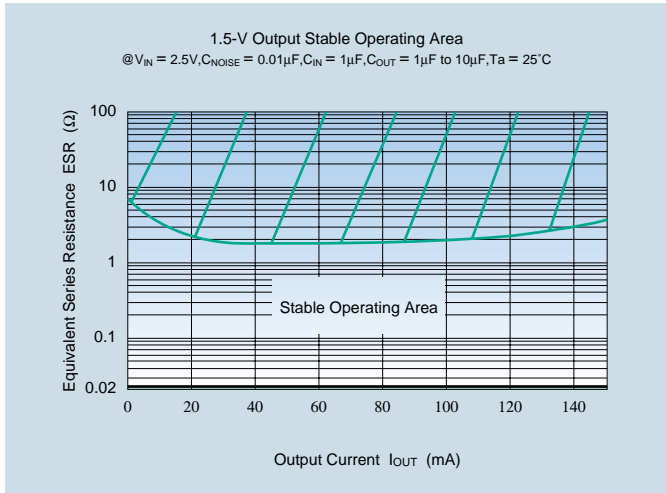
8. Point Regulator ICs (Low-Dropout Regulators)

Application Note for TAR5S xx U/TAR5SB xx /TAR5S xx Series

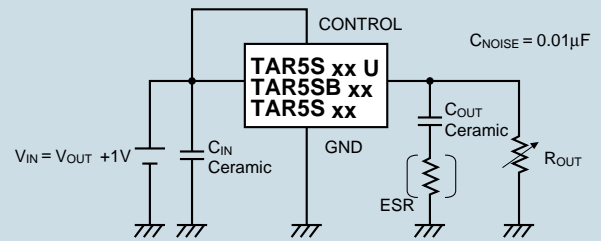
Stable Operating Area Characteristics

Shown below is the stable operation area, where the output voltage does not oscillate, evaluated using a Toshiba evaluation circuit. The equivalent series resistance (ESR) of the output capacitor and output current determines this area. TAR5Sxx Series devices operate stably even when a ceramic capacitor is used as the output capacitor.

Examples of stable operating area characteristics



Evaluation Circuit for Stable Operating Area



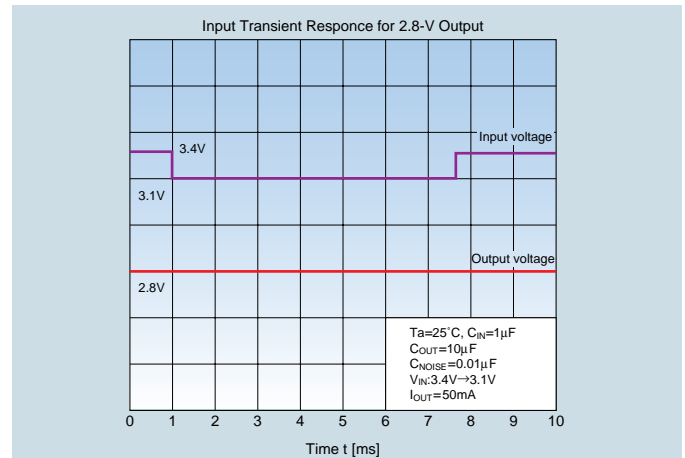
Capacitors used for evaluation

Manufactured by Murata C_{IN} : GRM40B105K

C_{OUT} : GRM40B105K/GRM40B106K

Input transient response characteristic

The TAR5S xx U/TAR5SB xx /TAR5S xx series feature an excellent characteristic in output fluctuation (input transient response characteristic) caused by a rapid drop in supply voltage.



8.2 Dual Output type

New Products

TAR8DxxK Series (Dual-output type, Independent ON/OFF control)

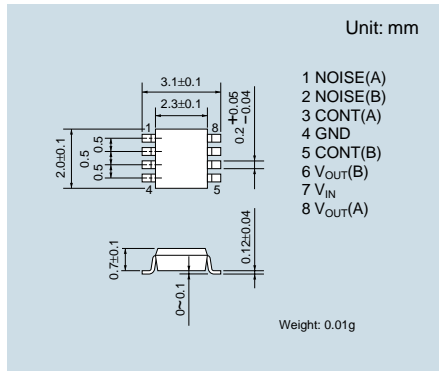
Features

- Incorporates two-output regulator IC in ultra-super-mini 8-pin package (US8), the smallest package type in the World.
- Output voltage can be set 0.1 V step, from 1.5 V to 5.0 (semi-custom products)

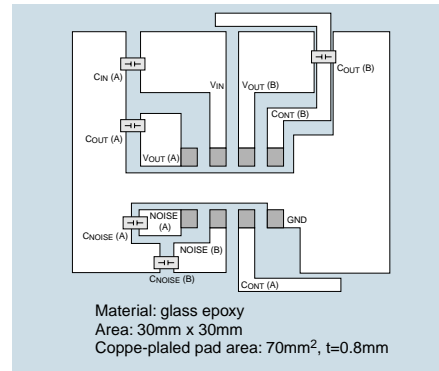
Typical Characteristics

- Dropout voltage: 120 mV (typ.), 180 mV (max)@30 mA
- Connection to a noise bypass capacitor realizes low noise of 30 μ Vrms (typ.).
- High-performance with ripple rejection of 70dB (typ.@f = 1 kHz)
- Both channel can be controlled individually.
- Standby current of 1 μ A or less (when control OFF)
- Built-in overtemperature and overcurrent protection circuits

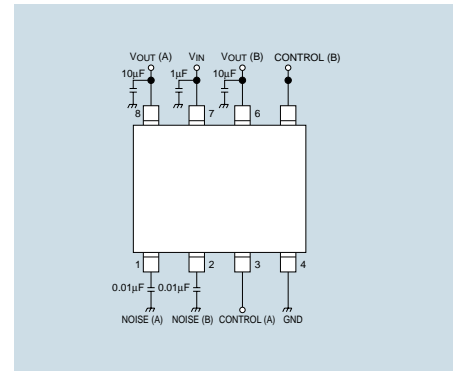
Package dimensions (pin connection)



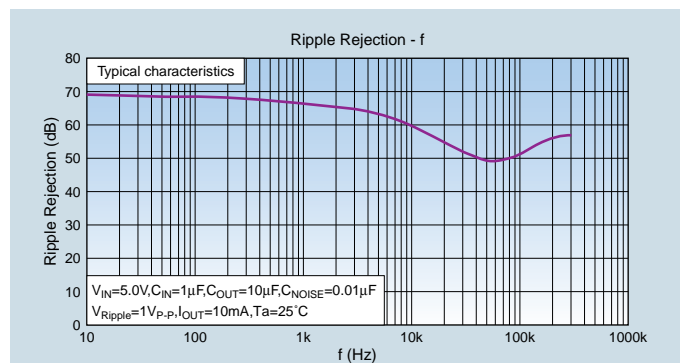
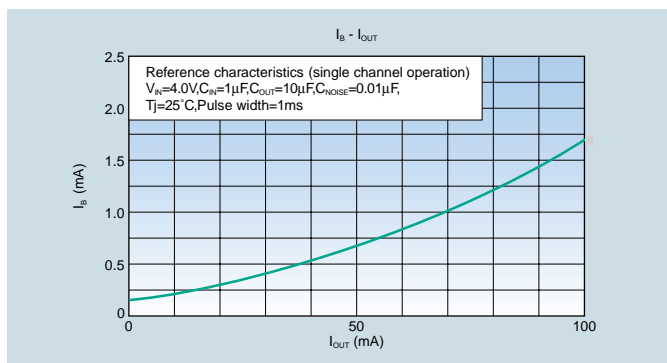
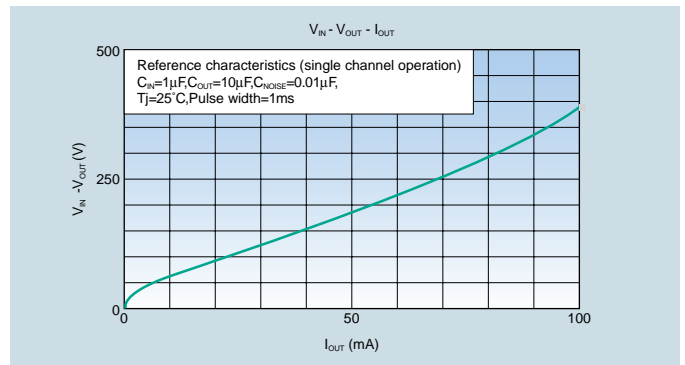
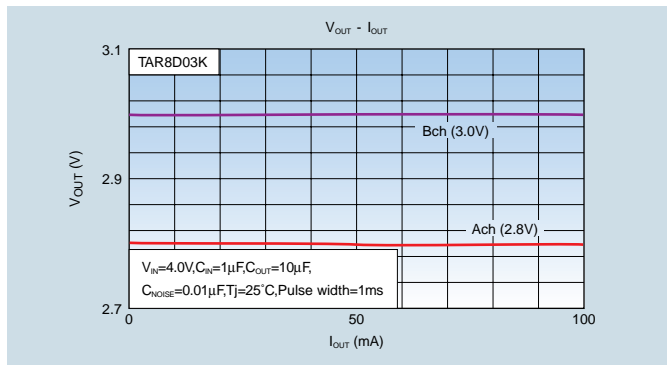
Power dissipation evaluation board



