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Diodes for Mobile Communications

Application Note

ADE-508-016

Rev.0
Aug. 2001
Hitachi

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Preface

Thank you for purchasing Hitachi semiconductor products.

In recent years, the development of the information technology (IT) industry has become prominent. Specifically, mobile communication is spreading widely due to improvements such as compact, light-weight devices with multi-functions. These improvements were widely adopted in information-data communications other than telecommunication because of their full reservation of communication capacity, improvement of communication quality, and high-privacy function.

With an ample product lineup, Hitachi diodes for mobile communications are widely used in various electronic devices.

The application notes for Hitachi mobile communications describes the electrical characteristics, maximum ratings, packages, reliability, and applications, etc., that are necessary for the user to select the appropriate type for their needs.

There is a demand for smaller, lighter, and lower priced digital mobile phones with longer battery life. Lower loss is also demanded for antenna switching circuits which are the largest cause of high-frequency electrical loss as well as lower prices.

Note that the technical information this document describes are the general characteristics of the product. For detailed data, please contact the Hitachi sales office.

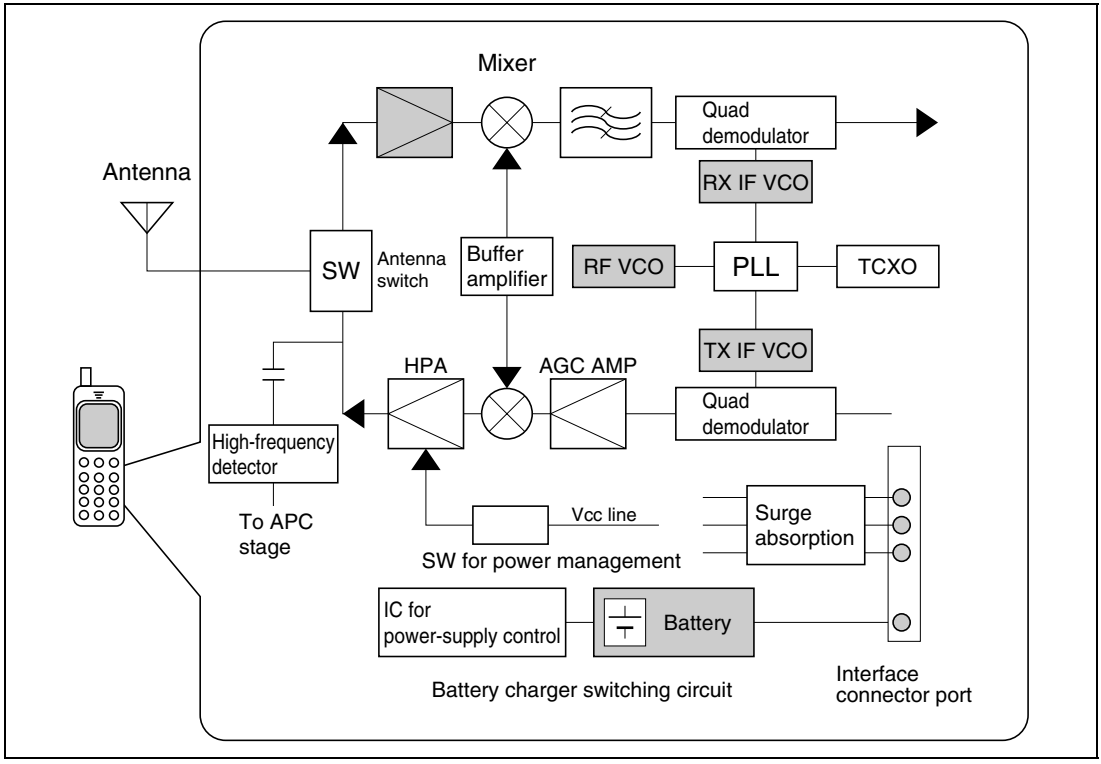
Product specifications may be modified for improvement, so please check the latest information on our website of Semiconductor & Integrated Circuits Group.

Typical applications include use for:

- Digital mobile phones, digital cordless phones,
- Various radio equipment (hand transceivers, mobile transceivers),
- Antenna switches for GSM and PCS, shifting frequency for CDMA, and other communication devices.

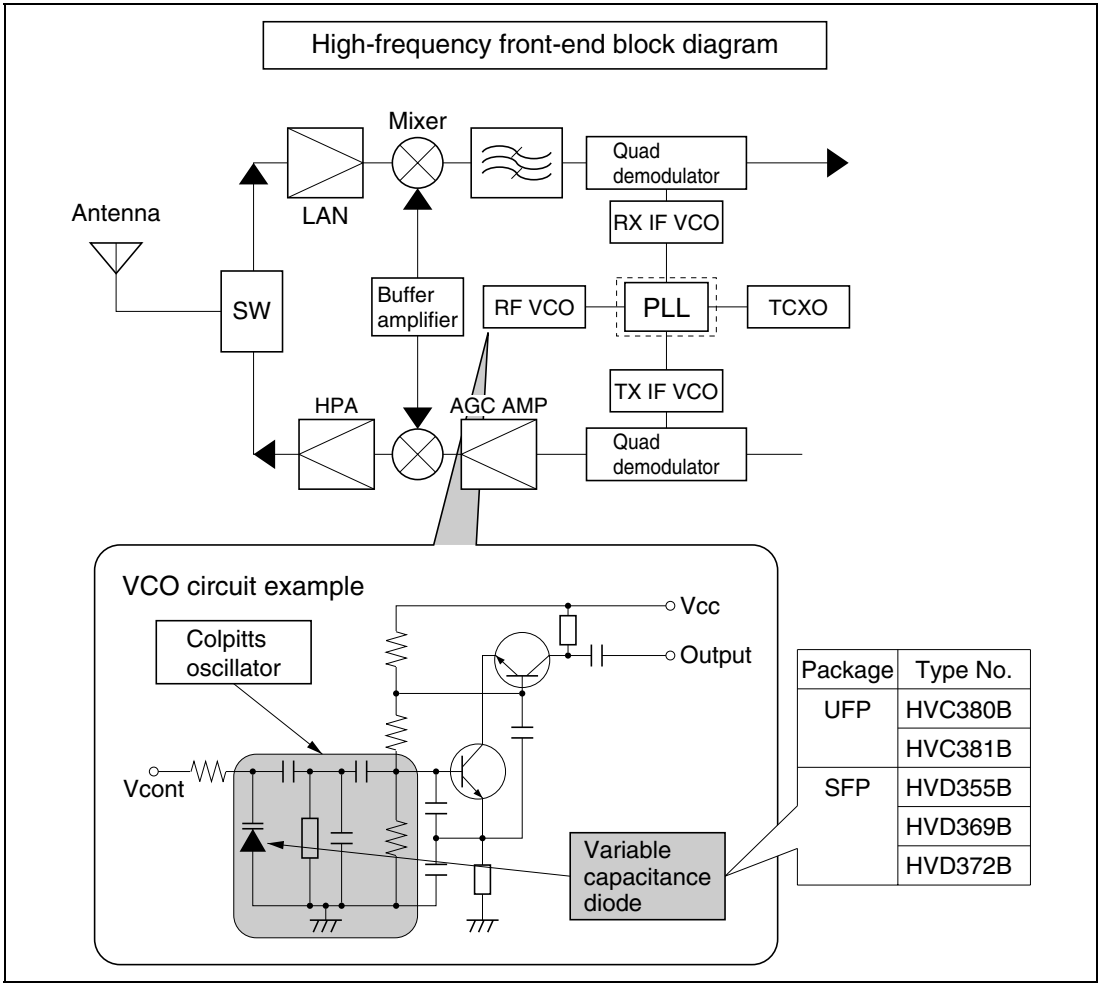
Contents

Described Products



Main applications

- Antenna switching circuit → PIN diodes
- VCO → Variable capacitance diodes
- Frequency signal detection circuit → Schottky barrier diodes
- Reverse current prevention circuit → Schottky barrier diodes
- Serge absorption circuit → Zener diodes



Package	Type No.
UFP	HVC380B
	HVC381B
SFP	HVD355B
	HVD369B
	HVD372B

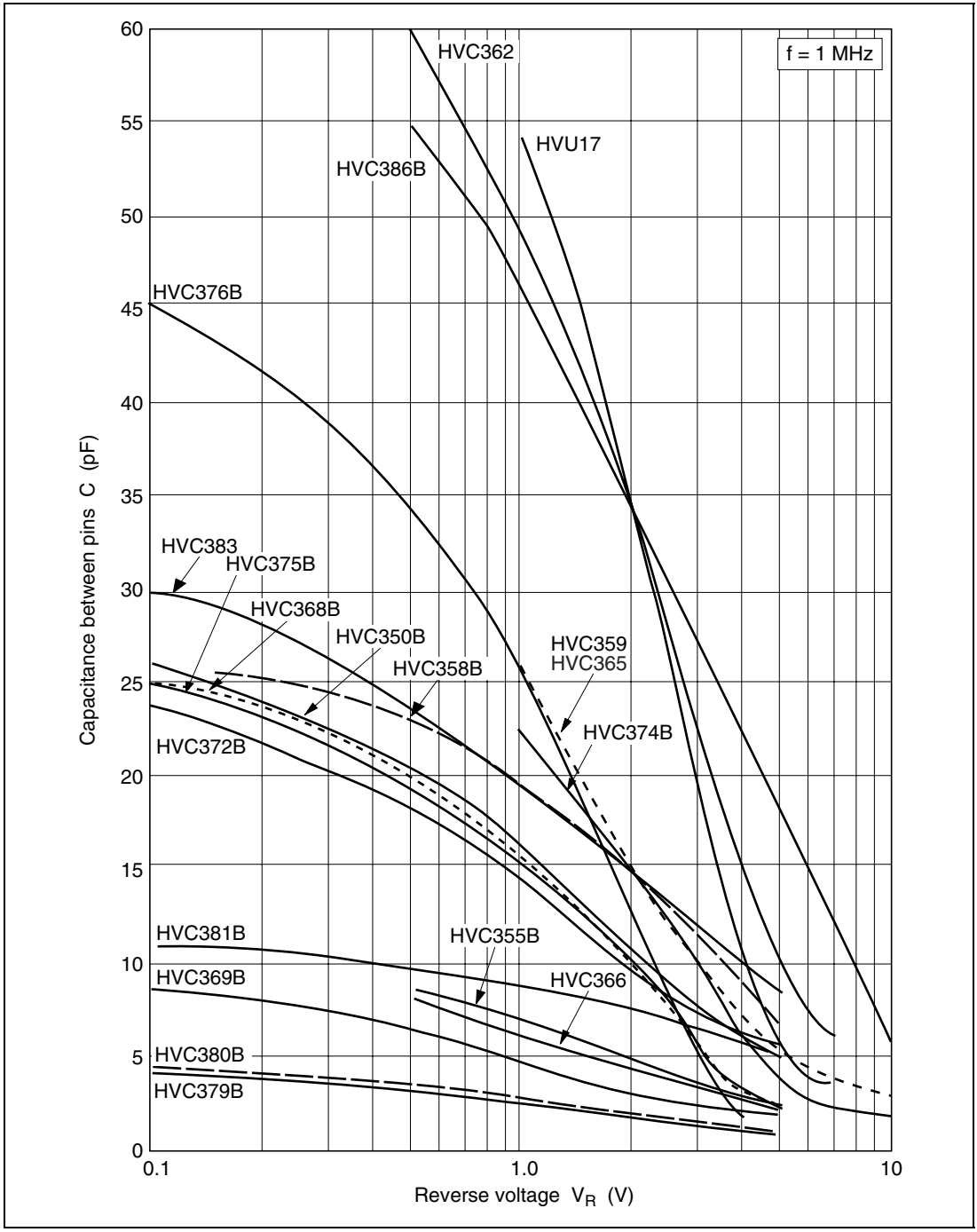
3.1 Characteristics of Variable Capacitance Diode Standard

