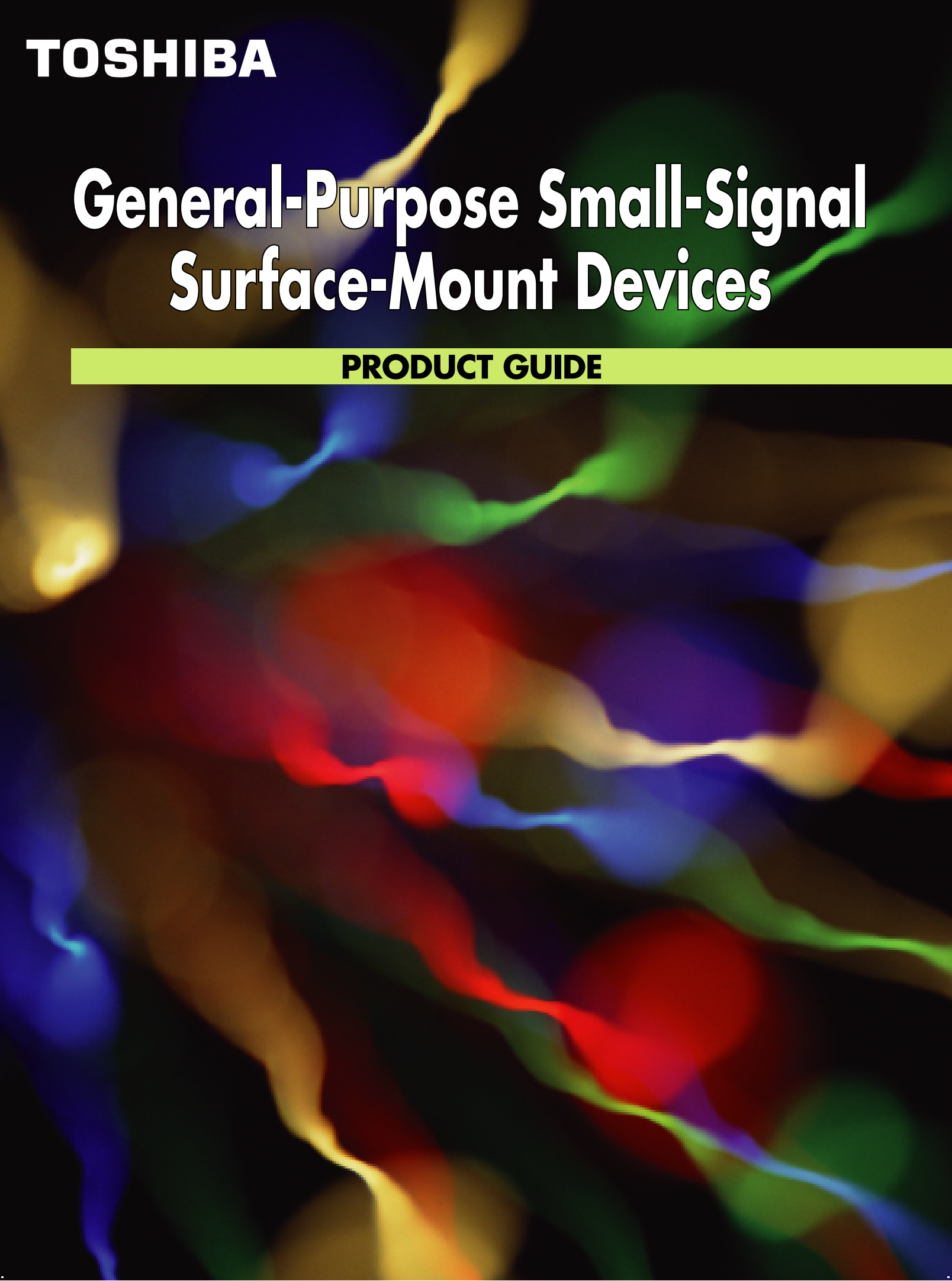




TOSHIBA

General-Purpose Small-Signal Surface-Mount Devices

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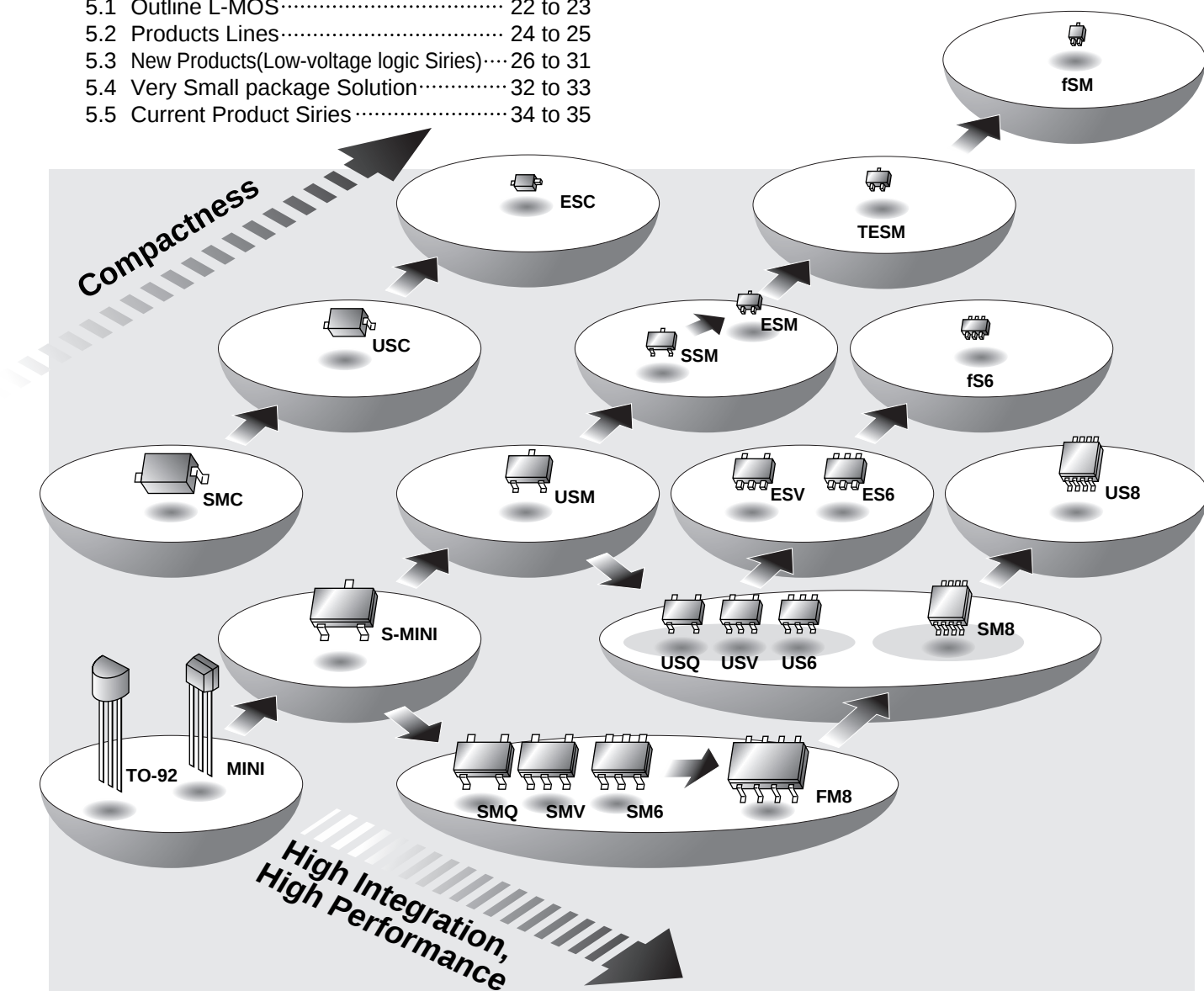
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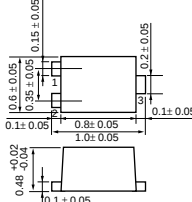
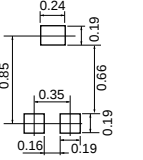
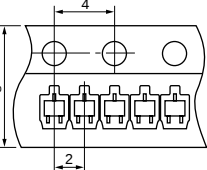
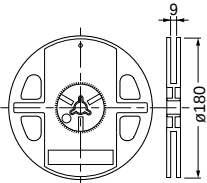
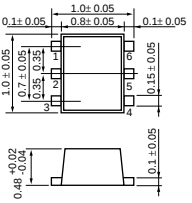
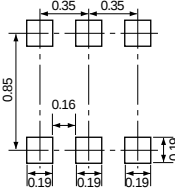
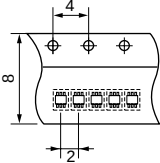
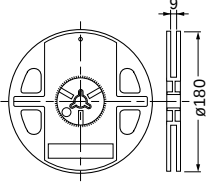
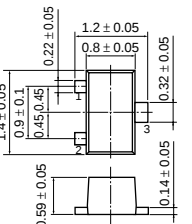
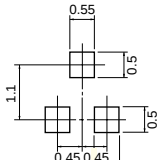
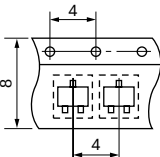
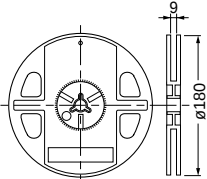
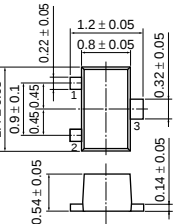
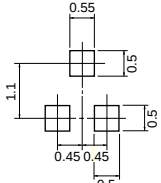
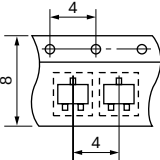
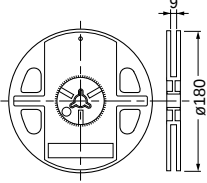
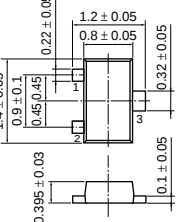
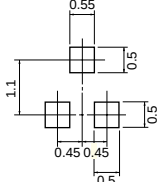
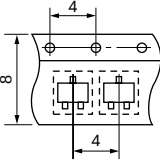
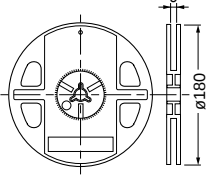
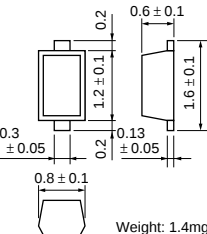
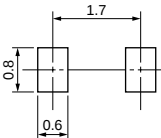
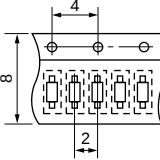
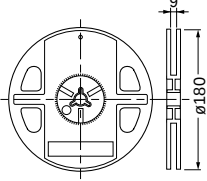
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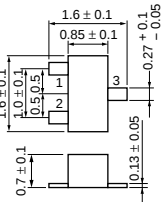
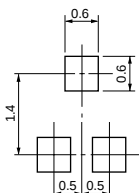
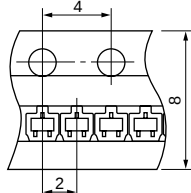
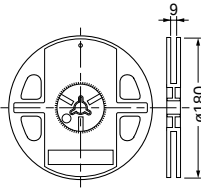
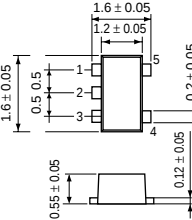
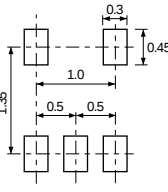
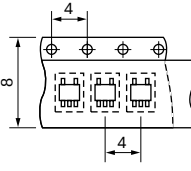
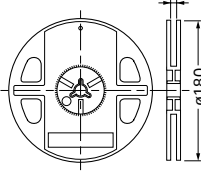
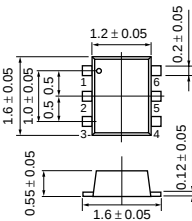
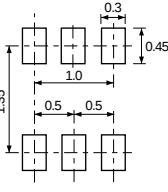
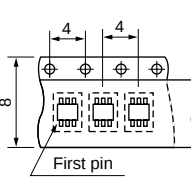
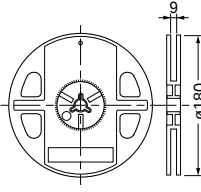
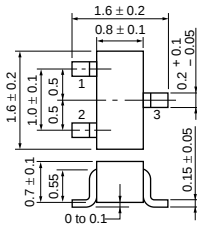
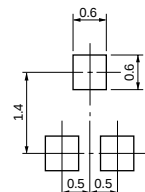
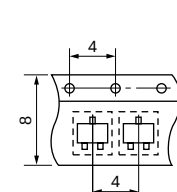
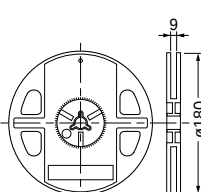
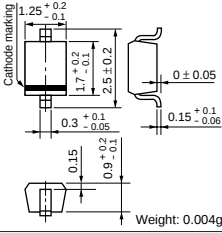
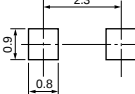
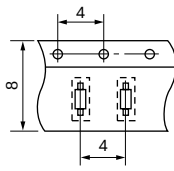
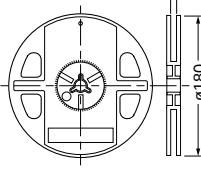
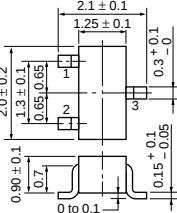
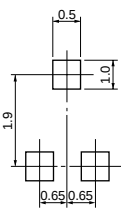
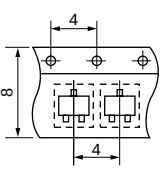
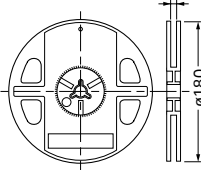
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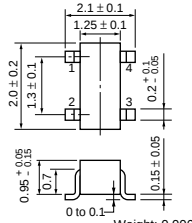
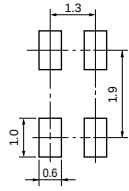
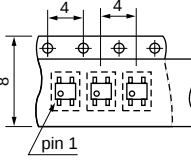
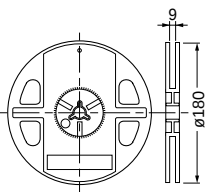
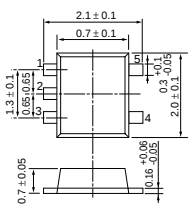
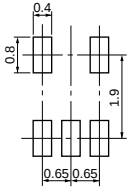
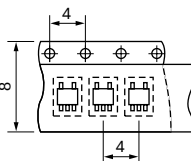
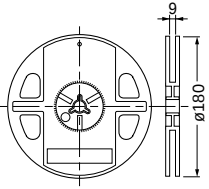
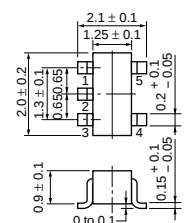
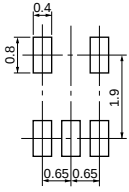
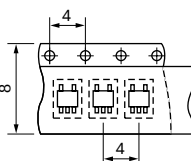
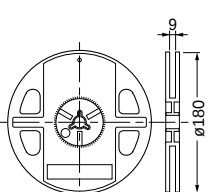
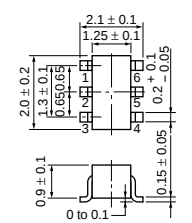
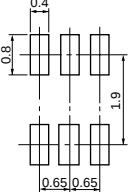
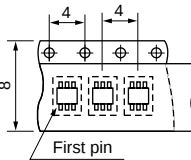
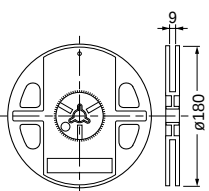
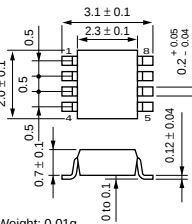
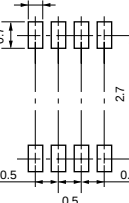
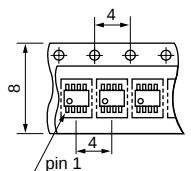
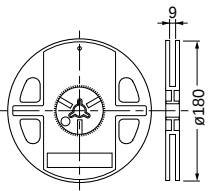
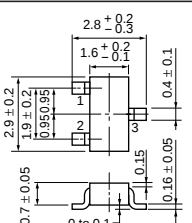
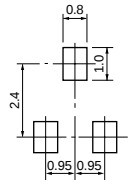
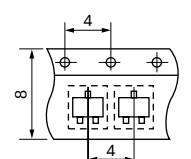
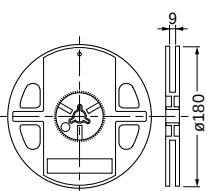


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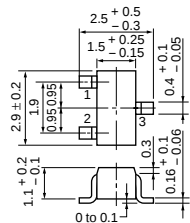
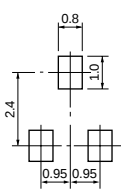
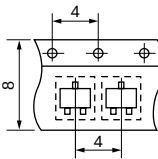
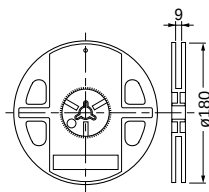
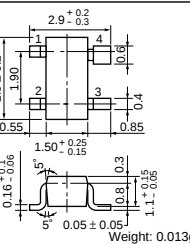
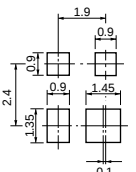
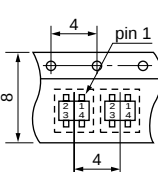
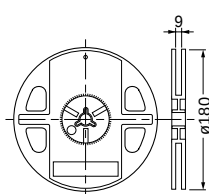
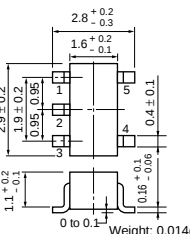
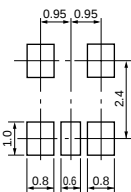
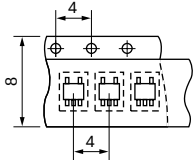
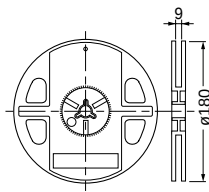
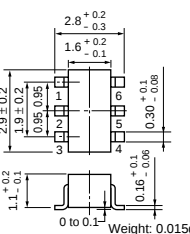
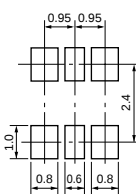
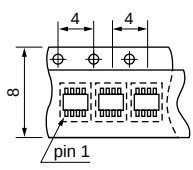
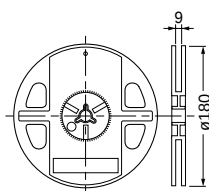
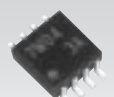
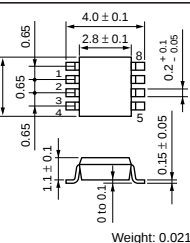
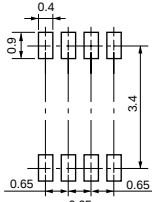
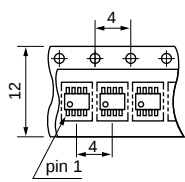
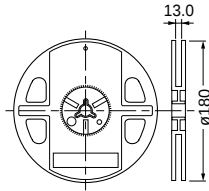
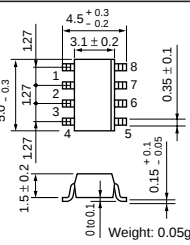
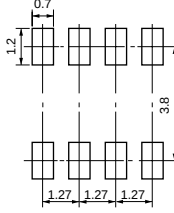
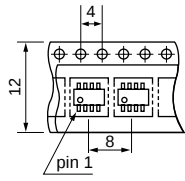
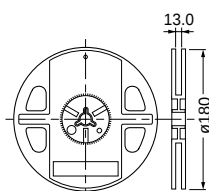
Toshiba package name	Package Type		Reference pad dimensions	Standard Tape Packing Specifications		
	Appearance	Dimensions		Tape type	Tape dimensions	Reel dimensions
fSM				TPL3		
	Packing quantity		10000/reel			
fS6				TPL3		
	Packing quantity		10000/reel			
TESM				TE85L		
	Packing quantity		4000/reel			
TESM2				TE85L		
	Packing quantity		4000/reel			
TESM3				TE85L		
	Packing quantity		5000/reel			
ESC (SOD-523)		 Weight: 1.4mg		TPL3		
	Packing quantity		4000/reel			

1. Package Information

Toshiba package name	Package Type		Reference pad dimensions	Standard Tape Packing Specifications		
	Appearance	Dimensions		Tape type	Tape dimensions	Reel dimensions
ESM (SOT-490) (SC-81)				TPL3		
	Packing quantity		8000/reel			
ESV				TE85L		
	Packing quantity		4000/reel			
ES6				TE85L	 First pin	
	Packing quantity		4000/reel			
SSM (SOT-416) (SC-75)				TE85L		
	Packing quantity		3000/reel			
USC (SOD-323)		 Cathode marking Weight: 0.004g		TPH3		
	Packing quantity		3000/reel			
USM (SOT-323) (SC-70)				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
USQ (SOT-343)		 Weight: 0.006g		TE85L	 pin 1	
	Packing quantity		3000/reel			
UFV				TE85L		
	Packing quantity		3000/reel			
USV (SOT-353) (SC-88A)				TE85L		
	Packing quantity		3000/reel			
US6 (SOT-363) (SC-88)				TE85L	 First pin	
	Packing quantity		3000/reel			
US8		 Weight: 0.01g		TE85L	 pin 1	
	Packing quantity		3000/reel			
TSM				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)				TE85L		
	Packing quantity		3000/reel			
SMQ (SOT-24) (SC-61)		 Weight: 0.013g		TE85L		
	Packing quantity		3000/reel			
SMV (SOT-25) (SC-74A)		 Weight: 0.014g		TE85L		
	Packing quantity		3000/reel			
SM6 (SOT-26) (SC-74)		 Weight: 0.015g		TE85L		
	Packing quantity		3000/reel			
SM8		 Weight: 0.021g		TE12L		
	Packing quantity		3000/reel			
FM8		 Weight: 0.05g		TE12L		
	Packing quantity		1000/reel			

2. Small Signal Transistors and Diodes

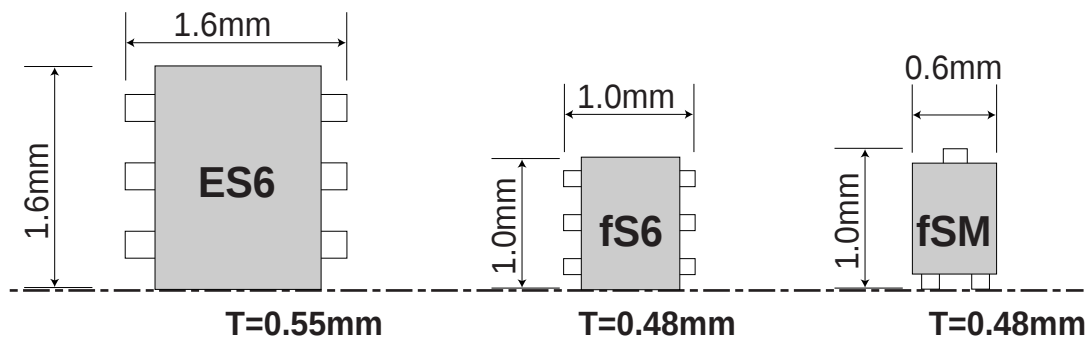
2.1 New Products

Very Small Package Solution for BRTs. fSM, fS6 package

Features

- Very Small Package fSM = 1.0 x 0.6mm* fS6 = 1.0 x 1.0mm* (* : Include Outer Lead)
- Very thin Package fSM/fS6 Height = 0.50mm max

Comparison of Package Size



Product Line-up

Rating	V _{CEO} (V)		50					
	I _c (mA)		100					
Package Name			fSM		fS6			
Polarity			NPN	PNP	NPN × 2	PNP × 2	NPN × 2	PNP × 2
Resistor(kΩ)								
R1	R2							
4.7	4.4		RN1101FS	RN2101FS	RN1961FS	RN2961FS	RN1901FS	RN2901FS
10	10		RN1102FS	RN2102FS	RN1962FS	RN2962FS	RN1902FS	RN2902FS
22	22		RN1103FS	RN2103FS	RN1963FS	RN2963FS	RN1903FS	RN2903FS
47	47		RN1104FS	RN2104FS	RN1964FS	RN2964FS	RN1904FS	RN2904FS
2.2	47		RN1105FS	RN2105FS	RN1965FS	RN2965FS	RN1905FS	RN2905FS
4.7	47		RN1106FS	RN2106FS	RN1966FS	RN2966FS	RN1906FS	RN2906FS
10	47		RN1107FS	RN2107FS	RN1967FS	RN2967FS	RN1907FS	RN2907FS
22	47		RN1108FS	RN2108FS	RN1968FS	RN2968FS	RN1908FS	RN2908FS
47	22		RN1109FS	RN2109FS	RN1969FS	RN2969FS	RN1909FS	RN2909FS
4.7	∞		RN1110FS	RN2110FS	RN1970FS	RN2970FS	RN1910FS	RN2910FS
10	∞		RN1111FS	RN2111FS	RN1971FS	RN2971FS	RN1911FS	RN2911FS
22	∞		RN1112FS	RN2112FS	RN1972FS	RN2972FS	RN1912FS	RN2912FS
47	∞		RN1113FS	RN2113FS	RN1973FS	RN2973FS	RN1913FS	RN2913FS