Recommended Circuit



Typical Characteristic curves



8. Point Regulator ICs (Low-Dropout Regulators)

TAR8HxxK Series (Dual-output type, Synchronous ON/OFF control)

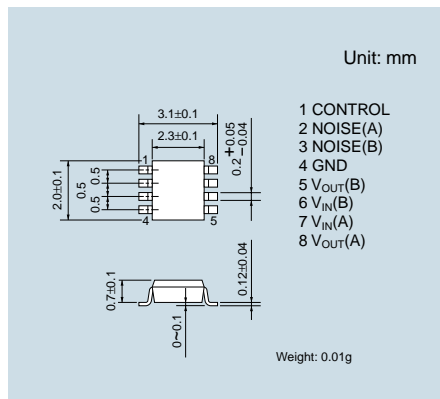
Features

- Incorporates two-output regulator IC in ultra-super-mini 8-pin package (US8), the smallest package type in the World.
- Output voltage can be set 0.1 V step, form 1.5 V to 5.0 V (semi-custom products).

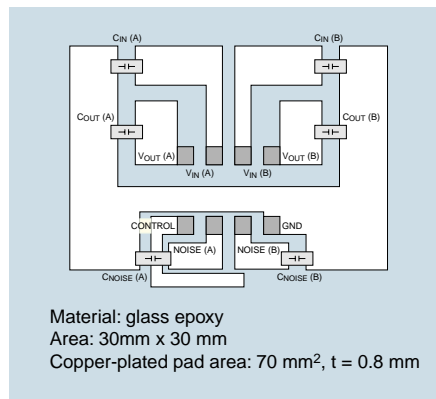
Typical Characteristics

- Dropout voltage (TAR8H01K)
Channel A: 130 mV (typ.), 200 mV (max) @30 mA
Channel B: 150 mV (typ.), 300 mV (max) @60 mA
- Connection to a noise bypass capacitor realizes low noise of 30 mVrms (typ.).
- High performance with ripple rejection of 65 dB (typ. @f = 200 Hz)
- Synchronous ON/OFF control of both channels (ON at 2.2 V or higher; OFF at 0.4 V or lower)
- Standby current of 10 μ A or less (when control OFF)
- Built-in overtemperature and overcurrent protection circuits

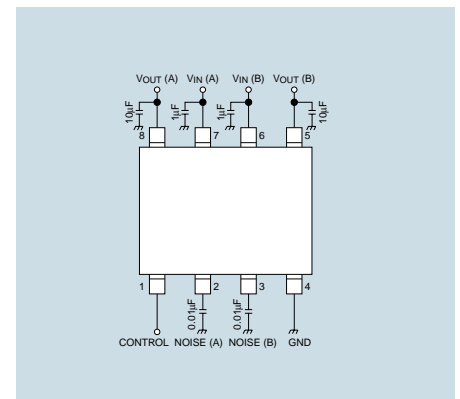
■ Package dimensions (pin connections)



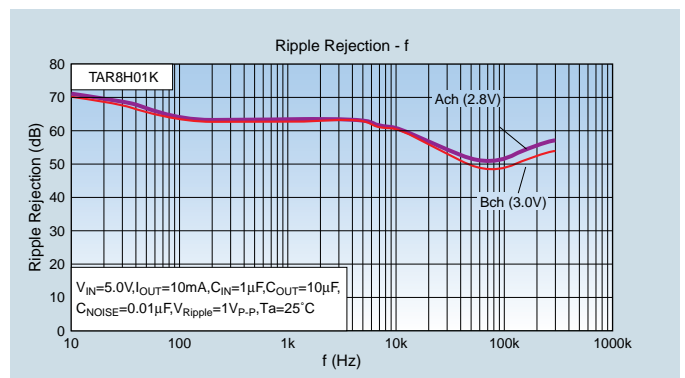
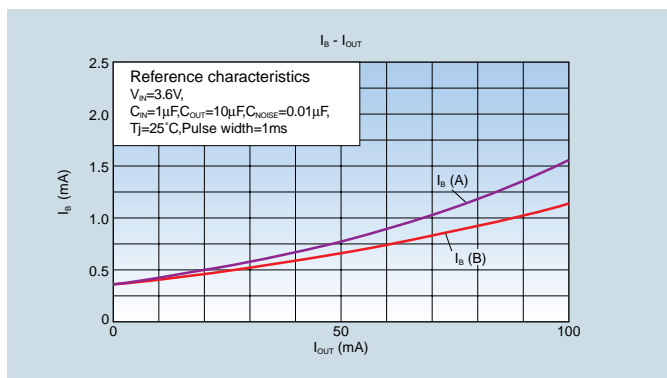
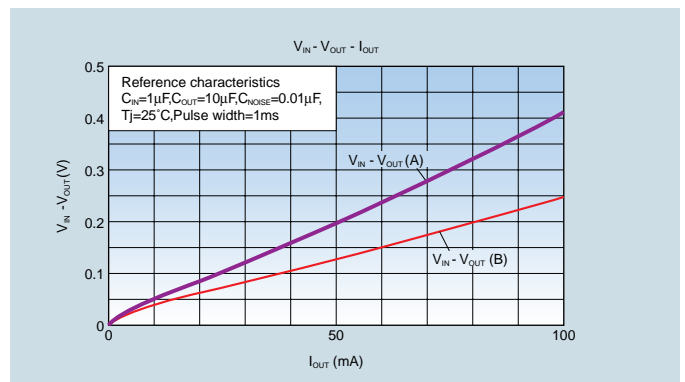
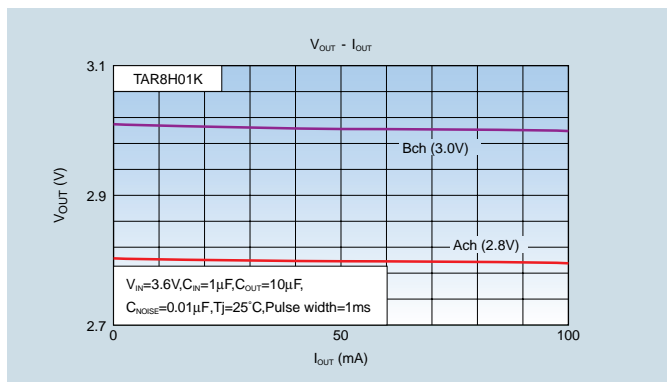
■ Power dissipation evaluation board



■ Recommended circuit



■ Typical characteristic curves

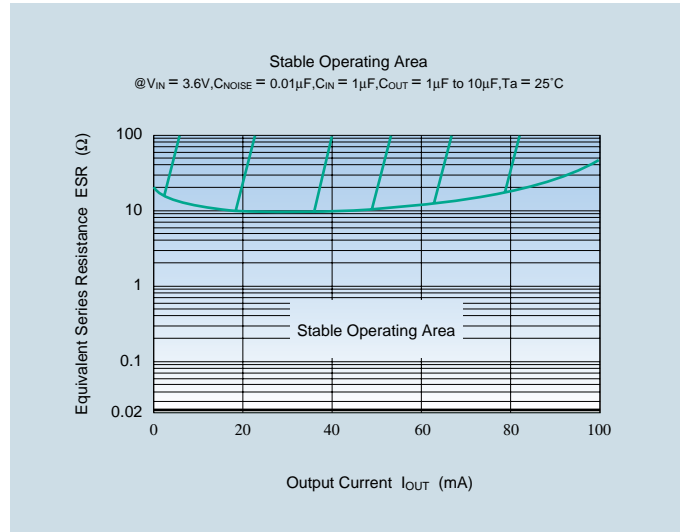
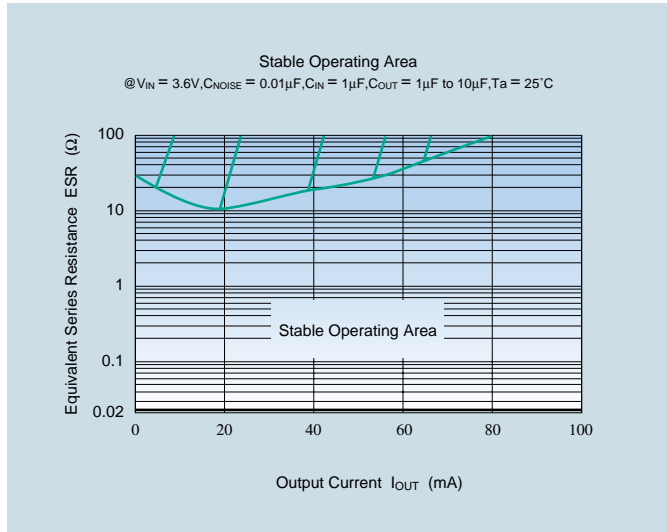


