FRED
Ultrafast Soft Recovery Diode Module, 200 A

FEATURES

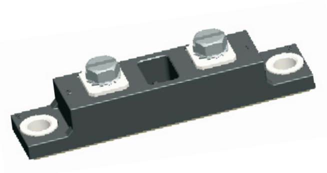
- Very low Q_{rr} and t_{rr}
- Lead (Pb)-free
- Designed and qualified for industrial level
- Reduced RFI and EMI
- Reduced snubbing

DESCRIPTION

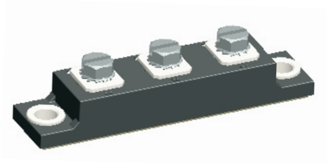
FRED diodes are optimized to reduce losses and EMI/RFI in high frequency power conditioning systems. An extensive characterization of the recovery behavior for different values of current, temperature and dI/dt simplifies the calculations of losses in the operating conditions. The softness of the recovery eliminates the need for a snubber in most applications.

TYPICAL APPLICATIONS

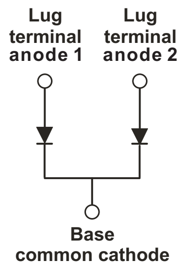
- Power converters
- Motor drives
- Welders
- Switching power supplies

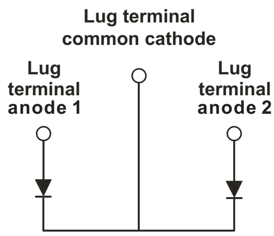


TO-244 (non-insulated)



TO-244 (insulated)





*Add suffix R for common anode

PRODUCT SUMMARY	
$I_{F(AV)}$	200A
V_R	400V
$I_{F(DC)}$ at T_C	160A at 100 °C

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS		MAX.	UNIT
Cathode to anode voltage	V_R			400	V
Average forward current	$I_{F(AV)}$	T_C =25°C, per leg		315	A
		T_C =120°C	per device	200	
			per leg	100	
DC forward current	$I_{F(DC)}$	T_C =100°C		160	
Single pulse forward current	I_{FSM}	Limited by junction temperature, per leg		1400	
Non-repetitive avalanche energy	E_{AS}	L = 100 μH, duty cycle limited by maximum T_J		1.4	mJ
Maximum power dissipation	P_D	T_C =25°C		394	W
		T_C =100°C		192	
Operating junction and storage temperature range	T_J, T_{Stg}			- 55 to 150	°C

ELECTRICAL SPECIFICATIONS (T_J = 25 ºC unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Cathode to anode breakdown voltage	V_{BR}	I_R = 100 µA	400	-	-	V
Maximum forward voltage	V_{FM}	I_F = 100 A	-	1.05	1.25	V
		I_F = 200 A	-	1.25	1.45	V
		I_F = 100 A, T_J = 125 ºC	-	0.90	1.10	V
Maximum reverse leakage current per leg	I_{RM}	T_J = 125°C, V_R = 400V	-	0.50	4.0	mA
		T_J = 25°C, V_R = 400V	-	2.0	10	µA
Junction capacitance	C_T	V_R = 200V	-	280	380	pF
Series inductance	L_S	From top of terminal hole to mounting plane	-	6.0	-	nH
Maximum RMS insulation voltage (for insulated type)	V_{INS}	50Hz	-	-	3000(1min) 3600(1s)	V

DYNAMIC RECOVERY CHARACTERISTICS PER LEG (T_J = 25 ºC unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Reverse recovery time	t_{rr}	I_F = 0.5A, I_R = 1.0A, I_{RR} = 0.25A		-	60	70	ns
		I_F = 1.0A, dI_F/dt=200A/µs, V_R = 30V		-	50	-	ns
		T_J = 25 ºC	I_F= 140A, dI_F/dt = 200 A/µs, V_R = 200 V	-	77	120	ns
		T_J = 125 ºC		-	290	440	ns
Peak recovery current	I_{RRM}	T_J = 25 ºC		-	7.5	14	A
		T_J = 125 ºC		-	16	30	A
Reverse recovery charge	Q_{rr}	T_J = 25 ºC		-	290	780	nC
		T_J = 125 ºC		-	2300	3600	nC
Peak rate of recovery current	$dI_{(rec)M}/dt$	T_J = 25 ºC		-	320	-	A/µs
		T_J = 125 ºC		-	270	-	A/µs

