Discrete Semiconductors Derating

This section describes derating requirements for Discrete Semiconductors. Use this section to select, design and derate Discrete Semiconductors.

Tables 1A, 1B and 1C illustrate derating requirements for silicon-based Discrete Semiconductors. Discrete semiconductors are divided into diode and transistor categories. For silicon Discrete Semiconductors, each part type has Derating Parameters, Quality Level, and Environmental Category for derating. Use these derating tables in conjunction with the manufacturer's specification sheet to properly rate each part.

Non-military parts are not designed to operate over the required 10 to 20 years life span or to meet the extreme environmental conditions of a "severe" environment. This is why non-military consumer parts are not allowed to be used in "severe" environments. Up screening or Up-Rating of Discrete Semiconductor parts is not allowed.

Table 1A. Silicon-Based Discrete Semiconductor Derating Requirements

			Environmental Category		
Part Type	Derating Parameter	Quality Level 1/	Protected	Normal	Severe
Diode General Purpose (Small Signal – Switching)	Forward Current (I_F)	1	100%	100%	100%
	Reverse Voltage (V_R)		95%	90%	85%
	Surge Current (I_{FSM})		100%	90%	80%
	Max T_J (°C)		150°C	125°C	125°C
	I_F	2	90%	90%	70%
	V_R		80%	75%	50%
	I_{FSM}		80%	80%	50%
	T_J		100°C	85°C	70°C
	I_F	3	75%	70%	
	V_R		70%	60%	
	I_{FSM}		60%	30%	

	T_J		70°C	35°C	
Power Rectifier	Forward Current (I_F)	1	100%	100%	90%
	Reverse Voltage (V_R)		95%	90%	85%
	Max T_J (°C)		150°C	125°C	125°C
	I_F	2	90%	85%	60%
	V_R		80%	75%	30%
	T_J		100°C	85°C	70°C
	I_F	3	60%	50%	
	V_R		50%	30%	
	T_J		70°C	35°C	
Schottky - PIN	Power Dissipation (P_D)	1	100%	100%	90%
	Reverse Voltage (V_R)		95%	90%	85%
	Max T_J (°C)		150°C	125°C	125°C
	P_D	2	90%	90%	50%
	V_R		80%	80%	25%
	T_J		100°C	85°C	70°C
	P_D	3	75%	75%	
	V_R		50%	30%	
	T_J		70°C	35°C	

1/ The Quality Levels are: (1) QML-19500, JANTX minimum; (2) Automotive parts certified QS-9000, Industrial-grade parts certified ISO-9000, or QML-19500 manufacturer with part less than JANTX level; and (3) Non-military consumer-grade parts certified ISO-9000.

Table 1B. Silicon-Based Discrete Semiconductors Derating Requirements

			Environmental Category		
Part Type	Derating Parameter	Quality Level 1/	Protected	Normal	Severe
Voltage Regulator/ Reference	Power Dissipation (P_D)	1	100%	100%	90%
	Max T_J (°C)		150°C	125°C	125°C
	P_D	2	90%	80%	50%
	T_J		100°C	85°C	70°C
	P_D	3	50%	50%	
	T_J		70°C	35°C	
Transient Voltage Suppress	Power Dissipation (P_D)	1	100%	100%	90%
	Average Current (I_O)		100%	100%	90%
	Max T_J (°C)		150°C	125°C	125°C
	Power Dissipation (P_D)	2	80%	80%	50%
	Average Current (I_O)		80%	80%	50%
	T_J		100°C	85°C	70°C
	Power Dissipation (P_D)	3	75%	50%	
	Average Current (I_O)		75%	50%	
	T_J		70°C	35°C	
Thyristor	On-State Current (I_t)	1	100%	100%	90%
	Off-State Voltage (VDM)		100%	100%	90%
	Max T_J (°C)		150°C	125°C	125°C
	I_t	2	90%	80%	50%
	VDM		90%	80%	50%

	T_J		100°C	85°C	70°C
	I_t	3	60%	50%	
	VDM		60%	50%	
	T_J		70°C	35°C	

Table 1C. Silicon-Based Discrete Semiconductors Derating Requirements

			Environmental Category		
Part Type	Derating Parameter	Quality Level 1/	Protected	Normal	Severe
Microwave	Power Dissipation (P_D)	1	100%	100%	90%
	Reverse Voltage (V_R)		90%	90%	85%
	Max T_J (°C)		150°C	125°C	125°C
	P_D	2	90%	80%	60%
	V_R		80%	75%	30%
	T_J		100°C	85°C	70°C
	P_D	3	75%	70%	
	V_R		50%	30%	
	T_J		70°C	35°C	
Transistors Bipolar	Power Dissipation (P_D)	1	100%	100%	90%
	Breakdown Voltage (V_{BR})		100%	90%	80%
	Safe Operating Area (SOA)		100% V_{CE}	90% V_{CE}	80% V_{CE}
	Collector Current (I_C)		100% I_C	90% I_C	90% I_C
	Max T_J (°C)		150°C	125°C	125°C
	P_D	2	90%	80%	60%
	V_{BR}		80%	75%	30%