Underdevelopment

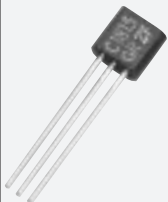
2. Small Signal Transistors and Diodes

2.2 Small-Signal Transistors

Transistors

Transistors																
Classification	V _{CEO} (V)	I _C (mA)	TESM2	TESM		ESM (SOT-490, SC-81)		SSM (SOT-416, SC-75)		USM (SOT-323, SC-70)		TSM	S-MINI (SOT-346, SC-59)		ESV	USV (SOT-353)
			NPN	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	NPN	PNP	PNP + NPN	NPN
General-purpose	50	150	2SC4738TT	2SC4738FT	2SA1832FT	2SC4738F	2SA1832F	2SC4738	2SA1832	2SC4116	2SA1586	—	2SC2712	2SA1162	HN4B01JE	2SC4944
Low-noise	120	100	—	—	—	—	—	—	—	2SC4117	2SA1587	—	2SC2713	2SA1163	—	—
			—	—	—	—	—	—	—	—	—	—	2SC3324	2SA1312	—	—
General-purpose	30	500	—	—	—	—	—	—	—	2SC4118	2SA1588	—	2SC2859	2SA1182	—	—
	50	500	—	—	—	—	—	—	—	—	—	—	2SC3325	2SA1313	—	—
Low saturation	12	400	—	—	—	2SC5376F	—	2SC5376	2SA1955	—	—	—	—	—	—	HN4C05JU
	12	500	—	—	—	—	—	—	—	2SC5233	2SA1954	—	2SC5232	2SA1953	—	—
	15	800	—	—	—	—	—	—	—	—	—	—	—	2SA1362	—	—
High current	25	800	—	—	—	—	—	—	—	—	—	—	2SC3265	2SA1298	—	—
	30	800	—	—	—	—	—	—	—	—	—	—	2SC4210	2SA1621	—	—
High withstand voltage capability	80	300	—	—	—	—	—	—	—	—	—	—	2SC4209	2SA1620	—	—
High h _{FE}	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			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)		2.0 × 1.25(3 pins)		2.9 × 1.6 (3 pins)	2.9 × 1.5(3 pins)		1.6 × 1.2 (5 pins) Flat lead	2.0 × 1.25

 New products

																
SC-88A)	SMV (SOT-25, SC-74A)			ES6			US6 (SOT-363, SC-88)			SM6 (SOT-26, SC-74)			MINI		TO-92	
PNP	NPN	PNP	PNP + NPN	NPN	PNP	PNP + NPN	NPN	PNP	PNP + NPN	NPN	PNP	PNP + NPN	NPN	PNP	NPN	PNP
2SA1873	2SC4207	2SA1618	—	HN1C01FE [*]	HN1A01FE [*]	—	HN1C01FU	HN1A01FU	HN1B01FU	HN1C01F	HN1A01F	HN1B01F	2SC2458	2SA1048	2SC1815	2SA1015
HN4A56JU				HN2C01FE [*]	HN2A01FE [*]	HN1B04FE	HN2C01FU [*] HN3C56FU ^{**}	HN2A01FU [*]	HN1B04FU [*] HN3B02FU ^{**}	—	HN3A56F ^{**}	HN3B01F ^{**}				
—	HN4C06J	HN4A06J	HN1B06J	—	—	—	—	—	—	HN3C51F ^{**}	HN3A51F ^{**}	—	2SC2459	2SA1049	2SC2240	2SA970
—	HN4C51J	HN4A51J	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	HN4B04J	—	—	—	—	—	—	—	—	—	—	—	2SC1959	2SA562TM
—	—	—	—	—	—	—	—	—	—	HN1C07F	HN1A07F	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	HN4C08J	HN4A08J	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	2SC2710	2SA1150	2SC2120	2SA950
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2SC1627	2SA817
—	—	—	—	—	—	—	—	—	—	—	—	—	2SC3113	—	2SC3112	—
—	—	—	—	—	—	—	HN1C03FU	—	—	HN1C03F	—	—	2SC3327	—	2SC2878	—
—	—	—	—	—	—	—	HN3C61FU ^{**}	—	—	—	—	—	—	—	2SC752 [®] TM	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2SC2551	2SA1091
—	—	—	—	—	—	—	—	—	—	—	—	—	2SC5720 2SC5765	—	2SC5853 2SC5854	—

(5 pins)	2.9 × 1.5(5 pins)	1.6 × 1.2(6 pins)	2.0 × 1.25(6 pins)	2.9 × 1.6(6 pins)
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^{*}: Mirror-image connections ^{*}: Point-symmetrical array
^{**}: Cascade connection

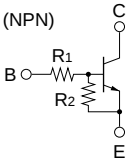
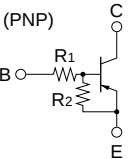
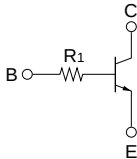
2. Small Signal Transistors and Diodes

2.3 Bias Resistor Built-in Transistors (BRTs)

		General-Purpose Type																			
Ratings	V _{CE0} (V)	50																			
	I _c (mA)	100																			
Package		TESM		ESM (SOT-490, SC-81)		SSM (SOT-416, SC-75)		USM (SOT-323, SC-70)		S-MINI (SOT-346, SC-59)		ESV		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	PNP × 2			
Internal resistors (kΩ)																					
		(Emitter-common)																		(Point-symmetrical array type)	
R1	R2	RN1101FT	RN2101FT	RN1101F	RN2101F	RN1101	RN2101	RN1301	RN2301	RN1401	RN2401	RN1701JE	RN2701JE	RN1701	RN2701	RN1501	RN2501	RN1901FE			
4.7	4.7	RN1102FT	RN2102FT	RN1102F	RN2102F	RN1102	RN2102	RN1302	RN2302	RN1402	RN2402	RN1702JE	RN2702JE	RN1702	RN2702	RN1502	RN2502	RN1902FE			
22	22	RN1103FT	RN2103FT	RN1103F	RN2103F	RN1103	RN2103	RN1303	RN2303	RN1403	RN2403	RN1703JE	RN2703JE	RN1703	RN2703	RN1503	RN2503	RN1903FE			
47	47	RN1104FT	RN2104FT	RN1104F	RN2104F	RN1104	RN2104	RN1304	RN2304	RN1404	RN2404	RN1704JE	RN2704JE	RN1704	RN2704	RN1504	RN2504	RN1904FE			
2.2	47	RN1105FT	RN2105FT	RN1105F	RN2105F	RN1105	RN2105	RN1305	RN2305	RN1405	RN2405	RN1705JE	RN2705JE	RN1705	RN2705	RN1505	RN2505	RN1905FE			
4.7	47	RN1106FT	RN2106FT	RN1106F	RN2106F	RN1106	RN2106	RN1306	RN2306	RN1406	RN2406	RN1706JE	RN2706JE	RN1706	RN2706	RN1506	RN2506	RN1906FE			
10	47	RN1107FT	RN2107FT	RN1107F	RN2107F	RN1107	RN2107	RN1307	RN2307	RN1407	RN2407	RN1707JE	RN2707JE	RN1707	RN2707	RN1507	RN2507	RN1907FE			
22	47	RN1108FT	RN2108FT	RN1108F	RN2108F	RN1108	RN2108	RN1308	RN2308	RN1408	RN2408	RN1708JE	RN2708JE	RN1708	RN2708	RN1508	RN2508	RN1908FE			
47	22	RN1109FT	RN2109FT	RN1109F	RN2109F	RN1109	RN2109	RN1309	RN2309	RN1409	RN2409	RN1709JE	RN2709JE	RN1709	RN2709	RN1509	RN2509	RN1909FE			
4.7	∞	RN1110FT	RN2110FT	RN1110F	RN2110F	RN1110	RN2110	RN1310	RN2310	RN1410	RN2410	RN1710JE	RN2710JE	RN1710	RN2710	RN1510	RN2510	RN1910FE			
10	∞	RN1111FT	RN2111FT	RN1111F	RN2111F	RN1111	RN2111	RN1311	RN2311	RN1411	RN2411	RN1711JE	RN2711JE	RN1711	RN2711	RN1511	RN2511	RN1911FE			
22	∞	RN1112FT	RN2112FT	RN1112F	RN2112F	RN1112	RN2112	RN1312	RN2312	RN1412	RN2412		RN2712JE								
47	∞	RN1113FT	RN2113FT	RN1113F	RN2113F	RN1113	RN2113	RN1313	RN2313	RN1413	RN2413		RN2713JE								
1	10	RN1114FT	RN2114FT	RN1114F	RN2114F	RN1114	RN2114	RN1314	RN2314	RN1414	RN2414				RN2714						
2.2	10	RN1115FT	RN2115FT	RN1115F	RN2115F	RN1115	RN2115	RN1315	RN2315	RN1415	RN2415										
4.7	10	RN1116FT	RN2116FT	RN1116F	RN2116F	RN1116	RN2116	RN1316	RN2316	RN1416	RN2416										
10	4.7	RN1117FT	RN2117FT	RN1117F	RN2117F	RN1117	RN2117	RN1317	RN2317	RN1417	RN2417										
47	10	RN1118FT	RN2118FT	RN1118F	RN2118F	RN1118	RN2118	RN1318	RN2318	RN1418	RN2418										
100	100	RN1130FT	RN2130FT	RN1130F	RN2130F																
100	∞	RN1131FT	RN2131FT	RN1131F	RN2131F																
200	∞	RN1132FT	RN2132FT	RN1132F	RN2132F																

New products

(NPN/PNP)

		High Current						Muting	
Ratings	V _{CE0} (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)		(NPN)  (PNP) 							
		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 products

	(Point-symmetrical array type)	(Point-symmetrical array type)	(Mirror-image array type)	(Point-symmetrical array type)							(Mirror-image array type)			E			E
RN2901FE	RN4901FE	RN4981FE	RN1961FE	RN2961FE	RN1901	RN2901	RN1961	RN2961	RN4901	RN4981	RN1601	RN2601	RN4601	RN1001	RN2001	RN1201	RN2201
RN2902FE	RN4902FE	RN4982FE	RN1962FE	RN2962FE	RN1902	RN2902	RN1962	RN2962	RN4902	RN4982	RN1602	RN2602	RN4602	RN1002	RN2002	RN1202	RN2202
RN2903FE	RN4903FE	RN4983FE	RN1963FE	RN2963FE	RN1903	RN2903	RN1963	RN2963	RN4903	RN4983	RN1603	RN2603	RN4603	RN1003	RN2003	RN1203	RN2203
RN2904FE	RN4904FE	RN4984FE	RN1964FE	RN2964FE	RN1904	RN2904	RN1964	RN2964	RN4904	RN4984	RN1604	RN2604	RN4604	RN1004	RN2004	RN1204	RN2204
RN2905FE	RN4905FE	RN4985FE	RN1965FE	RN2965FE	RN1905	RN2905	RN1965	RN2965	RN4905	RN4985	RN1605	RN2605	RN4605	RN1005	RN2005	RN1205	RN2205
RN2906FE	RN4906FE	RN4986FE	RN1966FE	RN2966FE	RN1906	RN2906	RN1966	RN2966	RN4906	RN4986	RN1606	RN2606	RN4606	RN1006	RN2006	RN1206	RN2206
RN2907FE	RN4907FE	RN4987FE	RN1967FE	RN2967FE	RN1907	RN2907	RN1967	RN2967	RN4907	RN4987	RN1607	RN2607	RN4607	RN1007	RN2007	RN1207	RN2207
RN2908FE	RN4908FE	RN4988FE	RN1968FE	RN2968FE	RN1908	RN2908	RN1968	RN2968	RN4908	RN4988	RN1608	RN2608	RN4608	RN1008	RN2008	RN1208	RN2208
RN2909FE	RN4909FE	RN4989FE	RN1969FE	RN2969FE	RN1909	RN2909	RN1969	RN2969	RN4909	RN4989	RN1609	RN2609	RN4609	RN1009	RN2009	RN1209	RN2209
RN2910FE	RN4910FE	RN4990FE	RN1970FE	RN2970FE	RN1910	RN2910	RN1970	RN2970	RN4910	RN4990	RN1610	RN2610	RN4610	RN1010	RN2010	RN1210	RN2210
RN2911FE	RN4911FE	RN4991FE	RN1971FE	RN2971FE	RN1911	RN2911	RN1971	RN2971	RN4911	RN4991	RN1611	RN2611	RN4611	RN1011	RN2011	RN1211	RN2211
							RN1973						RN4612				
								RN2975									

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R1 (kΩ)	R2 (kΩ)				
4.7	—	RN47A1JE	RN47A1	Q1	RN1310
4.7	—			Q2	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

 New products Under development

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2.2	47	RN49A1FE	RN49A1		Q1	RN2305
22	47				Q2	RN1308
22	22				Q1	RN2303
10	10			RN46A1	Q2	RN1302
2.2	47				Q1	RN2305
47	47				Q2	RN1304

 New products

3.Small-Signal MOSFETs(S-MOS)

3.1 Standard Family 1-in-1 Type

Polarity	Maximum Ratings			Packages					V _{th} (V)	R _{DS(on)} (Ω)	Typ.(Max)	
	V _{DSS} (V)	V _{GSS} (V)	I _D (mA)	S-MINI (SOT-346, SC-59)	USM (SOT-323, SC-70)	SSM (SOT-416, SC-75)	ESM (SOT-490, SC-81)	TESM (140806)			@V _{GS} (V)	
Nch	50	10	50	2SK1826	2SK1827	—	—	—	0.8 ~ 2.5	20 (50)	4	
	20	10	50	2SK1828	2SK1829	2SK1830	—	—	0.5 ~ 1.5	20 (40)	2.5	
	20	10	100	2SK2823	2SK2824	2SK2825	—	—	0.5 ~ 1.0	10 (40)	1.5	
	20	10	100	2SK2033	2SK2034	2SK2035	—	—	0.5 ~ 1.5	8 (12)	2.5	
	20	10	100	2SK2036	2SK2037	—	—	—	0.5 ~ 1.5	3.5 (6)	2.5	
	20	10	100	—	—	—	SSM3K03FE	SSM3K03TE	0.7 ~ 1.3	4 (12)	2.5	
	20	10	100	—	*SSM3K04FU	*SSM3K04FS	*SSM3K04FE	—	0.7 ~ 1.3	4 (12)	2.5	
	20	± 10	100	—	SSM3K16FU	SSM3K16FS	—	SSM3K16TE	0.6 ~ 1.1	2.2 (5)	2.5	
	30	± 20	100	SSM3K15F	SSM3K15FU	SSM3K15FS	—	SSM3K15TE	0.8 ~ 1.5	4 (7)	2.5	
	50	± 7	100	—	SSM3K17FU	—	—	—	0.9 ~ 1.5	22 (40)	2.5	
	60	± 20	200	2SK1062	—	—	—	—	2.0 ~ 3.5	0.6 (1.0)	10	
	30	± 20	200	2SK2009	—	—	—	—	0.5 ~ 1.5	1.2 (2.0)	2.5	
	20	± 12	400	—	SSM3K05FU	—	—	—	0.6 ~ 1.1	0.85 (1.2)	2.5	
	30	± 20	400	—	SSM3K09FU	—	—	—	1.1 ~ 1.8	0.8 (1.2)	4	
Pch	- 50	- 7	- 50	2SJ343	2SJ344	—	—	—	- 0.8 ~ - 2.5	20 (50)	- 4	
	- 20	- 7	- 50	2SJ345	2SJ346	2SJ347	—	—	- 0.5 ~ - 1.5	20 (40)	- 2.5	
	- 20	10	- 100	—	—	—	SSM3J03FE	—	- 0.7 ~ - 1.3	12 (25)	- 2.5	
	- 20	± 10	- 100	—	SSM3J16FU	SSM3J16FS	—	SSM3J16TE	- 0.6 ~ - 1.1	8 (12)	- 2.5	
	- 30	± 20	- 100	SSM3J15F	SSM3J15FU	SSM3J15FS	—	SSM3J15TE	- 1.1 ~ - 1.7	18 (36)	- 2.5	
	- 60	± 20	- 200	2SJ168	—	—	—	—	- 2.0 ~ - 3.5	1.3 (2)	- 10	
	- 30	± 20	- 200	2SJ305	—	—	—	—	- 0.5 ~ - 1.5	2.4 (4)	- 2.5	
	- 20	± 12	- 200	—	SSM3J05FU	—	—	—	- 0.6 ~ - 1.1	3.2 (4.0)	- 2.5	
	- 30	± 20	- 200	—	SSM3J09FU	—	—	—	- 1.1 ~ - 1.8	3.3 (4.2)	- 4	
	—	—	—	—	—	—	—	—	—	—	—	

New products ★ Pull-down resistance built-in type R_{GS} = 1MΩ

3.2 Standard Family 2-in-1 Type

Polarity	Maximum Ratings			Packages				V _{th} (V)	R _{DS(on)} (Ω)	Typ.(Max)		Combination
	V _{DSS} (V)	V _{GSS} (V)	I _D (mA)	US6 (SOT-363, SC-88)	USV (SOT-353, SC-88A)	ES6 (1612055 6pin)	ESV (1612055 5pin) Source-com.			@V _{GS} (V)		
Nch × 2	20	10	50	HN1K02FU	—	—	—	0.5 ~ 1.5	20 (40)	2.5	2SK1829 × 2	
	20	10	100	HN1K03FU	HN4K03JU	—	—	0.5 ~ 1.5	8 (12)	2.5	2SK2034 × 2	
	50	10	50	HN1K04FU	—	—	—	0.8 ~ 2.5	20 (50)	4	2SK1827 × 2	
	20	10	100	—	—	SSM6N03FE	SSM5N03FE	0.7 ~ 1.3	4 (12)	2.5	SSM3K03FE × 2	
	20	10	100	*SSM6N04FU	—	—	—	0.7 ~ 1.3	4 (12)	2.5	SSM3K04FU × 2	
	20	10	100	HN1K05FU	—	—	—	0.5 ~ 1.0	15 (50)	1.2	2SK2825 × 2	
	20	10	100	HN1K06FU	—	—	—	0.5 ~ 1.5	10 (40)	1.5	2SK2825 × 2	
	20	± 10	100	SSM6N16FU	SSM5N16FU	SSM6N16FE	SSM5N16FE	0.6 ~ 1.1	7 (28)	2.5	SSM3K16FU × 2	
	30	± 20	100	SSM6N15FU	SSM5N15FU	SSM6N15FE	SSM5N15FE	0.8 ~ 1.5	3.5 (6.0)	2.5	SSM3K15FU × 2	
	50	± 7	100	SSM6N17FU	—	—	—	0.9 ~ 1.5	2.2 (5)	2.5	SSM3K17FU × 2	
	20	± 12	400	SSM6N05FU	SSM5N05FU	—	—	0.6 ~ 1.1	4 (7)	2.5	SSM3K05FU × 2	
	30	± 20	400	SSM6N09FU	—	—	—	1.1 ~ 1.8	22 (40)	2.5	SSM3K09FU × 2	
	- 20	- 7	- 50	HN1J02FU	—	—	—	- 0.5 ~ - 1.5	0.85 (1.2)	4	SSM3K09FU × 2	
	- 20	± 10	- 100	SSM6P16FU	SSM5P16FU	SSM6P16FE	SSM5P16FE	- 0.6 ~ - 1.1	0.8 (1.2)	- 2.5	SSM3J16FU × 2	
Pch × 2	- 30	± 20	- 100	SSM6P15FU	SSM5P15FU	SSM6P15FE	SSM5P15FE	- 1.1 ~ - 1.7	8 (12)	- 2.5	SSM3J15FU × 2	
	- 20	± 12	- 200	SSM6P05FU	SSM5N05FU	—	—	- 0.6 ~ - 1.1	18 (36)	- 2.5	SSM3J05FU × 2	
	- 30	± 20	- 200	SSM6P09FU	—	—	—	- 1.1 ~ - 1.8	3.2 (4.0)	- 2.5	SSM3J09FU × 2	
	- 30	± 20	- 200	SSM6P09FU	—	—	—	- 1.1 ~ - 1.8	3.3 (4.2)	- 4	SSM3J09FU × 2	
Nch + Pch	20	10	50	HN1L02FU	—	—	—	0.5 ~ 1.5	20 (40)	2.5	2SK1829 + 2SJ346	
	- 20	- 7	- 50	HN1L03FU	—	—	—	- 0.5 ~ - 1.5	20 (40)	- 2.5	2SK1827 + 2SJ346	
	50	10	50	HN1L03FU	—	—	—	0.8 ~ 2.5	20 (50)	4	2SK1827 + 2SJ346	
	- 20	± 12	400	SSM6L05FU	—	—	—	0.6 ~ 1.1	20 (40)	- 2.5	SSM3K05FU + SSM3J05FU	
	- 20	± 12	- 200	SSM6L05FU	—	—	—	- 0.6 ~ - 1.1	0.85 (1.2)	2.5	SSM3K05FU + SSM3J05FU	
	30	± 20	400	SSM6L09FU	—	—	—	1.1 ~ 1.8	3.2 (4.0)	- 2.5	SSM3K09FU + SSM3J09FU	
- 30	± 20	- 200	SSM6L09FU	—	—	—	—	- 1.1 ~ - 1.8	0.8 (1.2)	4	SSM3K09FU + SSM3J09FU	
- 30	± 20	- 200	SSM6L09FU	—	—	—	—	- 1.1 ~ - 1.8	3.3 (4.2)	- 4	SSM3K09FU + SSM3J09FU	

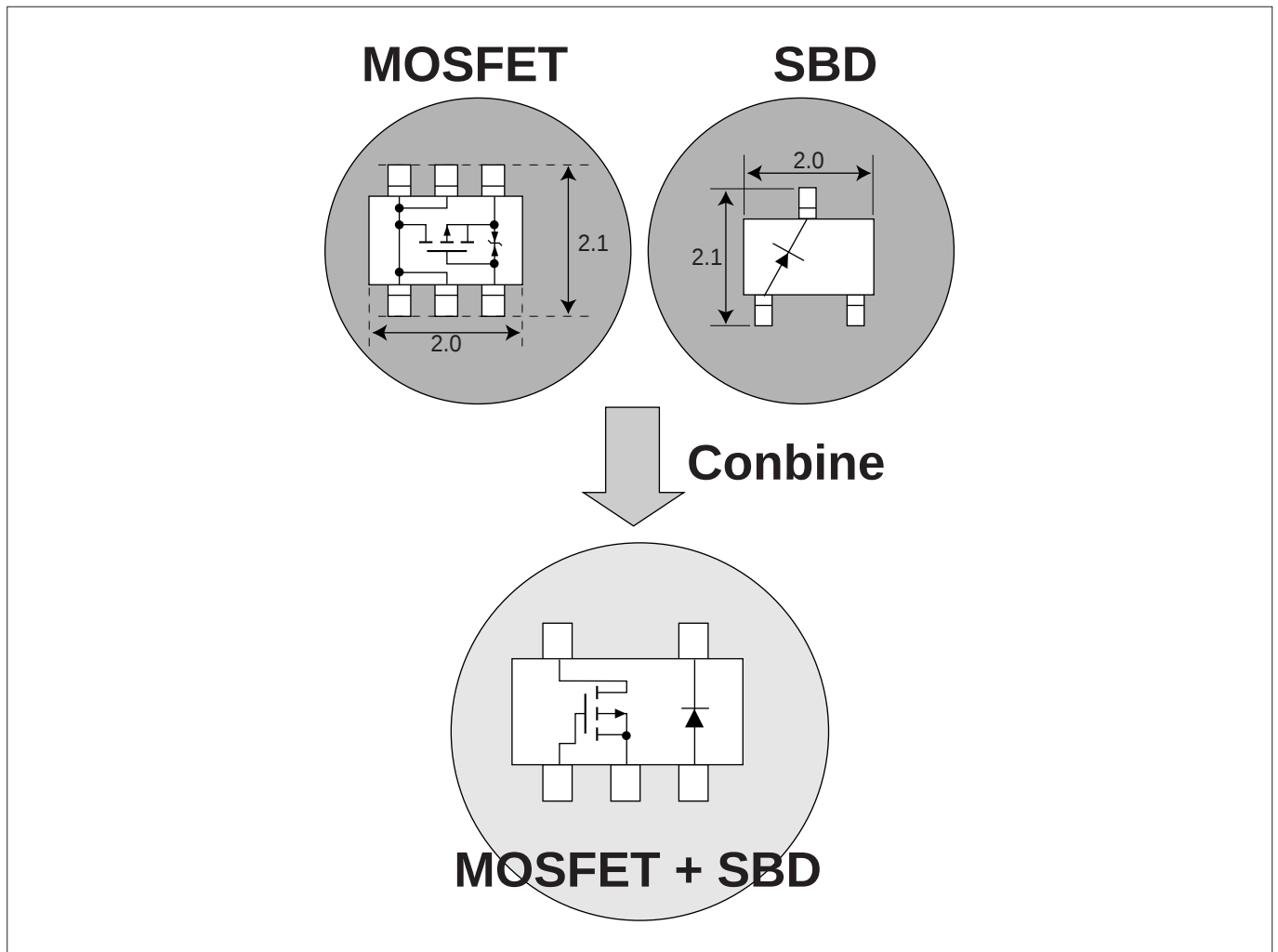
New products ★ Pull-down resistance built-in type R_{GS} = 1MΩ