Application Note for TAR8HxxK Series

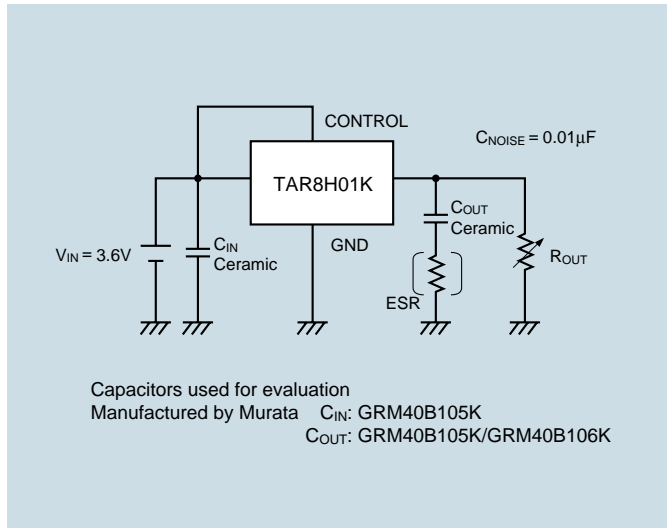
■ Stable Operating Area Characteristics

Shown below is the stable operation area, where the output voltage does not oscillate, evaluated using a Toshiba evaluation circuit. The equivalent series resistance (ESR) of the output capacitor and output current determines this area. TAR8Hxx Series devices operate stably even when a ceramic capacitor is used as the output capacitor.

Examples of stable operating area characteristics



Evaluation Circuit for Stable Operating Area



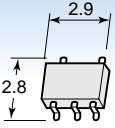
8. Point Regulator ICs (Low-Dropout Regulators)

8.3 Product Line-up

8.3.1 Single Output type

TAR5SxxU, TAR5SBxx, TAR5Sxx Series

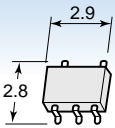
TAR5Sxx

Package	Maximum Rating	
	Output Current(mA)	Power Dissipation(mW)*
SMV (SC-74A) (SOT-25) 	200	380

*: Mounted on a glass epoxy circuit board of 30 mm × 30 mm.
Pad dimension of 50 mm²

New Products

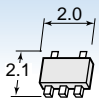
TAR5SBxx

Package	Maximum Rating	
	Output Current(mA)	Power Dissipation(mW)*
SMV (SC-74A) (SOT-25) 	200	380

*: Mounted on a glass epoxy circuit board of 30 mm × 30 mm.
Pad dimension of 50 mm²

New Products

TAR5SxxU

Package	Maximum Rating	
	Output Current(mA)	Power Dissipation(mW)*
UFV 	200	450

*: Mounted on a glass epoxy circuit board of 30mm × 30mm.
Pad dimension of 35mm²

TAR5Sxx TAR5SBxx TAR5SxxU	Output Voltage(V) (@50mA)		
	Min	Typ.	Max
15	1.44	1.5	1.56
16	1.54	1.6	1.66
17	1.64	1.7	1.76
18	1.74	1.8	1.86
19	1.84	1.9	1.96
20	1.94	2.0	2.06
21	2.04	2.1	2.16
22	2.14	2.2	2.26
23	2.24	2.3	2.36
24	2.34	2.4	2.46
25	2.43	2.5	2.57
26	2.53	2.6	2.67
27	2.63	2.7	2.77
28	2.73	2.8	2.87
29	2.82	2.9	2.98
30	2.92	3.0	3.08
31	3.02	3.1	3.18
32	3.12	3.2	3.28
33	3.21	3.3	3.39
34	3.31	3.4	3.49
35	3.41	3.5	3.59
36	3.51	3.6	3.69
37	3.6	3.7	3.8
38	3.7	3.8	3.9
39	3.8	3.9	4
40	3.9	4.0	4.1
41	3.99	4.1	4.21
42	4.1	4.2	4.31
43	4.19	4.3	4.41
44	4.29	4.4	4.51
45	4.38	4.5	4.62
46	4.48	4.6	4.71
47	4.58	4.7	4.82
48	4.68	4.8	4.92
49	4.77	4.9	5.03
50	4.87	5.0	5.13

8.3.2 Dual Output type

TAR8Dxx Series (dual-circuit, independent ON/OFF control)

Output voltage can be set, 0.1 V step fro 1.5 V to 5.0 V (semi-custom products)

Part Number	Output Voltage (V)					Maximum Rating		Package
	Ch	Min	Typ.	Max	Measurement current (mA)	Output Current (mA)	Power Dissipation (mW)	
TAR8D01K	A	2.43	2.5	2.57	30	100	400	US8
	B	2.73	2.8	2.87	30			
TAR8D02K	A	1.94	2.0	2.06	30			
	B	2.73	2.8	2.87	30			
TAR8D03K	A	2.73	2.8	2.87	30			
	B	2.92	3.0	3.08	30			
TAR8D04K	A	1.44	1.5	1.56	30			
	B	1.44	1.5	1.56	30			
TAR8D05K	A	2.73	2.8	2.87	30			
	B	2.73	2.8	2.87	30			
TAR8D06K	A	2.83	2.9	2.97	30			
	B	2.83	2.9	2.97	30			
TAR8D07K	A	2.92	3.0	3.08	30			
	B	2.92	3.0	3.08	30			
TAR8D08K	A	2.73	2.8	2.87	30			
	B	2.77	2.85	2.93	30			

Dual-output type: TAR8Hxx Series (dual-circuit, synchronous ON/OFF control)

Output voltage can be set, 0.1 V step fro 1.5 V to 5.0 V (semi-custom products)

Part Number	Output Voltage (V)					Maximum Rating		Package
	Ch	Min	Typ.	Max	Measurement current (mA)	Output Current (mA)	Power Dissipation (mW)	
TAR8H01K	A	2.73	2.8	2.87	30	100	400	US8
	B	2.92	3.0	3.08	60	150		
TAR8H02K	A	2.73	2.8	2.87	30	100		
	B	2.73	2.8	2.87	30	150		
TAR8H03K	A	2.43	2.5	2.57	30	100		
	B	2.73	2.8	2.87	60	150		
TAR8H04K	A	2.43	2.5	2.57	30	100		
	B	2.92	3.0	3.08	60	150		
TAR8H05K	A	1.74	1.8	1.86	30	100		
	B	2.73	2.8	2.87	60	150		
TAR8H06K	A	1.44	1.5	1.56	30	100		
	B	2.43	2.5	2.57	60	150		

Precautions for Use

The noise capacitor should be connected to NOISE pin to GND for stable operation, the recommended value is higher than 0.0047 μ F.

Although all devices in this catalog is built-in overtemperature and overcurrent protection circuits, these functions do not restrict use of the devices within their absolute maximum ratings.

Toshiba recommend that the specific technical data which relates to a product be checked before it is used, and that products always be used within their absolute maximum ratings.

9. Op Amp Comparator ICs

9.1 Product Line-up

Single type 1616 size ESV packages are added to the product line-up.

Dual 2.0 mm x 2.3 mm size US8 packages are added to the product line-up.

Single Circuit: SMV (F type: SOT-25, SC-74A), USV (FU type: SOT-353, SC-88A), ESV(FE type)

Function	Bipolar Comparators	CMOS Comparators				Bipolar Op Amps		CMOS Op Amps			
Part Number	TA75S393F	TC75S56F TC75S56FU TC75S56FE	TC75S57F TC75S57FU TC75S57FE	TC75S58F TC75S58FU TC75S58FE	TC75S59F TC75S59FU TC75S59FE	TA75S01F	TA75S558F	TC75S51F TC75S51FU TC75S51FE	TC75S54F TC75S54FU TC75S54FE	TC75S55F TC75S55FU TC75S55FE	TC75S60F TC75S60FU
Marking	TA	TC	TD	TE	TF	SA	SB	SC	SE	SF	SH
Features	Single/dual power supply, open collector output	Single/dual power supply, push-pull output, supper -low current consumption	Single/dual power supply, push-pull output, low current consumption	Single/dual power supply, open drain output, supper-low current consumption	Single/dual power supply, open drain output, low current consumption	Single/dual power supply, unity gain capability	Dual power supply	Single/dual power supply, low-voltage operations, wide dynamic range	Single/dual power supply, low-voltage operations, supper-low current consumption, wide dynamic range	Single/dual power supply, low-voltage operations, supper-low current consumption, wide dynamic range	Single/dual power supply, high slew rate, high fT, low-voltage operation, low current consumption
Operating voltage	2 to 36 V or ± 1 to ± 18 V	1.8 to 7 V or ± 0.9 to ± 3.5 V				3 to 12 V or ± 1.5 to ± 6 V	± 4 to 18 V	1.5 to 7 V or ± 0.75 to ± 3.5 V	1.8 to 7 V or ± 0.9 to ± 3.5 V		
Equivalent products	TA75393 (LM393) (LM2903)	—	—	—	—	TA75358C (LM358) (LM2804)	TA75558 (4558)	—	—	—	—
Pin layout (TOP VIEW)											

New product Note : The layout of input pins for the SMV op amp and the comoarator IC are different. The pin layout of the op amp and comparator IC are the same as that of the SM8 type.

