

# International IR Rectifier

# SERIES IRK.L56, .L71, .L91

FAST RECOVERY DIODES

ADD-A-pak™ Power Modules

INTERNATIONAL RECTIFIER

65E D

55A  
70A  
90A

## Features

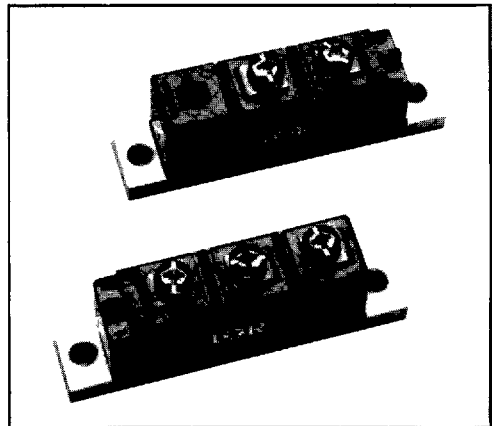
- Fast recovery time characteristics
- Electrically isolated base plate
- Standard JEDEC package
- Simplified mechanical designs, rapid assembly
- High surge capability
- Large creepage distances
- UL E 78996 approved
- 3500 V<sub>RMS</sub> isolating voltage

## Description

The IRK.L Series of ADD-A-paks use fast recovery power diodes in four basic configurations. The semiconductors are electrically isolated from the metal base, allowing common heatsinks and compact assemblies to be built. They can be interconnected to form single phase or three phase bridges and the single diode module can be used in conjunction with the thyristor modules as a freewheel diode. Application includes power supplies, battery chargers, welders, motor controls and general industrial current rectification. These modules are intended for those applications where very fast recovery characteristics are required.

## Major Ratings and Characteristics

Parameters	IRK.L56	IRK.L71	IRK.L91	Units	
I <sub>F(AV)</sub>	55	70	90	A	
I <sub>F(RMS)</sub>	86	110	141	A	
I <sub>FSM</sub>	@ 50Hz	950	1010	1427	A
	@ 60Hz	1000	1060	1494	A
I <sup>2</sup> t	@ 50Hz	4525	5110	10180	A <sup>2</sup> s
	@ 60Hz	4130	4660	9300	A <sup>2</sup> s
V <sub>RRM</sub> range	400 to 1000			V	
t <sub>rr</sub> range	200 to 1000			ns	
T <sub>J</sub> range	-40 to 150			°C	



## ELECTRICAL SPECIFICATIONS

## Voltage Ratings

Type number	Voltage Code	$t_r$ Code	$V_{RRM}$ , maximum repetitive peak reverse voltage V	$V_{RSM}$ , maximum non-repetitive peak reverse voltage V	$I_{RRM}$ max. mA
IRK.L56	04	S02, S05, S10	400	500	20
	06	S02, S05, S10	600	700	20
IRK.L71	08	S05, S10	800	900	20
IRK.L91	10	S05, S10	1000	1100	20

## Forward Conduction

Parameters	IRK.L56	IRK.L71	IRK.L91	Units	Conditions		
$I_{F(AV)}$ Max. average forward current @ Case temperature	55	70	90	A	180° conduction, half sine wave		
	70	75	75	°C			
$I_{F(RMS)}$ Max. RMS forward current	86	110	141	A			
$I_{FSM}$ Max. peak, one-cycle forward, non-repetitive surge current	950	1010	1427	A	t = 10ms	Sinusoidal half wave, Initial $T_J = T_{J \text{ max}}$	
	1000	1060	1494	A	t = 8.3ms		No voltage reapplied
	800	850	1200	A	t = 10ms		100% $V_{RRM}$
	840	890	1256	A	t = 8.3ms		reapplied
$I^2t$ Maximum $I^2t$ for fusing	4525	5110	10180	A <sup>2</sup> s	t = 10ms	Sinusoidal half wave, Initial $T_J = T_{J \text{ max}}$	
	4130	4660	9300	A <sup>2</sup> s	t = 8.3ms		No voltage reapplied
	3200	3610	7200	A <sup>2</sup> s	t = 10ms		100% $V_{RRM}$
	2920	3300	6570	A <sup>2</sup> s	t = 8.3ms		reapplied
$I^2t$ Maximum $I^2t$ for fusing	45250	51100	101800	A <sup>2</sup> /s	t = 0.1 to 10ms, no voltage reapplied		
$V_{F(TO)1}$ Low level value of threshold voltage	1.05	0.85	0.85	V	$(16.7\% \times \pi \times I_{F(AV)}) < I < \pi \times I_{F(AV)}$		
$V_{F(TO)2}$ High level value of threshold voltage	1.31	1.14	1.25	V	$(\pi \times I_{F(AV)}) < I < 20 \times \pi \times I_{F(AV)}$		
$r_{\theta 1}$ Low level value of forward slope resistance	3.37	2.11	2.04	mΩ	$(16.7\% \times \pi \times I_{F(AV)}) < I < \pi \times I_{F(AV)}$		
$r_{\theta 2}$ High level value of forward slope resistance	2.07	0.97	0.84	mΩ	$(\pi \times I_{F(AV)}) < I < 20 \times \pi \times I_{F(AV)}$		
$V_{FM}$ Max. forward voltage drop	1.72	1.36	1.45	V	$I_{FM} = \pi \times I_{F(AV)}$ , $T_J = 25^\circ\text{C}$ , 180° conduction Av. power = $V_{F(TO)} \times I_{F(AV)} + r_f \times (I_{F(RMS)})^2$		