3.3 High Current Family

New Products

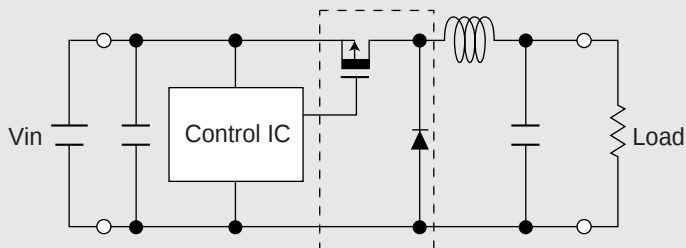
High Current S-MOS + SBD for DC/DC Converter Application

Concept



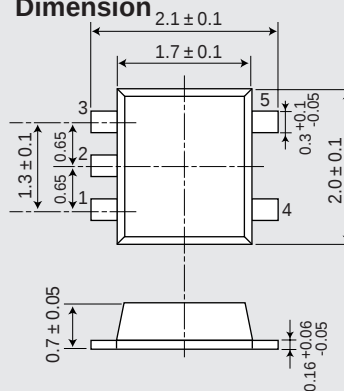
Application Example

DC-DC Converter

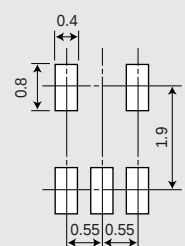


Package Information

Dimension



Land Pattern



3.Small-Signal MOSFETs(S-MOS)

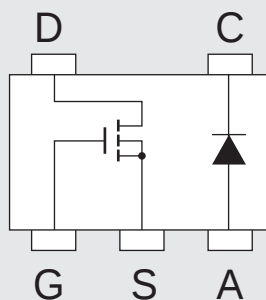


Line-up

Name	Typ	V(V)	I(A)	V _{th} (V)	characteristic	
					R _{DS(on)} max(mΩ)	V _F max(V)
SSM5H01TU	Nch	30	1.4	1.0 ~ 2.4	0.45@4.0V	0.45@0.3A
	SBD	12	0.5			
SSM5H03TU	Nch	12	1.4	1.0 ~ 2.3	0.3@4.0V	0.43@0.5A
	SBD	12	0.5			
SSM5G01TU	Pch	-30	-1.0	-0.8 ~ -1.8	0.80@-4.0V	0.45@0.3A
	SBD	20	0.5			
SSM5G02TU	Pch	-12	-1.0	-0.4 ~ -1.1	0.48@-1.8V	0.43@0.5A
	SBD	12	0.5			
SSM5G04TU	Pch	-12	-1.0	-0.4 ~ -1.1	0.42@-2.5V	0.43@0.5A
	SBD	12	0.5			

 New Products

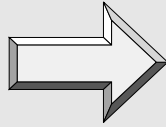
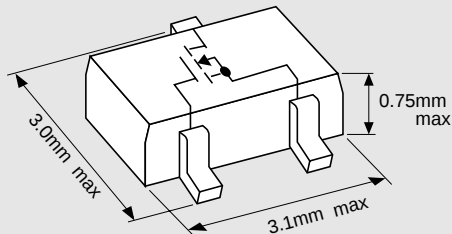
Internal Connection



New Products

TSM Package Series

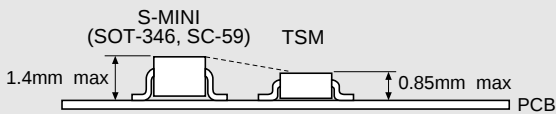
Feature of TSM Package



Feature

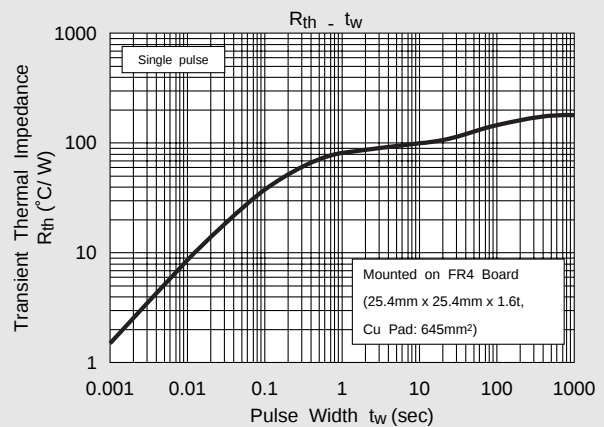
Compact package: 3.1 mm(max) x 3.0 mm(max)
Mold thickness: 0.75 mm(max)
 $P_D = 1.25$ W (when mounted on a PCB, $t = 10$ s)

To meet the demand for S-MOS devices which can be incorporated into thin equipment, Toshiba have reduced the package thickness from 1.4 mm max. to 0.85 mm max. (for the TSM package).



Thermal resistance

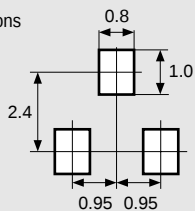
Ratings of $R_{th} = 100^\circ\text{C/W}$ and $P_D = 1.25$ W can be achieved when this package is mounted on an FR4-type PCB. ($t_w = 10$ s)



* Actual thermal resistance and permissible power dissipation values will be affected by the following factors: the PCB material, the PCB thickness, the pad area and the nature of the environment in which the devices are used. When using a device, please take both these factors and the thermal characteristics of the individual device into account.

Mounting area is the same as that of the S-MINI(SOT-346, SC-59) package.

Minimum pad dimensions (for reference)



Unit: mm

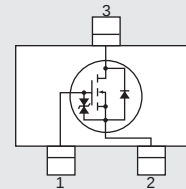
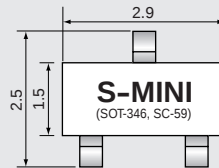
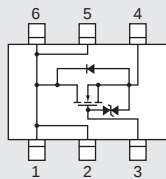
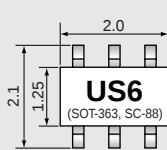
Line-up

Type	Name	$V_{DSS}(V)$	$I_D(A)$	$V_{th}(V)$	$R_{DS(ON)}$ max (m Ω)	
					$V_{GS(1)}$	$V_{GS(2)}$
Nch	SSM3K01T	30	3.2	0.6 ~ 1.1	150 @ 2.5 V	120 @ 4 V
	SSM3K02T		2.5	0.6 ~ 1.1	250 @ 2.5 V	200 @ 4 V
	SSM3K12T		3.0	1.1 ~ 1.8	—	145 @ 4.5 V
	SSM3K14T		4.0	1.0 ~ 2.5	—	60 @ 4.5 V
Pch	SSM3J13T	-12	-3	-0.45 ~ -1.1	95 @ -2.5 V	70 @ -4 V
	SSM3J01T	-30	-1.7	-0.6 ~ -1.1	600 @ -2.5 V	400 @ -4 V
	SSM3J02T		-1.5	-0.6 ~ -1.1	700 @ -2.5 V	500 @ -4 V
	SSM3J14T		-2.6	-0.8 ~ -2.0	—	145 @ -4.5 V

3.Small-Signal MOSFETs(S-MOS)

High-Current Family

Drive Voltage	Polarity	Packages		Maximum Ratings			R _{DS(ON)} (mΩ)			V _{th} (V)				ton (ns)	toff (ns)		
		US6 (SOT-363, SC-88)	S-MINI (SOT-346, SC-59)	V _{DS} (V)	V _{GSS} (V)	I _D (A)	Typ.	Max.	@V _{GS} (V)	Min.	Max.	@V _{DS} (V)	@I _D (mA)	Typ.	Typ.	@V _{GS} (V)	@I _D (A)
2.5 V	Nch	—	SSM3K01F	30	± 10	1.3	115	150	2.5	0.6	1.1	3	0.1	45	69	2.5	0.5
							85	120	4								
2.5 V	Nch	—	SSM3K02F	30	± 10	1	180	250	2.5	0.6	1.1	3	0.1	52	80	2.5	0.5
							140	200	4								
2.5 V	Nch	SSM6K06FU	—	20	± 12	1.1	160	210	2.5	0.6	1.1	3	0.1	42	100	2.5	0.5
							120	160	4								
2.5 V	Nch	SSM6K08FU	—	20	± 12	1.6	100	140	2.5	0.5	1.2	3	0.1	16	15	2.5	0.8
							77	105	4								
2.5 V	Pch	SSM6J08FU	—	−20	± 12	−1.3	200	260	−2.5	−0.5	−1.1	−3	−0.1	33	47	−2.5	−0.65
							140	180	−4								
2.5 V	Pch	—	SSM3J01F	−30	± 10	−0.7	400	600	−2.5	−0.6	−1.1	−3	−0.1	36	37	−2.5	−0.3
							300	400	−4								
2.5 V	Pch	—	SSM3J02F	−30	± 10	−0.6	550	700	−2.5	−0.6	−1.1	−3	−0.1	55	52	−2.5	−0.3
							400	500	−4								
2.5 V	Pch	SSM6J06FU	—	−20	± 12	−0.65	550	700	−2.5	−0.6	−1.1	−3	−0.1	27	43	−2.5	−0.3
							400	500	−4								
4 V	Nch	SSM6K07FU	—	30	± 20	1.5	170	220	4	1.1	1.8	5	0.1	46	65	4	0.75
							105	130	10								
4 V	Pch	SSM6J07FU	—	−30	± 20	−0.8	570	800	−4	−1.1	−1.8	−5	−0.1	28	38	−4	−0.4
							350	450	−10								



Unit: mm

New products

Junction FETs (J-FETs)

Polarity	S-MINI (SOT-346) (SC-59)	USM (SOT-323) (SC-70)	SMV (SOT-25) (SC-74A)	USV (SOT-353) (SC-88A)	V _{GDS} (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.)	V _{DS} (V)	f (MHz)	Marking
Nch	2SK208	2SK879	—	—	−50	10	100	0.3 ~ 6.5	10	0	1.2 (min)	10	0	2.6	10	1	J□
Pch	2SJ106	2SJ144	—	—	50	−10	100	−1.2 ~ −14	−10	0	1 (min)	−10	0	3.6	−10	1	V□
Nch	2SK209	2SK880	2SK2145	2SK3320	−50	10	100	1.2 ~ 14	10	0	15 (typ.)	10	0	3	10	1	X□
Nch	2SK368	—	—	—	−100	10	100	0.6 ~ 6.5	10	0	4.6 (typ.)	10	0	3	10	1	KA□

Alphabetic characters of marking prefix indicates loss rank.

4. Small Signal Diodes

4.1 Switching Diodes

Electrical Characteristics (Ta=25°C)																	
V _R (V)	I _o (mA)	t _{rr} (ns)		ESC (SOD-523)	ESM (SOT-490, SC-81)	SSM (SOT-416, SC-75)	USC (SOD-323)	USM (SOT-323, SC-70)	USQ (SOT-343)	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)	MINI	ESV	ES6
30	100	—									1SS307						
80	100	—						1SS412*			1SS379						
80	100	1.6 typ.			1SS360F	1SS360		1SS300		HN1D01FU	1SS181		1SS308	HN1D01F	1SS200		HN1D01FE
80	100	1.6 typ.			1SS361F	1SS361		1SS301		HN1D02FU	1SS184		1SS309	HN1D02F	1SS201		HN1D02 FE
80	100 (80)	1.6 typ.				(1SS362)		1SS302			1SS226						
80	100 (80)	1.6 typ.		1SS387			1SS352			(HN2D01FU)	1SS193			(HN2D01F)		HN2D01JE	
80	100	1.6 typ.						1SS382			1SS196	1SS272					
80	100	1.6 typ.							HN1D03FU					HN1D03F			
80	200	7.0 typ.									1SS336						
80	200	6.0 typ.									1SS337						
200	100	30 typ.					1SS403	1SS370			1SS250	1SS306					
400	100	500 typ.						1SS397			1SS311	1SS399		HN2D03F*			
400	100	500 typ.									1SS398						

New products Under development

4. Small Signal Diodes

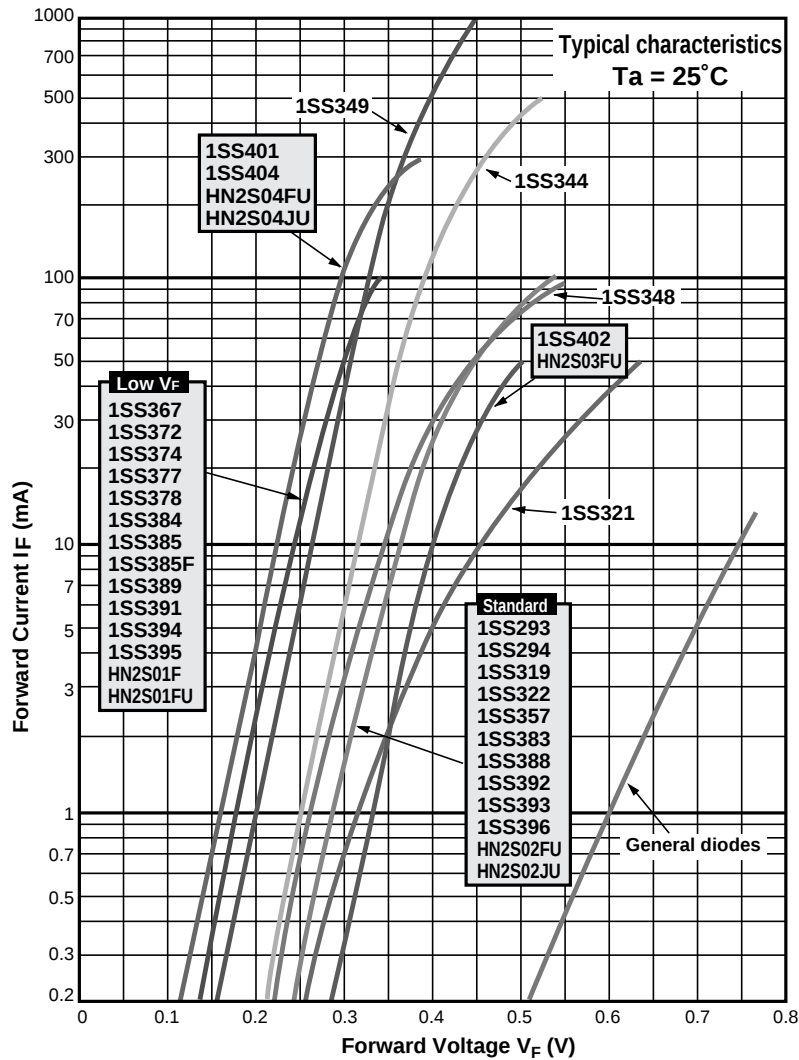
4.2 Schottky Barrier Diodes (SBDs)

Features	Maximum Ratings				Electrical Characteristics (Ta=25°C)															
	V _{RM} (V)	V _R (V)	I _{FM} (mA)	I _O (mA)	V _F (V)			ESC (SOD-523)	ESM (SOT-490, SC-81)	SSM (SOT-416, SC-75)	USC (SOD-323)	USM (SOT-323, SC-70)	USQ (SOT-343)	US6 (SOT-363, SC-88)	S-MINI (SOT-346, SC-59)	SMQ (SOT-24, SC-61)	SM6 (SOT-26, SC-74)	MINI	ESV	USV (SOT-353, SC-88A)
					Typ.	Max.	@I _F (mA)													
Low-V _F	15	10	200	100	0.23	0.3	5	1SS389												
					0.35	0.5	100													
	15	10	200	100	0.23	0.3	5		1SS385F	1SS385		1SS378			1SS377					
					0.35	0.5	100													
	15	10	200	100	0.23	0.3	5					1SS372			1SS374					
					0.35	0.5	100													
Low-I _R , High-speed	25	20	100	50	0.33	—	1	1SS405					1SS406		1SS402	HN2S03FU				
					0.38	—	5													
					0.50	0.55	50													
Low-I _R	12	10	150	50	0.63	1.0	100								1SS321					
Standard	45	40	300	100	0.54	0.6	100	1SS388				1SS357	1SS322	1SS383	HN2S02FU	1SS294	1SS319		1SS293	HN2S02JE
												1SS393			1SS392					
High-V _R	85	80	300	100	0.54	0.6	100								1SS396					
High-I _O , Low-V _F	25	20	700	300	0.16	—	1								1SS348					
					0.22	—	10													
					0.38	0.45	300					1SS404	1SS401		HN2S04FU					HN2S04JU
High-I _O	25	20	1500	500	0.50	0.55	500								1SS344					
High-I _O	25	20	3000	1000	0.46	0.55	1000								1SS349					

■ New products ★ Under development

Schottky Barrier Diodes

● I_F-V_F Characteristics (typ.)

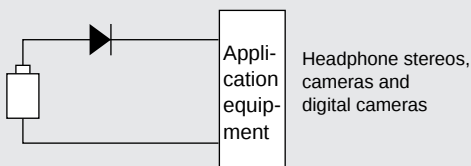


Functions and Applications

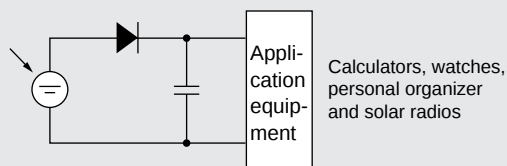
Functional Use	Applications
Battery reverse-connection prevention	Headphone stereos, cameras and digital cameras
Memory back-up circuits	Notebook computers, word processors, cellular phones and pagers
Speed-up circuits	Measuring instruments
Low-voltage operation circuits	Calculators and watches
Others	DC-DC converters

Application Examples of Schottky Barrier Diodes

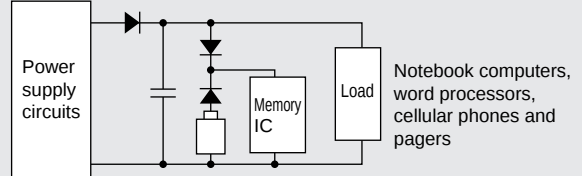
● Battery reverse-connection prevention



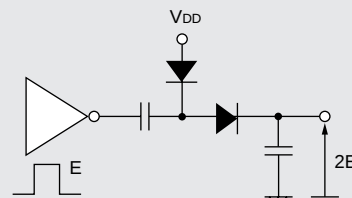
● Solar cell battery



● Memory back-up circuits

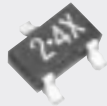
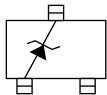
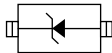
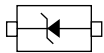


● DC-DC converters



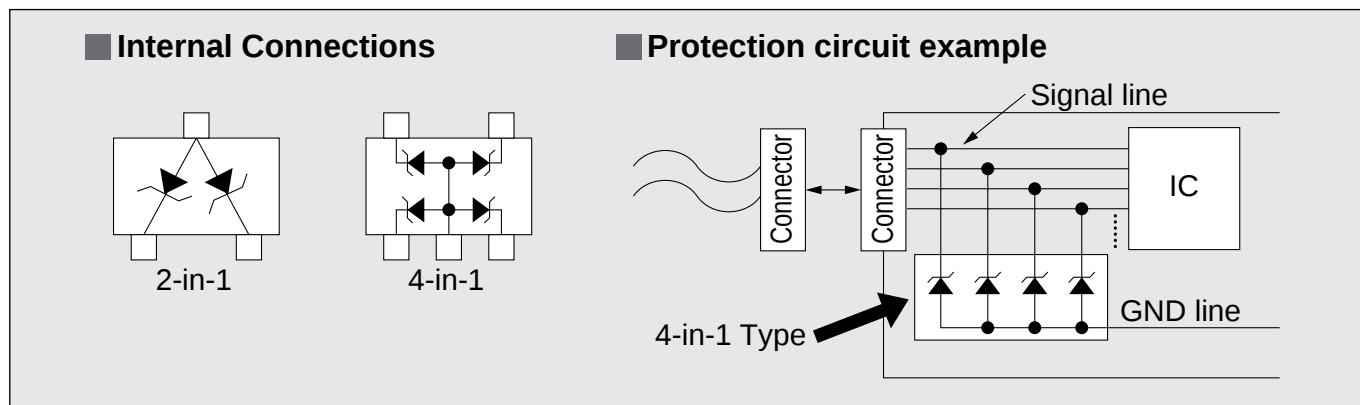
4. Small Signal Diodes

4.3 Zener Diodes

Package Zener Voltage V _z (V)			
	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	
15	02CZ15	02DZ15	
16	02CZ16	02DZ16	
18	02CZ18	02DZ18	
20	02CZ20	02DZ20	
22	02CZ22	02DZ22	
24	02CZ24	02DZ24	
27	02CZ27		
30	02CZ30		
33	02CZ33		
36	02CZ36		
39	02CZ39		
43	02CZ43		
47	02CZ47		
Pin assignent			
P (mW)	200	200	150

4.4 Diodes for Protection against ESD

Small-signal zener diodes are suitable for protecting electronic circuits against ESD from external pins. (Since multiple devices are incorporated into a single package, the product is ideal for interface protection.)



Single Type

Product No.	V _Z (V)			@I _Z (mA)	I _R (μA)	@V _R (V)	C _T (μF)	@V _R (V)	Package USC
	Min	Typ.	Max						
DF2S12FU	11.4	12.0	12.6	5	0.05	9	15	0	

New product

Standard Type

2-in-1		4-in-1				V _Z (V)		I _R (μA)	
ESM	USM	ESV	USV	SMV	US8				
						Typ.	@I _Z (mA)	Max	@V _Z (V)
DF3A3.3FE	DF3A3.3FU	DF5A3.3JE*	DF5A3.3FU	DF5A3.3F		3.3	5	20	1.0
DF3A5.6FE	DF3A5.6FU	DF5A5.6JE*	DF5A5.6FU	DF5A5.6F	DF8A5.6FK*	3.6	5	10	1.0
DF3A6.2FE	DF3A6.2FU	DF5A6.2JE*	DF5A6.2FU	DF5A6.2F	DF8A6.2FK*	6.2	5	1	3.0
DF3A6.8FE	DF3A6.8FU	DF5A6.8JE	DF5A6.8FU	DF5A6.8F	DF8A6.8FK	6.8	5	0.5	5.0
DF3A8.2FE	DF3A8.2FU	DF5A8.2JE	DF5A8.2FU	DF5A8.2F		8.2	5	0.5	6.5

New products * Under development

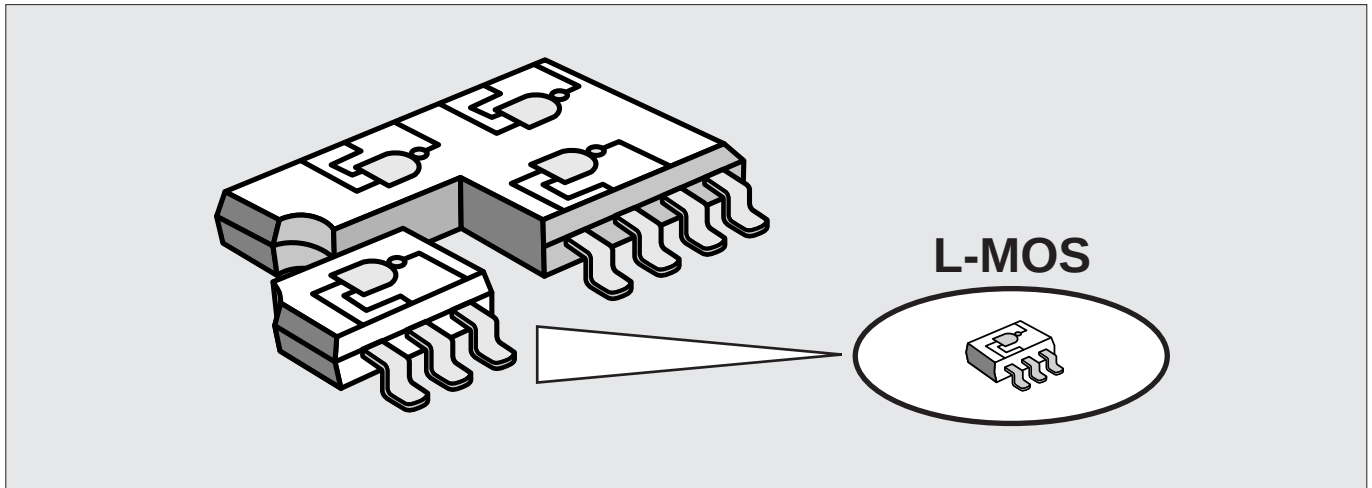
High-Speed Signal Type

2-in-1		4-in-1			V _Z (V)		C _T (pF)		
ESM	USM	ESV	USV	SMV					
					Typ.	@I _Z (mA)	Typ.	@V _Z (V)	
DF3A6.2LFE*	DF3A6.2LFU*	DF5A6.2LJE*	DF5A6.2LFU*	DF5A6.2LF*	6.2	5	6.5	0	
DF3A6.8LFE	DF3A6.8LFU	DF5A6.8LJE	DF5A6.8LFU	DF5A6.8LF	6.8	5	6	0	
DF3A8.2LFE	DF3A8.2LFU	DF5A8.2LJE	DF5A8.2LFU	DF5A8.2LF	8.2	5	6	0	

New products * Under development

5. L-MOS

5.1 Outline of L-MOS



Features

1. Very Small

The smallest package USV's area is only 5% of CMOS SOP package.
It is very good for high density mount set.
And it is suitable for circuit minor change.