Dual Circuit: SM8 (FU type), US8 (FK type)

Function	Bipolar Comparators	CMOS Comparators				Bipolar Op Amps		CMOS Op Amps			
Part Number	TA75W393FU	TC75W56FU TC75W56FK	TC75W57FU TC75W57FK	TC75W58FU TC75W58FK	TC75W59FU TC75W59FK	TA75W01FU	TA75W558FU	TC75W51FU TC75W51FK	TC75W54FU TC75W54FK	TC75W55FU TC75W55FK	TC75W60FU TC75W60FK
Marking	5W393	5W56	5W57	5W58	5W59	5W01	5W558	5W51	5W54	5W55	5W60
Features	Single/dual power supply, open collector output	Single/dual power supply, push-pull output, -low current consumption	Single/dual power supply, push-pull output, low current consumption	Single/dual power supply, open drain output, supper-low current consumption	Single/dual power supply, open drain output, low current consumption	Single/dual power supply, unity gain capability	Dual power supply	Single/dual power supply, low-voltage operations, wide dynamic range	Single/dual power supply, low-voltage operations, supper-low current consumption, wide dynamic range	Single/dual power supply, low-voltage operations, supper-low current consumption, wide dynamic range	Single/dual power supply, high slew rate, high fT, low-voltage operation, low current consumption
Operating voltage	2 to 36 V or ± 1 to ± 18 V	1.8 to 7 V or ± 0.9 to ± 3.5 V				3 to 12 V or ± 1.5 to ± 6 V	± 4 to 18 V	1.5 to 7 V or ± 0.75 to ± 3.5 V	1.8 to 7 V or ± 0.9 to ± 3.5 V		
Equivalent products	TA75393 (LM393) (LM2903)	—	—	—	—	TA75358C (LM358) (LM2904)	TA75558 (4558)	—	—	—	—
Pin layout (TOP VIEW)											

New product

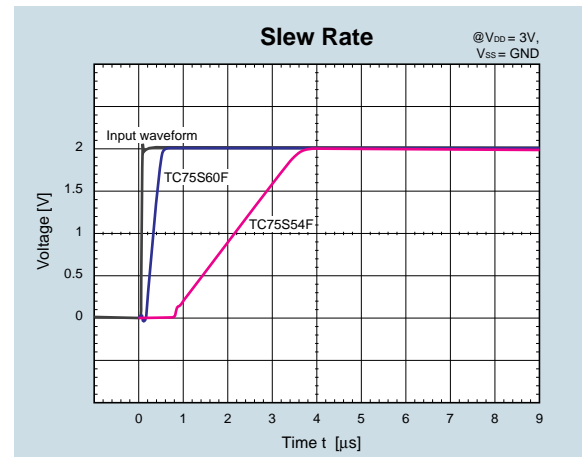
9.2 New Product

New Products

High Slew Rate Single and Dual CMOS Op Amp: TC75S60/TC75W60 Series

Features

- High slew rate: 5.1 V/μs (typ.) @V_{DD} = 3 V
- Low supply current: 330 μA (typ.), V_{DD} = 3 V (single-circuit)
- Single and dual power supplies are used.
- Low-voltage operation possible: 1.8 V to 7 V



Line-up

	Part Number	Package	Marking	Pin Assignment
Single-Circuit	TC75S60F	SMV (SC-74A, SOT-25)	SH	
	TC75S60FU	USV (SC-88A, SOT-353)		
Dual-Circuit	TC75W60FU	SM8	5W60	
	TC75W60FK	US8		

New Products

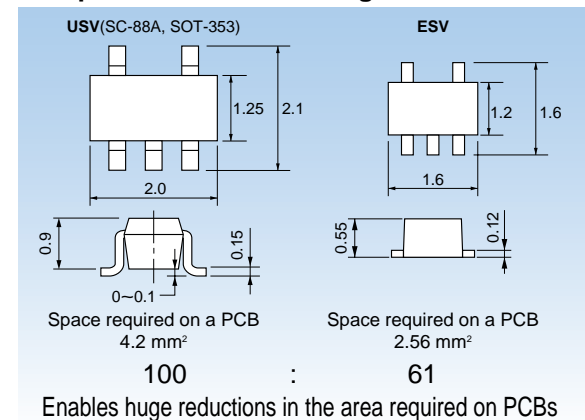
CMOS Op Amps and Comparator ICs Housed in ESV Package

Line-up

Function	ESV Package	Equivalent USV Package
CMOS OP Amps	TC75S51FE	TC75S51FU
	TC75S54FE	TC75S54FU
	TC75S55FE	TC75S55FU
CMOS Comparator ICs	TC75S56FE	TC75S56FU
	TC75S57FE	TC75S57FU
	TC75S58FE	TC75S58FU
	TC75S59FE	TC75S59FU

Compared with USV Package

Unit: mm



9. Op Amp Comparator ICs

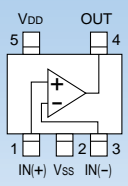
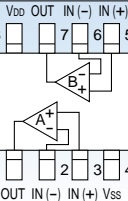
9.3 Current Products

Single and Dual CMOS Op Amp ICs: TC75S51/54/55 and TC75W51/54/55 Series

Features

- Low supply current:
 - Single-circuit
 - 10 μ A: TC75S55F/FU
 - 60 μ A: TC75S51F/FU
 - 100 μ A: TC75S54F/FU
 - Dual-circuit
 - 20 μ A: TC75W55FU/FK
 - 120 μ A: TC75W51FU/FK
 - 200 μ A: TC75W54FU/FK
- Wide range of output voltage: $V_{DD}-0.1\text{ V}@V_{DD}=3\text{ V}$, $R_L=100\text{ k}\Omega$
- Single and dual power supplies are used.
 - 1.5 V to 7 V: TC75S51F Series
 - 1.8 V to 7 V: TC75S54F/55F Series

Line-up

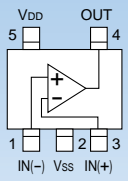
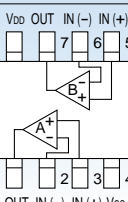
	Part Number	Marking	Package	Pin Assignment
Single-circuit	TC75S51F/FU	SC	SMV (SC-74A, SOT-25) USV (SC-88A, SOT-353)	
	TC75S54F/FU	SE		
	TC75S55F/FU	SF		
Dual-circuit	TC75W51FU/FK	5W51	SM8/US8	
	TC75W54FU/FK	5W54		
	TC75W55FU/FK	5W55		

Single and Dual CMOS Comparator ICs: TC75S56/57/58/59 and TC75W56/57/58/59 Series

Features

- Output circuit type
 - Push-pull output circuit (TC75S56F/57F Series)
 - Open drain (TC75S58F/59F Series)
- Low supply current
 - Single-circuit
 - 10 μ A: TC75S56F/58F Series
 - 100 μ A: TC75S57F/59F Series
 - Dual Circuit
 - 20 μ A: TC75W56FU/58FU Series
 - 200 μ A: TC75W57FU/59FU Series
- Low-voltage operation: 1.8 V to 7 V,
- Full-swing output

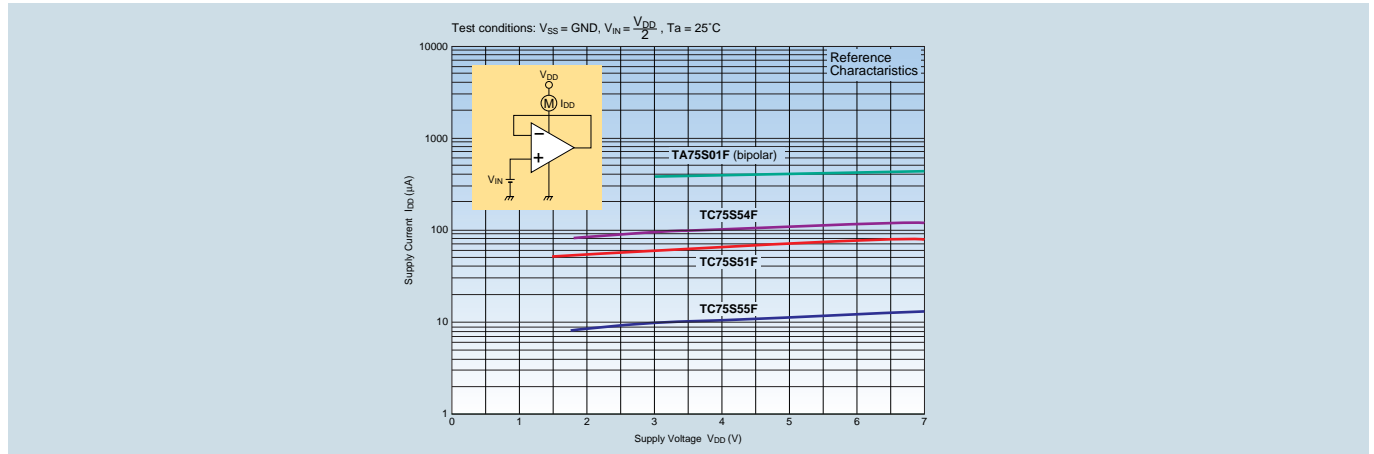
Line-up

	Part Number	Marking	Package	Pin Assignment
Single-circuit	TC75S56F/FU	TC	SMV (SC-74A, SOT-25) USV (SC-88A, SOT-353)	
	TC75S57F/FU	TD		
	TC75S58F/FU	TE		
	TC75S59F/FU	TF		
Dual-circuit	TC75W56F/FU	5W56	SM8/US8	
	TC75W57F/FU	5W57		
	TC75W58F/FU	5W58		
	TC75W59F/FU	5W59		