	SOA		80% V_{CE}	75% V_{CE}	40% V_{CE}
	Collector Current (I_C)		90% I_C	80% I_C	60% I_C
	T_J		100°C	85°C	70°C
	P_D	3	50%	50%	
	V_{BR}		25%	25%	
	SOA		50% V_{CE}	50% V_{CE}	
	Collector Current (I_C)		50% I_C	50% I_C	
	T_J		70°C	35°C	
Transistors FET	Power Dissipation (P_D)	1	100%	100%	90%
	Breakdown Voltage (V_{BR})		100%	95%	90%
	Max T_J (°C)		150°C	125°C	125°C
	P_D	2	90%	80%	50%
	V_{BR}		80%	75%	50%
	T_J		100°C	85°C	70°C
	P_D	3	50%	50%	
	V_{BR}		25%	25%	
	T_J		70°C	35°C	

Table 2A, and 2B detail derating requirements for GaAs Discrete Semiconductors. Since GaAs Discrete Semiconductors are not as mature as their silicon counterparts, they are not derated by quality level or application life span. All derating values are based on manufacturers rated specifications and recommended derating figures.

Table 2A. GaAs Transistor Derating Requirements

			Environmental Category		
Part Type(Transistors)	Derating Parameter	Recommended Maximum Value	Protected	Normal	Severe
MESFET(Low Noise)	Drain to Source Voltage (V_{ds})	5V	80%	75%	60%
	Gate to Source Voltage (V_{gs})	-6V	80%	75%	60%
	Drain Current (I_{ds})	Idss	90%	85%	80%

	Gate Current (I_{gsf})	0.05 mA	100%	90%	85%
	Reverse Gate Current (I_{gsr})	0.01 mA	100%	95%	90%
	Power Dissipation (P_d)	Mfg. Spec.	100%	90%.	80%.
	Channel Temperature (T_{ch})	175°C	175°C	150°C	125°C
	Storage Temperature (T_{st})	-65 to 175°C			
PHEMT (Low Noise)	Drain to Source Voltage (V_{ds})	2V	80%	75%	50%
	Gate to Source Voltage (V_{gs})	-3V	90%	80%	70%
	Drain Current (I_{ds})	Idss	100%	95%	90%
	Forward Gate Current (I_{gsf})	1.0 mA	100%	90%	85%
	Power Dissipation (P_d)	Mfg. Spec.	100%	90%	80%.
	Channel Temperature (T_{ch})	175°C	175°C	150°C	125°C
	Storage Temperature (T_{st})	-65 to 175°C			
MESFET(Power)	Drain to Source Voltage (V_{ds})	10V	100%	90%	85%
	Gate to Source Voltage (V_{gs})	-5V	100%	90%	85%
	Drain Current (I_{ds})	Idss	100%	90%	85%
	Forward Gate Current (I_{gsf})	2.0 mA	100%	90%	85%
	Reverse Gate Current (I_{gsr})	-0.5 mA	100%	85%	80%
	Power Dissipation (P_d)	Mfg. Spec.	100%	90%	80%
	Channel Temperature (T_{ch})	175°C	175°C	150°C	125°C
	Storage Temperature (T_{st})	-65 to 175°C			
HEMT/ PHEMT (Power)	Drain to Source Voltage (V_{ds})	9V	100%	90%	85%
	Gate to Source Voltage (V_{gs})	-6V	100%	90%	85%
	Drain Current (I_{ds})	Idss	100%	90%	85%
	Gate Current (I_{gsf})	2.0 mA	100%	90%	85%
	Power Dissipation (P_d)	Mfg. Spec.	100%	90%	80%
	Channel Temperature (T_{ch})	175°C	175°C	150°C	125°C
	Storage Temperature (T_{st})	-65 to 175°C			

Note: All parameters are the manufacturers recommended maximum operating values.

Table 2B. GaAs Diode Derating Requirements

			Environmental Category		
Part Type(Diodes)	Derating Parameter	Recommended Maximum Value	Protected	Normal	Severe
Varactor	Reverse Voltage (V_r)	80% of rated V_{br}	100%	95%	90%
	Forward Current (I_f)	80 mA	90%	85%	80%
	Power Dissipation (P_d)	200 mW	100%	90%	80%
	Operating Temperature (T)	150°C	150°C	135°C	125°C
	Storage Temperature (T_s)	-65 to 175°C			
Schottky	Reverse Voltage (V_r)	80% of rated V_{br}	100%	95%	
	Forward Current (I_f)	80% of rated I_f	100%	95%	
	Power Dissipation (P_d)	Mfg. Spec.	90%	80%	
	Operating Temperature (T)	150°C	150°C	135°C	
	Storage Temperature (T_s)	-65 to 175°C			
Schottky	Power Dissipation (P_d)	Mfg. Spec.	80%		
	Operating Temperature (T)	150°C	70°C		
	Junction Temperature (T_j)	175°C	150°C		
	Storage Temperature (T_s)	-65 to 175°C			