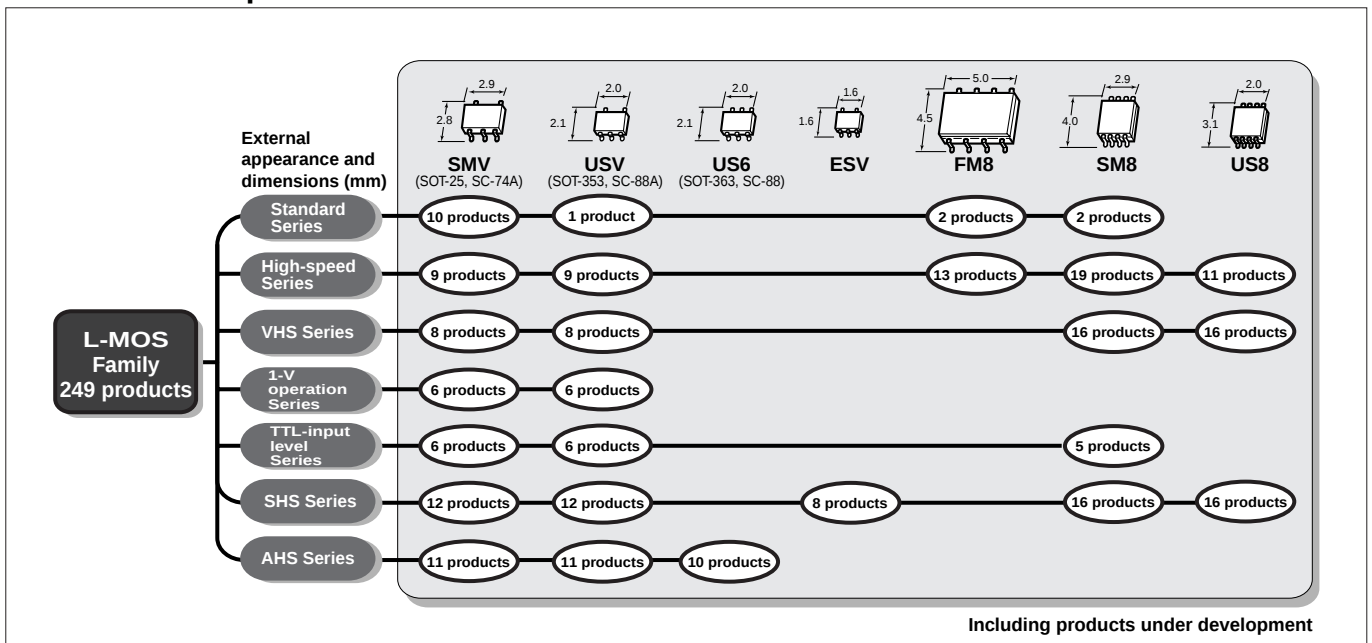
2. Easy Layout Arrangement

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. Thin Thickness

The thinnest package ESV is only 0.6mm height.
It is convenience for portable set like PDA.

Products Line-up



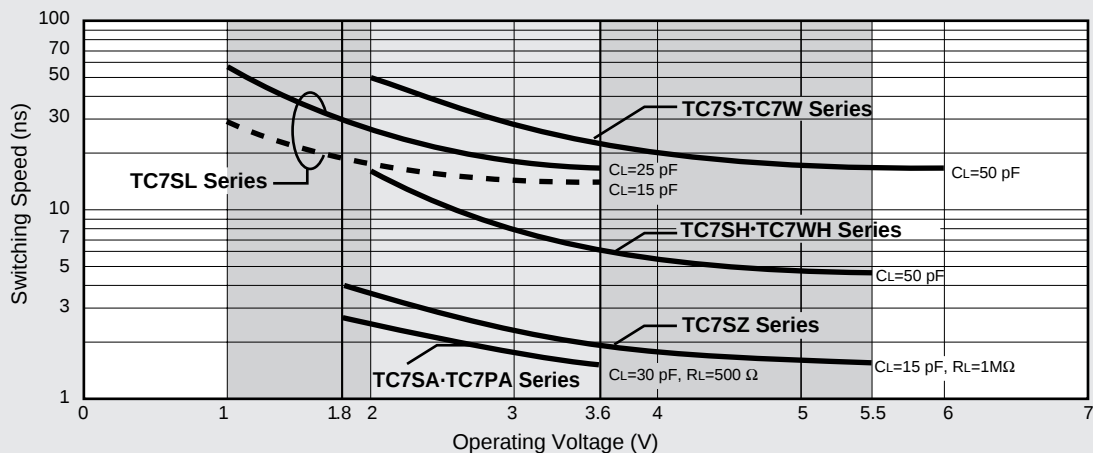
● L-MOS Performance Summary

Parameter		Standard Series	High-Speed Series *1		Very-High-Speed Series	1-V Operation Series *1	TTL-Level Input Series		Super-High-Speed Series *2	AHS Series
		TC4SxxF TC4WxxF/FU	TC7SxxF/FU	TC7WxxF/FU/FK TC3WxxF/FU	TC7SHxxF/FU TC7WHxxF/FU/FK	TC7SLxxF/FU	TC7SETxxF/FU	TC7WTxxFU	*TC7SZxxF/FU *TC7SZxxAFE *TC7WZxxF/FU/FK	*TC7SAxxF/FU *TC7PAxxF/FU
Propagation delay time (NAND gate)		65 ns typ. @V _{CC} = 5 V C _L = 15pF Ta=25°C	7 ns typ. @V _{CC} = 5 V C _L = 15pF Ta=25°C	6 ns typ. @V _{CC} = 5 V C _L = 15pF Ta=25°C	3.7 ns typ. @V _{CC} = 5 V C _L = 15pF Ta=25°C	7.5 ns typ. @V _{CC} = 3 V C _L = 15pF Ta=25°C	4.2 ns typ. @V _{CC} = 5 V C _L = 15pF Ta=25°C	10 ns typ. (3state Bu) @V _{CC} = 5.5 V C _L = 15pF Ta=25°C	2.4 ns typ. @V _{CC} = 3.3 V C _L = 15pF R _L = 1MΩ Ta=25°C	2.8 ns max @V _{CC} = 3.3 V C _L = 30pF R _L = 500Ω Ta=-40 ~ 85°C
Operating voltage range		3 ~ 18 V	2 ~ 6 V	2 ~ 6 V	2 ~ 5.5 V	1 ~ 3.6 V	4.5 ~ 5.5 V	4.5 ~ 5.5 V	1.8 ~ 5.5 V	1.8 ~ 3.6 V
Operating temperature range		- 40 ~ 85°C	- 40 ~ 85°C	- 40 ~ 85°C	- 40 ~ 85°C	- 40 ~ 85°C	- 40 ~ 85°C	- 40 ~ 85°C	- 40 ~ 85°C	- 40 ~ 85°C
Output current	I _{OH}	0.42mA min (@V _{CC} = 5V)	2mA min (@V _{CC} = 4.5V)	4mA min (@V _{CC} = 4.5V)	8mA min (@V _{CC} = 4.5V)	1mA min (@V _{CC} = 1.5V)	8mA min (@V _{CC} = 4.5V)	4mA min (@V _{CC} = 4.5V)	24mA min (@V _{CC} = 3V)	24mA min (@V _{CC} = 3V)
	I _{OL}	0.42mA min (@V _{CC} = 5V)	2mA min (@V _{CC} = 4.5V)	4mA min (@V _{CC} = 4.5V)	8mA min (@V _{CC} = 4.5V)	1mA min (@V _{CC} = 1.5V)	8mA min (@V _{CC} = 4.5V)	4mA min (@V _{CC} = 4.5V)	24mA min (@V _{CC} = 3V)	24mA min (@V _{CC} = 3V)
Electrical characteristics (except for permissible power dissipation rating)		Same as those of the TC4xxxB series	Output current is 1/2 that of the TC74HCxxA series	Same as those of the TC74HCxxA series	Same as those of the TC74VHCxxx 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 TC74LCxxx series when operating V _{CC} = 3.3V	Same as those of the TC74VCxxx series

*: Some products are in under development stage.

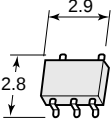
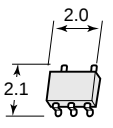
*1: TC3WxxF/FU and TC7SLxxF/FU are original L-MOS devices and it is not a C²MOS logic IC.

*2: TC7SZxxF/FU Series have 5-V tolerant function for input and output same as those of the TC74LCxx Series. TC7SZxxAFE Series only have 5-V tolerant function for input.



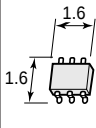
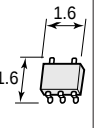
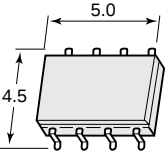
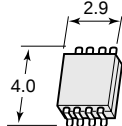
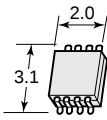
5. L-MOS

5.2 Products Lines

Package Name	SMV (SOT-25, SC-74A)							USV (SOT-353, SC-88A)				
Appearance Image (mm)												
Function	Standard Series	High-Speed Series	1-V Operation Series	VHS Series		SHS Series	AHS Series	High-Speed Series	1-V Operation Series	VHS Series		SHS Series
					TTL level input Series						TTL level input Series	
NAND	TC4S11F	TC7S00F	TC7SL00F	TC7SH00F	TC7SET00F	TC7SZ00F	TC7SA00F	TC7S00FU	TC7SL00FU	TC7SH00FU	TC7SET00FU	TC7SZ00FU
NAND (unbuffer)	TC4SU11F											
NAND (Open Drain)						*TC7SZ38F						*TC7SZ38FU
AND	TC4S81F	TC7S08F	TC7SL08F	TC7SH08F	TC7SET08F	TC7SZ08F	TC7SA08F	TC7S08FU	TC7SL08FU	TC7SH08FU	TC7SET08FU	TC7SZ08FU
NOR	TC4S01F	TC7S02F	TC7SL02F	TC7SH02F	TC7SET02F	TC7SZ02F	*TC7SA02F	TC7S02FU	TC7SL02FU	TC7SH02FU	TC7SET02FU	TC7SZ02FU
OR	TC4S71F	TC7S32F	TC7SL32F	TC7SH32F	TC7SET32F	TC7SZ32F	*TC7SA32F	TC7S32FU	TC7SL32FU	TC7SH32FU	TC7SET32FU	TC7SZ32FU
Exclusive-OR	TC4S30F	TC7S86F		TC7SH86F	TC7SET86F	TC7SZ86F		TC7S86FU		TC7SH86FU	TC7SET86FU	TC7SZ86FU
Inverter	TC4S69F	TC7S04F	TC7SL04F	TC7SH04F	TC7SET04F	TC7SZ04F	TC7SA04F	TC7S04FU	TC7SL04FU	TC7SH04FU	TC7SET04FU	TC7SZ04FU
Inverter (unbuffer)	TC4SU69F	TC7SU04F	TC7SLU04F	TC7SHU04F		TC7SZU04F	TC7SAU04F	TC7SU04FU	TC7SLU04FU	TC7SHU04FU		TC7SZU04FU
Inverter (open drain)						TC7SZ05F	TC7SA05F					TC7SZ05FU
Schmitt inverter	TC4S584F	TC7S14F		TC7SH14F		TC7SZ14F	*TC7SA14F	TC7S14FU		TC7SH14FU		TC7SZ14FU
Schmitt buffer												
Buffer							TC7SA34F					
Analog switch	TC4S66F TC4S66FU(USV)	TC7S66F						TC7S66FU				
Analog multiplexer												
D-type flip-flop												
D-type flip-flop with clear												
3-state buffer						TC7SZ125F	*TC7SA125F					TC7SZ125FU
3-state buffer						TC7SZ126F	*TC7SA126F					TC7SZ126FU
3-state inverting buffer												
3-state buffer												
Bus transceiver												
Bus transceiver with open drain												
Monostable multivibrator												
Digital multiplexer												
D-type latch with 3-state												
D-type flip flop with 3-state												
2-to-4 decoder												
2-to-3 decoder with Enable												
2-to-3 decoder with Enable												
Oscillator & divider												

The suffix "F" denotes SMV or FM8 package. The suffix "FU" denotes a USV or SM8 package. The suffix "FK" denotes a US8 package. The suffix "FE" denotes a ESV package.

■ New product * : Under development

	US6 (SOT-363, SC-88)	ESV	FM8		SM8				US8			Package	
												Appearance Image (mm)	
AHS Series	AHS Series	SHS Series	Standard Series	High-Speed Series	Standard Series	High-Speed Series		VHS Series	SHS Series	High-Speed Series	VHS Series	SHS Series	Function
							TTL level input Series						
TC7SA00FU		TC7SZ00AFE		TC7W00F		TC7W00FU		TC7WH00FU	TC7WZ00FU	TC7W00FK	TC7WH00FK	TC7WZ00FK	NAND
													NAND (unbuffer)
									TC7WZ38FU			TC7WZ38FK	NAND (Open Drain)
TC7SA08FU		TC7SZ08AFE		TC7W08F		TC7W08FU		TC7WH08FU	TC7WZ08FU	TC7W08FK	TC7WH08FK	TC7WZ08FK	AND
*TC7SA02FU		TC7SZ02AFE		TC7W02F		TC7W02FU		TC7WH02FU	TC7WZ02FU	TC7W02FK	TC7WH02FK	TC7WZ02FK	NOR
*TC7SA32FU		TC7SZ32AFE		TC7W32F		TC7W32FU		TC7WH32FU	TC7WZ32FU	TC7W32FK	TC7WH32FK	TC7WZ32FK	OR
									*TC7WZ86FU			*TC7WZ86FK	Exclusive-OR
TC7SA04FU	TC7PA04FU	TC7SZ04AFE		TC7W04F		TC7W04FU		TC7WH04FU	TC7WZ04FU	TC7W04FK	TC7WH04FK	TC7WZ04FK	Inverter
TC7SAU04FU	TC7PAU04FU	TC7SZU04AFE		TC7WU04F		TC7WU04FU		TC7WHU04FU	TC7WZU04FU	TC7WU04FK	TC7WHU04FK	TC7WZU04FK	Inverter (unbuffer)
TC7SA05FU	TC7PA05FU								TC7WZ05FU			TC7WZ05FK	Inverter (open drain)
*TC7SA14FU	*TC7PA14FU			TC7W14F		TC7W14FU		TC7WH14FU	*TC7WZ14FU	TC7W14FK	TC7WH14FK	*TC7WZ14FK	Schmitt inverter
	*TC7PA17FU												Schmitt buffer
TC7SA34FU	TC7PA34FU					TC7W34FU		TC7WH34FU	TC7WZ34FU	TC7W34FK	TC7WH34FK	TC7WZ34FK	Buffer
			TC4W66F	TC7W66F	TC4W66FU	TC7W66FU				TC7W66FK			Analog switch
	TC7PA53FU		TC4W53F	TC7W53F	TC4W53FU	TC7W53FU				TC7W53FK			Analog multiplexer
				TC7W74F		TC7W74FU	TC7WT74FU	TC7WH74FU	TC7WZ74FU		TC7WH74FK	TC7WZ74FK	D-type flip-flop
	*TC7PA175FU												D-type flip-flop with clear
*TC7SA125FU		TC7SZ125AFE				TC7W125FU	TC7WT125FU	TC7WH125FU	*TC7WZ125FU		TC7WH125FK	*TC7WZ125FK	3-state buffer
*TC7SA126FU		TC7SZ126AFE				TC7W126FU	TC7WT126FU	TC7WH126FU	*TC7WZ126FU		TC7WH126FK	*TC7WZ126FK	3-state buffer
						TC7W240FU	TC7WT240FU	TC7WH240FU			TC7WH240FK		3-state inverting buffer
						TC7W241FU	TC7WT241FU	TC7WH241FU			TC7WH241FK		3-state buffer
								TC7WH245FU	*TC7WZ245FU		TC7WH245FK	*TC7WZ245FK	Bus transceiver
									*TC7WZ246FU			*TC7WZ246FK	Bus transceiver with open drain
								TC7WH123FU			TC7WH123FK		Monostable multivibrator
								TC7WH157FU			TC7WH157FK		Digital multiplexer
	*TC7PA373FU												D-type latch with 3-state
	*TC7PA374FU												D-type flip flop with 3-state
				TC7W139F		TC7W139FU							2-to-4 decoder
				TC3W01F		TC3W01FU							2-to-3 decoder with Enable
				TC3W02F		TC3W02FU							2-to-3 decoder with Enable
						TC3W03FU							Oscillator & divider

11

5.3 New Products (Low-voltage logic series)

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

● Outline

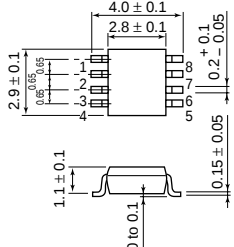
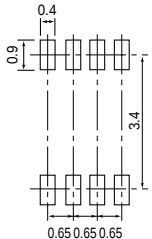
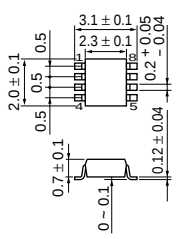
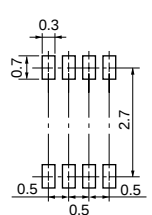
Two or three circuits of super-high-speed propagation delay time and high drive capability SHS single types are housed in 8-pin packages.

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 TC74LCXxx Series.

● Package dimensions

Package	SM8	Package	US8
Dimensions	Recommended land pattern	Dimensions	Recommended land pattern
Unit: mm  Weight: 0.021g	Unit: mm 	Unit: mm  Weight: 0.01g	Unit: mm 

● Product line-up

Product No.	Function	Package
TC7WZ00FU/FK	Dual 2-input NAND gate	SM8/US8
TC7WZ02FU/FK	Dual 2-input NOR gate	
TC7WZ04FU/FK	Triple inverter	
TC7WZU04FU/FK	Triple inverter (unbuffer)	
TC7WZ05FU/FK	Triple inverter (open drain output)	
TC7WZ08FU/FK	Dual 2-input AND gate	
★ TC7WZ14FU/FK	Triple schmitt trigger inverter	
TC7WZ32FU/FK	Dual 2-input OR gate	
TC7WZ34FU/FK	Triple non-inverter	
TC7WZ38FU/FK	Dual 2-input NAND gate (open drain output)	
TC7WZ74FU/FK	D-type flip-flop	
★ TC7WZ86FU/FK	Dual 2-input exclusive OR gate	
★ TC7WZ125FU/FK	Dual 3-state buffer	
★ TC7WZ126FU/FK	Dual 3-state buffer	
★ TC7WZ245FU/FK	Dual BUS Transceiver	
★ TC7WZ246FU/FK	Dual BUS Transceiver with open drain	

★ : Under development

AHS Series Housed in New 6-pin Package: TC7PAxxFU

● Outline

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

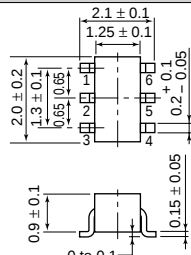
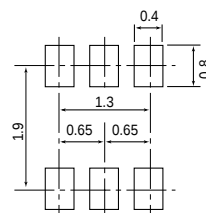
There are new function products for L-MOS family.

: 175(D-F/F), 53(Analog MPX), 373(D-F/F with 3 state output)

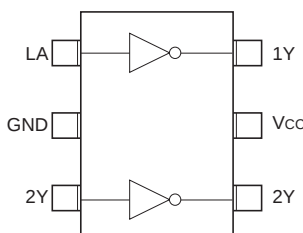
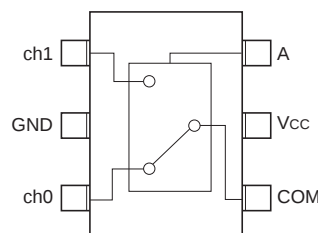
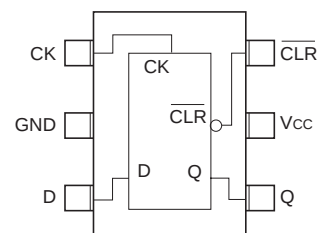
● Features

- 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: $1.8\text{V} \sim 3.6\text{V}$
- 3.6-V output tolerant function and protection function which prevents the input power voltage from dropping for all inputs and outputs.
- 2.5 V and 3.3 V systems
- These electrical characteristics are the same those of the TC74VCXxx.

● Package dimensions

Dimensions	Recommended land pattern
 Unit: mm US6 (SOT-363, SC-88) Weight: 0.03g	 Unit: mm

● Pin Assignment

Inverter	Analog MPX	D-FLIP FLOP (Under development)
		

● Product line-up

Product No.	Function
TC7PA04FU	Dual inverter
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
★ TC7PA373FU	D-type latch with 3-state output
★ TC7PA374FU	D-type flip-flop with 3-state output

★ : Under development

5. L-MOS

AHS/SHS Interface

● Interface performance

AHS series, SHS series and VHS 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)

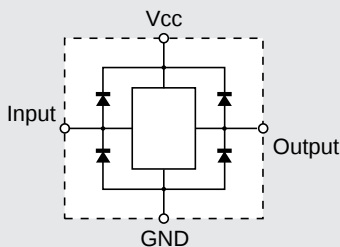
■ Power-down protection: enables to supply power to I/O when power is down (for IC protection)

I/O permissible voltage

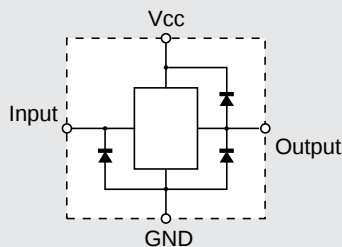
Series		AHS	SHS	VHS
Input voltage range	During operation	0 ~ 3.6 V	0 ~ 5.5 V	0 ~ 5.5V
	When power-down	0 ~ 3.6 V	0 ~ 5.5 V	0 ~ 5.5V
Output voltage range	When output enable	0 ~ Vcc	0 ~ Vcc	0 ~ Vcc
	When output disable	0 ~ 3.6 V	0 ~ 5.5 V	0 ~ Vcc
	When power-down	0 ~ 3.6 V	0 ~ 5.5 V	—

● I/O equivalent circuit diagrams

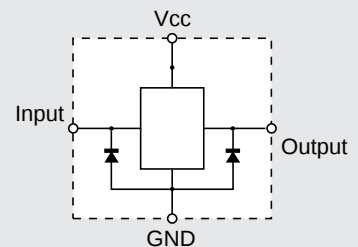
High-speed Series



VHS Series SHS(TC7SZxxAFE) Series

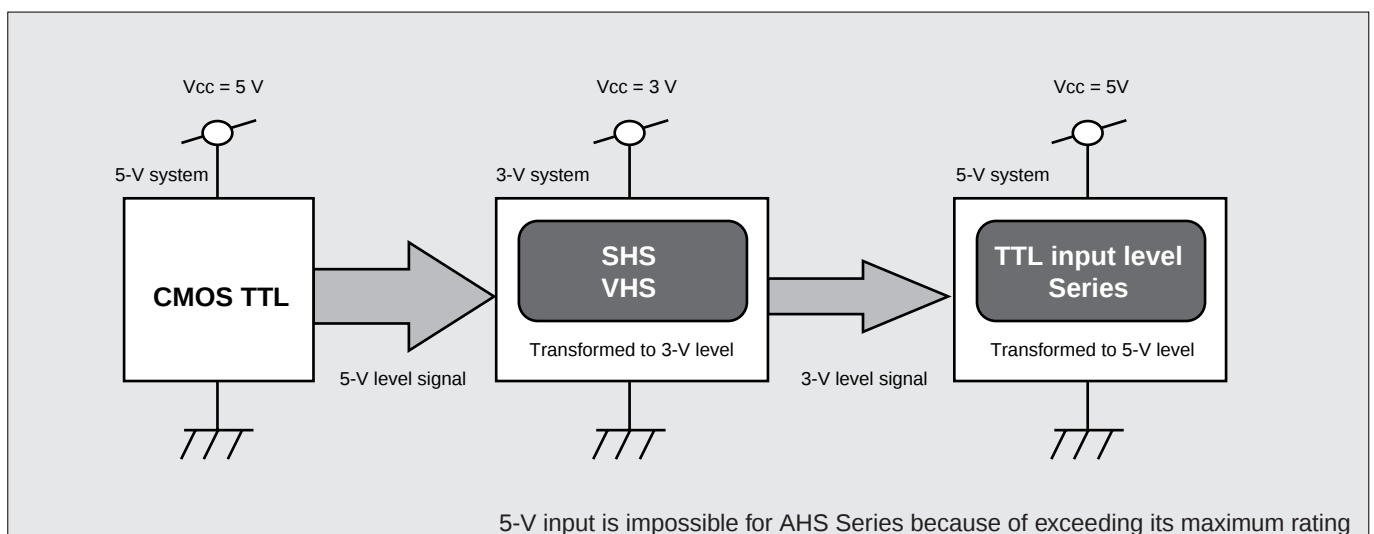


AHS Series SHS Series



● 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).