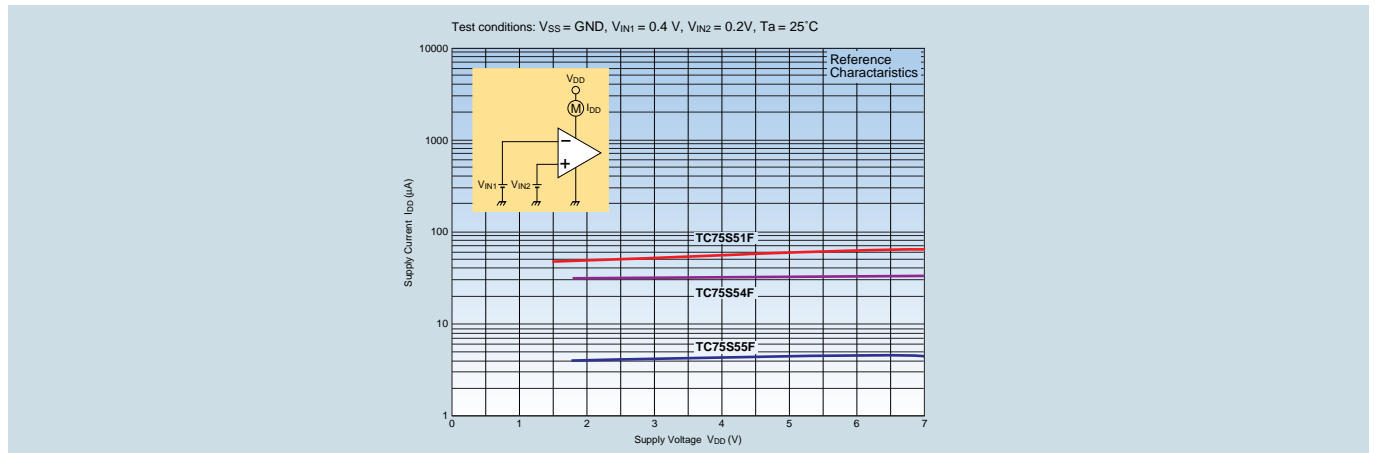
Power Supply Current in CMOS Op Amp ICs

Power supply current in CMOS operational amplifiers varies depending on the use conditions. The standard method for measuring operational amplifier power supply current is specified by JEITA and JIS. Toshiba's test circuit for measuring power supply current is standard type. Note that with CMOS operational amplifiers, even if power supply current is small in the test circuit, power supply current may vary depending on the mode used. Toshiba's line-up features several types of CMOS operational amplifier, each with individual features. In principle, Toshiba design for low-voltage operation and low power supply current. Comparison data for CMOS operational amplifier power supply current are shown below.

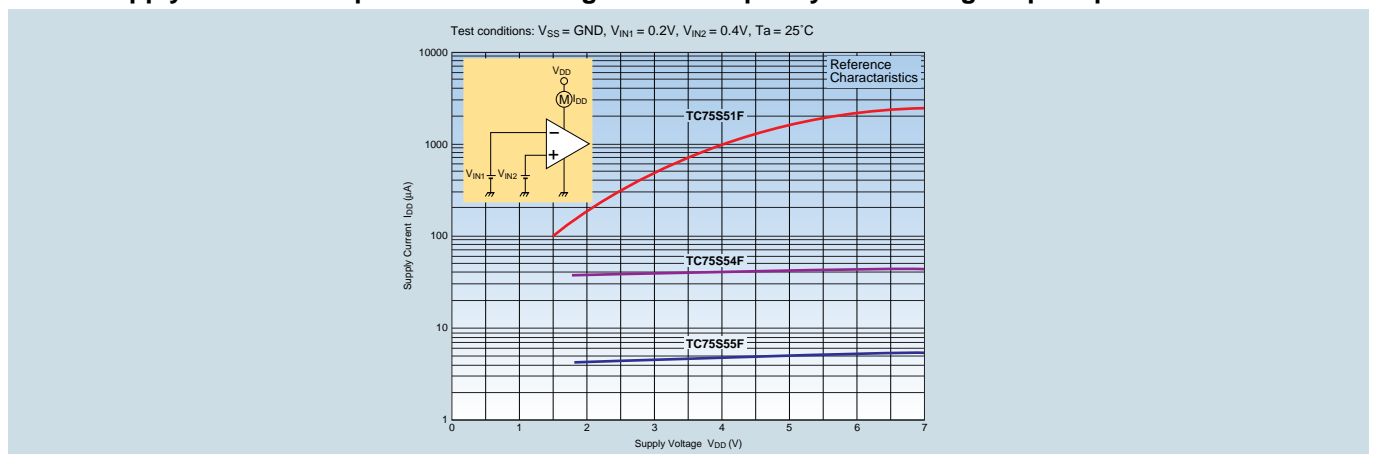
Standard Power Supply Current Comparison Data for CMOS Single Op Amp