Application	Type No.	Absolute Maximum Rating (Ta = 25°C)			Electrical Characteristics (Ta = 25°C)																			Package	Type No.
					V_R(V)		I_R(nA)			Q			rs(Ω)			C(pF)				n					
						Test Condition		Test Condition			Test Condition			Test Condition				Test Condition				Test Condition			
		V_R (V)	Tj (°C)	Tstg (°C)	min.	I_R(µA)	max.	V_R(V)	Ta(°C)	min.	V_R(V)	f(MHz)	max.	V_R(V)	f(MHz)	min.	max.	V_R(V)	f(MHz)	min.	max.	$C(V_R)/C(V_R)$	f(MHz)		
For VCO	HVU17	15	125	-55 to +125	15	10	100	9	25	50	2.5	10	—	—	—	50.00	85.00	1	1	5.60	—	1/4.5	1	URP	HVU17
																16.10	27.30	3							
																5.23	8.84	4.5							
	HVU350B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.5	1	470	15.50	17.00	1	1	2.80	—	1/4	1	URP	HVU350B
							100	15	60							5.00	6.00	4							
	HVU355B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.6	1	470	6.40	7.20	1	1	2.20	—	1/4	1	URP	HVU355B
							100	15	60							2.55	2.95	4							
	HVU359	15	125	-55 to +125	—	—	10	10	25	—	—	—	1.5	4	100	24.80	29.80	1	1	3.00	—	1/4	1	URP	HVU359
							100	10	60							6.00	8.30	4							
	HVU383B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.5	1	470	19.00	21.00	1	1	2.00	—	1/4	1	URP	HVU383B
							100	15	60							8.50	10.00	4		3.50	—	1/7			
																4.50	5.50	7							
	HVC350B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.5	1	470	15.50	17.00	1	1	2.00	—	1/4	1	UFP	HVC350B
							100	15	60							5.00	6.00	4							
	HVC355B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.6	1	470	6.40	7.20	1	1	2.20	—	1/4	1	UFP	HVC355B
							100	15	60							2.55	2.95	4							
	HVC358B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.4	1	100	19.50	21.00	1	1	2.20	—	1/4	1	UFP	HVC358B
							100	15	60							8.00	9.30	4							
	HVC359	15	125	-55 to +125	—	—	10	10	25	—	—	—	1.5	4	100	24.80	29.80	1	1	3.00	—	1/4	1	UFP	HVC359
							100	10	60							6.00	8.30	4							
	HVC362	15	125	-55 to +125	—	—	10	10	25	—	—	—	2.0	4	100	41.60	49.90	1	1	3.00	—	1/4	1	UFP	HVC362
							100	10	60							10.10	14.80	4							
	HVC365	15	125	-55 to +125	—	—	10	10	25	—	—	—	1.5	4	100	27.05	28.55	1	1	3.00	—	1/4	1	UFP	HVC365
							100	10	60							6.05	7.55	4							
	HVC366	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.6	1	470	6.30	6.80	1	1	1.39	—	1/2	1	UFP	HVC366
							100	15	60							4.35	4.95	2							
	HVC368B	10	125	-55 to +125	—	—	10	10	25	—	—	—	1.1	2	470	15.00	16.50	1	1	2.20	—	1/3	1	UFP	HVC368B
							100	10	60							9.00	10.20	2							
																5.00	6.00	3							
	HVC369B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.5	1	470	4.65	5.15	1	1	2.30	—	1/4	1	UFP	HVC369B
							100	15	60							1.85	2.15	4							
	HVC372B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.4	1	470	15.00	17.00	1	1	2.00	—	1/4	1	UFP	HVC372B
							100	15	60							7.00	8.50	4							
	HVC374B	10	125	-55 to +125	—	—	10	10	25	—	—	—	1.2	1	470	21.50	24.00	1	1	1.68	1.75	1/2	1	UFP	HVC374B
							100	10	60							12.50	14.50	2							
	HVC375B	10	125	-55 to +125	—	—	10	10	25	—	—	—	1.1	2	470	15.00	16.50	1	1	4.00	—	1/4	1	UFP	HVC375B
							100	10	60							5.00	6.00	3							
																3.30	4.00	4							

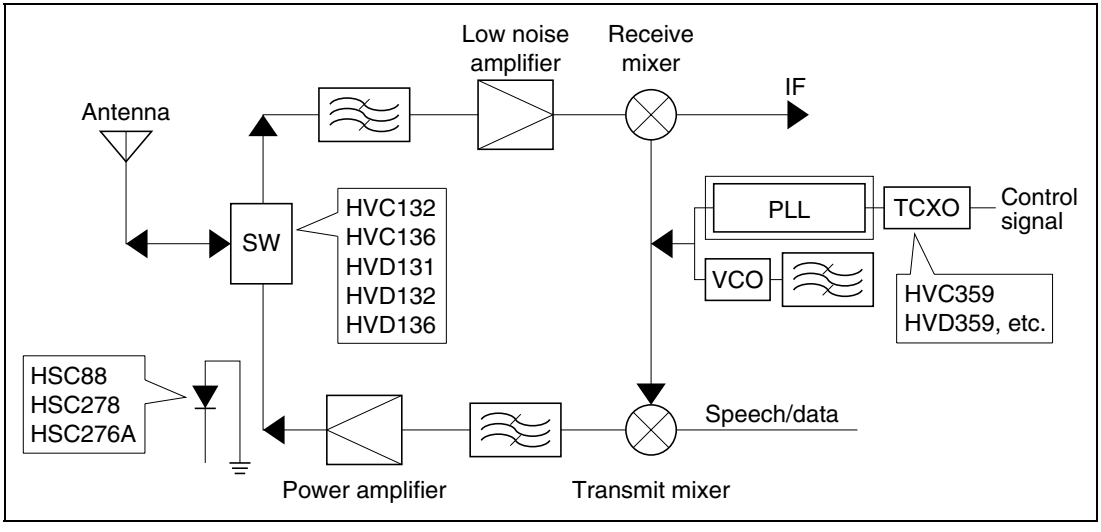
RENESAS

Application	Type No.	Absolute Maximum Rating (Ta = 25°C)			Electrical Characteristics (Ta = 25°C)																				Package	Type No.
					V_R(V)		I_R(nA)			Q				rs(Ω)			C(pF)				n					
		V_R (V)	Tj (°C)	Tstg (°C)	min.	Test Condition I_R(μA)	max.	Test Condition V_R(V)	Test Condition Ta(°C)	min.	Test Condition V_R(V)	Test Condition f(MHz)	max.	Test Condition V_R(V)	Test Condition f(MHz)	min.	max.	Test Condition V_R(V)	Test Condition f(MHz)	min.	max.	Test Condition $C(V_R)/C(V_R)$	Test Condition f(MHz)		
For VCO	HVC376B	15	125	-55 to +125	—	—	10	10	25	—	—	—	0.8	1	470	25.00	28.50	1	1	4.30	—	1/4	1	UFP	HVC376B
							100	10	60							4.80	6.80	4							
	HVC379B	10	125	-55 to +125	—	—	10	10	25	—	—	—	1.0	1	470	2.90	3.20	0.5	1	1.80	—	0.5/2.5	1	UFP	HVC379B
							100	10	60							1.25	1.53	2.5							
	HVC381B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.5	1	470	10.00	11.00	1	1	1.65	—	1/3	1	UFP	HVC381B
							10	15	60							5.80	6.40	3							
	HVC383B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.5	1	470	19.00	21.00	1	1	2.00	—	1/4	1	UFP	HVC383B
							100	15	60							8.50	10.00	4		3.50	—	1/7			
																4.50	5.50	7							
	HVC386B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.9	5	470	43.00	49.00	1	1	1.80	—	1/4	1	UFP	HVC386B
							100	15	60							18.50	25.50	4							
	HVD350B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.5	1	470	15.50	17.00	1	1	2.80	—	1/4	1	SFP	HVD350B
							100	15	60							5.00	6.00	4							
	HVD355B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.6	1	470	6.40	7.20	1	1	2.80	—	1/4	1	SFP	HVD355B
							100	15	60							2.55	2.95	4							
	HVD358B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.4	1	470	19.50	21.00	1	1	2.20	—	1/4	1	SFP	HVD358B
							100	10	60							8.00	9.30	4							
	HVD359	15	125	-55 to +125	—	—	10	10	25	—	—	—	1.5	4	100	24.80	29.80	1	1	3.00	—	1/4	1	SFP	HVD359
							100	10	60							6.00	8.30	4							
	HVD365	15	125	-55 to +125	—	—	10	10	25	—	—	—	1.5	4	100	27.05	28.55	1	1	3.00	—	1/4	1	SFP	HVD365
							100	10	60							6.05	7.55	4							
	HVD368B	10	125	-55 to +125	—	—	10	10	25	—	—	—	1.1	2	470	15.00	16.50	1	1	2.20	—	1/3	1	SFP	HVD368B
							100	10	60							9.00	10.20	2							
																5.00	6.00	3							
	HVD369B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.5	1	470	4.65	5.15	1	1	2.30	—	1/4	1	SFP	HVD369B
							100	15	60							1.85	2.15	4							
	HVD372B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.4	1	470	15.00	17.00	1	1	2.00	—	1/4	1	SFP	HVD372B
							100	15	60							7.00	8.50	4							
	HVD381B	15	125	-55 to +125	—	—	10	15	25	—	—	—	0.5	1	470	10.00	11.00	1	1	1.65	—	1/3	1	SFP	HVD381B
							10	15	60							5.80	6.40	3							

3.2 Characteristics of Variable Capacitance Diodes



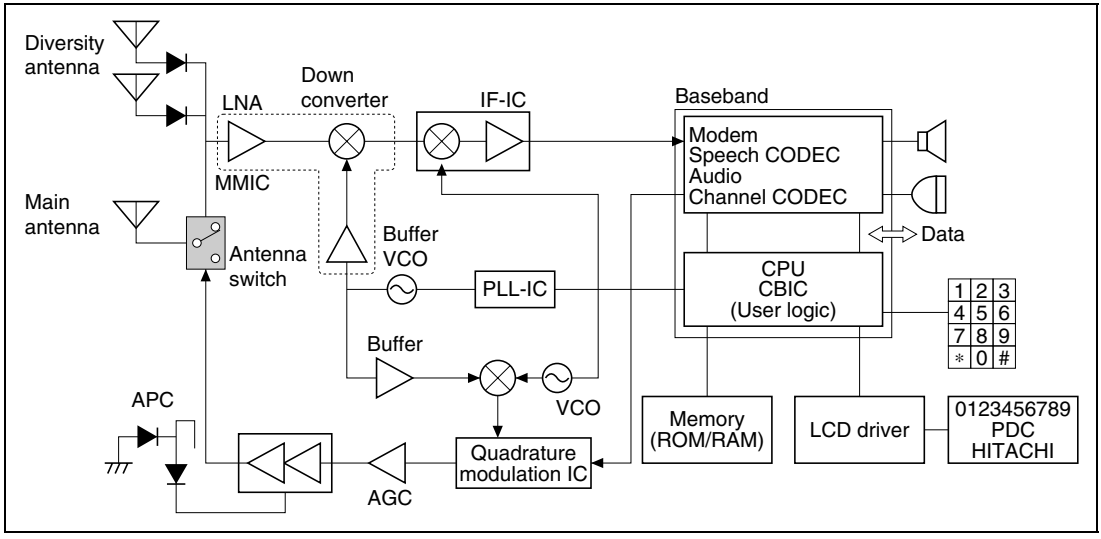
3.3 Digital Cellular Phone



Variable Capacitance Diodes

to 200 MHz	200 to 400 MHz	300 to 500 MHz	500 to 1000 MHz	1 to 3 GHz
Cordless phones	Pagers Marine telecoms	Cordless phones Taxi radios	Vehicle phones MCA Mobile phones	Digital cordless phones Marine satellite communications GPS
HVU359 HVC359 HVD359	HVC350B, HVU350B, HVC375B, HVC368B			HVU355B HVC355B HVD355B
HVC362	HVC359, HVU359, HVD369B			HVC369B HVD369B
HVU369B HVC374B	HVC358B			HVC379B
HVC376B	HVC372B, HVD372B			HVC380B