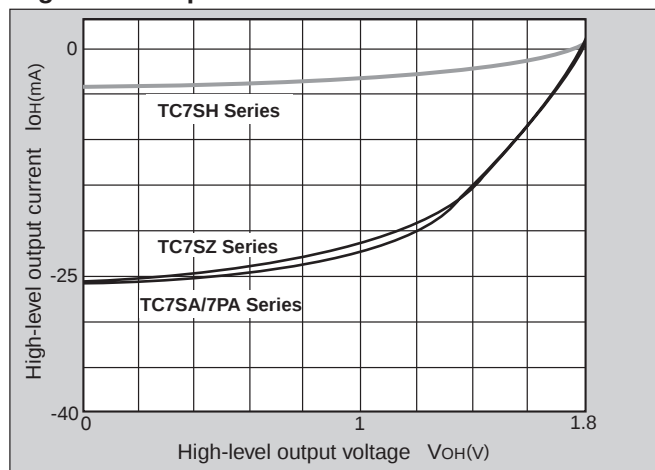
Typical characteristics for Low Voltage logic Series

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

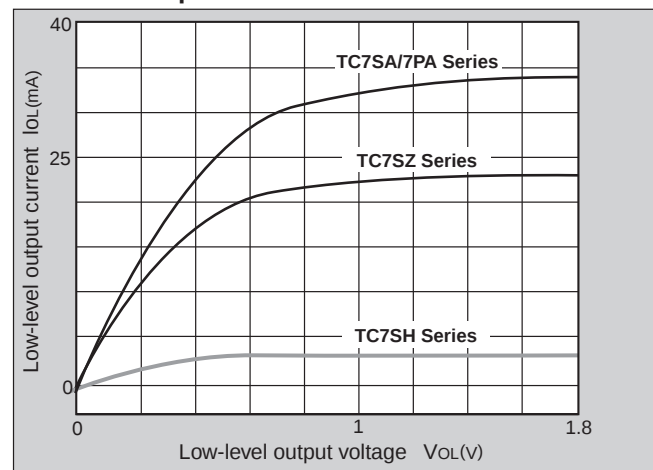
Drive current (typ.)

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

High-level output current

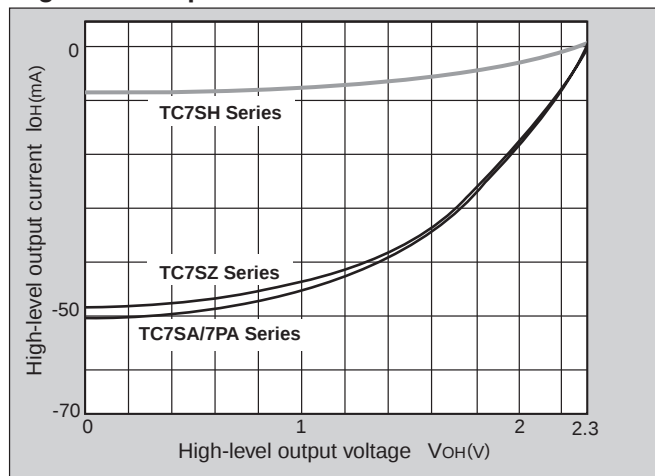


Low-level output current

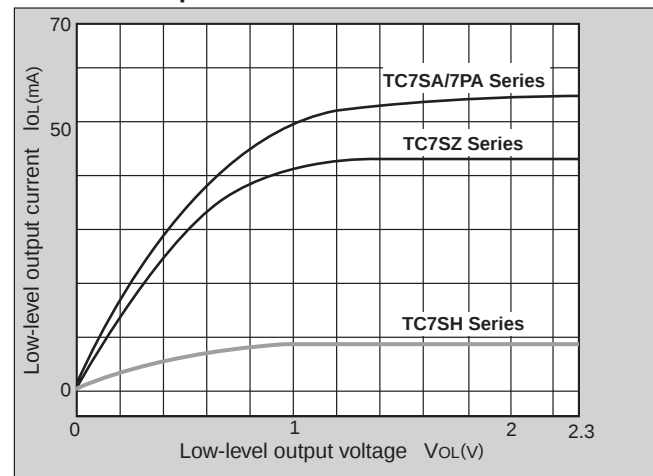


● $V_{CC} = 2.3\text{ V}$, $T_a = 25\text{ }^{\circ}\text{C}$

High-level output current

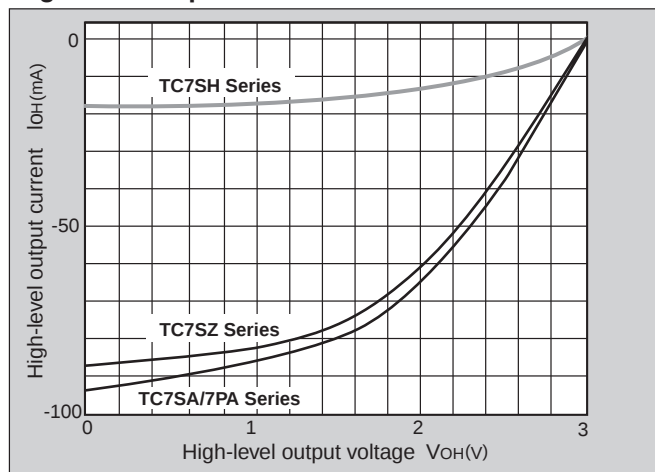


Low-level output current

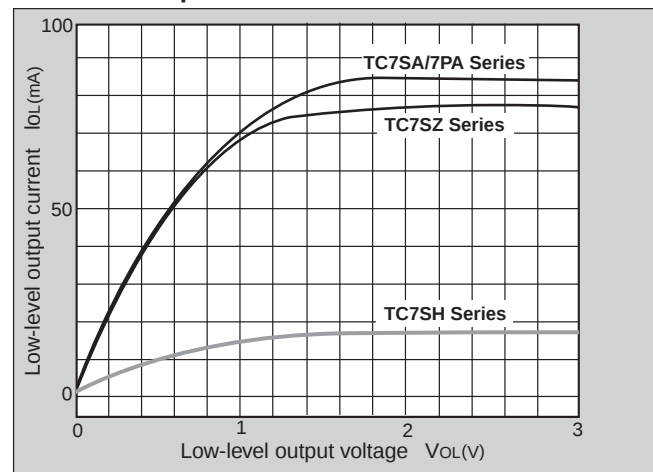


● $V_{CC} = 3.0\text{ V}$, $T_a = 25\text{ }^{\circ}\text{C}$

High-level output current



Low-level output current

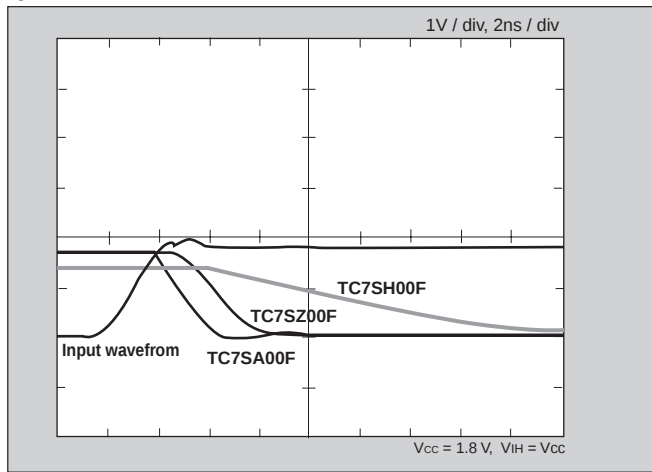


5. L-MOS

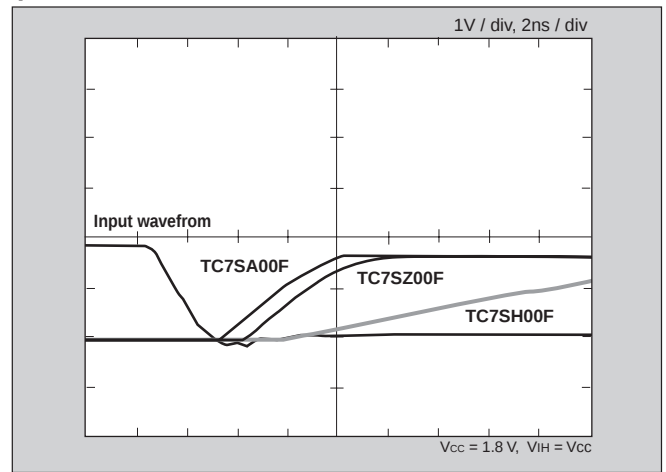
Switching waveform (typ.)

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

tpHL

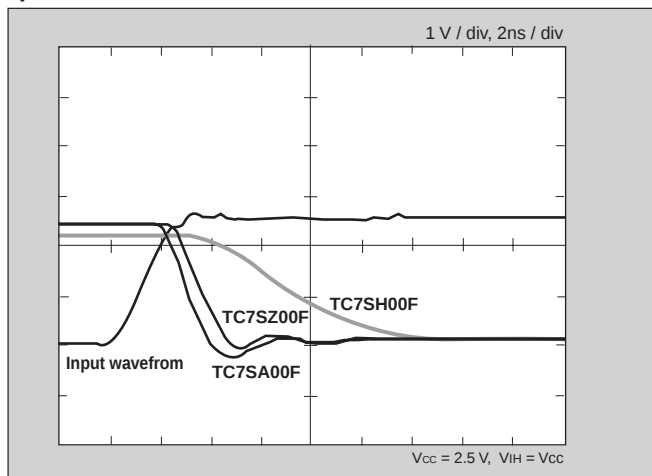


tpLH

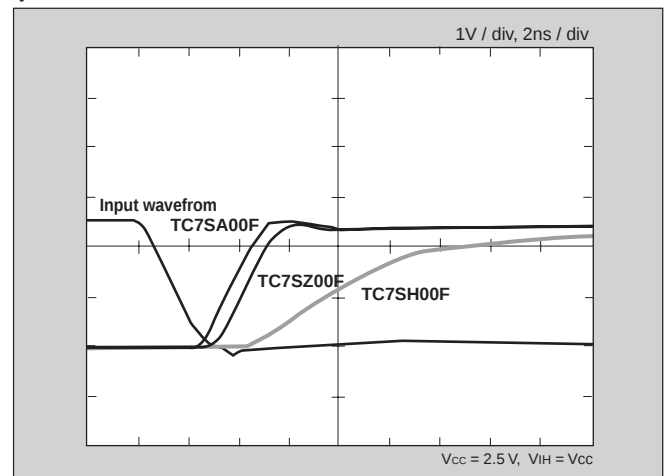


● $V_{CC} = 2.5\text{ V}$, $C_L = 30\text{ pF}$, $R_L = 500\ \Omega$

tpHL

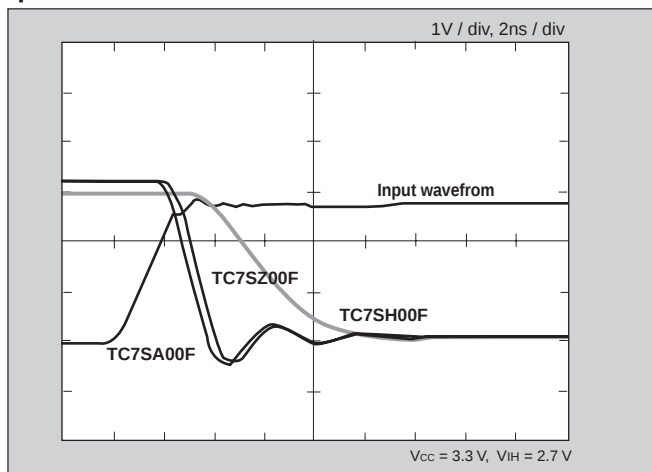


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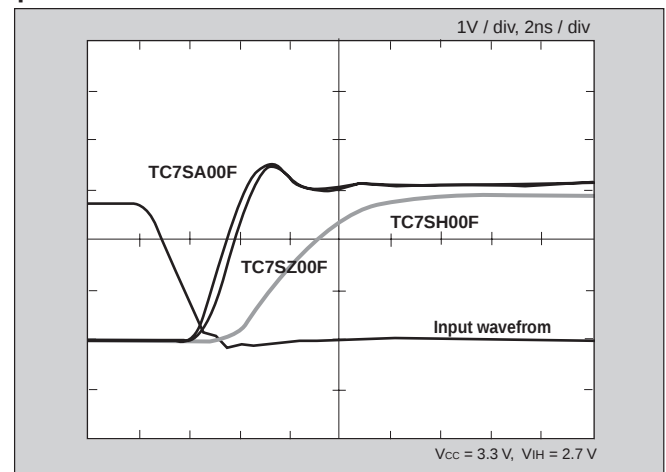


● $V_{CC} = 3.3\text{ V}$, $C_L = 30\text{ pF}$, $R_L = 500\ \Omega$

tpHL

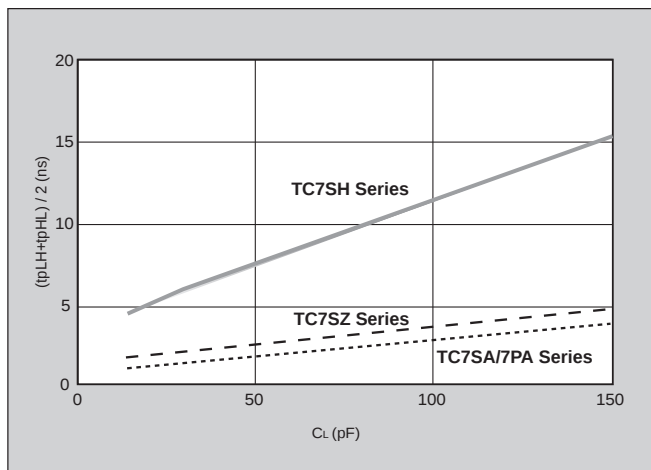


tpLH

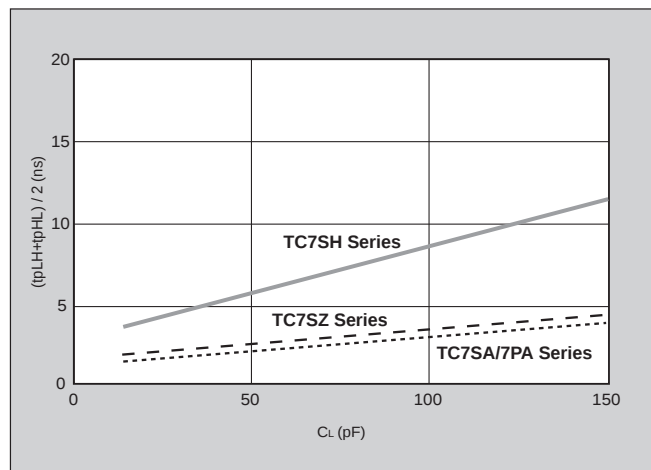


Load capacitance dependence (typ.)

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

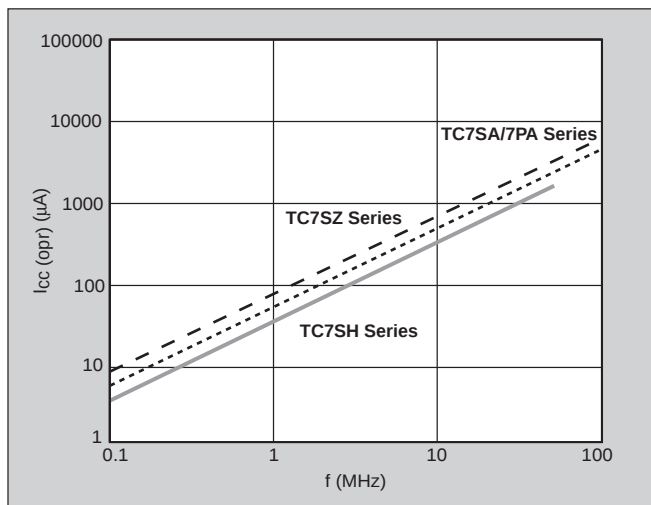


● $V_{CC} = 3.3\text{ V}$, $R_L = 500\ \Omega$, $T_a = 25\ ^\circ\text{C}$



Operating current consumption (typ.)

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



5. L-MOS

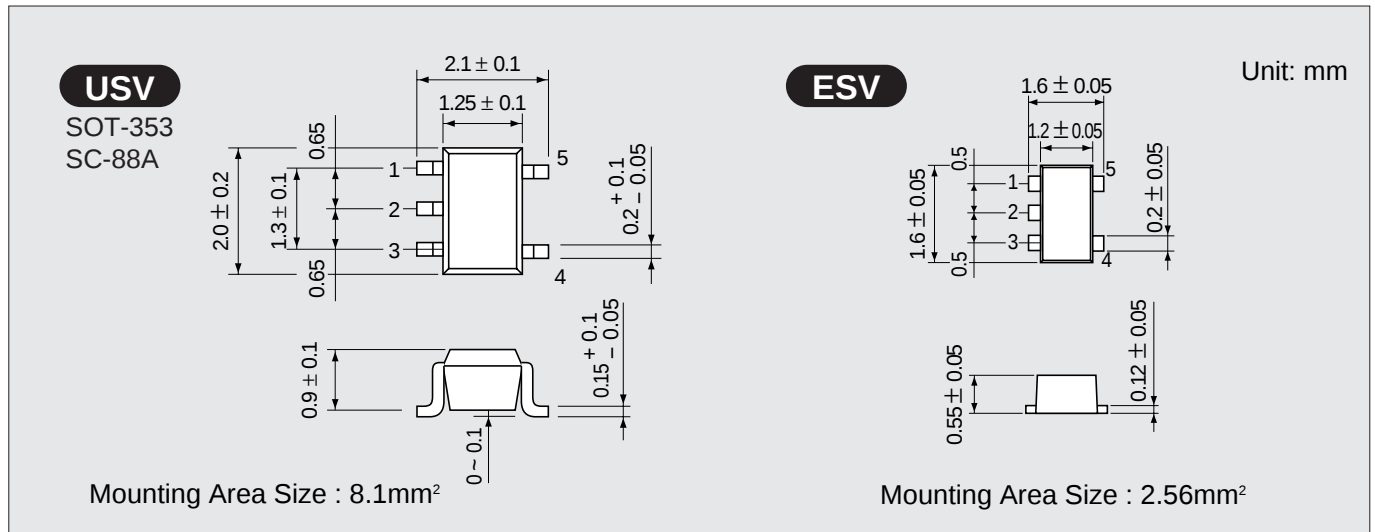
5.4 Very Small package Solution

ESV Package for TC7SZxxAFE 5-pin ultra-small and thin package

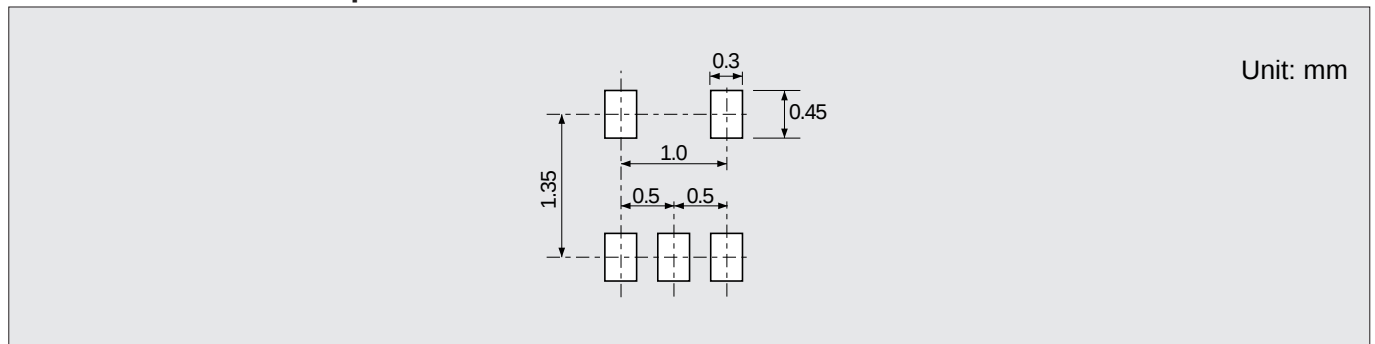
● Features

- Lead pitch: 0.5 mm
- Product height: 0.55 mm (typ.), 0.6 mm (max)
- ESVs are flat-lead packages which suitable for use in high-speed and high-density mounting.

● Package comparison between USV(SOT-353, SC-88A) and ESV



● Recommended land pattern for ESV



● Line-up

■ TC7SZxxAFE Series

Series	Product No.	Function
SHS	TC7SZ00AFE	2-input NAND gate
	TC7SZ02AFE	2-input NOR gate
	TC7SZ04AFE	Inverter gate
	TC7SZU04AFE	Inverter gate (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.

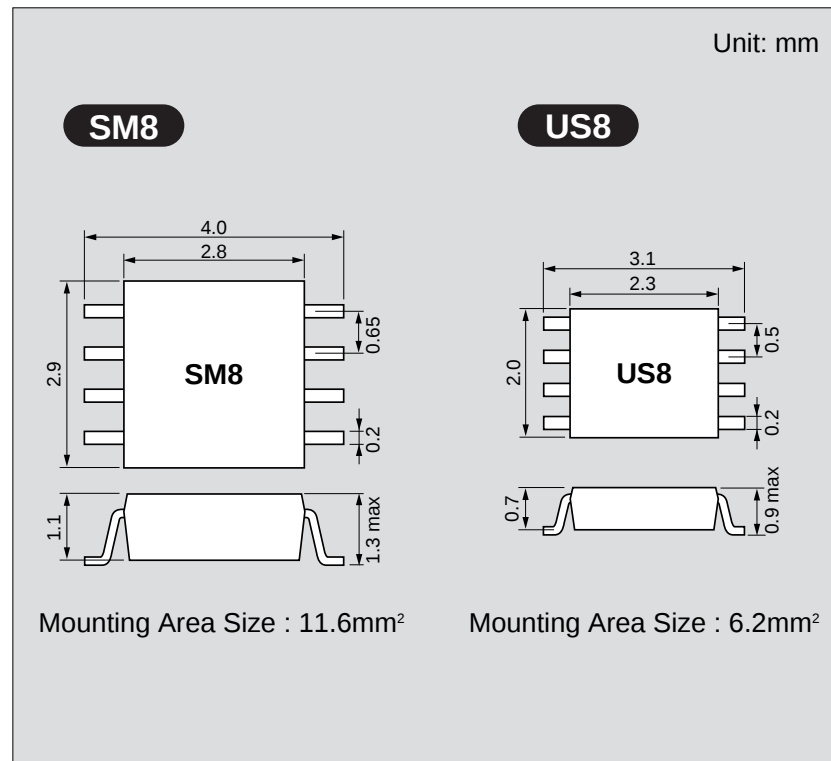
US8 Packages for TC7WxxFK and TC7WHxxFK

8-pin ultra-small package

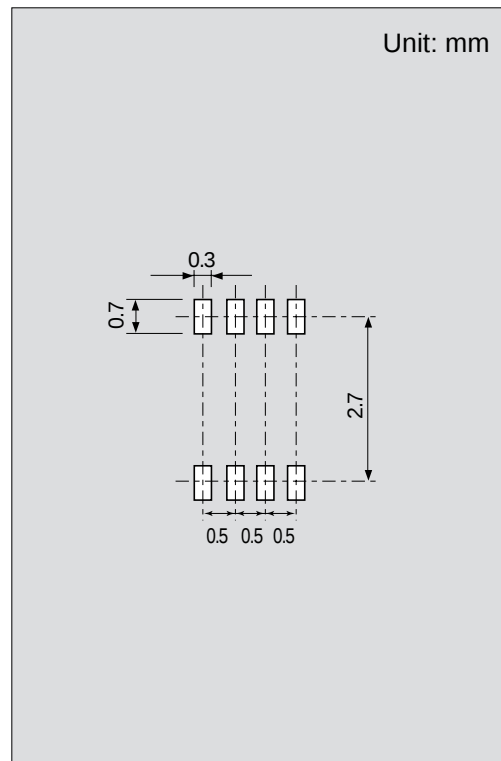
● Features

- Lead pitch: 0.5 mm
- Flat area is 47% that of SM8 package.