Power Supply Current Comparison Data at Low-Level Output by CMOS Single Op Amp



Power Supply Current Comparison Data at High-Level Output by CMOS Single Op Amp

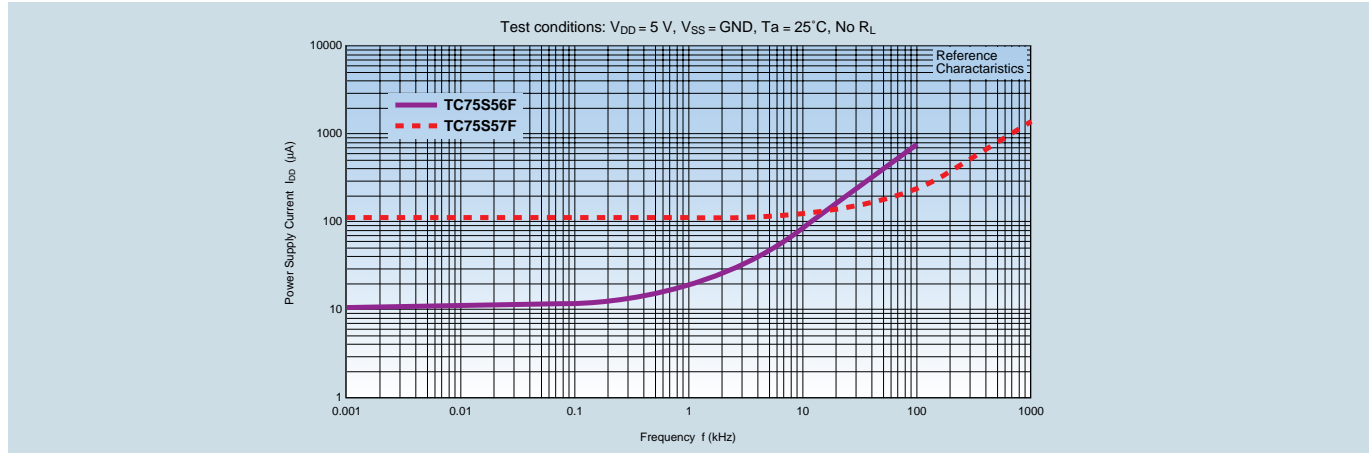


9. Op Amp Comparator ICs

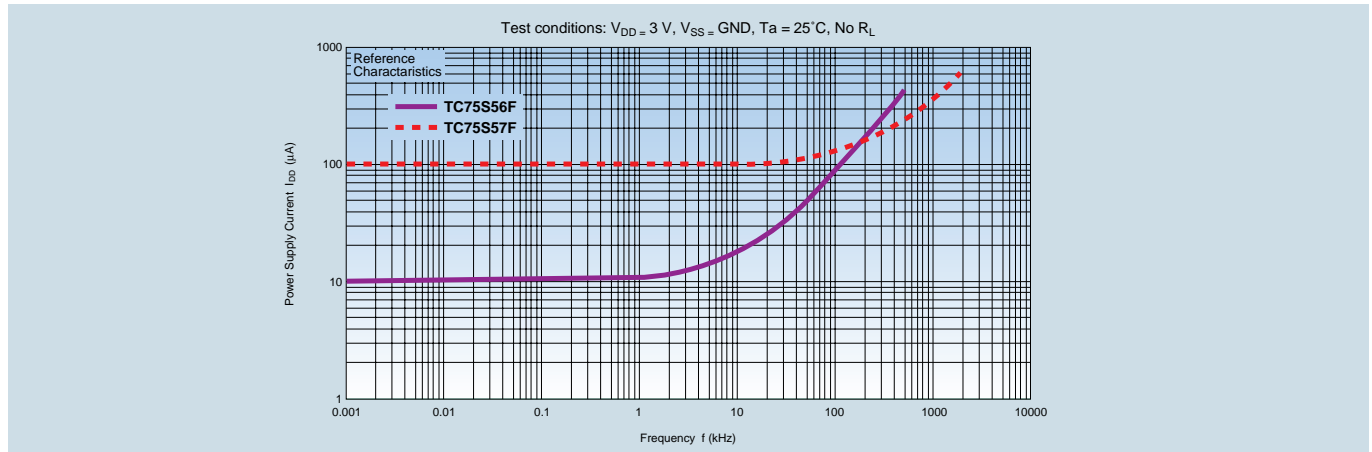
Power Supply Current and Frequency Characteristics in CMOS Comparator ICs

In CMOS comparators power supply current rises as the operating frequency increases, since the overlap current increases in step with the operating frequency. Therefore, select a comparator according to the frequency of the signal to be used.

TC75S56F/TC75S57F Power Supply Current — Frequency Characteristics



TC75S56F/TC75S57F Power Supply Current — Frequency Characteristics



Comparison of CMOS Op Amp ICs and Bipolar Op Amp ICs Characteristics

Our super-miniature operational amplifier product line includes both CMOS and bipolar operational amplifier, both of which offer excellent characteristics. However, our existing CMOS operational amplifier series was developed specifically for low-voltage operation and low power supply current. Therefore, compared to the bipolar operational amplifier, the CMOS operational amplifier can substantially reduce power dissipation. The following table compares the principal characteristics of typical Toshiba bipolar and CMOS operational amplifier.

Product Type Characteristic	CMOS Operational Amplifier		Bipolar Operational Amplifier
	TC75S54F	TC75S55F	TA75S01F
Operating Power Supply Voltage Range	1.8 to 7.0 V	1.8 to 7.0 V	3.0 to 12.0 V
Power Supply Current (typ.)	100 μA ($V_{DD} = 3\text{ V}$) 80 μA ($V_{DD} = 1.8\text{ V}$)	10 μA ($V_{DD} = 3\text{ V}$) 8 μA ($V_{DD} = 1.8\text{ V}$)	400 μA ($V_{CC} = 5\text{ V}$)
Input Bias Current (typ.)	1 pA ($V_{DD} = 3\text{ V}$)	1 pA ($V_{DD} = 3\text{ V}$)	45 nA ($V_{CC} = 5\text{ V}$)
Maximum Output Voltage (typ.)	$V_{DD} - 0.1\text{ V}$ ($V_{DD} = 3\text{ V}$, $R_L = 100\text{ k}\Omega$)	$V_{DD} - 0.1\text{ V}$ ($V_{DD} = 3\text{ V}$, $R_L = 1\text{ M}\Omega$)	3.4 V ($V_{CC} = 5\text{ V}$, $R_L = 2\text{ k}\Omega$)
Source Current (typ.)	200 μA ($V_{DD} = 3\text{ V}$) 160 μA ($V_{DD} = 1.8\text{ V}$)	20 μA ($V_{DD} = 3\text{ V}$) 16 μA ($V_{DD} = 1.8\text{ V}$)	40 mA ($V_{CC} = 5\text{ V}$)
Sink Current (typ.)	700 μA ($V_{DD} = 3\text{ V}$) 600 μA ($V_{DD} = 1.8\text{ V}$)	450 μA ($V_{DD} = 3\text{ V}$) 400 μA ($V_{DD} = 1.8\text{ V}$)	20 mA ($V_{CC} = 5\text{ V}$)

10. Products line-up for Oversea factory which located in Malaysia, Thailand and China

Diodes

Part Number	Package Name			Production		
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	China
1SS181	S-MINI	SC-59	SOT-346		○	
1SS184	S-MINI	SC-59	SOT-346		○	
1SS187	S-MINI	SC-59	SOT-346		○	
1SS190	S-MINI	SC-59	SOT-346		○	
1SS193	S-MINI	SC-59	SOT-346		○	
1SS196	S-MINI	SC-59	SOT-346		○	
1SS226	S-MINI	SC-59	SOT-346		○	
1SS250	S-MINI	SC-59	SOT-346		○	
1SS294	S-MINI	SC-59	SOT-346		○	
1SS300	USM	SC-70	SOT-323			○
1SS301	USM	SC-70	SOT-323			○
1SS302	USM	SC-70	SOT-323			○
1SS322	USM	SC-70	SOT-323			○
1SS401	USM	SC-70	SOT-323			○
1SS387	ESC	SC-79	SOT-523		○	
1SS388	ESC	SC-79	SOD-523		○	
1SS389	ESC	SC-79	SOD-523		○	
015AZ2.0	ESC	SC-79	SOD-523		○	
015AZ2.2	ESC	SC-79	SOD-523		○	
015AZ2.4	ESC	SC-79	SOD-523		○	
015AZ2.7	ESC	SC-79	SOD-523		○	
015AZ3.0	ESC	SC-79	SOD-523		○	
015AZ3.3	ESC	SC-79	SOD-523		○	
015AZ3.6	ESC	SC-79	SOD-523		○	
015AZ3.9	ESC	SC-79	SOD-523		○	
015AZ4.3	ESC	SC-79	SOD-523		○	
015AZ4.7	ESC	SC-79	SOD-523		○	
015AZ5.1	ESC	SC-79	SOD-523		○	
015AZ5.6	ESC	SC-79	SOD-523		○	
015AZ6.2	ESC	SC-79	SOD-523		○	
015AZ6.8	ESC	SC-79	SOD-523		○	
015AZ7.5	ESC	SC-79	SOD-523		○	
015AZ8.2	ESC	SC-79	SOD-523		○	
015AZ9.1	ESC	SC-79	SOD-523		○	
015AZ10	ESC	SC-79	SOD-523		○	
015AZ11	ESC	SC-79	SOD-523		○	
015AZ12	ESC	SC-79	SOD-523		○	
HN4D01JU	USV	SC-88A	SOT-353		○	
HN4D02JU	USV	SC-88A	SOT-353		○	
HN2S01F	SM6	SC-74	SOD-26		○	
1SS360	SSM	SC-75	SOT-416		○	
1SS361	SSM	SC-75	SOT-416		○	
1SS362	SSM	SC-75	SOT-416		○	
1SS364	SSM	SC-75	SOT-416		○	
1SS385	SSM	SC-75	SOT-416		○	
1SS300	USM	SC-70	SOT-323			○
1SS301	USM	SC-70	SOT-323			○
1SS302	USM	SC-70	SOT-323			○
1SS322	USM	SC-70	SOT-323			○
1SS401	USM	SC-70	SOT-323			○

Junction FETs

Part Number	Package Name			Production		
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	China
2SK208	S-MINI	SC-59	SOT-346		○	
2SK209	S-MINI	SC-59	SOT-346		○	

Transistors

Part Number	Package Name			Production		
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	China
2SC2712	S-MINI	SC-59	SOT-346		○	
2SC2713	S-MINI	SC-59	SOT-346		○	
2SC2859	S-MINI	SC-59	SOT-346		○	
2SC3265	S-MINI	SC-59	SOT-346		○	
2SC3325	S-MINI	SC-59	SOT-346		○	
2SC3326	S-MINI	SC-59	SOT-346		○	
2SC3295	S-MINI	SC-59	SOT-346		○	
2SA1162	S-MINI	SC-59	SOT-346		○	
2SA1163	S-MINI	SC-59	SOT-346		○	
2SA1182	S-MINI	SC-59	SOT-346		○	
2SA1298	S-MINI	SC-59	SOT-346		○	
2SA1313	S-MINI	SC-59	SOT-346		○	
2SA1362	S-MINI	SC-59	SOT-346		○	
TBC846	S-MINI	SC-59	SOT-346		○	
TBC847	S-MINI	SC-59	SOT-346		○	
TBC848	S-MINI	SC-59	SOT-346		○	
TBC849	S-MINI	SC-59	SOT-346		○	
TBC850	S-MINI	SC-59	SOT-346		○	
TBC856	S-MINI	SC-59	SOT-346		○	
TBC857	S-MINI	SC-59	SOT-346		○	
TBC858	S-MINI	SC-59	SOT-346		○	
TBC859	S-MINI	SC-59	SOT-346		○	
TBC860	S-MINI	SC-59	SOT-346		○	
2SC4738	SSM	SC-75	SOT-416		○	
2SC5376	SSM	SC-75	SOT-416		○	
2SA1832	SSM	SC-75	SOT-416		○	
2SA1955	SSM	SC-75	SOT-416		○	
2SC4116	USM	SC-70	SOT-323			○
2SC4117	USM	SC-70	SOT-323			○
2SC4118	USM	SC-70	SOT-323			○
2SC4213	USM	SC-70	SOT-323			○
2SC4666	USM	SC-70	SOT-323			○
2SC4667	USM	SC-70	SOT-323			○
2SC5233	USM	SC-70	SOT-323			○
2SA1586	USM	SC-70	SOT-323			○
2SA1587	USM	SC-70	SOT-323			○
2SA1588	USM	SC-70	SOT-323			○