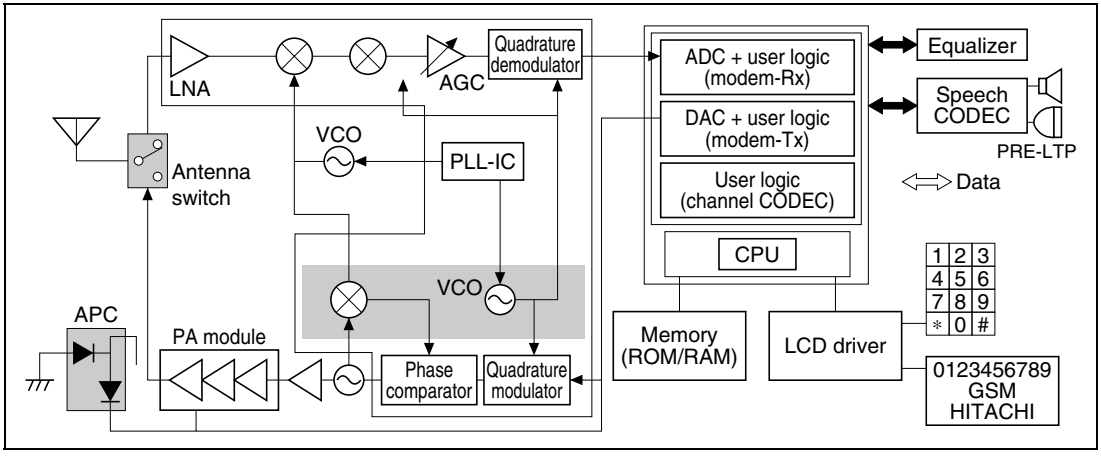
3.4 PDC System Configuration Example



Diodes for PDC

Block		Product	Features	
For RF power control		HSB276AS, HSC278, HSC88, etc.	Low VF, small package	
RF discrete	For VCO	HVC350B/358B/372B	to 1 GHz	Variable capacitance diodes with high capacitance change ratio and low serial resistance
		HVC355B/369B	1 to 3 GHz	
For antenna switch For diversity antenna switch (reel type)		HVC131 to 134/135/136 HVD131, etc.	Low loss, small package (PIN diodes)	
Surge protection of data input/output part		HZM6.8ZMFA, etc.	Low capacitance, high surge tolerance, ample lineup	

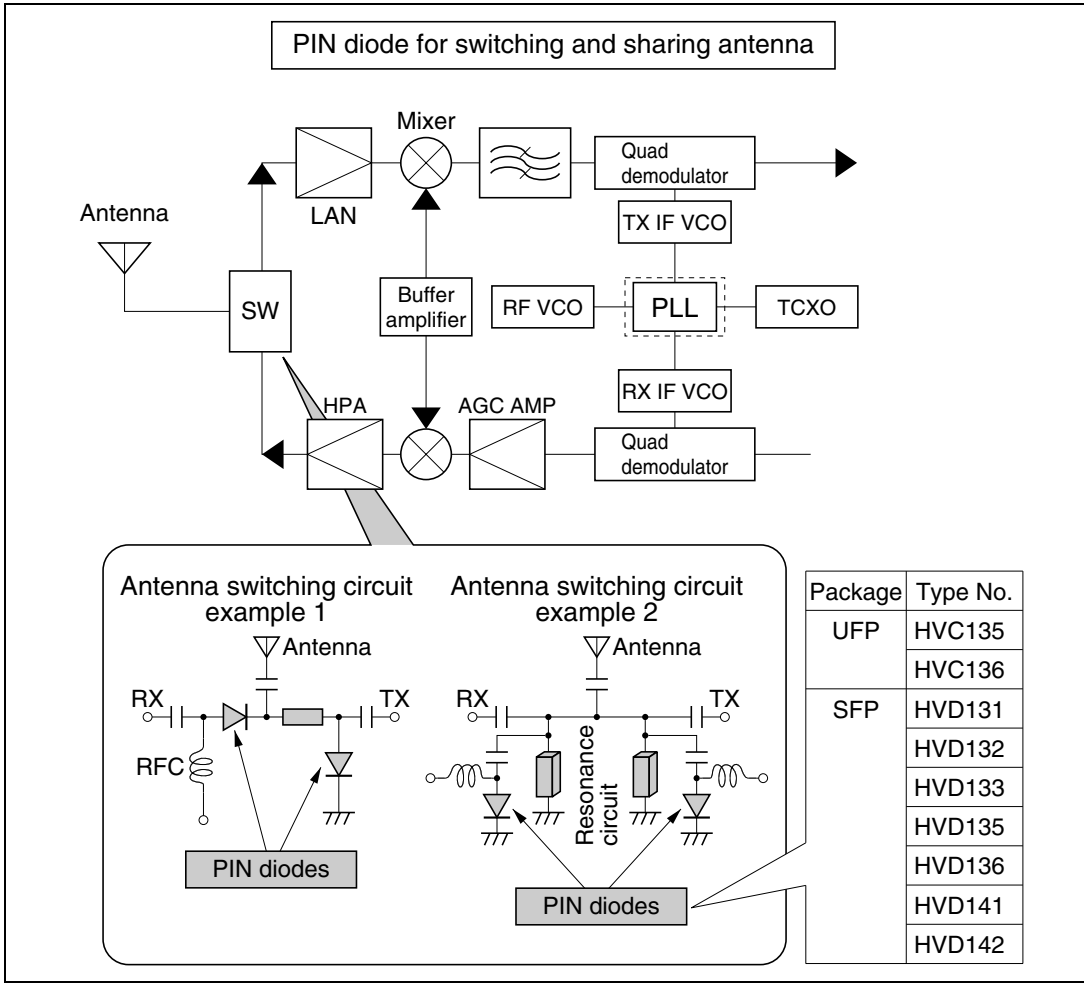
3.5 GSM System Configuration Example



Diodes for GSM

Block		Product	Features	
For RF power control		HSB276A, HSC278, HSC88, etc.	Low VF, small package	
RF discrete	For VCO	HVC350B/358B/372B	to 1 GHz	Variable capacitance diodes with high capacitance change ratio and low serial resistance
		HVC355B/369B, etc.	1 to 3 GHz	
For antenna switch		HVC131 to 134/135/136	Low loss, small package (PIN diodes)	
Surge protection of data input/output part		HZM6.8ZMFA, etc.	Low capacitance, high surge tolerance, ample lineup	

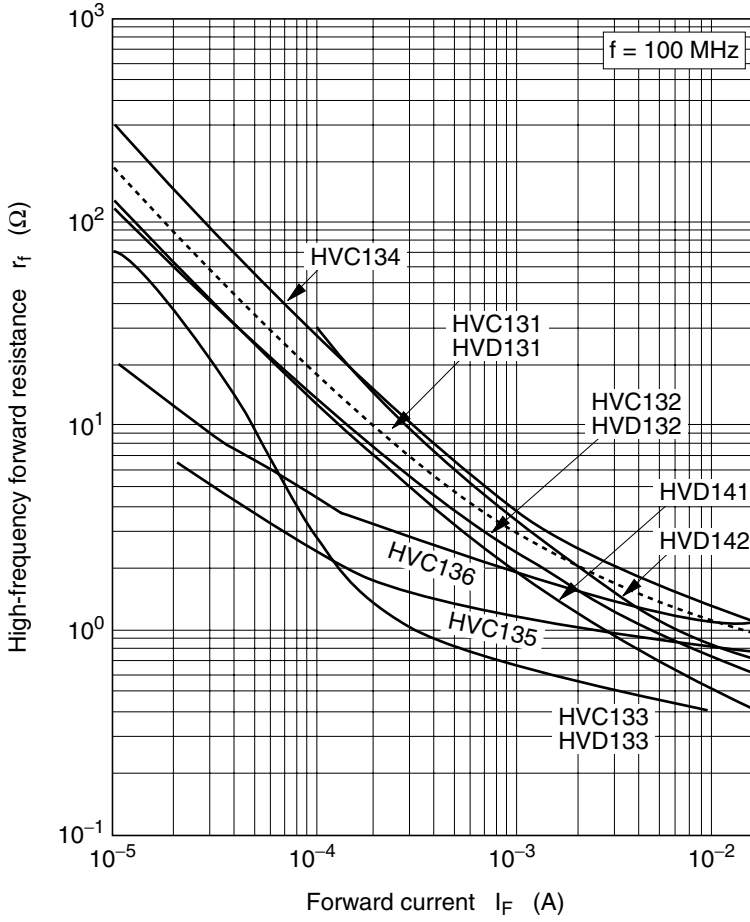
3.6 PIN Diodes for Switching Antenna



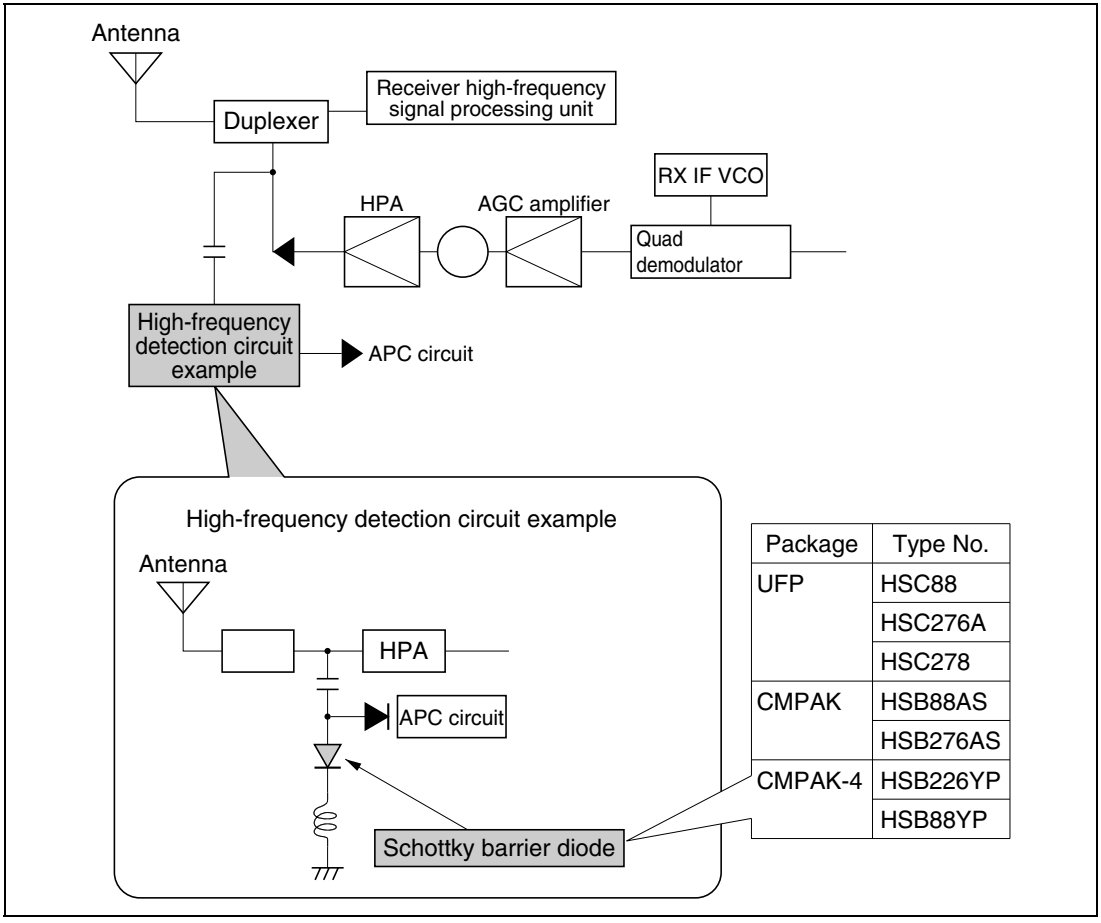
Package	Type No.
UFP	HVC135
	HVC136
SFP	HVD131
	HVD132
	HVD133
	HVD135
	HVD136
	HVD141
	HVD142