THERMAL AND MECHANICAL SPECIFICATIONS

PARAMETER		SYMBOL	MIN.	TYP.	MAX.	UNIT
Maximum junction and storage temperature range		T_{J}, T_{stg}	-55	-	150	ºC
Thermal resistance, junction to case per leg	TO-244 (non-insulated)	R_{thJC}	-	-	0.19	ºC/W
	TO-244 (insulated)		-	-	0.28	ºC/W
Thermal resistance, junction to case per module	TO-244 (non-insulated)	R_{thJC}	-	-	0.095	ºC/W
	TO-244 (insulated)		-	-	0.14	ºC/W
Typical thermal resistance, case to heatsink		R_{thCS}	-	0.10	-	ºC/W
Weight	TO-244 (non-insulated)		-	80 (2.82)	-	g (oz.)
	TO-244 (insulated)		-	95 (3.36)	-	g (oz.)
Mounting torque [1]			30 (3.4)	-	40 (4.6)	lbf · in (N · m)
Mounting torque center hole			12 (1.4)	-	18 (2.1)	lbf · in (N · m)
Terminal torque			30 (3.4)	-	40 (4.6)	lbf · in (N · m)
Vertical pull			-	-	80	lbf · in
2" lever pull			-	-	35	lbf · in

Note

(1)Mounting surface must be smooth, flat, free of burrs or other protrusions. Apply a thin even film or thermal grease to mounting surface. Gradually tighten each mounting bolt in 5 to 10 lbf. in steps until desired or maximum torque limits are reached

Ordering Information Tabel

Device code

NK	F	D	200	–	40	R	I
1	2	3	4		5	6	7

1 - Nell's power module
2 - F for Ultrafast soft recovery diode
3 - D for Dual Diodes, TO-244 Package
4 - Maximum average forward current, A
5 - Voltage rating (40 = 400V)
6 - None for common cathode configuration
"R" for common anode configuration
7 - None for non-insulated type
"I" for insulated type

Fig.1 Maximum forward voltage drop vs. Instantaneous forward current (per leg)

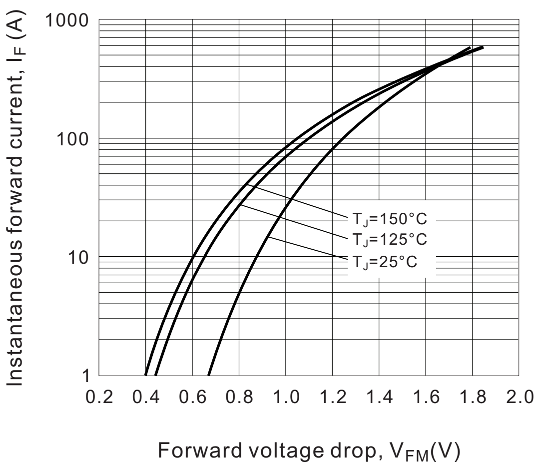


Fig.2 Typical reverse current vs. reverse voltage (per leg)

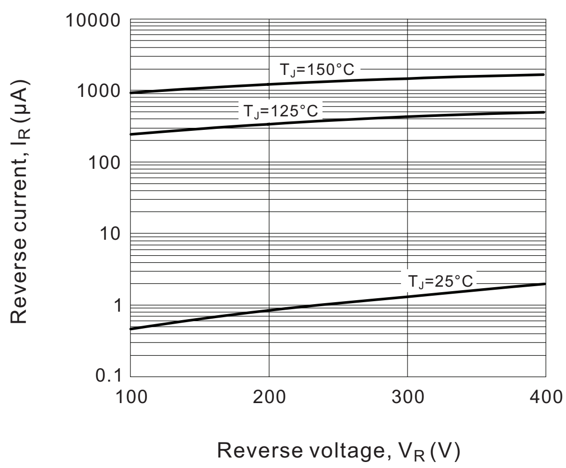


Fig.3 Typical junction capacitance vs. reverse voltage (per leg)