● Package comparison between SM8 and US8



● Recommended land pattern for US8



● Line-up

Product No.		Function
High speed	VHS	
TC7W00FK	TC7WH00FK	Dual 2-input NAND
TC7W02FK	TC7WH02FK	Dual 2-input NOR
TC7W04FK	TC7WH04FK	Triple inverter
TC7WU04FK	TC7WHU04FK	Triple inverter (unbuffer)
TC7W08FK	TC7WH08FK	Dual 2-input AND
TC7W14FK	TC7WH14FK	Triple schmitt trigger inverter
TC7W32FK	TC7WH32FK	Dual 2-input OR
TC7W34FK	TC7WH34FK	Triple buffer
TC7W53FK	—	Analog Multiplexer
TC7W66FK	—	Analog switch
TC7W74FK	TC7WH74FK	D-type flip-flop
—	TC7WH123FK	Mono-multivibrator
—	TC7WH125FK	Dual 3-state buffer
—	TC7WH126FK	Dual 3-state buffer
—	TC7WH157FK	Digital multiplexer
—	TC7WH240FK	Dual 3-state buffer
—	TC7WH241FK	Dual 3-state buffer
—	TC7WH245FK	Bus transceiver

5. L-MOS

5.5 Current Product Series

High-Speed Analog Switch Family

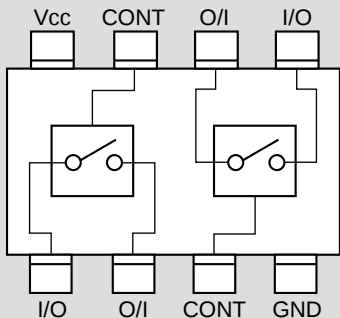
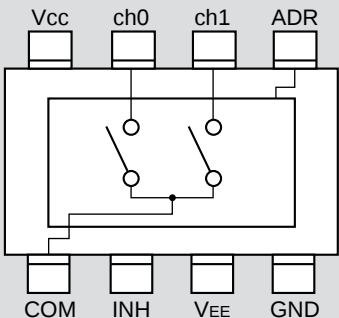
● Dual analog switch TC7W66FU/FK

● Analog multiplexer TC7W53FU/FK

The dual analog switch has a low ON-resistance when operated with a 3-V power supply.

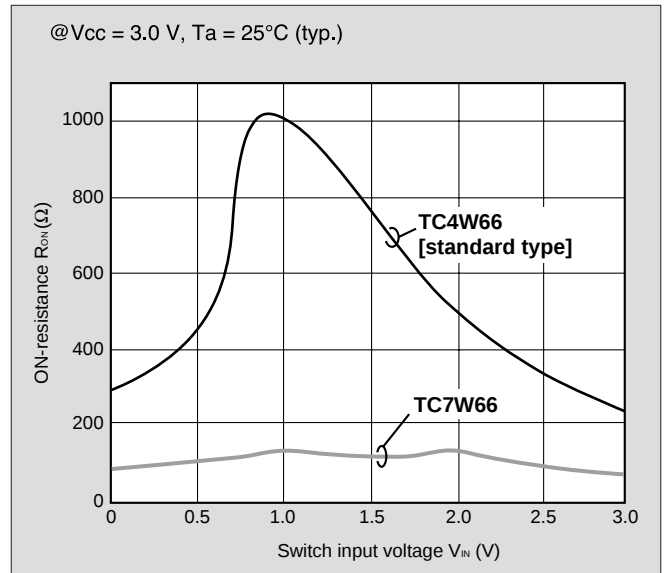
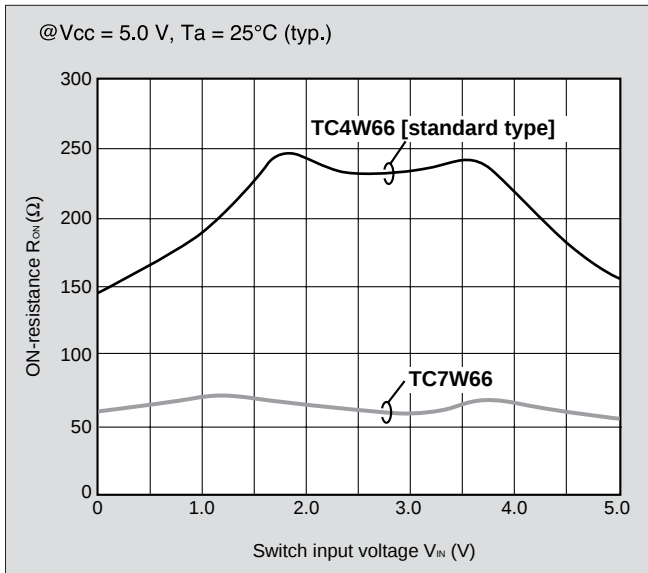
● Features

- Low R_{ON} (ON-resistance): $R_{ON} = 96\ \Omega$ (typical) at $V_{CC} = 4.5\ V$
 R_{ON} is half that of the standard type (TC4W66).
- Wide operating voltage range: $V_{CC} = 2\ V$ to $12\ V$
- High operating frequency: $f_{max} = 200\ MHz$ (typical) at $V_{CC} = 10\ V$
- Pins and functions same as those of L-MOS Standard Series (TC4W66, TC4W53)

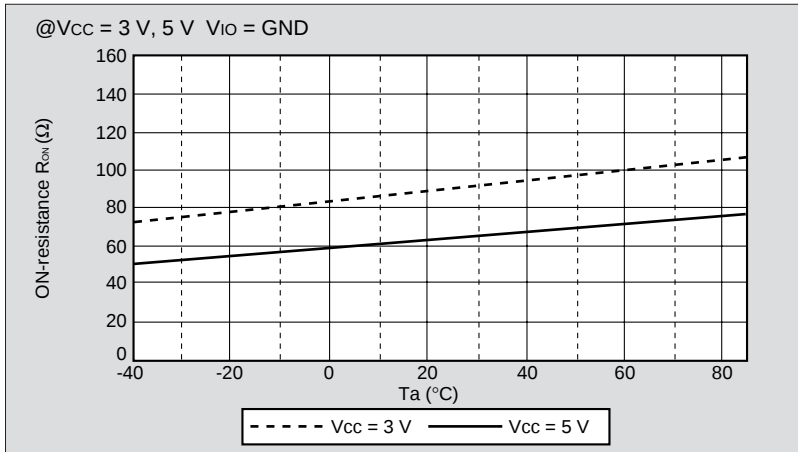
Product No.	TC7W66FU	TC7W66FK	TC7W53FU	TC7W53FK
Package	SM8	US8	SM8	US8
Electrical Characteristics	Same as TC74HC4066A		Same as TC74HC4053A	
Pin assignment				

*TC7W53F/FU: Analog switch characteristics are the same as those of the TC7W66.

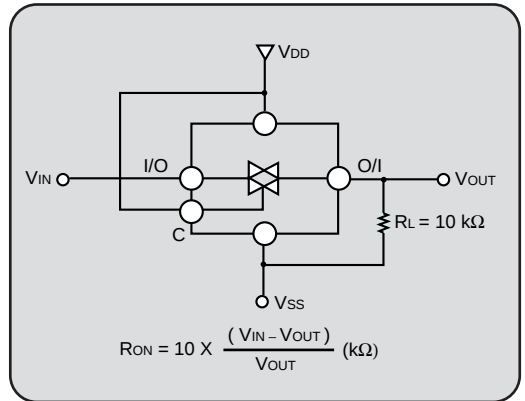
● ON-resistance (R_{ON})



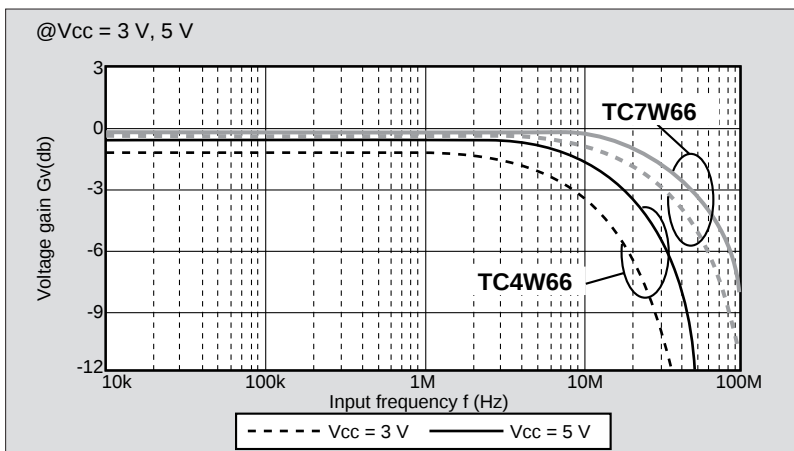
● ON-resistance - temperature characteristic (R_{ON} vs. T_a)



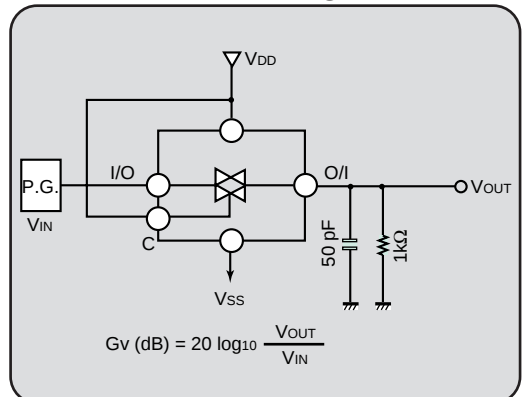
Circuit for measuring R_{ON}



● Cut-off frequency (F_{max})



Circuit for measuring f_{max}



6. 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.

6.1 Single Output type

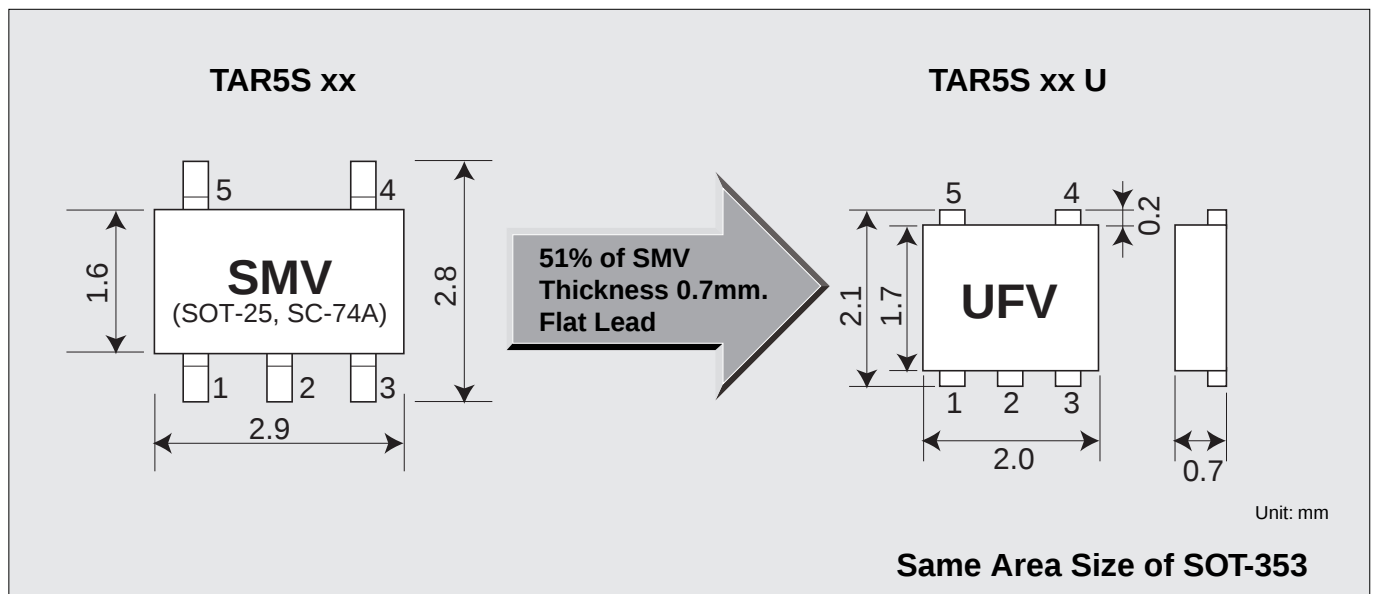
New Products

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

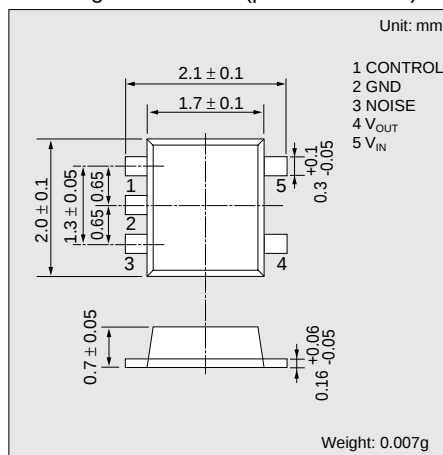
Features

- 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

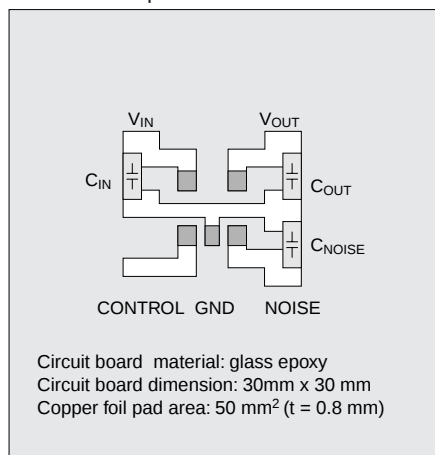
• Comparison between Current Standard package and New Small package



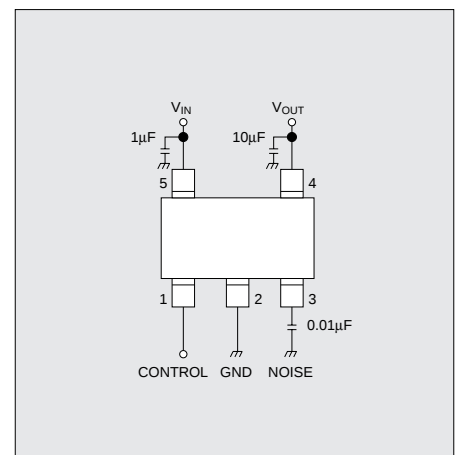
■ Package dimensions (pin connections)



■ Power dissipation evaluation board



■ Recommend circuit



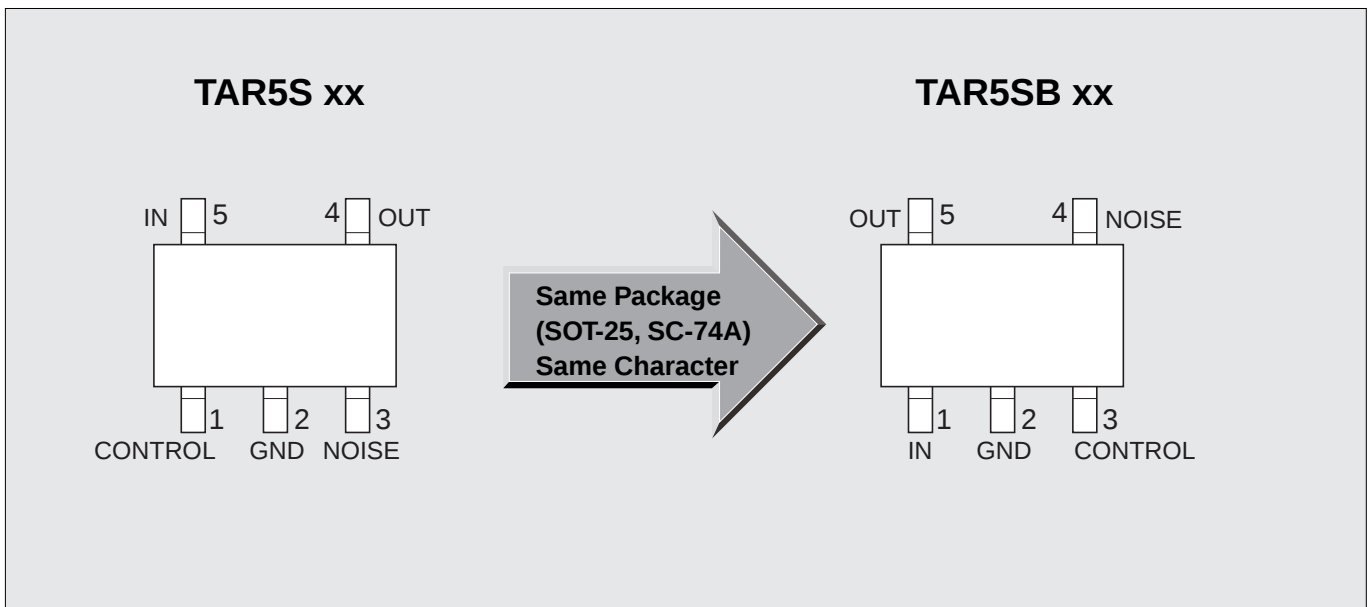
New Products

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

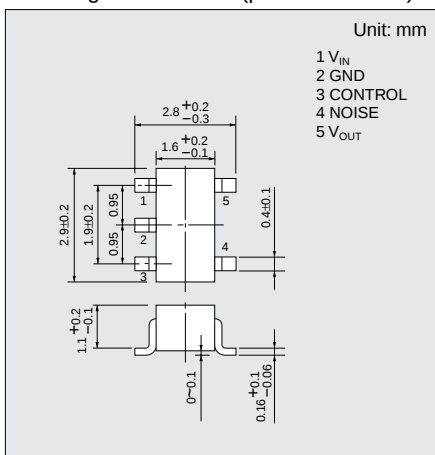
Features

- 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

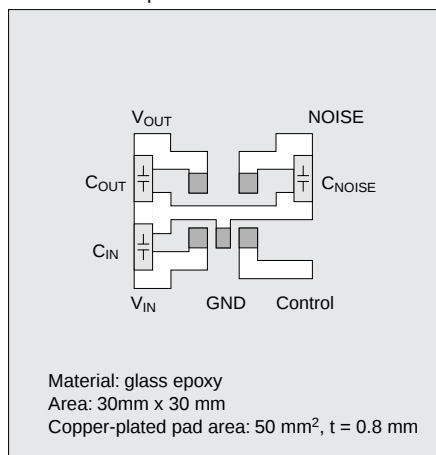
• Comparison between Current and New pin assignment



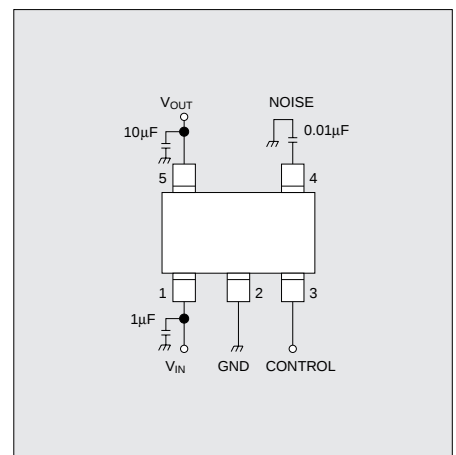
■ Package dimensions (pin connections)



■ Power dissipation evaluation board



■ Recommend circuit



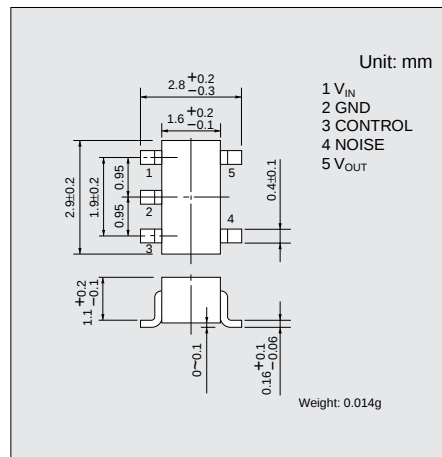
6. Point Regulator ICs (Low-Dropout Regulators)

TAR5Sxx Series (single-output type)

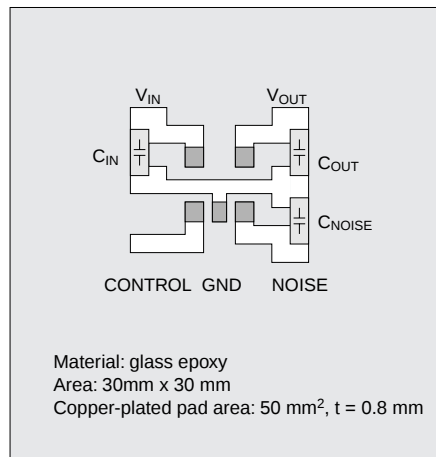
Features

- 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

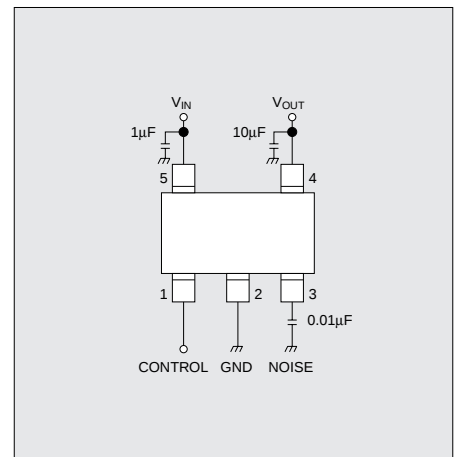
Package dimensions (pin connections)



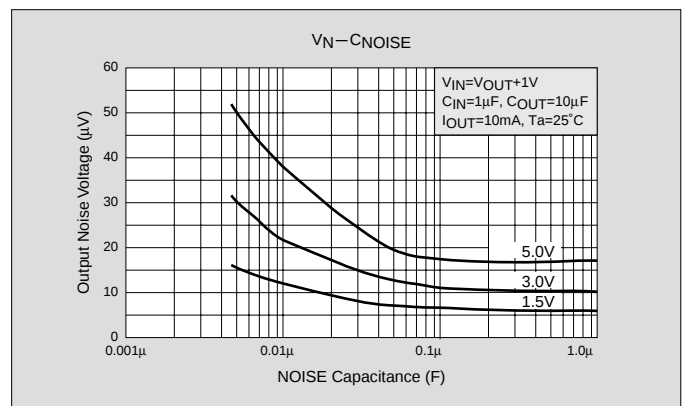
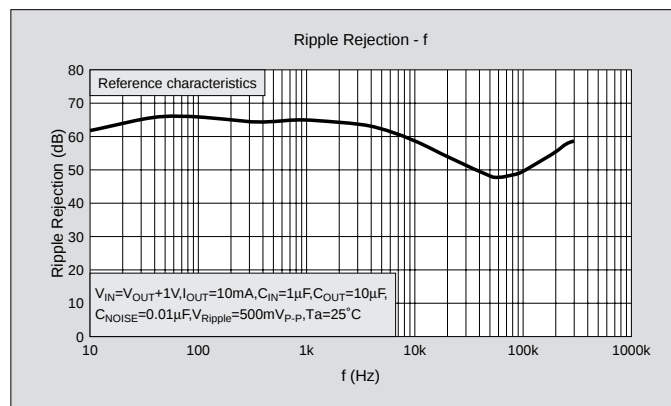
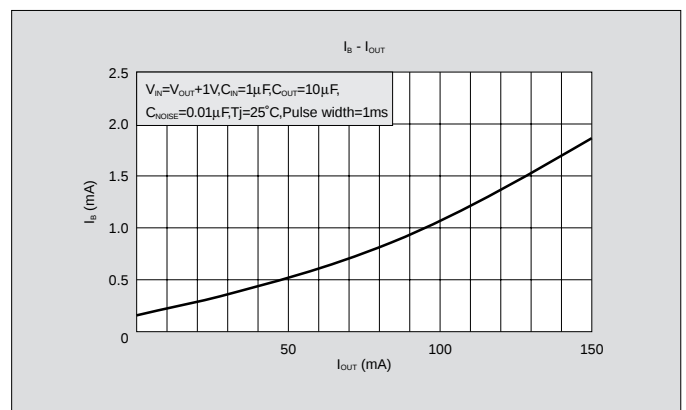
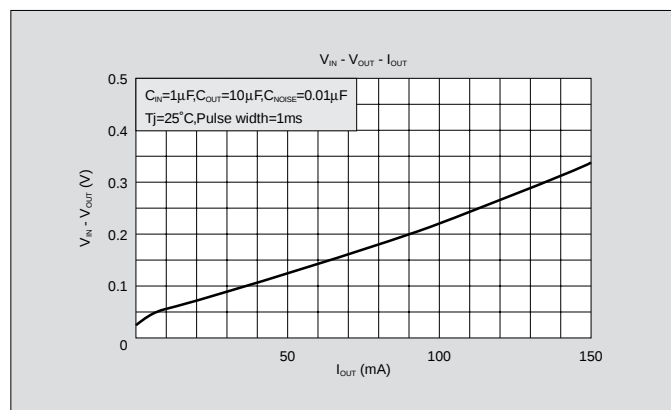
Power dissipation evaluation board