Application	Type No.	Absolute Maximum Rating (Ta = 25°C)						Electrical Characteristics (Ta = 25°C)														Package	Type No.
								V_R(V)		I_R(μA)		V_F(V)		C(pF)			rf(Ω)						
		V_{RM} (V)	V_R (V)	I_F (mA)	Pd (mW)	Tj (°C)	Tstg (°C)	min.	Test Condition I_R(μA)	max.	Test Condition V_R(V)	max.	Test Condition I_F(mA)	max.	Test Condition V_R(V)	Test Condition f (MHz)	typ.	max.	Test Condition I_F(mA)	Test Condition f (MHz)			
For switching antenna	HVU131	65	60	100	150	125	-55 to +125	—	—	0.1	60	1.0	10	0.80	1	1	—	1.0	10	100	URP	HVU131
	HVU132	65	60	100	150	125	-55 to +125	—	—	0.1	60	1.0	10	0.50	1	1	—	2.0	10	100	URP	HVU132
	HVU133	—	30	—	150	125	-55 to +125	30	1.0	0.1	25	0.85	2	1.00	1	1	0.55	0.7	2	100	URP	HVU133
														0.90	6							
	HVC131	65	60	100	150	125	-55 to +125	—	—	0.1	60	1.0	10	0.80	1	1	—	1.0	10	100	UFP	HVC131
	HVC132	65	60	100	150	125	-55 to +125	—	—	0.1	60	1.0	10	0.50	1	1	—	2.0	10	100	UFP	HVC132
	HVC133	—	30	—	150	125	-55 to +125	30	1.0	0.1	25	0.85	2	1.00	1	1	0.55	0.7	2	100	UFP	HVC133
														0.90	6							
	HVC134	65	60	100	150	125	-55 to +125	—	—	0.1	60	1.0	10	0.40	1	1	—	2.0	10	100	UFP	HVC134
	HVC135	65	60	100	150	125	-55 to +125	—	—	0.1	60	0.9	2	0.60	1	1	—	2.0	2	100	UFP	HVC135
	HVC136	65	60	100	150	125	-55 to +125	—	—	0.1	60	0.9	2	0.45	1	1	—	2.5	2	100	UFP	HVC136
	HVD131	65	60	100	150	125	-55 to +125	—	—	0.1	60	1.0	10	0.80	1	1	—	1.0	10	100	SFP	HVD131
	HVD132	65	60	100	150	125	-55 to +125	—	—	0.1	60	1.0	10	0.50	1	1	—	2.0	10	100	SFP	HVD132
	HVD133	—	30	—	150	125	-55 to +125	30	1.0	0.1	25	0.85	2	1.00	1	1	0.55	0.7	2	100	SFP	HVD133
														0.90	6							
	HVD135	65	60	100	150	125	-55 to +125	—	—	0.1	60	0.9	2	0.60	1	1	—	2.0	2	100	SFP	HVD135
	HVD136	65	60	100	150	125	-55 to +125	—	—	0.1	60	0.9	2	0.45	1	1	—	2.5	2	100	SFP	HVD136
	HVD141	—	30	100	150	125	-55 to +125	—	—	0.1	30	1.0	10	0.82	1	1	—	0.8	10	100	SFP	HVD141
	HVD142	—	30	100	150	125	-55 to +125	—	—	0.1	30	1.0	10	0.35	1	1	—	1.5	10	100	SFP	HVD142

3.8 Characteristics of PIN Diodes



3.9 Schottky Barrier Diode



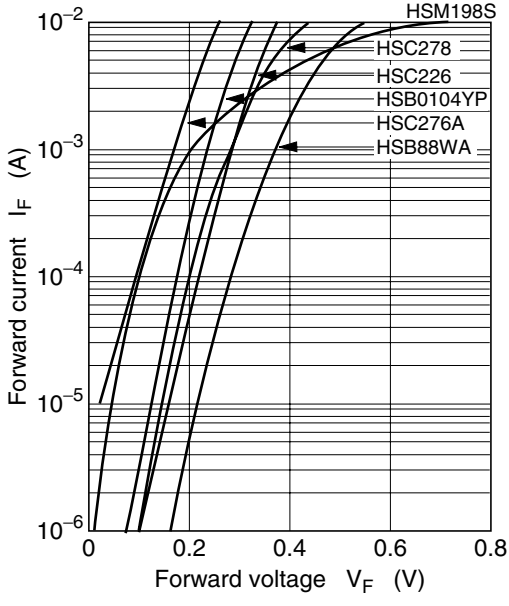
Package	Type No.
UFP	HSC88
	HSC276A
	HSC278
CMPAK	HSB88AS
	HSB276AS
CMPAK-4	HSB226YP
	HSB88YP

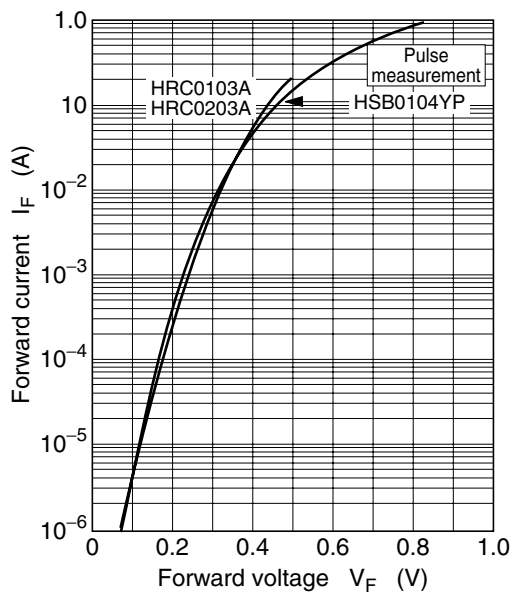
3.10 Characteristics of Schottky Barrier Diode Standard

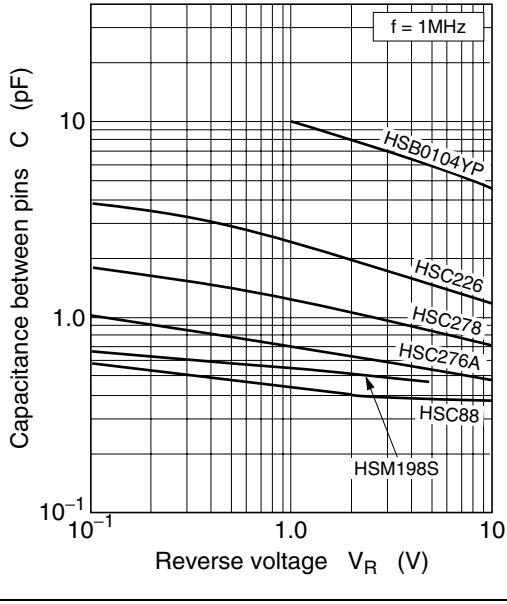
Application	Type No.	Absolute Maximum Rating (Ta = 25°C) V_{RRM} (V)	V_R (V)	I_{FSM} (mA)	I_F (mA)	I_{FM} (mA)	I_O (mA)	Tj (°C)	Tstg (°C)	Electrical Characteristics (Ta = 25°C) V_R(V) min.	V_R(V) Test Condition I_R(mA)	I_R(μA) typ.	I_R(μA) max.	I_R(μA) Test Condition V_R(V)	I_F(mA) min.	I_F(mA) max.	I_F(mA) Test Condition V_F(V)	V_F(mV) min.	V_F(mV) typ.	V_F(mV) max.	V_F(mV) Test Condition I_F(mA)	C(pF) typ.	C(pF) max.	C(pF) Test Condition V_R(V)	C(pF) Test Condition f(MHz)	ΔC(pF) max.	ΔC(pF) Test Condition V_R(mA)	ΔC(pF) Test Condition f(MHz)	$ΔV_F$(mV) max.	$ΔV_F$(mV) Test Condition I_F(mA)	Package
For Schottky barrier	HSU88	—	10	—	—	—	15	125	-55 to +125	—	—	—	0.2	2	—	—	—	350	—	420	1	—	0.8	0	1	—	—	—	—	—	URP
													10	10				500	—	580	10	—									
	HSU227	25	—	200	—	—	50	125	-55 to +125	—	—	0.3	2	20	—	—	—	—	0.29	0.35	1	2.45	3	1	1	—	—	—	—	—	URP
	HSU276A	5	3	—	—	—	30	125	-55 to +125	3	1	—	50	0.5	35	—	0.5	—	—	—	—	—	0.9	0.5	1	—	—	—	—	—	URP
	HSC88	—	10	—	—	—	15	125	-55 to +125	—	—	—	0.2	2	—	—	—	350	—	420	1	—	0.8	0	1	—	—	—	—	—	UFP
													10	10				500	—	580	10	—									
	HSC226	25	—	200	50	—	—	125	-55 to +125	—	—	—	0.45	20	—	—	—	—	—	0.33	1	—	2.8	1	1	—	—	—	—	—	UFP
																				0.38	5										
	HSC276A	5	3	—	—	—	30	125	-55 to +125	3	1	—	50	0.5	35	—	0.5	—	—	—	—	—	0.85	0.5	1	—	—	—	—	—	UFP
	HSC278	30	30	200	—	150	30	125	-55 to +125	—	—	—	0.7	10	—	—	—	—	—	300	1	—	1.50	1	1	—	—	—	—	—	UFP
																				950	30										
	HSD278	30	30	200	—	150	30	125	-55 to +125	—	—	—	0.7	10	—	—	—	—	—	300	1	—	1.50	1	1	—	—	—	—	—	SFP
																				950	30										
	HSM88AS	—	10	—	—	—	15	125	-55 to +125	—	—	—	0.2	2	—	—	—	350	—	420	1	—	0.85	0	1	0.1	0	1	10	10	MPAK
													10	10				500	—	580	10										
	HSM88ASR	—	10	—	—	—	15	125	-55 to +125	—	—	—	0.2	2	—	—	—	350	—	420	1	—	0.85	0	1	0.1	0	1	10	10	MPAK
													10	10				500	—	580	10										
	HSM88WA	—	10	—	—	—	15	125	-55 to +125	—	—	—	0.2	2	—	—	—	350	—	420	1	—	0.85	0	1	0.1	0	1	10	10	MPAK
													10	10				500	—	580	10										
	HSM88WK	—	10	—	—	—	15	125	-55 to +125	—	—	—	0.2	2	—	—	—	350	—	420	1	—	0.85	0	1	0.1	0	1	10	10	MPAK
													10	10				500	—	580	10										
	HSM198S	—	10	—	—	—	30	125	-55 to +125	—	—	—	70	6	5	—	1	—	—	1.1	5	—	1.5	1	1	—	—	—	10	5	MPAK
	HSM276AS	5	3	—	—	—	30	125	-55 to +125	3	1	—	50	0.5	35	—	0.5	—	—	—	—	—	0.90	0.5	1	0.1	0.5	1	—	—	MPAK
	HSM276ASR	5	3	—	—	—	30	125	-55 to +125	3	1	—	50	0.5	35	—	0.5	—	—	—	—	—	0.90	0.5	1	0.1	0.5	1	—	—	MPAK
	HSB88AS	—	10	—	—	—	15	125	-55 to +125	—	—	—	0.2	2	—	—	—	350	—	420	1	—	0.8	0	1	0.1	0	1	10	10	CMPAK
													10	10				500	—	580	10										
	HSB88YP	—	10	—	—	—	15	125	-55 to +125	—	—	—	0.2	2	—	—	—	350	—	420	1	—	0.8	0	1	0.1	0	1	10	10	CMPAK-4
													10	10				500	—	580	10										
	HSB88WK	—	10	—	—	—	15	125	-55 to +125	—	—	—	0.2	2	—	—	—	350	—	420	1	—	0.8	0	1	0.1	0	1	10	10	CMPAK
													10	10				500	—	580	10										
	HSB88WA	—	10	—	—	—	15	125	-55 to +100	—	—	—	0.2	2	—	—	—	350	—	420	1	—	0.9	0	1	0.1	0	1	10	10	CMPAK
													10	10				500	—	580	10										
	HSB226S	25	—	200	50	—	—	125	-55 to +125	—	—	—	0.45	20	—	—	—	—	—	330	1	—	2.80	1	1	—	—	—	—	—	CMPAK
																				380	5										
	HSB226WK	25	—	200	50	—	—	125	-55 to +125	—	—	—	0.45	20	—	—	—	—	—	330	1	—	2.8	1	1	—	—	—	—	—	CMPAK
																				380	5										
	HSB226YP	25	—	200	50	—	—	125	-55 to +125	—	—	—	0.45	20	—	—	—	—	—	330	1	—	2.8	1	1	—	—	—	—	—	CMPAK-4
																				380	5										
	HSB276AS	5	3	—	—	—	30	125	-55 to +125	3	1	—	50	0.5	35	—	0.5	—	—	—	—	—	0.90	0.5	1	0.1	0.5	1	—	—	CMPAK
	HSB276AYP	5	3	—	—	—	30	125	-55 to +125	3	1	—	50	0.5	35	—	0.5	—	—	—	—	—	0.85	0.5	1	0.1	0.5	1	—	—	CMPAK-4
	HSB0104YP	40	—	3(A)	100	—	—	125	-55 to +125	—	—	—	50	40	—	—	—	—	—	0.58	100	20	—	0	1	—	—	—	—	—	CMPAK-4
	HRC0103A	30	—	3(A)	—	—	100	125	-55 to +125	—	—	—	50	30	—	—	—	—	—	0.44	100	—	—	—	—	—	—	—	—	—	UFP
	HRC0203B	30	—	3(A)	—	—	200	125	-55 to +125	—	—	—	10	30	—	—	—	—	—	0.52	200	—	—	—	—	—	—	—	—	—	UFP