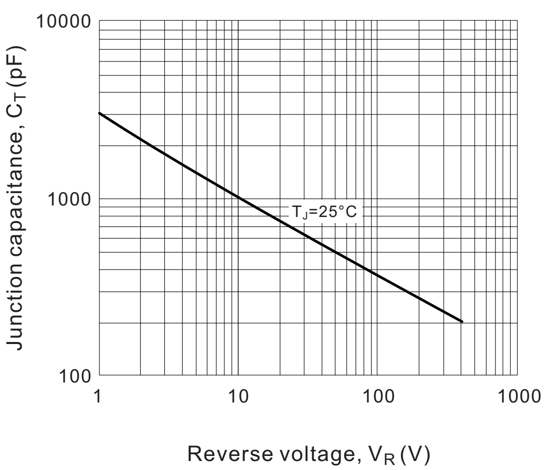


Fig.4 Maximum allowable case temperature vs. DC forward current (per leg)

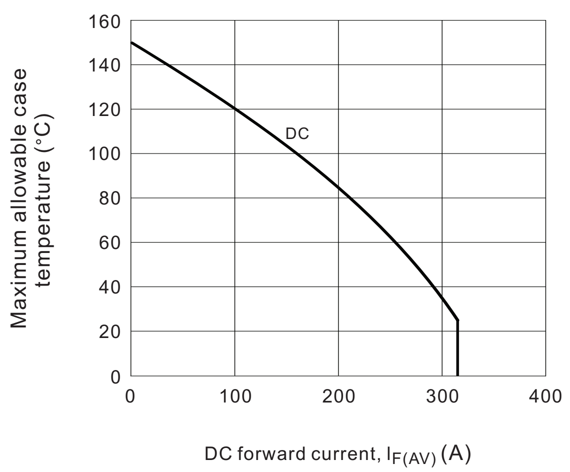


Fig.5 Typical reverse recovery time vs. dI_F/dt (per leg)

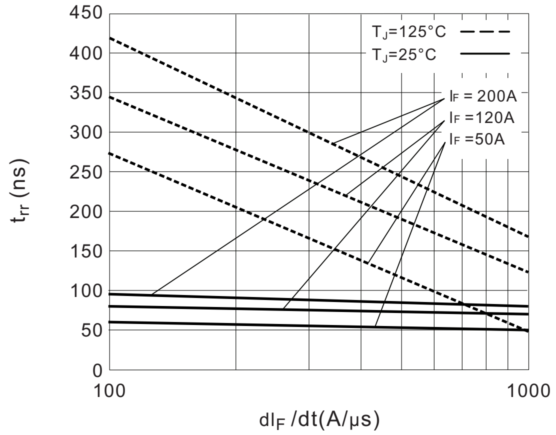


Fig.6 Typical recovery current vs. dI_F/dt (per leg)

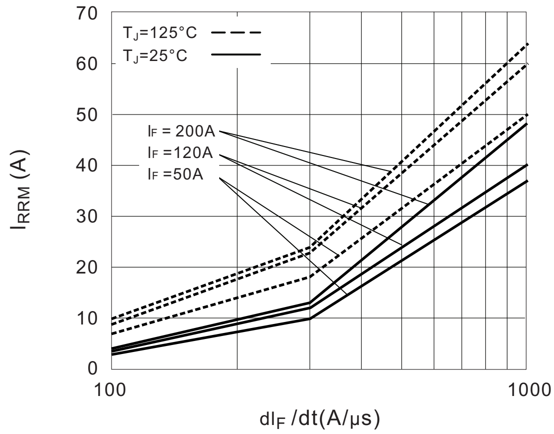


Fig.7 Typical stored charge vs. dI_F/dt (per leg)

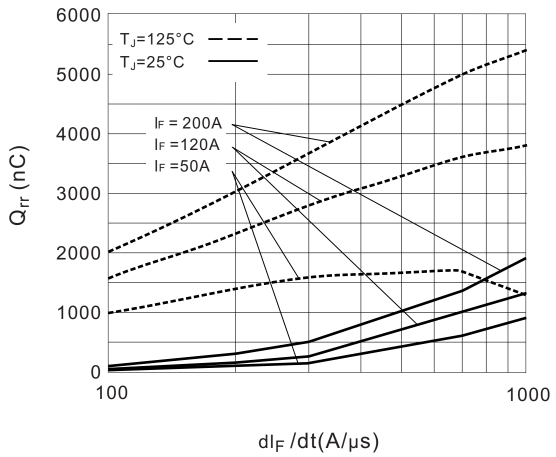


Fig.8 Typical $dI_{(rec)M}/dt$ vs. dI_F/dt (per leg)