Recommend circuit



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

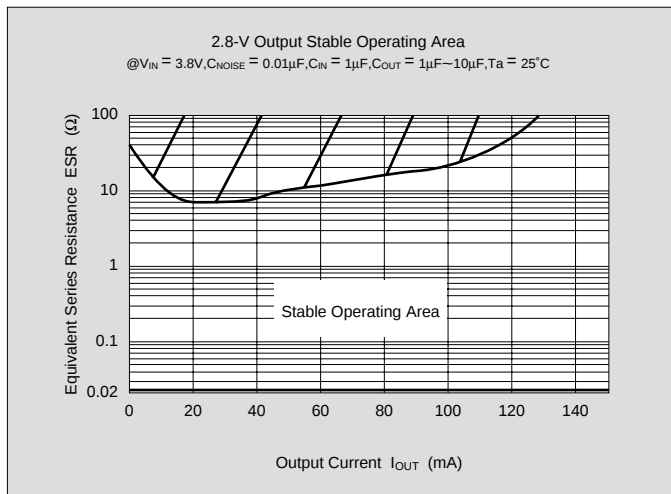
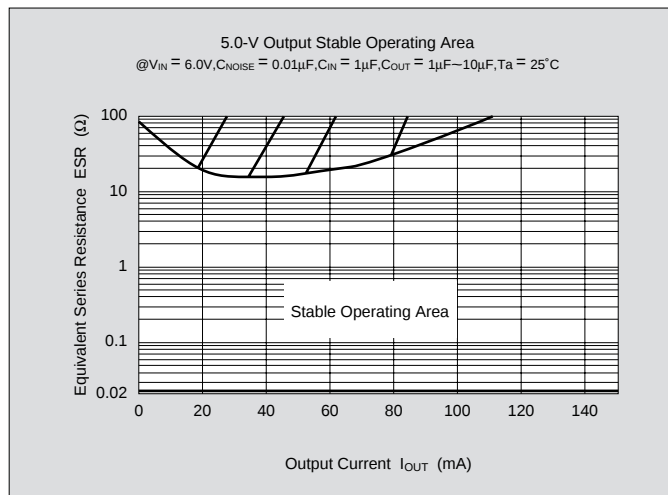
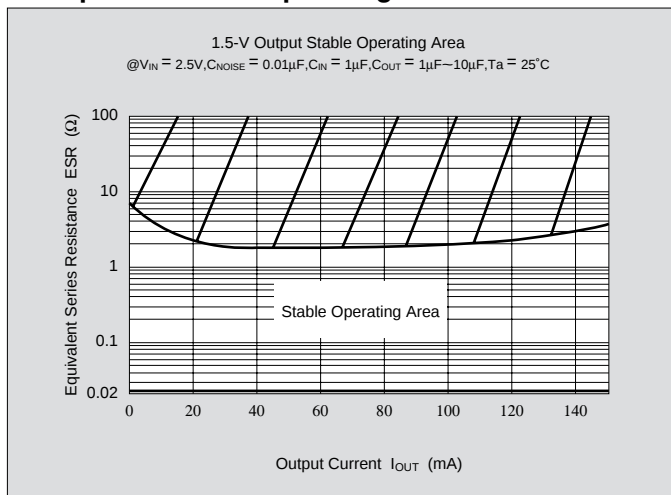


Application Note for TAR5S xx U/TAR5SB xx /TAR5S xx Series

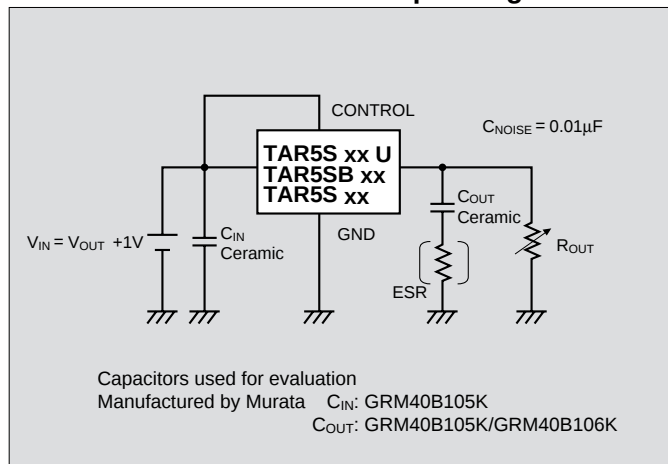
■ Stable Operating Area Characteristics

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

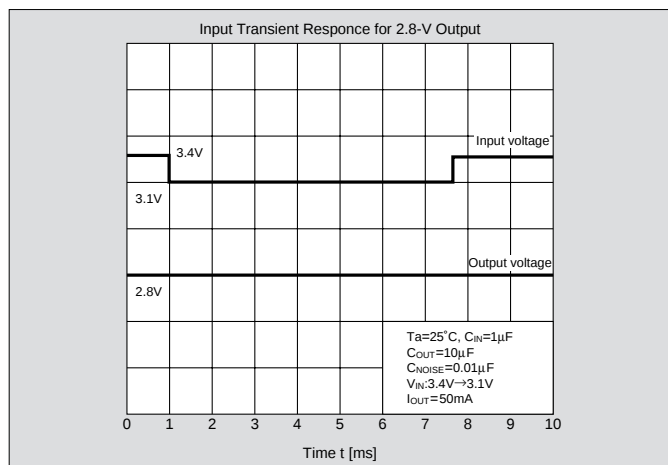


Evaluation Circuit for Stable Operating Area



■ 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.



6. Point Regulator ICs (Low-Dropout Regulators)

6.2 Dual Output type

New Products

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

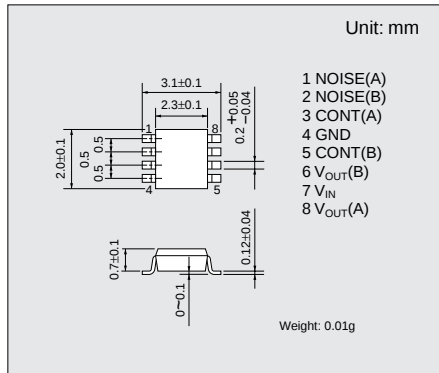
Features

- 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)

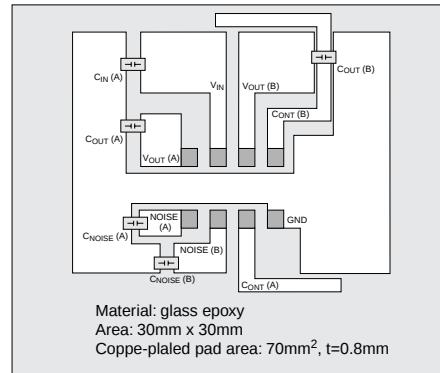
Typical Characteristics

- 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

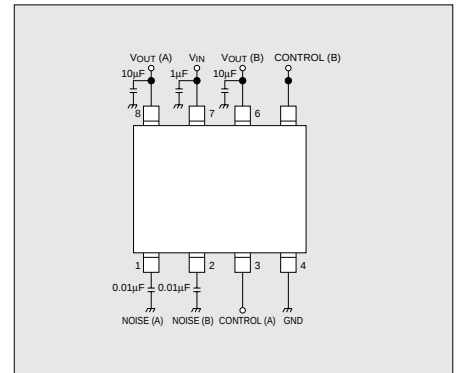
■Package dimensions (pin connection)



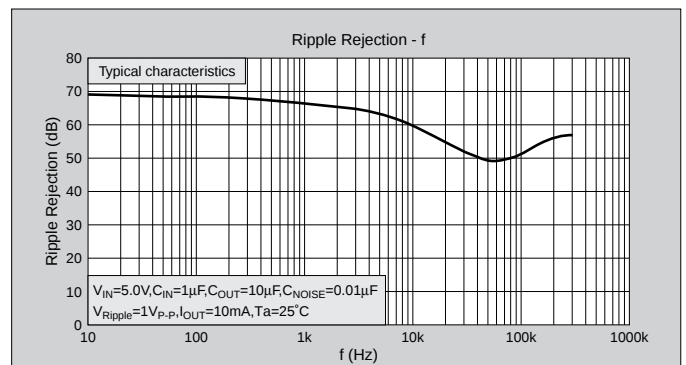
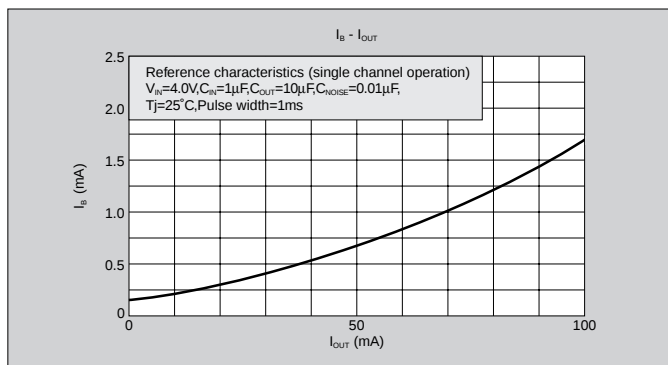
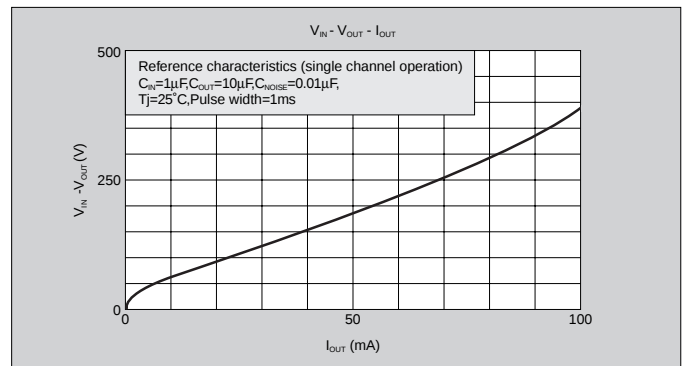
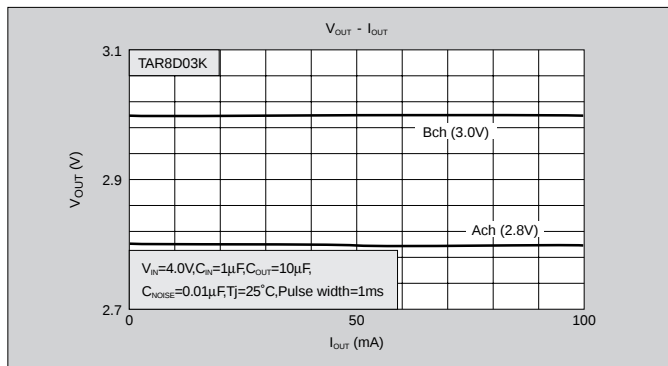
■Power dissipation evaluation board



■Recommended Circuit



■Typical Characteristic curves



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

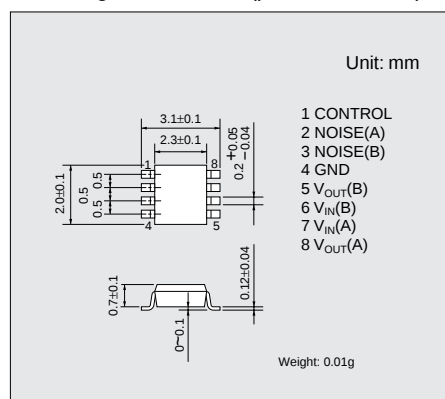
Features

- 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).

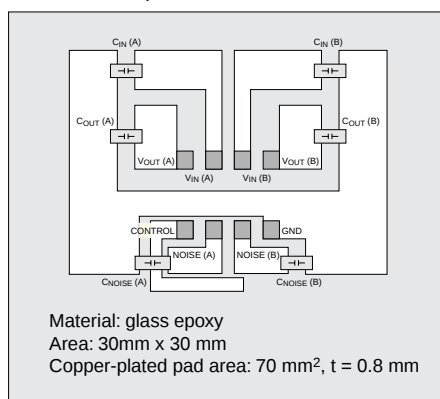
Typical Characteristics

- 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 μVrms (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 μA or less (when control OFF)
- Built-in overtemperature and overcurrent protection circuits

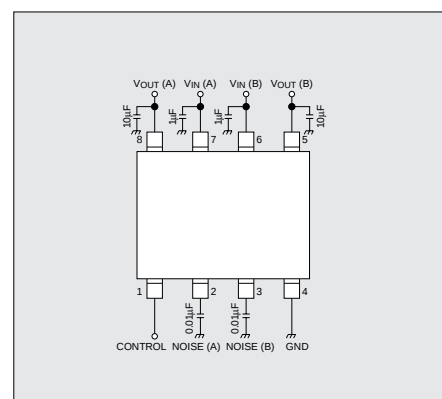
■ Package dimensions (pin connections)



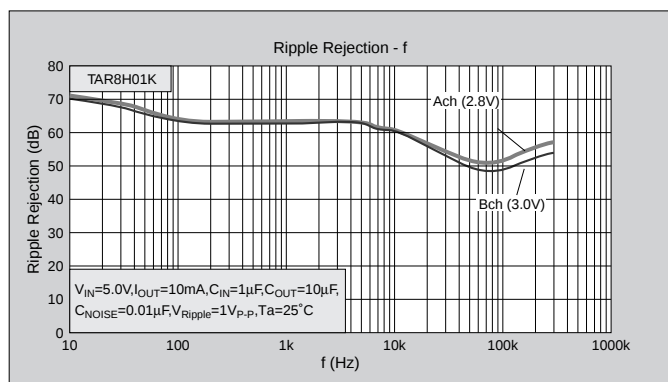
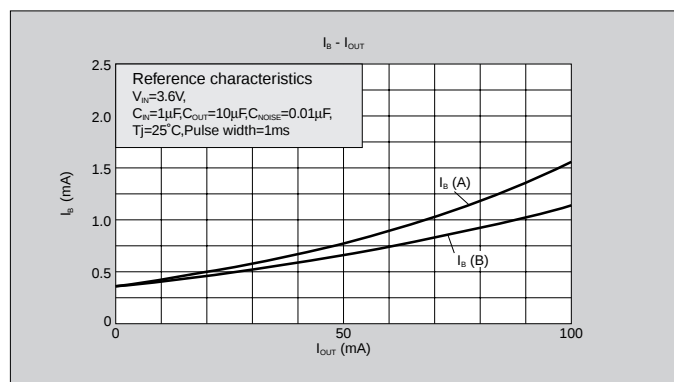
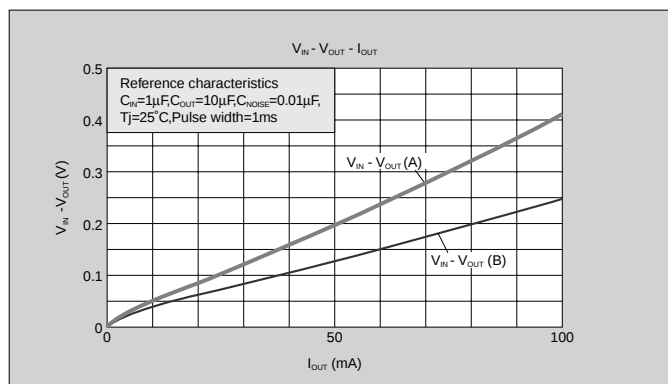
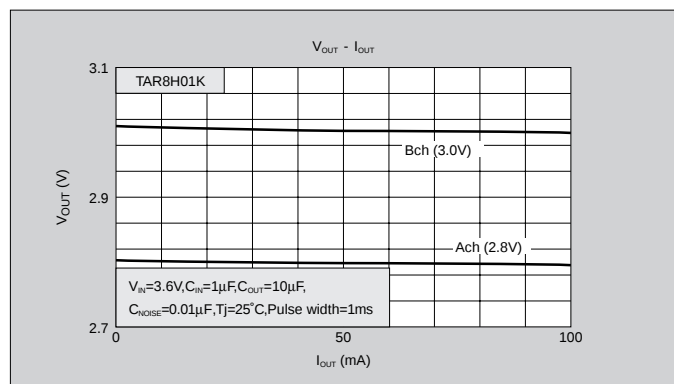
■ Power dissipation evaluation board



■ Recommended circuit



■ Typical characteristic curves



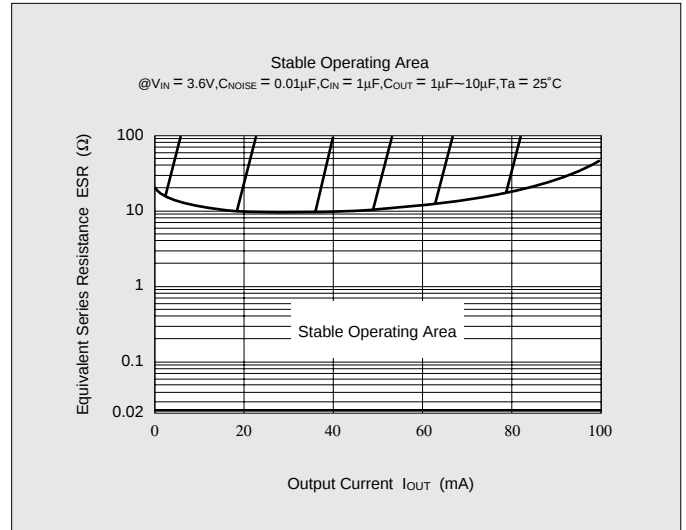
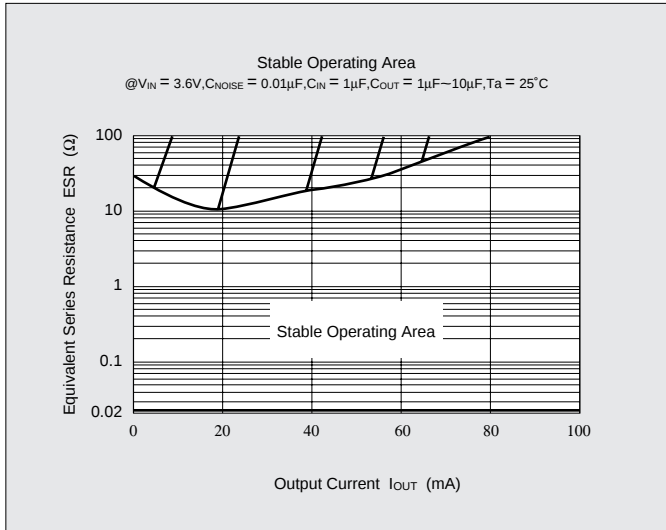
6. Point Regulator ICs (Low-Dropout Regulators)

Application Note for TAR8HxxK Series

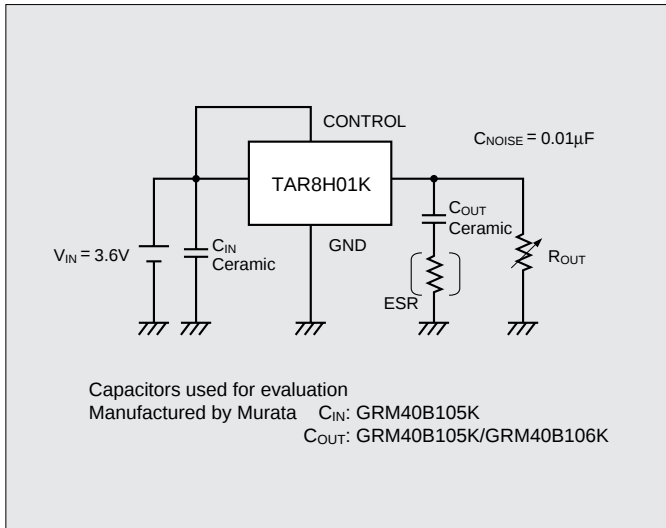
■ Stable Operating Area Characteristics

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



6.3 Product Line-up

6.3.1 Single Output type

New Products

TAR5SxxU Series

Product No.	Output Voltage(V) (@50mA typ)*2			Maximum Rating		Package
	Min	Typ.	Max	Output Current (mA)	Power Dissipation (mW)*1	
TAR5S15U	1.44	1.5	1.56	200	450	UFV
TAR5S18U	1.74	1.8	1.86			
TAR5S25U	2.43	2.5	2.57			
TAR5S28U	2.73	2.8	2.87			
TAR5S29U	2.83	2.9	2.97			
TAR5S30U	2.92	3.0	3.08			
TAR5S33U	3.21	3.3	3.39			

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

*2: Other output voltage products can be realized by 0.1V step between 1.5V and 5.0V range.

New Products

TAR5SBxx Series

Product No.	Output Voltage(V) (@50mA typ)*4			Maximum Rating		Package
	Min	Typ.	Max	Output Current (mA)	Power Dissipation (mW)*3	
TAR5SB15	1.44	1.5	1.56	200	380	SMV (SC-74A) (SOT-25)
TAR5SB18	1.74	1.8	1.86			
TAR5SB23	2.24	2.3	2.36			
TAR5SB24	2.34	2.4	2.46			
TAR5SB25	2.43	2.5	2.57			
TAR5SB27	2.63	2.7	2.77			
TAR5SB28	2.73	2.8	2.87			
TAR5SB29	2.83	2.9	2.97			
TAR5SB30	2.92	3.0	3.08			
TAR5SB33	3.21	3.3	3.39			

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

*4: Other output voltage products can be realized by 0.1V step between 1.5V and 5.0V range.

TAR5Sxx Series

Product No.	Output Voltage(V) (@50mA typ)			Maximum Rating		Package
	Min	Typ.	Max	Output Current (mA)	Power Dissipation (mW)*3	
TAR5S15	1.44	1.5	1.56	200	380	SMV (SC-74A) (SOT-25)
TAR5S16	1.54	1.6	1.66			
TAR5S17	1.64	1.7	1.76			
TAR5S18	1.74	1.8	1.86			
TAR5S19	1.84	1.9	1.96			
TAR5S20	1.94	2.0	2.06			
TAR5S21	2.04	2.1	2.16			
TAR5S22	2.14	2.2	2.26			
TAR5S23	2.24	2.3	2.36			
TAR5S24	2.34	2.4	2.46			
TAR5S25	2.43	2.5	2.57			
TAR5S26	2.53	2.6	2.67			
TAR5S27	2.63	2.7	2.77			
TAR5S28	2.73	2.8	2.87			
TAR5S29	2.83	2.9	2.97			
TAR5S30	2.92	3.0	3.08			
TAR5S31	3.02	3.1	3.18			
TAR5S32	3.12	3.2	3.28			
TAR5S33	3.21	3.3	3.39			
TAR5S34	3.31	3.4	3.49			
TAR5S35	3.41	3.5	3.59			
TAR5S45	4.38	4.5	4.62			
TAR5S48	4.68	4.8	4.92			
TAR5S50	4.87	5.0	5.13			

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

6. Point Regulator ICs (Low-Dropout Regulators)

6.3.2 Dual Output type

New Products

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)

Product No.	Ch	Output Voltage (V)				Maximum Rating		Package
		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			

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)

Product No.	Ch	Output Voltage (V)				Maximum Rating		Package
		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		

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.