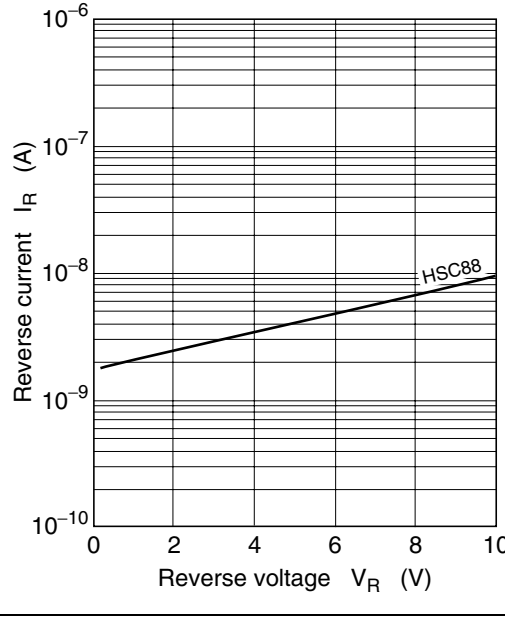
RENESAS

3.11 Characteristics of Schottky Barrier Diodes

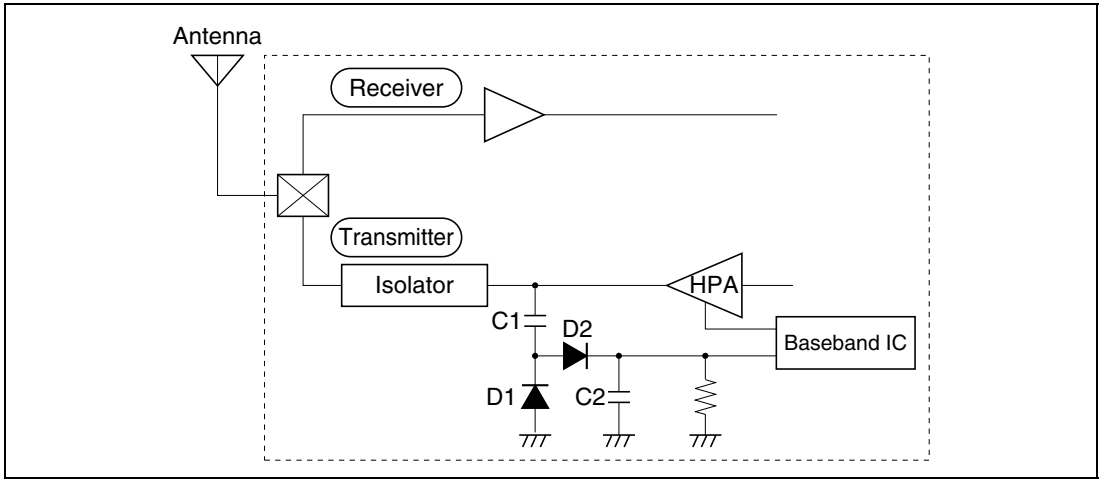






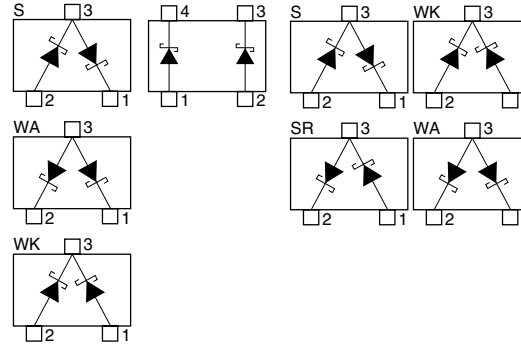


3.12 Power Control Circuit for Mobile Phones



Small Signal Schottky Barrier Diodes for Mobile Communications

Type	SFP (1406)	UFP (1608)	URP (2512)	CMPAK-3 (SC-70)	CMPAK-4 (SC-70M)	MPAK-3 (SC-59A)	Application
HS∗276A	—	HSC276A	HSU276A	HSB276AS	HSB276AYP	HSM276AS HSM276ASR	Signal processing
HS∗88	—	HSC88	HSU88	HSB88AS HSB88WA HSB88WK	HSB83YP HSB88YP	HSM88ASS HSM88ASR HSM88WA HSM88WK	Signal processing, reverse current protection
HS∗226 HS∗227 HS∗278	 HSD278	HSC226 HSC278	 HSU227 	HSB226S HSB226WK	HSB226YP	—	Signal processing, reverse current protection
Pin arrangement	(Top view)			(Top view)	(Top view)	(Top view)	



3.13 Characteristics of Zener Diodes for Surge Absorption

Absolute maximum ratings (Ta = 25°C)

Type No.	Pd (mW)	Tj (°C)	Tstg (°C)
HZU-G Series	200 *1	150	–55 to +150
HZM5.6ZFA	200 *2		
HZM6.2ZFA	200 *2		
HZM6.2ZWA	200 *3		
HZM6.8ZMFA	200 *2		
HZM6.8MFA	200 *2		
HZM6.8MWA	200 *3		
HZM6.8ZMWA	200 *3		

Notes: 1. See figure 1 in section 3.14.
2. See figure 2 in section 3.14.
3. See figure 3 in section 3.14.

Electrical Characteristics (Ta = 25°C)

	Zener Voltage			Reverse Current		Operating Resistance		Static electricity destroy voltage	
	V_R (V) *1		Test Condition	I_R (μA)	Test Condition	rd (Ω)	Test Condition	— (kV) *2	
Type No.	Min	Max	I_Z (mA)	Max	V_R (V)	Max	I_Z (mA)	Min	Failure determination criteria
HZU5.1G	4.84	5.37	5	5	1.5	130	5	30	I_R standard is used
HZU5.6G	5.31	5.92	5	5	2.5	80	5	30	
HZU6.2G	5.86	6.53	5	2	3	50	5	30	
HZU6.8G	6.47	7.14	5	2	3.5	30	5	30	
HZU7.5G	7.06	7.84	5	2	4	30	5	30	
HZU8.2G	7.76	8.64	5	2	5	30	5	30	
HZU9.1G	8.56	9.55	5	2	6	30	5	30	
HZU10G	9.45	10.55	5	2	7	30	5	30	
HZM5.6ZFA	5.31	5.92	5	0.5	2.5	80	5	8	I_R > 0.5 μA (V_R = 2.5 V)
HZM6.2ZFA	5.90	6.50	5	3	5.5	60	5	13	I_R > 3 μA (V_R = 5.5 V)
HZM6.2ZWA	5.90	6.50	5	3	5.5	60	5	13	
HZM6.8ZMFA	6.47	7.00	5	2	3.5	30	5	25	I_R > 2 μA (V_R = 3.5 V)
HZM6.8MFA	6.47	7.00	5	2	3.5	30	5	30	
HZM6.8MWA	6.47	7.00	5	2	3.5	30	5	30 *3	
HZM6.8ZMWA	6.47	7.00	5	2	3.5	30	5	220 *3	

Notes: 1. V_Z is a value of 40-ms pulse.
2. C = 150 pF, R = 330 Ω, forward and reverse currents are applied 10 times each.
3. Surge tolerance between cathode and anode.

3.14 Main Characteristics of Zener Diodes for Surge Absorption

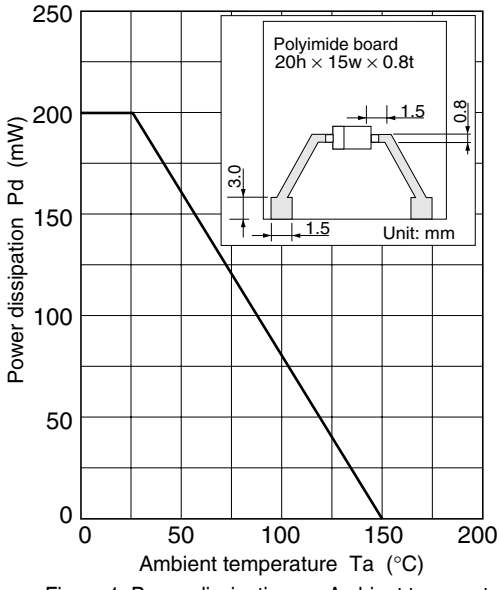


Figure 1. Power dissipation vs. Ambient temperature

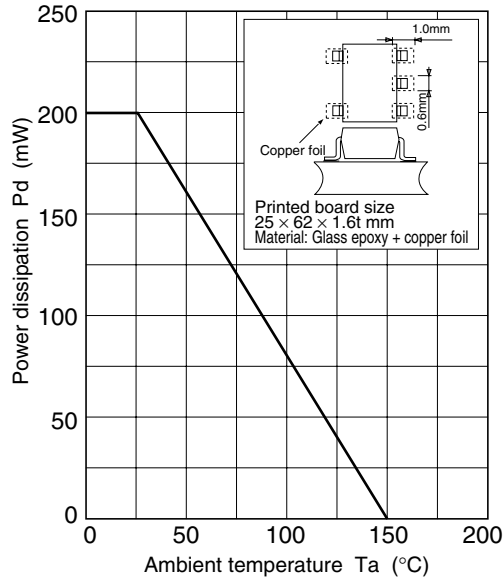


Figure 2. Power dissipation vs. Ambient temperature

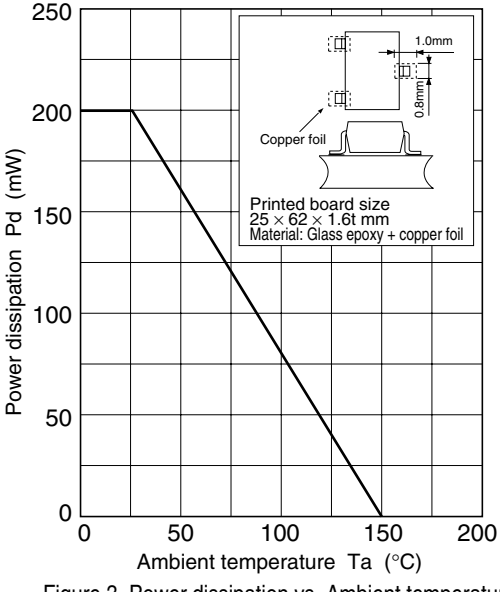
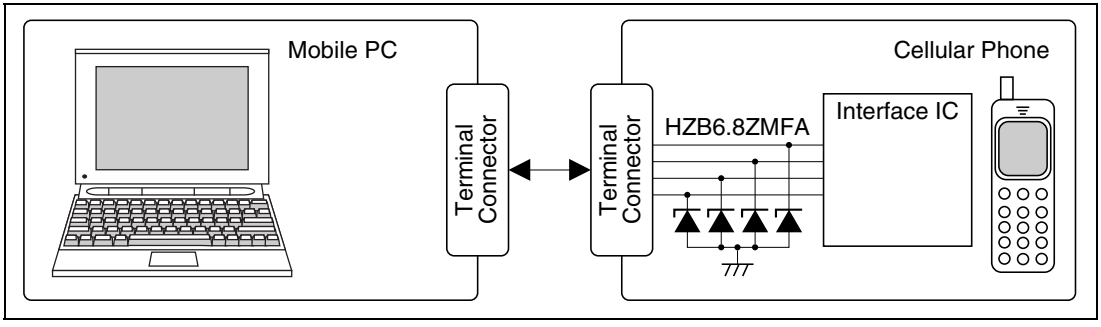