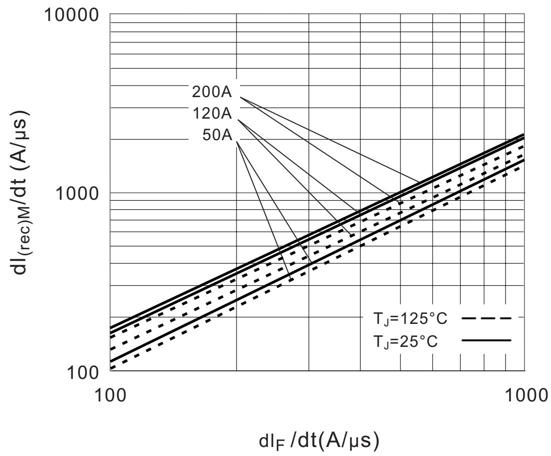


Fig.9-1 Maximum thermal impedance $R_{th(j-c)}$ characteristics (per leg, for TO-244 non-insulated)

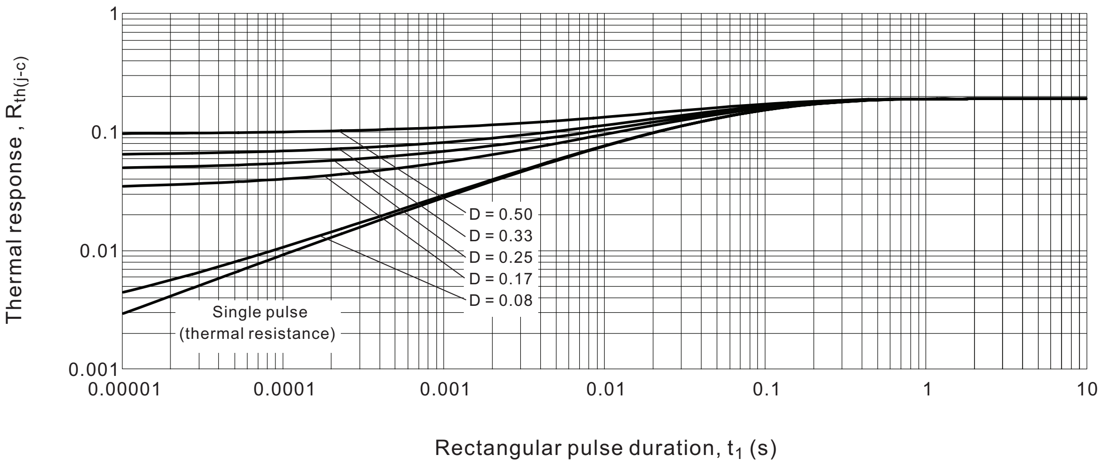


Fig.9-2 Maximum thermal impedance $R_{th(j-c)}$ characteristics (per leg, for TO-244 insulated)