MCD

Part Number	Package Name			Production		
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	China
HN1A01FU	US6	SC-88	SOT-363		○	
HN1B01FU	US6	SC-88	SOT-363		○	
HN1C01FU	US6	SC-88	SOT-363		○	
HN1B04FU	US6	SC-88	SOT-363		○	
HN2A01FU	US6	SC-88	SOT-363		○	
HN2C01FU	US6	SC-88	SOT-363		○	
HN1K02FU	US6	SC-88	SOT-363		○	
HN1K03FU	US6	SC-88	SOT-363		○	
HN1L02FU	US6	SC-88	SOT-363		○	
HN7G01FU	US6	SC-88	SOT-363		○	
HN1D01FU	US6	SC-88	SOT-363		○	
HN1D02FU	US6	SC-88	SOT-363		○	
HN1D03FU	US6	SC-88	SOT-363		○	
HN2D01FU	US6	SC-88	SOT-363		○	
HN2S01FU	US6	SC-88	SOT-363		○	

10. Products line-up for Oversea factory which located in Malaysia, Thailand and China

BRTs (Bias Resistor Built-in Transistors)

Part Number	Package Name			Production		
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	China
RN1401	S-MINI	SC-59	SOT-346		○	
RN1402	S-MINI	SC-59	SOT-346		○	
RN1403	S-MINI	SC-59	SOT-346		○	
RN1404	S-MINI	SC-59	SOT-346		○	
RN1405	S-MINI	SC-59	SOT-346		○	
RN1406	S-MINI	SC-59	SOT-346		○	
RN1407	S-MINI	SC-59	SOT-346		○	
RN1408	S-MINI	SC-59	SOT-346		○	
RN1409	S-MINI	SC-59	SOT-346		○	
RN1410	S-MINI	SC-59	SOT-346		○	
RN1411	S-MINI	SC-59	SOT-346		○	
RN2401	S-MINI	SC-59	SOT-346		○	
RN2402	S-MINI	SC-59	SOT-346		○	
RN2403	S-MINI	SC-59	SOT-346		○	
RN2404	S-MINI	SC-59	SOT-346		○	
RN2405	S-MINI	SC-59	SOT-346		○	
RN2406	S-MINI	SC-59	SOT-346		○	
RN2407	S-MINI	SC-59	SOT-346		○	
RN2408	S-MINI	SC-59	SOT-346		○	
RN2409	S-MINI	SC-59	SOT-346		○	
RN2410	S-MINI	SC-59	SOT-346		○	
RN2411	S-MINI	SC-59	SOT-346		○	
RN1701	USV	SC-88A	SOT-353		○	
RN1702	USV	SC-88A	SOT-353		○	
RN1703	USV	SC-88A	SOT-353		○	
RN1704	USV	SC-88A	SOT-353		○	
RN1705	USV	SC-88A	SOT-353		○	
RN1706	USV	SC-88A	SOT-353		○	
RN1707	USV	SC-88A	SOT-353		○	
RN1708	USV	SC-88A	SOT-353		○	
RN1709	USV	SC-88A	SOT-353		○	
RN1710	USV	SC-88A	SOT-353		○	
RN1711	USV	SC-88A	SOT-353		○	
RN2701	USV	SC-88A	SOT-353		○	
RN2702	USV	SC-88A	SOT-353		○	
RN2703	USV	SC-88A	SOT-353		○	
RN2704	USV	SC-88A	SOT-353		○	
RN2705	USV	SC-88A	SOT-353		○	
RN2706	USV	SC-88A	SOT-353		○	
RN2707	USV	SC-88A	SOT-353		○	
RN2708	USV	SC-88A	SOT-353		○	
RN2709	USV	SC-88A	SOT-353		○	
RN2710	USV	SC-88A	SOT-353		○	
RN2711	USV	SC-88A	SOT-353		○	
RN47A1	USV	SC-88A	SOT-353		○	
RN47A2	USV	SC-88A	SOT-353		○	
RN47A3	USV	SC-88A	SOT-353		○	
RN47A4	USV	SC-88A	SOT-353		○	
RN47A5	USV	SC-88A	SOT-353		○	
RN47A6	USV	SC-88A	SOT-353		○	
RN1601	SM6	SC-74	SOT-26		○	
RN1602	SM6	SC-74	SOT-26		○	
RN1603	SM6	SC-74	SOT-26		○	
RN1604	SM6	SC-74	SOT-26		○	
RN1605	SM6	SC-74	SOT-26		○	
RN1606	SM6	SC-74	SOT-26		○	
RN1607	SM6	SC-74	SOT-26		○	
RN1608	SM6	SC-74	SOT-26		○	
RN1609	SM6	SC-74	SOT-26		○	
RN1610	SM6	SC-74	SOT-26		○	
RN1611	SM6	SC-74	SOT-26		○	
RN2601	SM6	SC-74	SOT-26		○	
RN2602	SM6	SC-74	SOT-26		○	
RN2603	SM6	SC-74	SOT-26		○	
RN2604	SM6	SC-74	SOT-26		○	
RN2605	SM6	SC-74	SOT-26		○	
RN2606	SM6	SC-74	SOT-26		○	
RN2607	SM6	SC-74	SOT-26		○	
RN2608	SM6	SC-74	SOT-26		○	
RN2609	SM6	SC-74	SOT-26		○	

Part Number	Package Name			Production		
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	China
RN2610	SM6	SC-74	SOT-26		○	
RN2611	SM6	SC-74	SOT-26		○	
RN4601	SM6	SC-74	SOT-26		○	
RN4602	SM6	SC-74	SOT-26		○	
RN4603	SM6	SC-74	SOT-26		○	
RN4604	SM6	SC-74	SOT-26		○	
RN4605	SM6	SC-74	SOT-26		○	
RN4606	SM6	SC-74	SOT-26		○	
RN4607	SM6	SC-74	SOT-26		○	
RN4608	SM6	SC-74	SOT-26		○	
RN4609	SM6	SC-74	SOT-26		○	
RN4610	SM6	SC-74	SOT-26		○	
RN4611	SM6	SC-74	SOT-26		○	
RN1901	US6	SC-88	SOT-363		○	
RN1902	US6	SC-88	SOT-363		○	
RN1903	US6	SC-88	SOT-363		○	
RN1904	US6	SC-88	SOT-363		○	
RN1905	US6	SC-88	SOT-363		○	
RN1906	US6	SC-88	SOT-363		○	
RN1907	US6	SC-88	SOT-363		○	
RN1908	US6	SC-88	SOT-363		○	
RN1909	US6	SC-88	SOT-363		○	
RN1910	US6	SC-88	SOT-363		○	
RN1911	US6	SC-88	SOT-363		○	
RN2901	US6	SC-88	SOT-363		○	
RN2902	US6	SC-88	SOT-363		○	
RN2903	US6	SC-88	SOT-363		○	
RN2904	US6	SC-88	SOT-363		○	
RN2905	US6	SC-88	SOT-363		○	
RN2906	US6	SC-88	SOT-363		○	
RN2907	US6	SC-88	SOT-363		○	
RN2908	US6	SC-88	SOT-363		○	
RN2909	US6	SC-88	SOT-363		○	
RN2910	US6	SC-88	SOT-363		○	
RN2911	US6	SC-88	SOT-363		○	
RN4901	US6	SC-88	SOT-363		○	
RN4902	US6	SC-88	SOT-363		○	
RN4903	US6	SC-88	SOT-363		○	
RN4904	US6	SC-88	SOT-363		○	
RN4905	US6	SC-88	SOT-363		○	
RN4906	US6	SC-88	SOT-363		○	
RN4907	US6	SC-88	SOT-363		○	
RN4908	US6	SC-88	SOT-363		○	
RN4909	US6	SC-88	SOT-363		○	
RN4910	US6	SC-88	SOT-363		○	
RN4911	US6	SC-88	SOT-363		○	
RN49A1	US6	SC-88	SOT-363		○	
RN49A2	US6	SC-88	SOT-363		○	
RN49A5	US6	SC-88	SOT-363		○	
RN4981	US6	SC-88	SOT-363		○	
RN4982	US6	SC-88	SOT-363		○	
RN4983	US6	SC-88	SOT-363		○	
RN4984	US6	SC-88	SOT-363		○	
RN4985	US6	SC-88	SOT-363		○	
RN4986	US6	SC-88	SOT-363		○	
RN4987	US6	SC-88	SOT-363		○	
RN4988	US6	SC-88	SOT-363		○	
RN4989	US6	SC-88	SOT-363		○	
RN4990	US6	SC-88	SOT-363		○	
RN4991	US6	SC-88	SOT-363		○	
RN1101	SSM	SC-75	SOT-416		○	
RN1102	SSM	SC-75	SOT-416		○	
RN1103	SSM	SC-75	SOT-416		○	
RN1104	SSM	SC-75	SOT-416		○	
RN1105	SSM	SC-75	SOT-416		○	
RN1106	SSM	SC-75	SOT-416		○	
RN1107	SSM	SC-75	SOT-416		○	
RN1108	SSM	SC-75	SOT-416		○	
RN1109	SSM	SC-75	SOT-416		○	
RN1110	SSM	SC-75	SOT-416		○	