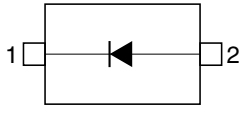
Figure 3. Power dissipation vs. Ambient temperature

3.15 Example of Using Zener Diode for Surge Absorption



3.16 Pin Arrangement

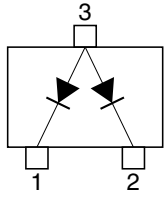
URP



1. Cathode
2. Anode

(Top view)

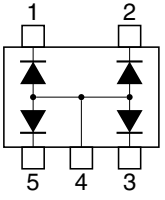
MPAK
CMPAK



1. Cathode
2. Cathode
3. Anode

(Top view)

MPAK-5
CMPAK-5



1. Cathode
2. Cathode
3. Cathode
4. Anode
5. Cathode

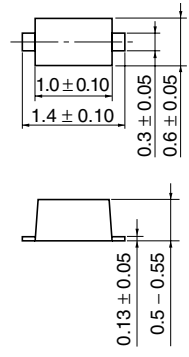
(Top view)

Section 4 Standard Dimensions of Diode Packages

Note: For description of dimensions of footprint (land), see pages 27 and 28.

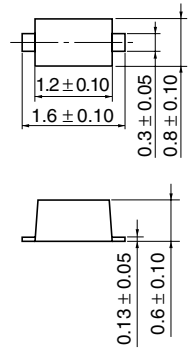
•SFP

Unit: mm



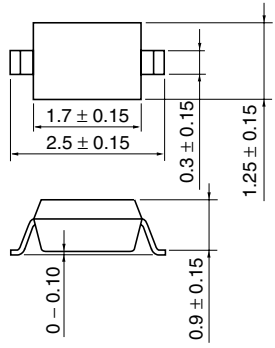
•UFP

Unit: mm



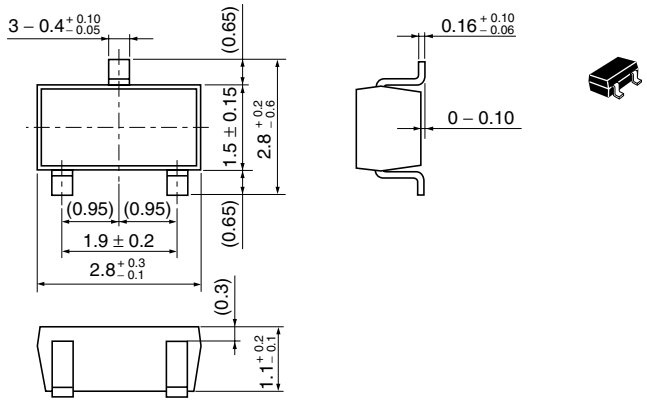
•URP

Unit: mm



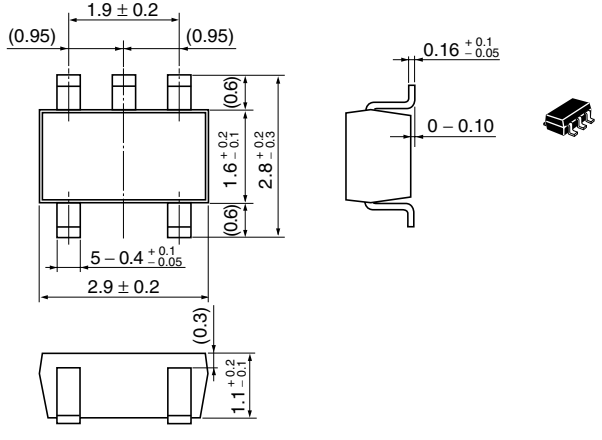
•MPAK

Unit: mm



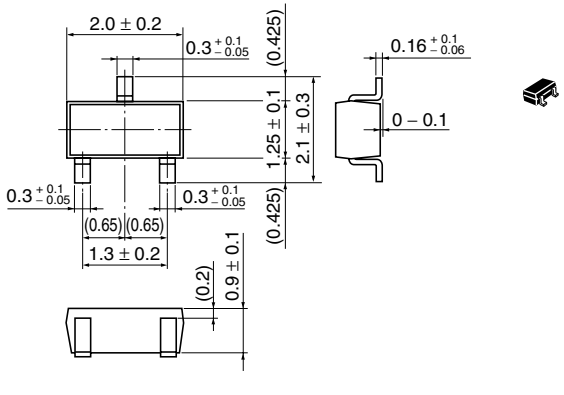
•MPAK-5

Unit: mm



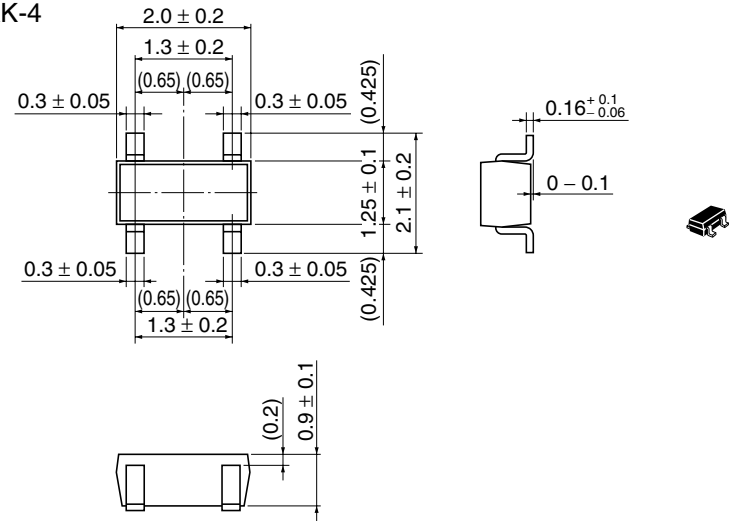
•CMPAK

Unit: mm



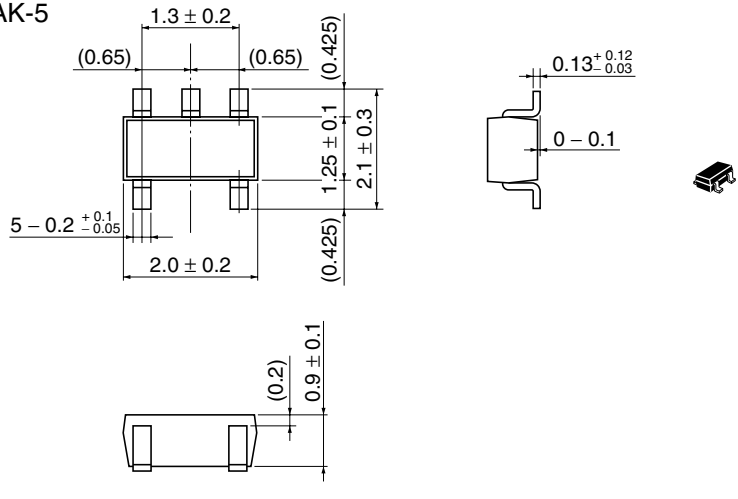
•CMPAK-4

Unit: mm

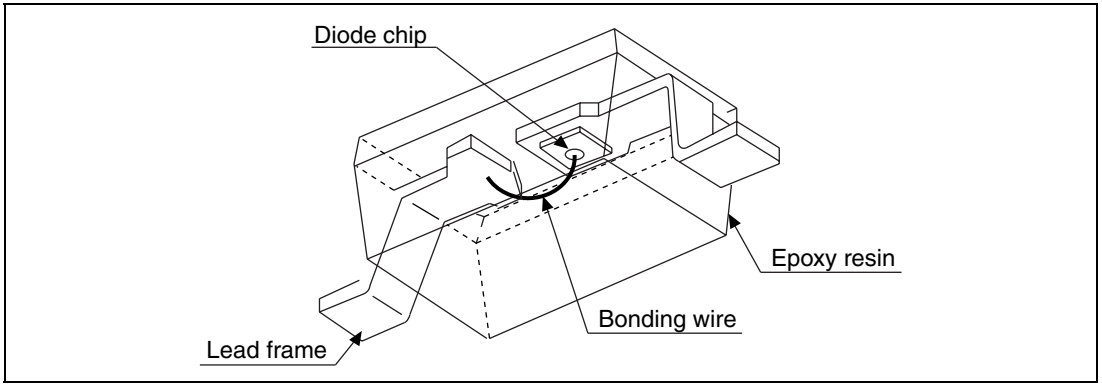


•CMPAK-5

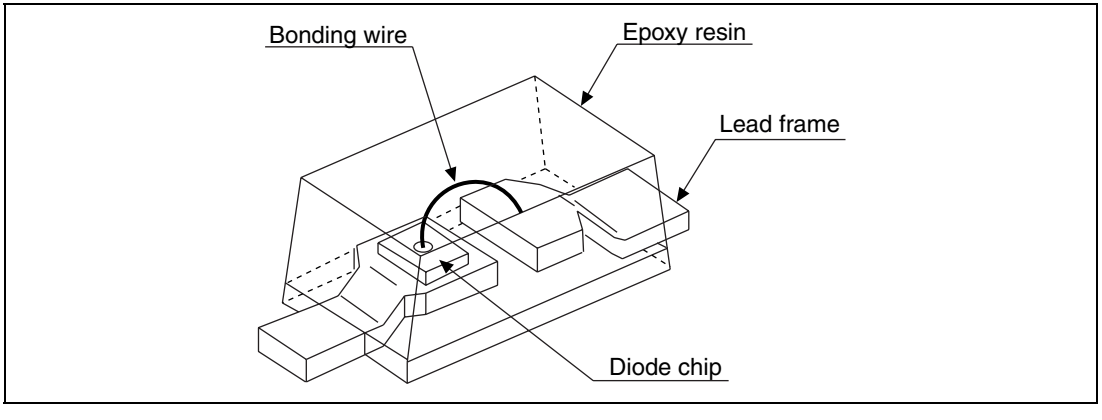
Unit: mm



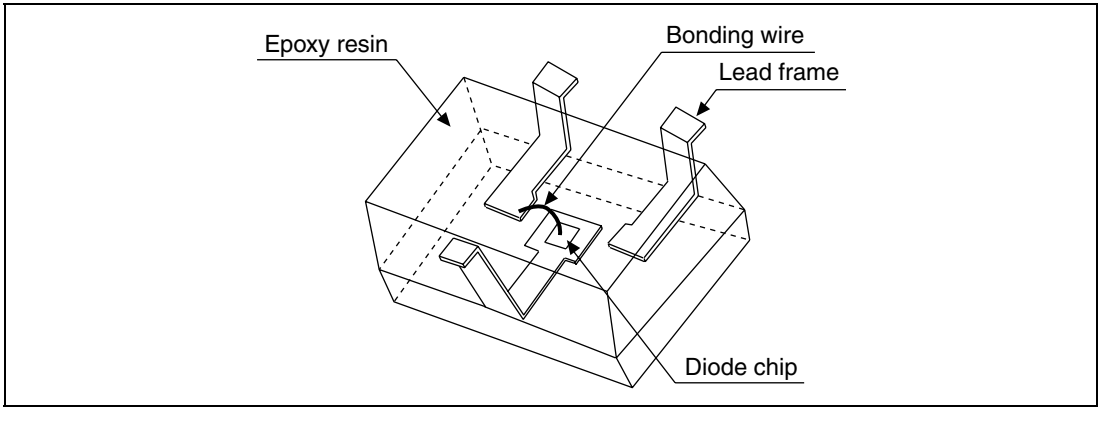
Assembly structure of SRP and URP



Assembly structure of UFP and SFP



Assembly structure of MPAK and CMPAK



6.1 Hitachi Diode Manufacturing Process and Quality Control

Hitachi makes every possible effort to maintain the quality of its diodes from manufacturing to shipment, and pays strict attention to quality control in the production process. Meticulous care over each of the manufacturing process enables timely detection of faults, and helps maintain stable quality control.