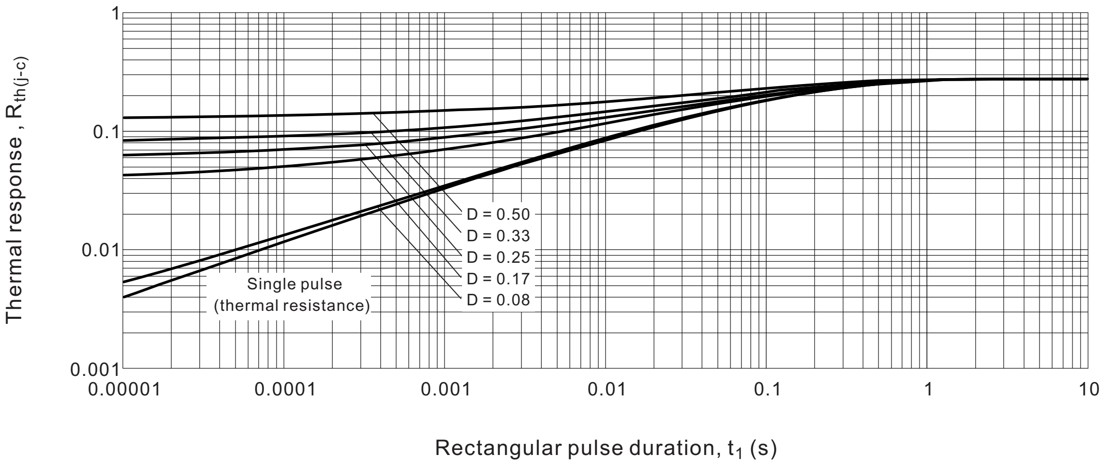


Fig.10 Reverse recovery parameter test circuit

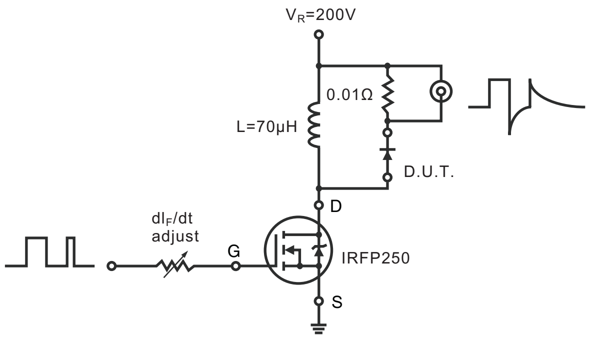
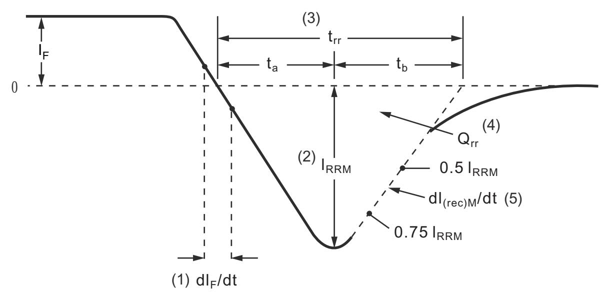


Fig.11 Reverse recovery waveform and definitions



(1) dI_F/dt - rate of change of current through zero crossing

(2) I_{RRM} - peak reverse recovery current

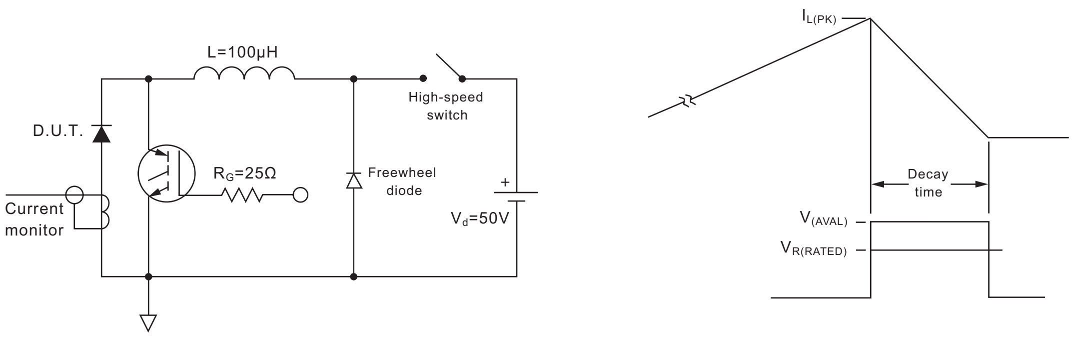
(3) t_{rr} - reverse recovery time measured from zero crossing point of negative going I_F to point where a line passing through 0.75 I_{RRM} and 0.50 I_{RRM} extrapolated to zero current.