BRTs (Bias Resistor Built-in Transistors)

Part Number	Package Name			Production		
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	China
RN1111	SSM	SC-75	SOT-416		○	
RN1112	SSM	SC-75	SOT-416		○	
RN1113	SSM	SC-75	SOT-416		○	
RN1114	SSM	SC-75	SOT-416		○	
RN1115	SSM	SC-75	SOT-416		○	
RN1116	SSM	SC-75	SOT-416		○	
RN1117	SSM	SC-75	SOT-416		○	
RN1118	SSM	SC-75	SOT-416		○	
RN2101	SSM	SC-75	SOT-416		○	
RN2102	SSM	SC-75	SOT-416		○	
RN2103	SSM	SC-75	SOT-416		○	
RN2104	SSM	SC-75	SOT-416		○	
RN2105	SSM	SC-75	SOT-416		○	
RN2106	SSM	SC-75	SOT-416		○	
RN2107	SSM	SC-75	SOT-416		○	
RN2108	SSM	SC-75	SOT-416		○	
RN2109	SSM	SC-75	SOT-416		○	
RN2110	SSM	SC-75	SOT-416		○	
RN2111	SSM	SC-75	SOT-416		○	
RN2112	SSM	SC-75	SOT-416		○	
RN2113	SSM	SC-75	SOT-416		○	
RN2114	SSM	SC-75	SOT-416		○	
RN2115	SSM	SC-75	SOT-416		○	
RN2116	SSM	SC-75	SOT-416		○	
RN2117	SSM	SC-75	SOT-416		○	
RN2118	SSM	SC-75	SOT-416		○	
RN1301	USM	SC-70	SOT-323			○
RN1302	USM	SC-70	SOT-323			○
RN1303	USM	SC-70	SOT-323			○
RN1304	USM	SC-70	SOT-323			○
RN1305	USM	SC-70	SOT-323			○
RN1306	USM	SC-70	SOT-323			○
RN1307	USM	SC-70	SOT-323			○
RN1308	USM	SC-70	SOT-323			○
RN1309	USM	SC-70	SOT-323			○
RN1310	USM	SC-70	SOT-323			○
RN1311	USM	SC-70	SOT-323			○
RN2301	USM	SC-70	SOT-323			○
RN2302	USM	SC-70	SOT-323			○
RN2303	USM	SC-70	SOT-323			○
RN2304	USM	SC-70	SOT-323			○
RN2305	USM	SC-70	SOT-323			○
RN2306	USM	SC-70	SOT-323			○
RN2307	USM	SC-70	SOT-323			○
RN2308	USM	SC-70	SOT-323			○
RN2309	USM	SC-70	SOT-323			○
RN2310	USM	SC-70	SOT-323			○
RN2311	USM	SC-70	SOT-323			○

Part Number	Package Name			Production		
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	China
TC7SH04F	SMV	SC-74A	SOT-25		○	
TC7SHU04F	SMV	SC-74A	SOT-25		○	
TC7SH08F	SMV	SC-74A	SOT-25		○	
TC7SH14F	SMV	SC-74A	SOT-25		○	
TC7SH32F	SMV	SC-74A	SOT-25		○	
TC7SH86F	SMV	SC-74A	SOT-25		○	
TC7SET00F	SMV	SC-74A	SOT-25		○	
TC7SET02F	SMV	SC-74A	SOT-25		○	
TC7SET04F	SMV	SC-74A	SOT-25		○	
TC7SET08F	SMV	SC-74A	SOT-25		○	
TC7SET32F	SMV	SC-74A	SOT-25		○	
TC7SET86F	SMV	SC-74A	SOT-25		○	
TC4S01F	SMV	SC-74A	SOT-25		○	
TC4S11F	SMV	SC-74A	SOT-25		○	
TC4SU11F	SMV	SC-74A	SOT-25		○	
TC4S30F	SMV	SC-74A	SOT-25		○	
TC4S66F	SMV	SC-74A	SOT-25		○	
TC4S69F	SMV	SC-74A	SOT-25		○	
TC4SU69F	SMV	SC-74A	SOT-25		○	
TC4S71F	SMV	SC-74A	SOT-25		○	
TC4S81F	SMV	SC-74A	SOT-25		○	
TC4S584F	SMV	SC-74A	SOT-25		○	
TC7SZ00F	SMV	SC-74A	SOT-25		○	
TC7SZ02F	SMV	SC-74A	SOT-25		○	
TC7SZ04F	SMV	SC-74A	SOT-25		○	
TC7SZU04F	SMV	SC-74A	SOT-25		○	
TC7SZ05F	SMV	SC-74A	SOT-25		○	
TC7SZ08F	SMV	SC-74A	SOT-25		○	
TC7SZ125F	SMV	SC-74A	SOT-25		○	
TC7SZ126F	SMV	SC-74A	SOT-25		○	
TC7SZ14F	SMV	SC-74A	SOT-25		○	
TC7SZ32F	SMV	SC-74A	SOT-25		○	
TC7SZ86F	SMV	SC-74A	SOT-25		○	
TC7S00FU	USV	SC-88A	SOT-353		○	
TC7S02FU	USV	SC-88A	SOT-353		○	
TC7S04FU	USV	SC-88A	SOT-353		○	
TC7SU04FU	USV	SC-88A	SOT-353		○	
TC7S08FU	USV	SC-88A	SOT-353		○	
TC7S14FU	USV	SC-88A	SOT-353		○	
TC7S32FU	USV	SC-88A	SOT-353		○	
TC7S86FU	USV	SC-88A	SOT-353		○	
TC7S66FU	USV	SC-88A	SOT-353		○	
TC7SH00FU	USV	SC-88A	SOT-353		○	
TC7SH02FU	USV	SC-88A	SOT-353		○	
TC7SH04FU	USV	SC-88A	SOT-353		○	
TC7SHU04FU	USV	SC-88A	SOT-353		○	
TC7SH08FU	USV	SC-88A	SOT-353		○	
TC7SH14FU	USV	SC-88A	SOT-353		○	
TC7SH32FU	USV	SC-88A	SOT-353		○	
TC7SH86FU	USV	SC-88A	SOT-353		○	
TC7SET00FU	USV	SC-88A	SOT-353		○	
TC7SET02FU	USV	SC-88A	SOT-353		○	
TC7SET04FU	USV	SC-88A	SOT-353		○	
TC7SET08FU	USV	SC-88A	SOT-353		○	
TC7SET32FU	USV	SC-88A	SOT-353		○	
TC7SET86FU	USV	SC-88A	SOT-353		○	
TC7SZ00FU	USV	SC-88A	SOT-353		○	
TC7SZ02FU	USV	SC-88A	SOT-353		○	
TC7SZ04FU	USV	SC-88A	SOT-353		○	
TC7SZ05FU	USV	SC-88A	SOT-353		○	
TC7SZ08FU	USV	SC-88A	SOT-353		○	
TC7SZ125FU	USV	SC-88A	SOT-353		○	
TC7SZ126FU	USV	SC-88A	SOT-353		○	
TC7SZ32FU	USV	SC-88A	SOT-353		○	

L-MOS (one-gate CMOS logic)

Part Number	Package Name			Production		
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	China
TC7S00F	SMV	SC-74A	SOT-25		○	
TC7S02F	SMV	SC-74A	SOT-25		○	
TC7S04F	SMV	SC-74A	SOT-25		○	
TC7SU04F	SMV	SC-74A	SOT-25		○	
TC7S08F	SMV	SC-74A	SOT-25		○	
TC7S14F	SMV	SC-74A	SOT-25		○	
TC7S32F	SMV	SC-74A	SOT-25		○	
TC7S86F	SMV	SC-74A	SOT-25		○	
TC7S66F	SMV	SC-74A	SOT-25		○	
TC7SH00F	SMV	SC-74A	SOT-25		○	
TC7SH02F	SMV	SC-74A	SOT-25		○	

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