Figure 6.1 shows the manufacturing process, Figure 6.2 shows details of quality control.

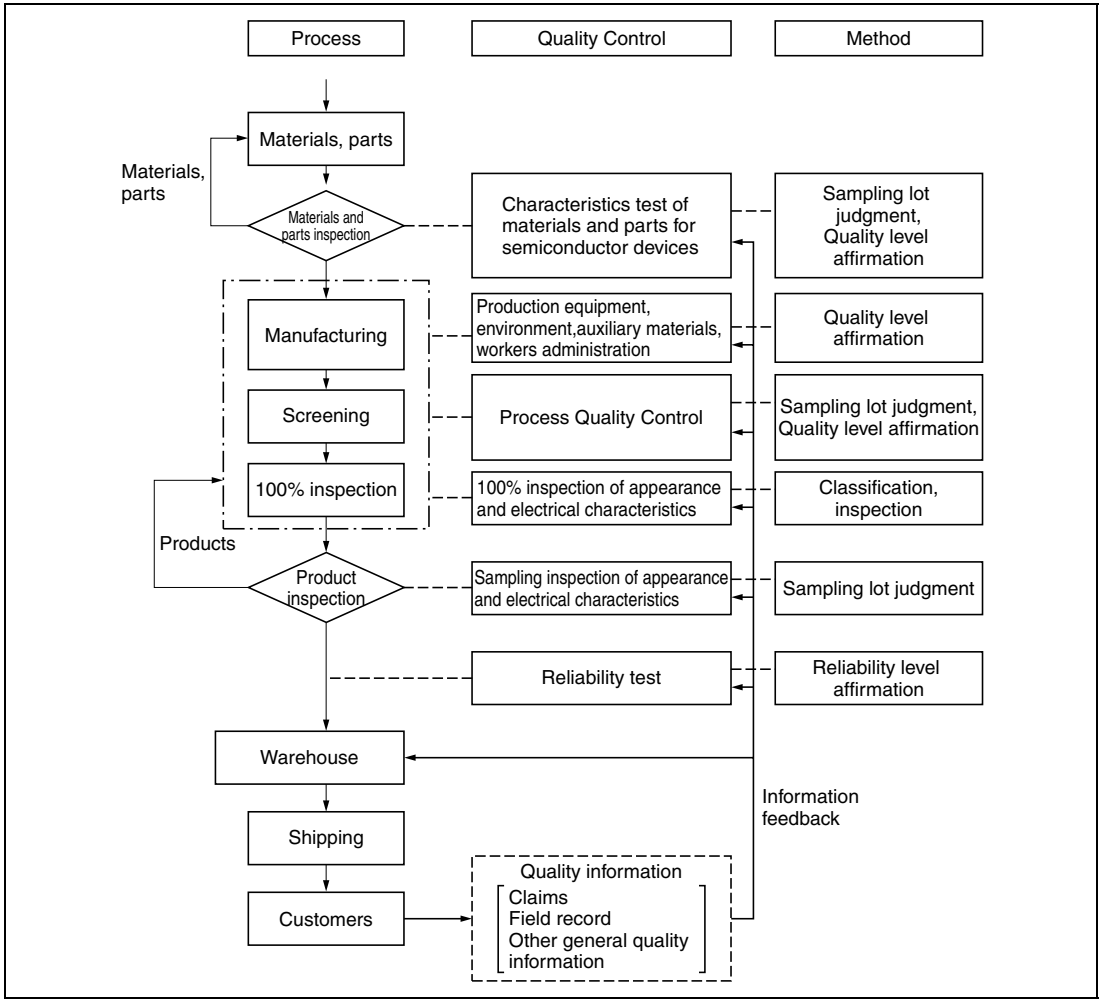


Figure 6.1 Manufacturing Process and Quality Control Flowchart

Process Name		Main Equipment	Control Item		Remarks
Wafer	Diffusion	Metallurgical microscope Resistivity meter	Diffusion depth Resistivity	1 wafer/batch	
	Photolitho-graphy	Metallurgical microscope	External appearance	All wafers	
	Metallization				
	PQC	Metallurgical microscope	External appearance	2 lots/day	
	Dicing				
	Pellet grading	Stereoscopic microscope	External appearance	All units	
	PQC	Stereoscopic microscope	External appearance	2 lots/day	
Frame bonding wire	Assembly				
	PQC	Tension gage Stereoscopic microscope	Wire bonding strength External appearance	1 time/month×machine 1 time/month×machine	
	Molding				
	Soldering process				
	Marking				
	Disconnection Forming				
	PQC	Stereoscopic microscope	External appearance	1 time/3days×machine	
	Total inspection	Automatic measuring equipment	Electrical characteristics	All units	
Packing material	Taping Packing	Tension gage	Cover tape Peeling strength	1 time/day/machine (10 to 70 g)	
	Inspection	Equipment for each type of inspection	Electrical characteristics External appearance dimensions	JIS Z 9015 Major AQL = 0.1% Minor AQL = 1.0%	
Ware-house					
○ Work process ◇ PQC work △ Inspection process					

Figure 6.2 Quality Control Flowchart of Diodes for Mobile Communications

6.2 Periodic Reliability Tests

Periodic reliability tests are performed to guarantee the reliability of Hitachi diodes for mobile communications.

Table 6.1 Periodic Reliability Tests (Examples)

Test Items	Conditions
Operation life test	V_R Max, Ta = 125°C, 1000 h
High temp./humidity storage	Ta = 85°C, 85%R.H., t = 1000 h
Temp. cycling	Ta = –55 to +150°C, 10 cycles
Pressure cooker	Ta = 121°C, 100%R.H., t = 40 h
Solder heat resistance	260°C, 10 s

6.3 Periodic Reliability Data

Examples of reliability test data are shown in table 6.2.

Table 6.2 Reliability Test Results for MPAK, CMPAK, URP, UFP, and SFP

Classification	Test Items	Conditions	Result
Mechanical tests	Terminal strength (1)	15°, bebding, 1 time (MPAK, CMPAK, URP)	0/15
	Terminal strength (2)	Static load, 2.5 N, 10 s (MPAK)	0/15
	Shock test	1500 m/s^2, 0.5 ms, 3 times each in the XYZ directions	0/15
	Drop test	Height: 75 cm, Onto 3 cm thick maple board	0/100
	Variable frequency vibration	100 to 2000 Hz, 200 m/s^2, XYZ direction	0/15
Environmental tests	Temp. cycling	Ta = –55 to +150°C, 10 cycles	0/450
	Solder heat resistance	260°C ± 5°C, 10 s	0/280
	Solderability	235°C ± 5°C, 5 ± 0.5 s	0/360
	Thermal shock	Ta = 0 to 100°C, 5 cycles	0/160
	Temp. and humidity cycling	Ta = –10 to +65°C, R.H. ≥ 90°C, 10 cycles	0/40
	PCT	Ta = 121°C, 100%R.H., t = 40 h	0/360
Life tests	High temp. storage	Ta = 125°C, t = 1000 h	0/120
	Low temp. storage	Ta = –55°C, t = 1000 h	0/120
	High temp. and humidity storage	Ta = 85°C, 85%R.H., t = 1000 h	0/400
	Operation life	Ta = 25°C, Pd Max, t = 1000 h	0/45

Section 7 Precautions for Application

7.1 Precautions for Storage

Although the general precautions for storage and transportation of electronic components can be applied as they are to semiconductor devices, the latter require certain special precautions in addition to these. The following account includes includes the general precautions.

Storage of Semiconductor Devices

The following methods of storage are advisable for semiconductor devices. If the precuations are not observed, faults in electrical characteristics, solderability, external appearance and other attributes may occur. In some cases, failure may also result.

Precautions for storage are as follows:

a. The storage location should be kept within the optimum ranges of temperature and humidity: 5 to 35°C and 45 to 75% R.H. are the optimal conditions.
b. The atmosphere in the storage location should not contain any noxious gases, and the amound of dust should be minimal.
c. Storage containers should not be susceptible to static electricity.
d. Semiconductor devices should not be subjected to loads.
e. When storing for long periods, store in the non-processed state. When leads have already been formed, corrosion at their bent portion of leads may occur.
f. Be sure that sudden temperature changes sufficient to cause condensation do not occur during storage of the devices.

7.2 Precautions for Transportation

When transporting semiconductor devices or their assembly units or subsystems, the same precautions as for other electronic components should be taken. The items listed in section 4.1 have to be followed.

a. Transportation containers, jigs etc., should not pick up static charge due to vibration en route.
b. Persons handling semiconductor devices should be grounded via a high resistance to discharge any static electricity that may be adhering to their clothing. The resistance value should be around 1 MΩ and no other person should come between the person being discharged and ground (GND).
c. When transporting semiconductor devices and PCBs, try to keep mechanical vibration and shocks to an absolute minimum.

7.3 Precautions for Soldering

SMD diodes are formed in consideration of PCB mountability, and can be mounted without modification.

a. When mounting on a PCB, adhesive is used to temporarily hold diodes in place before solder is applied. When a SMD diode is held by adhesive, be sure that it is not subjected to undue stress.
b. Using a mounter to fix SMD diodes to a PCB can result in bending of the leads, so make sure that a force of no more than 1 N is applied. And also required to not apply any force on the leads as being mounted, especially for UFP, SFP package. At the time of mounting, the nozzle's presser force should not exceed 5 N.
c. Since SMD diodes come in small package, be aware of thermal stress from soldering. Soldering should be done in as short a time as possible.

   For conditions on high-temperature soldering, please contact us on an individual basis.

   — When flow solder is used: 260°C or less, 10 s or less
   — When soldering iron is used: 350°C or less, 3 s or less
   — When high-temperature atmosphere is used: 235°C or less, 10 s or less
   — Do not apply high-temperature soldering using soldering iron etc. to the SFP package since it puts a large heat stress to the package.
d. Use the reflow method for mounting SFP packages.

Surface Mounting Diode (SMD)

The recommended conditions for soldering SMD diodes are shown in table 7.1.