7. Op Amp Comparator ICs

7.1 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			
Product No.	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 products 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			
Product No.	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, 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 products

7. Op Amp Comparator ICs

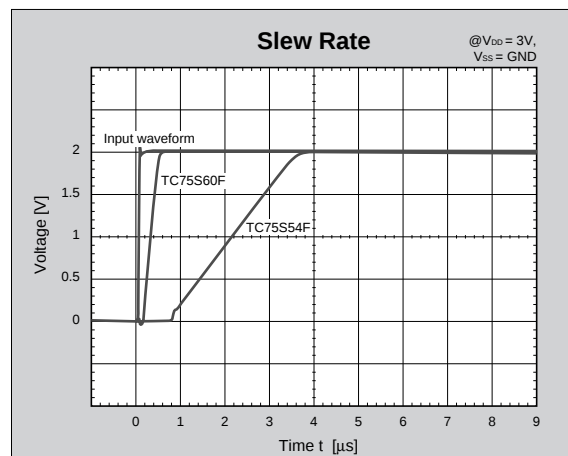
7.2 New Product

New Products

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

Features

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



Line-up

	Product No.	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

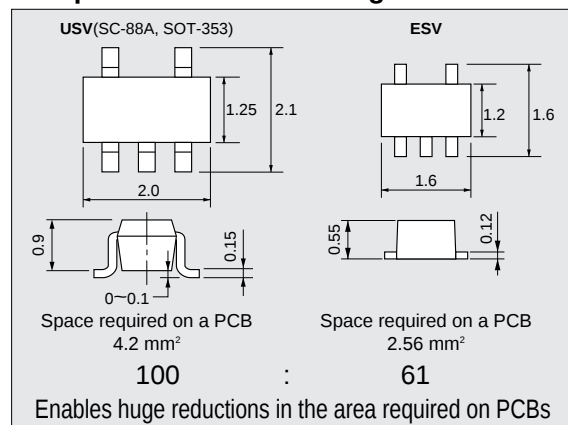
CMOS Op Amps and Comparator ICs Housed in ESV Package

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



7.3 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: $V_{DD}-0.1V@V_{DD}=3V, R_L=100k\Omega$
- Single and dual power supplies are used.
 - 1.5 V $\sim$ 7 V: TC75S51F Series
 - 1.8 V $\sim$ 7 V: TC75S54F/55F Series

Line-up

	Product No.	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 $\sim$ 7 V,
- Full-swing output

Line-up

	Product No.	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		

7. Op Amp Comparators ICs

Power Supply Current in CMOS Op Amp ICs

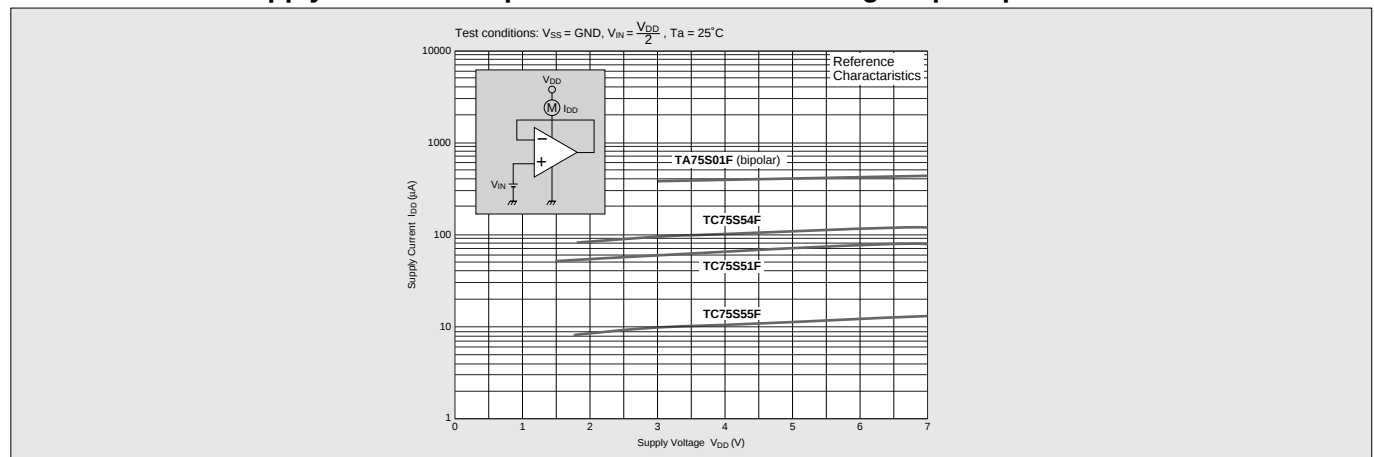
Power supply current in CMOS operational amplifiers varies depending on the use conditions.

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.

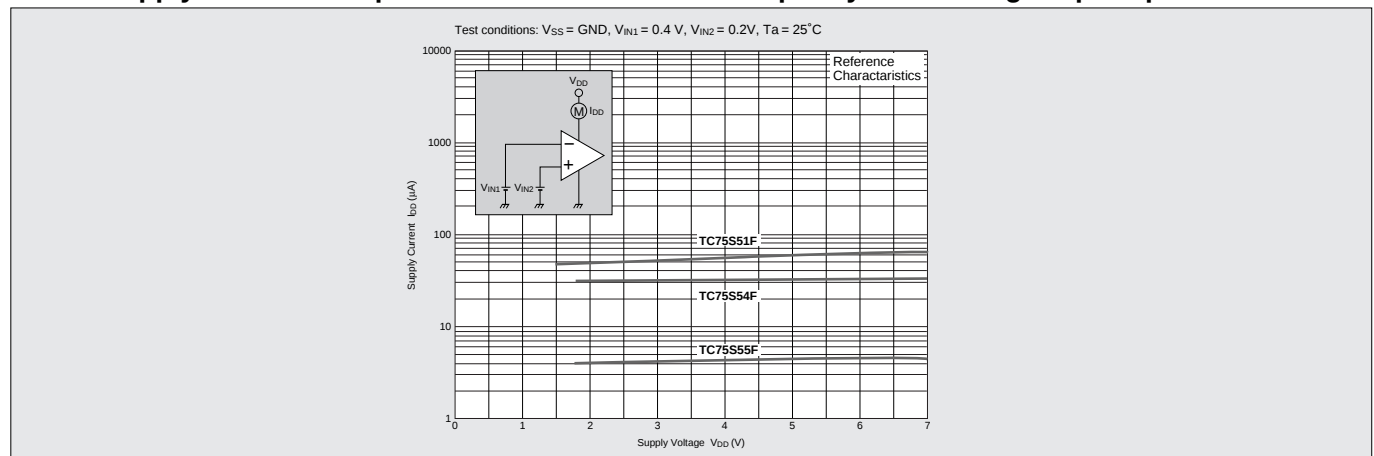
Toshiba's line-up features several types of CMOS operational amplifier, each with individual features. In principle, Toshiba design for low-voltage operation and low power supply current.

Comparison data for CMOS operational amplifier power supply current are shown below.

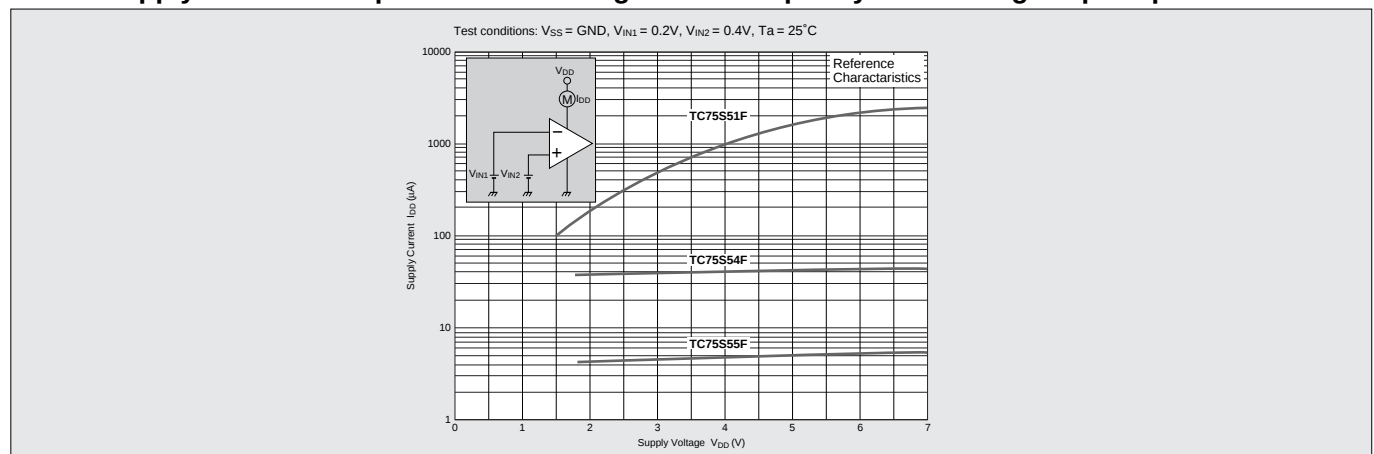
Standard Power Supply Current Comparison Data for CMOS Single Op Amp



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



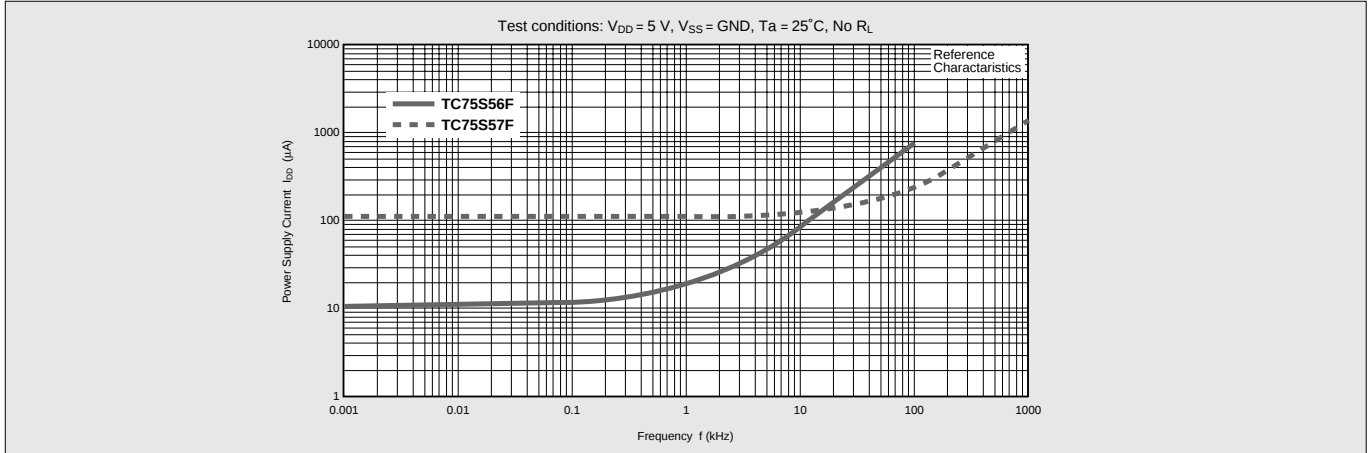
Power Supply Current Comparison Data at High-Level Output by CMOS Single Op Amp



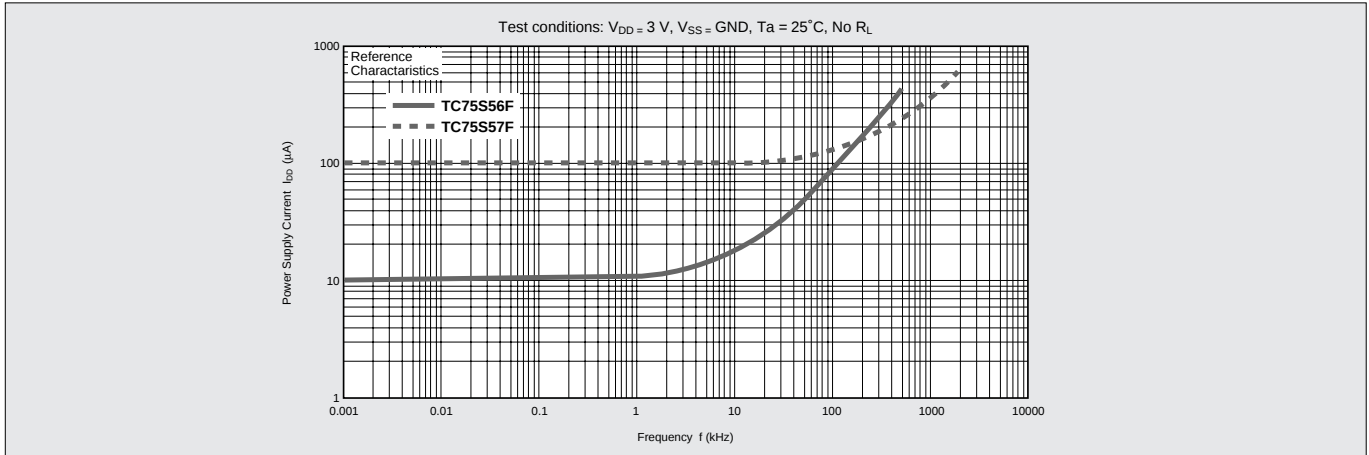
Power Supply Current and Frequency Characteristics in CMOS Comparator ICs

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	1.8~7.0 V	1.8~7.0 V	3.0~12.0 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 ($V_{CC} = 5\text{ V}$)

8. Products line-up for Oversea's factory which located in Malaysia and Thailand.

Diodes

Products Number	Package Name			Production		Page
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	
1SS181	S-MINI	SC-59	SOT-346			17
1SS184	S-MINI	SC-59	SOT-346			17
1SS187	S-MINI	SC-59	SOT-346			-
1SS190	S-MINI	SC-59	SOT-346			-
1SS193	S-MINI	SC-59	SOT-346			17
1SS196	S-MINI	SC-59	SOT-346			17
1SS226	S-MINI	SC-59	SOT-346			17
1SS250	S-MINI	SC-59	SOT-346			17
1SS294	S-MINI	SC-59	SOT-346			18
1SS300	USM	SC-70	SOT-323			17
1SS301	USM	SC-70	SOT-323			17
1SS302	USM	SC-70	SOT-323			17
1SS322	USM	SC-70	SOT-323			18

FETs

Products Number	Package Name			Production		Page
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	
2SK208	S-MINI	SC-59	SOT-346			16
2SK209	S-MINI	SC-59	SOT-346			16
2SK879	USM	SC-70	SOT-323			16
2SK880	USM	SC-70	SOT-323			16

Transistors

Products Number	Package Name			Production		Page
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	
2SA1162	S-MINI	SC-59	SOT-346			8
2SA1163	S-MINI	SC-59	SOT-346			8
2SA1182	S-MINI	SC-59	SOT-346			8
2SA1298	S-MINI	SC-59	SOT-346			8
2SA1313	S-MINI	SC-59	SOT-346			8
2SA1362	S-MINI	SC-59	SOT-346			8
2SA1586	USM	SC-70	SOT-323			8
2SA1587	USM	SC-70	SOT-323			8
2SA1588	USM	SC-70	SOT-323			8
2SC2712	S-MINI	SC-59	SOT-346			8
2SC2713	S-MINI	SC-59	SOT-346			8
2SC2859	S-MINI	SC-59	SOT-346			8
2SC3265	S-MINI	SC-59	SOT-346			8
2SC3295	S-MINI	SC-59	SOT-346			8
2SC3325	S-MINI	SC-59	SOT-346			8
2SC3326	S-MINI	SC-59	SOT-346			8
2SC4116	USM	SC-70	SOT-323			8
2SC4117	USM	SC-70	SOT-323			8
2SC4118	USM	SC-70	SOT-323			8
2SC4213	USM	SC-70	SOT-323			8
2SC4666	USM	SC-70	SOT-323			8
2SC4667	USM	SC-70	SOT-323			8

BRTs

Products Number	Package Name			Production		Page
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	
RN1301	USM	SC-70	SOT-323			10
RN1302	USM	SC-70	SOT-323			10
RN1303	USM	SC-70	SOT-323			10
RN1304	USM	SC-70	SOT-323			10
RN1305	USM	SC-70	SOT-323			10

Products Number	Package Name			Production		Page
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	
RN1306	USM	SC-70	SOT-323			10
RN1307	USM	SC-70	SOT-323			10
RN1308	USM	SC-70	SOT-323			10
RN1309	USM	SC-70	SOT-323			10
RN1310	USM	SC-70	SOT-323			10
RN1311	USM	SC-70	SOT-323			10
RN1401	S-MINI	SC-59	SOT-346			10
RN1402	S-MINI	SC-59	SOT-346			10
RN1403	S-MINI	SC-59	SOT-346			10
RN1404	S-MINI	SC-59	SOT-346			10
RN1405	S-MINI	SC-59	SOT-346			10
RN1406	S-MINI	SC-59	SOT-346			10
RN1407	S-MINI	SC-59	SOT-346			10
RN1408	S-MINI	SC-59	SOT-346			10
RN1409	S-MINI	SC-59	SOT-346			10
RN1410	S-MINI	SC-59	SOT-346			10
RN2301	S-MINI	SC-59	SOT-346			10
RN2302	USM	SC-70	SOT-323			10
RN2303	USM	SC-70	SOT-323			10
RN2304	USM	SC-70	SOT-323			10
RN2305	USM	SC-70	SOT-323			10
RN2306	USM	SC-70	SOT-323			10
RN2307	USM	SC-70	SOT-323			10
RN2308	USM	SC-70	SOT-323			10
RN2309	USM	SC-70	SOT-323			10
RN2310	USM	SC-70	SOT-323			10
RN2311	USM	SC-70	SOT-323			10
RN2401	USM	SC-70	SOT-323			10
RN2402	S-MINI	SC-59	SOT-346			10
RN2403	S-MINI	SC-59	SOT-346			10
RN2404	S-MINI	SC-59	SOT-346			10
RN2405	S-MINI	SC-59	SOT-346			10
RN2406	S-MINI	SC-59	SOT-346			10
RN2407	S-MINI	SC-59	SOT-346			10
RN2408	S-MINI	SC-59	SOT-346			10
RN2409	S-MINI	SC-59	SOT-346			10
RN1405	S-MINI	SC-59	SOT-346			10
RN2410	S-MINI	SC-59	SOT-346			10
RN2411	S-MINI	SC-59	SOT-346			10

MCDs

Products Number	Package Name			Production		Page
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	
HN1A01F	SM6	SC-74	SOT-26			9
HN1A01FU	US6	SC-88A	SOT-363			9
HN1B01F	SM6	SC-74	SOT-26			9
HN1B04FU	US6	SC-88A	SOT-363			9
HN1C01F	SM6	SC-74	SOT-26			9
HN1C01FU	US6	SC-88A	SOT-363			9
HN1C03F	SM6	SC-74	SOT-26			9
HN1D01F	SM6	SC-74	SOT-26			17
HN1D01FU	US6	SC-88A	SOT-363			17
HN1D02F	SM6	SC-74	SOT-26			17
HN1D02FU	US6	SC-88A	SOT-363			17
HN1D03F	SM6	SC-74	SOT-26			17
HN1D03FU	US6	SC-88A	SOT-363			17
HN1K02FU	US6	SC-88A	SOT-363			12
HN1K03FU	US6	SC-88A	SOT-363			12
HN1L02FU	US6	SC-88A	SOT-363			12

Products Number	Package Name			Production		Page
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	
HN2D01F	SM6	SC-74	SOT-26			17
HN2S01F	SM6	SC-74	SOT-26			18
HN2B01F	SM6	SC-74	SOT-26			-
HN7G01FU	US6	SC-88	SOT-363			-
RN1601	SM6	SC-74	SOT-26			11
RN1602	SM6	SC-74	SOT-26			11
RN1603	SM6	SC-74	SOT-26			11
RN1604	SM6	SC-74	SOT-26			11
RN1605	SM6	SC-74	SOT-26			11
RN1606	SM6	SC-74	SOT-26			11
RN1607	SM6	SC-74	SOT-26			11
RN1608	SM6	SC-74	SOT-26			11
RN1609	SM6	SC-74	SOT-26			11
RN1610	SM6	SC-74	SOT-26			11
RN1611	SM6	SC-74	SOT-26			11
RN1901	US6	SC-88	SOT-363			11
RN1902	US6	SC-88	SOT-363			11
RN1903	US6	SC-88	SOT-363			11
RN1904	US6	SC-88	SOT-363			11
RN1905	US6	SC-88	SOT-363			11
RN1906	US6	SC-88	SOT-363			11
RN1907	US6	SC-88	SOT-363			11
RN1908	US6	SC-88	SOT-363			11
RN1909	US6	SC-88	SOT-363			11
RN1910	US6	SC-88	SOT-363			11
RN1911	US6	SC-88	SOT-363			11
RN2601	SM6	SC-74	SOT-26			11
RN2602	SM6	SC-74	SOT-26			11
RN2603	SM6	SC-74	SOT-26			11
RN2604	SM6	SC-74	SOT-26			11
RN2605	SM6	SC-74	SOT-26			11
RN2606	SM6	SC-74	SOT-26			11
RN2607	SM6	SC-74	SOT-26			11
RN2608	SM6	SC-74	SOT-26			11
RN2609	SM6	SC-74	SOT-26			11
RN2610	SM6	SC-74	SOT-26			11
RN2611	SM6	SC-74	SOT-26			11
RN2901	US6	SC-88	SOT-363			11
RN2902	US6	SC-88	SOT-363			11
RN2903	US6	SC-88	SOT-363			11
RN2904	US6	SC-88	SOT-363			11
RN2905	US6	SC-88	SOT-363			11
RN2906	US6	SC-88	SOT-363			11
RN2907	US6	SC-88	SOT-363			11
RN2908	US6	SC-88	SOT-363			11
RN2909	US6	SC-88	SOT-363			11
RN2910	US6	SC-88	SOT-363			11
RN2911	US6	SC-88	SOT-363			11
RN4601	SM6	SC-74	SOT-26			11
RN4602	SM6	SC-74	SOT-26			11
RN4603	SM6	SC-74	SOT-26			11
RN4604	SM6	SC-74	SOT-26			11
RN4605	SM6	SC-74	SOT-26			11
RN4606	SM6	SC-74	SOT-26			11
RN4607	SM6	SC-74	SOT-26			11
RN4608	SM6	SC-74	SOT-26			11
RN4609	SM6	SC-74	SOT-26			11
RN4610	SM6	SC-74	SOT-26			11
RN4611	SM6	SC-74	SOT-26			11
RN4901	US6	SC-88	SOT-363			11

Products Number	Package Name			Production		Page
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	
RN4902	US6	SC-88	SOT-363			11
RN4903	US6	SC-88	SOT-363			11
RN4904	US6	SC-88	SOT-363			11
RN4905	US6	SC-88	SOT-363			11
RN4906	US6	SC-88	SOT-363			11
RN4907	US6	SC-88	SOT-363			11
RN4908	US6	SC-88	SOT-363			11
RN4909	US6	SC-88	SOT-363			11
RN4910	US6	SC-88	SOT-363			11
RN4911	US6	SC-88	SOT-363			11
RN4981	US6	SC-88	SOT-363			11
RN4982	US6	SC-88	SOT-363			11
RN4983	US6	SC-88	SOT-363			11
RN4984	US6	SC-88	SOT-363			11
RN4985	US6	SC-88	SOT-363			11
RN4986	US6	SC-88	SOT-363			11
RN4987	US6	SC-88	SOT-363			11
RN4988	US6	SC-88	SOT-363			11
RN4989	US6	SC-88	SOT-363			11
RN4990	US6	SC-88	SOT-363			11
RN4991	US6	SC-88	SOT-363			11
RN49A1	US6	SC-88	SOT-363			11

L-MOS

Products Number	Package Name			Production		Page
	Toshiba	JEITA	JEDEC	Malaysia	Thailand	
TC4S01F	SMV	SC-74A	SOT-25			24
TC4S11F	SMV	SC-74A	SOT-25			24
TC4S30F	SMV	SC-74A	SOT-25			24
TC4S584F	SMV	SC-74A	SOT-25			24
TC4S66F	SMV	SC-74A	SOT-25			24
TC4S69F	SMV	SC-74A	SOT-25			24
TC4S71F	SMV	SC-74A	SOT-25			24
TC4S81F	SMV	SC-74A	SOT-25			24
TC4SU69F	SMV	SC-74A	SOT-25			24
TC7S00F	SMV	SC-74A	SOT-25			24
TC7S02F	SMV	SC-74A	SOT-25			24
TC7S04F	SMV	SC-74A	SOT-25			24
TC7S08F	SMV	SC-74A	SOT-25			24
TC7S14F	SMV	SC-74A	SOT-25			24
TC7S32F	SMV	SC-74A	SOT-25			24
TC7S66F	SMV	SC-74A	SOT-25			24
TC7S86F	SMV	SC-74A	SOT-25			24
TC7SET00F	SMV	SC-74A	SOT-25			24
TC7SET02F	SMV	SC-74A	SOT-25			24
TC7SET04F	SMV	SC-74A	SOT-25			24
TC7SET08F	SMV	SC-74A	SOT-25			24
TC7SET32F	SMV	SC-74A	SOT-25			24
TC7SET86F	SMV	SC-74A	SOT-25			24
TC7SH00F	SMV	SC-74A	SOT-25			24
TC7SH02F	SMV	SC-74A	SOT-25			24
TC7SH04F	SMV	SC-74A	SOT-25			24
TC7SH08F	SMV	SC-74A	SOT-25			24
TC7SH14F	SMV	SC-74A	SOT-25			24
TC7SH32F	SMV	SC-74A	SOT-25			24
TC7SH86F	SMV	SC-74A	SOT-25			24
TC7SHU04F	SMV	SC-74A	SOT-25			24
TC7SU04F	SMV	SC-74A	SOT-25			24

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(As of May, 2002)

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