(4) Q_{rr} - area under curve defined by t_{rr} and I_{RRM}

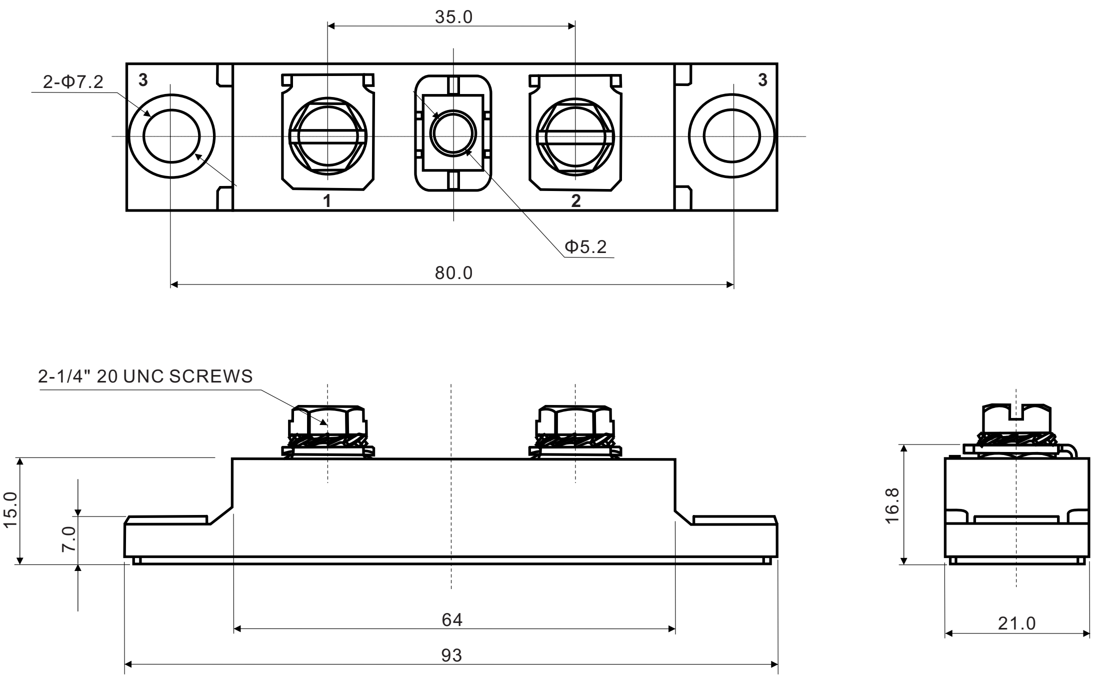
$$Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$$

(5) $dI_{(rec)M}/dt$ - peak rate of change of current during t_b portion of t_{rr}

Fig.12 Avalanche test circuit and waveforms

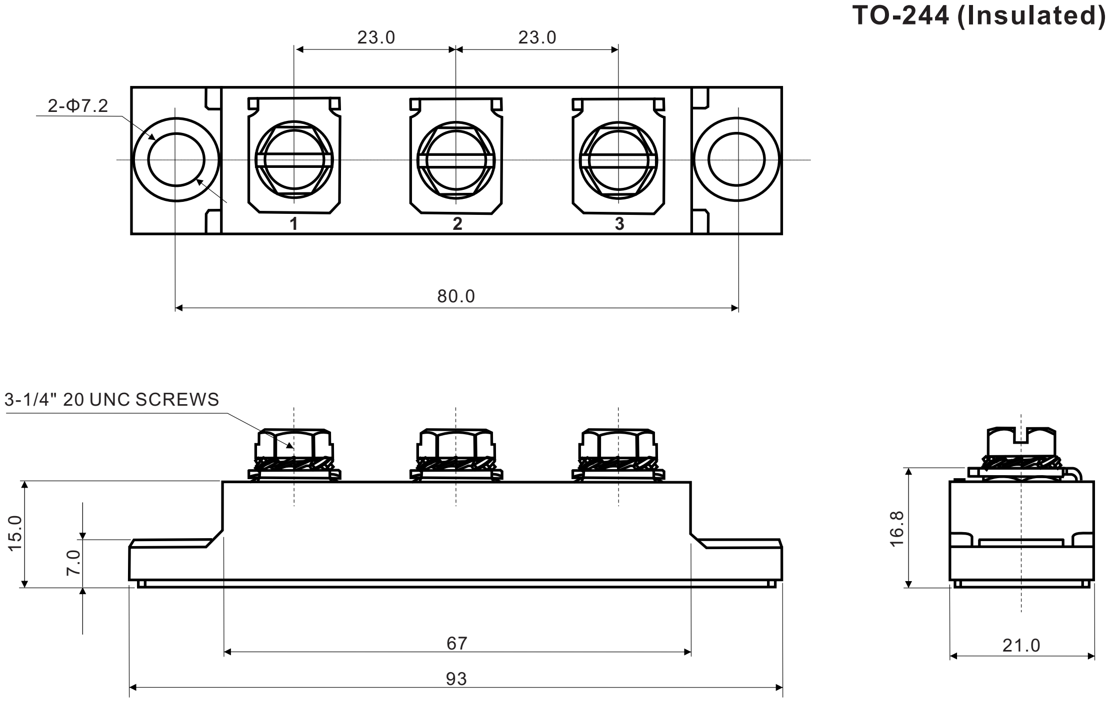


TO-244 (Non-Insulated)



All dimensions in millimeters

TO-244 (Insulated)



All dimensions in millimeters