Table 7.1 SMD Soldering Mounting Inset Conditions

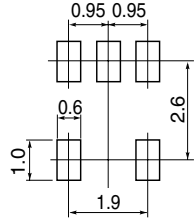
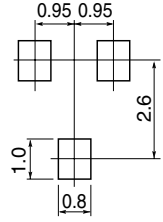
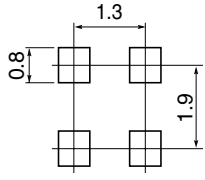
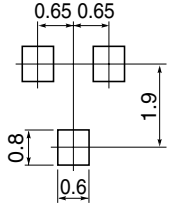
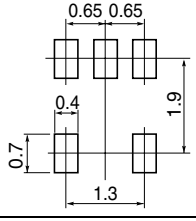
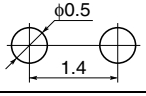
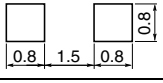
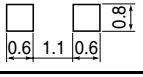
Package	Footprint (land) Dimensions	Cream Solder Thickness
MPAK-5		0.15 to 0.30 mm
MPAK		0.15 to 0.30 mm

Table 7.1 SMD Soldering Mounting Inset Conditions (cont)

Package	Footprint (land) Dimensions	Cream Solder Thickness
CMPAK-4		0.15 to 0.30 mm
CMPAK		0.15 to 0.30 mm
CMPAK-5		0.15 to 0.30 mm
SFP		0.15 to 0.30 mm
URP		0.15 to 0.30 mm
UFP		0.15 to 0.30 mm

Notes: 1. Footprint (land) dimension units: mm.
2. Cream solder thickness at reflow installation.

7.4 Cleaning

Fading of the Marking and Color Codes

Clearness of markings and color-fastness of color codes may be lost due to cleaning. Be sure to check these after using cleaning agents.

Electrical and mechanical characteristics (discoloration, deformation, denaturation, etc.)

After cleaning a PCB, some corrosive material contained in the cleaning agent or flux may remain on semiconductor devices, causing corrosion of device wiring and leads with resulting loss of reliablility. Thorough cleaning is therefore required for PCBs. It is recommended that the level of purity of the PCB after cleaning should conform with the MIL standard below.

Table 7.2 PCB Level of Purity After Cleaning

Item	Standard
Remaining Cl volume	$\leq 1\ \mu g/cm^2$
Resistance of solvent (after extraction)	$\geq 2 \times 10^6 \Omega \bullet cm$

Notes: 1. PCB surface area: Both sides of the PCB + mounted components.
2. Extract solvent: Isopropyl alcohol : H_2O = 3 : 1
(Resistance of solvent before extraction is $\geq 6 \times 10^6 \Omega \bullet cm$)
3. Extraction method: Clean both sides of PCB with 10 ml/$2.54 \times 2.54\ cm^2$
(minimum of 1 minute)
4. Measuring extracted solvent resistance: Conductivity meter
See MIL-P-28809A for details of the MIL standard.

Ultrasonic cleaning

It should be avoid to resonant to the devices. We recommend the following conditions.

- SMD, etc.
  Frequency : 28 to 29 kHz (device should resonant)
  Ultrasonic power output : 15 W/l (1 time)
  Time : up to 30 s
  Others : Make sure that neither devices nor PCB come into contact with the vibration source.

7.5 Genaral Precautions for Circuit Mounting

Matching the circuit design and initial standards is a prerequisite for regards reliability design, while a margin must be allowed in consideration of deratings and fluctuations in characteristics. Reliability problems involve wiring, external surge, reactance load, noise margin, area of safe operation (ASO), reverse bias, flyback pulse, static electricity pulse stress and more.

7.6 **General Precautions** (General Precautions for Circuit Designing)

Important factors in achieving the specified system reliability are using the devices within the parameter specifications shown in the catalog and observing the following points, taking account of the influence of peripheral components.

a. Keep the peripheral temperature as low as possible in order to avoid high temperatures in the vicinity of semiconductor elements.

b. Ensure that the power supply voltage, input voltage, power consumption, etc., are within specification, and use degrading.

c. Ensure that an excessive voltage is not applied to, or caused on, input, output, power supply, and other pins. Also ensure that these pins are not subjected to strong electromagnetic waves.

d. Ensure that static electricity is not generated during use.

e. When using high-speed elements, which have an extremely fine structure, either provide protection circuitry, etc., for the input section, or else ensure that electrostatic pulses are not applied.

f. When power is turned on and off, ensure that voltage application does not become unbalanced. For example, excessive stress will be exerted if a voltage is applied to input or power supply pins, etc., when circuit ground pins are floating.

g. Note on use in electromagnetic wave environments

   A source of strong electromagnetic waves in the vicinity of a Zener diode may alter the characteristics of the diode. For example, a drop in the breakdown voltage has been reported when a portable wireless unit (144 MHz, 430 MHz) with a 3 W output is brought within a distance of 10 cm from a diode.

   Please consult Hitachi if there is a risk of exposure to strong electromagnetic waves in the operating environment.

h. About lot traceability

   To help us handle customer inquiries smoothly, please write down the following on the labels on the component's package or reels before using the diode products.

   1. Type number (INT.C/TYPE)
   2. Lot number (LOT)
   3. Weekly code (W/C)

7.7 Characteristic Parameters and their Relation to Reliability

Each semiconductor device has its own characteristic parameters prescribed accoding to function and application. Each of these parameters has a predetermined range which should be matched. In system design, the significance of these parameters varies a great deal depending on application, and design must project a margin in initial characteristics as regards the critical parameters, or derating must be carried out. In the former case, a device should be selected with regard to the limit of operation range as a system. The statistical design method should be employed, and reliability testing as well as failure criteria of Hitachi semiconductor devices should also be taken into consideration. In the case of derating, refer to the derating applications given under Hitachi Semiconductor Device Reliability. Since the majority of parameter fluctuations cannot be foreseen under conditions of use, althouth design employing initial standards is considered justifiable in many cases, design with reference to failure criteria is needed as regards significant system items or items with no margin.

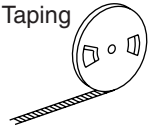
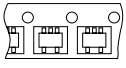
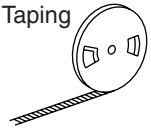
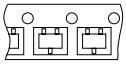
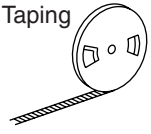
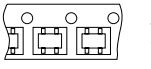
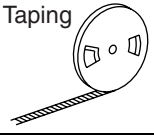
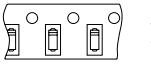
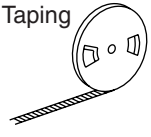
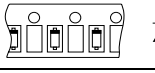
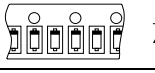
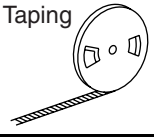
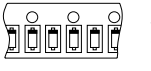
The following are points for consideration with regard to parameters.

- Whether the significance of a parameter extends to system failure.
- The state of the parameter's initial value margin.
- Does the parameter change over time, and if so, is the change in the direction of the margin?
- Is the change permissible for use of the device with other devices?
- Is redundant design possible?
- Is it possible to introduce the statistical design method for parameters?

8.1 Taping Specifications

Table 8.1 is a list of taping specifications.

Table 8.1 Taping Specifications

Appearance	Packing Form	Packing Unit	Packing Specification Code	Comments
MPAK-5 CMPAK-5	Taping 	3000 *2 (units/reel)	TR (Taping to Right)	TR withdrawl direction→ 
MPAK CMPAK	Taping 	3000 *2 (units/reel)	TR (Taping to Right)	TR withdrawl direction→  (Marked surface up)
CMPAK-4	Taping 	3000 *2 (units/reel)	TR (Taping to Right)	TR withdrawl direction→  (Marked surface up)
SRP URP	Taping 	3000 *2 (units/reel)	TR (Taping to Right)	TR withdrawl direction→ 
UFP	Taping 	4000 (units/reel)	TR (Taping to Right)	TR withdrawl direction→ 
		8000 (units/reel)	KR	KR withdrawl direction→ 
SFP	Taping 	8000 (units/reel)	KR	KR withdrawl direction→ 

Notes: 1. Missing devices ≤ 0.2%/reel, continous miss = 0/reel.
2. Recommended taping specifications.

8.2 After-Sales Service System

Hitachi has an after-sales service system with sales, product marketing, design, fabrication, and quality assurance departments all united as one so that quick and appropriate responses can be made to customer inquires and in the event of failures related to diodes. Thorough quality control system prevents reoccurrence of failures so customers can use Hitachi diodes with assurance.

Figure 8.1 shows the after-sale service system.

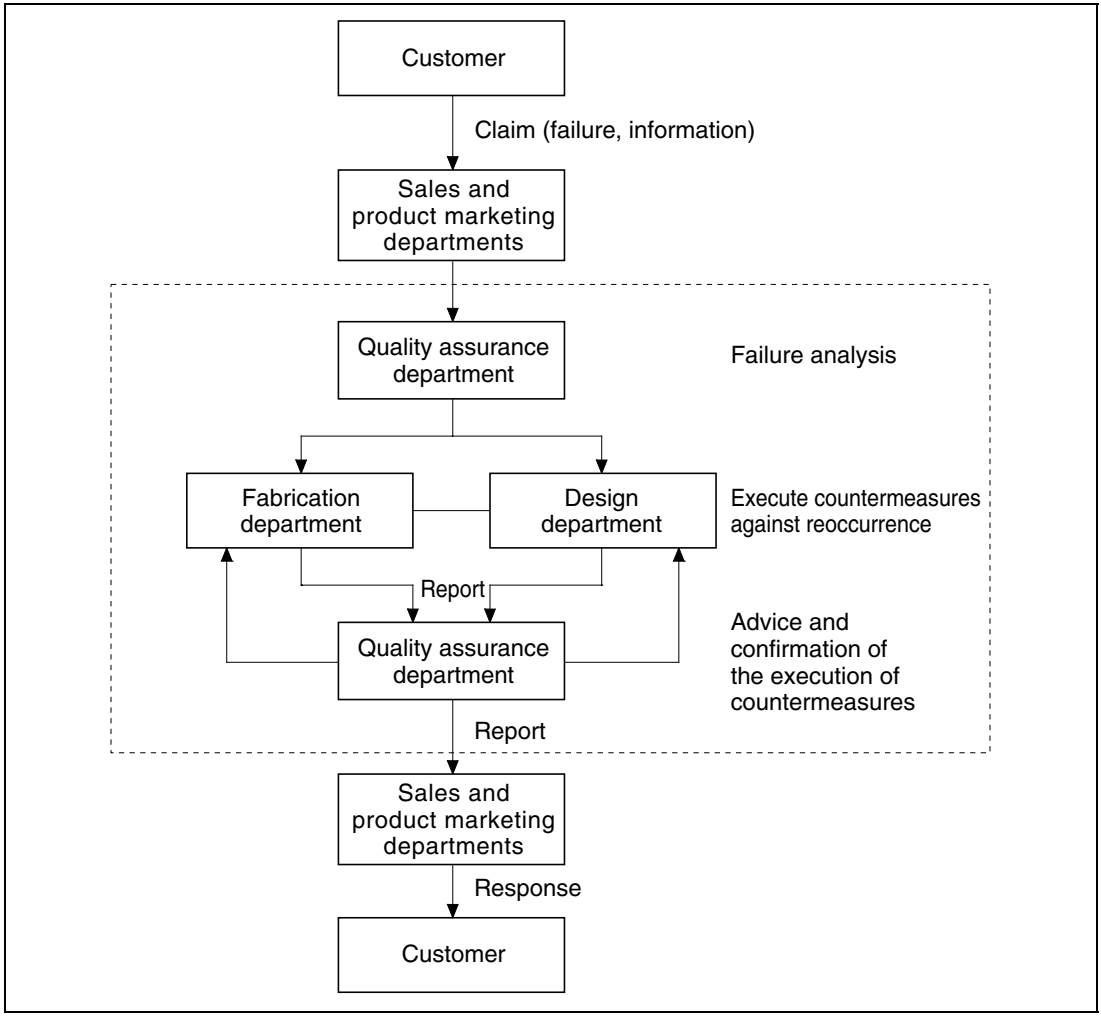


Figure 8.1 After-Sales Service System

Diodes for Mobile Communications Application Note

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