## Thermal and Mechanical Specifications

$T_J$ Junction operating temperature	-40 to 150			°C	
$T_{stg}$ Storage temperature range	-40 to 150			°C	
$R_{\theta JC}$ Max. internal thermal resistance junction to case	0.30	0.265	0.19	K/W	IRKD../IRKJ../IRKC.. Per module, DC operation
	0.60	0.53	0.38	K/W	IRKE.. Per junction, DC operation
$R_{\theta c-s}$ Thermal resistance, case to heatsink	0.1	0.1	0.1	K/W	Mounting surface flat, smooth and greased
T Mounting ADD-A-pak to torque ±10% heatsink Busbar to ADD-A-pak	5			Nm	A mounting compound is recommended and the torque should be rechecked after a period of about 3 hours to allow for the spread of the compound
	3			Nm	
wt Approximate weight	170 (6)			g (oz)	
Case style	TO-240AA			JEDEC	

## Blocking

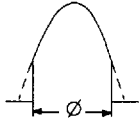
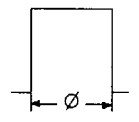
$I_{RRM}$ Max. peak rev. leakage current	20	20	20	mA	$T_J = 150^\circ\text{C}$
$V_{INS}$ RMS isolation voltage	3500	3500	3500	V	50Hz, circuit to base, all terminals shorted; t = 1s

**ΔR Conduction (per Junction)**

**INTERNATIONAL RECTIFIER**

**6SE D**

(The following table shows the increment of thermal resistance  $R_{thJC}$  when devices operate at different conduction angles than DC)

Conduction angle		IRK.L56..	IRK.L71..	IRK.L91..	Units	Conditions
	180°	0.054	0.041	0.033	K/W	$T_J = T_{J \text{ max.}}$ Per junction
	120°	0.068	0.052	0.041	K/W	
	90°	0.088	0.068	0.055	K/W	
	60°	0.130	0.100	0.081	K/W	
	30°	0.215	0.165	0.135	K/W	
	180°	0.043	0.033	0.027	K/W	$T_J = T_{J \text{ max.}}$ Per junction
	120°	0.073	0.057	0.046	K/W	
	90°	0.097	0.075	0.061	K/W	
	60°	0.135	0.104	0.085	K/W	
	30°	0.217	0.167	0.138	K/W	

**Reverse Recovery Characteristics**

Parameter	IRK.L56..			IRK.L71..			IRK.L91..			Units	Conditions (*)
	S02	S05	S10	S02	S05	S10	S02	S05	S10		
$t_{rr}$ Maximum reverse recovery time	70	110	270	70	110	270	80	120	290	ns	$T_J = 25^\circ\text{C}$ , $I_F = 1\text{A}$ to $V_R = 30\text{V}$ $-di_F/dt = 100\text{A}/\mu\text{s}$
	200	500	1000	200	500	1000	200	500	1000	ns	$T_J = 25^\circ\text{C}$ , $-di_F/dt = 25\text{A}/\mu\text{s}$ $I_{FM} = \pi \times \text{rated } I_{F(AV)}$
$Q_{rr}$ Maximum reverse recovered charge	0.25	0.4	1.35	0.25	0.4	1.35	0.3	0.6	1.6	$\mu\text{C}$	$T_J = 25^\circ\text{C}$ , $I_F = 1\text{A}$ to $V_R = 30\text{V}$ $-di_F/dt = 100\text{A}/\mu\text{s}$
	0.55	2.0	8.0	0.6	2.1	8.5	0.8	3.5	1.5	$\mu\text{C}$	$T_J = 25^\circ\text{C}$ , $-di_F/dt = 25\text{A}/\mu\text{s}$ $I_{FM} = \pi \times \text{rated } I_{F(AV)}$

(\*) Tested on LEM 300A Diodemeter Tester

**Ordering Information Table**

**Device Code**

IRK	D	L	91	-	10	S10
①	②	③	④		⑤	⑥

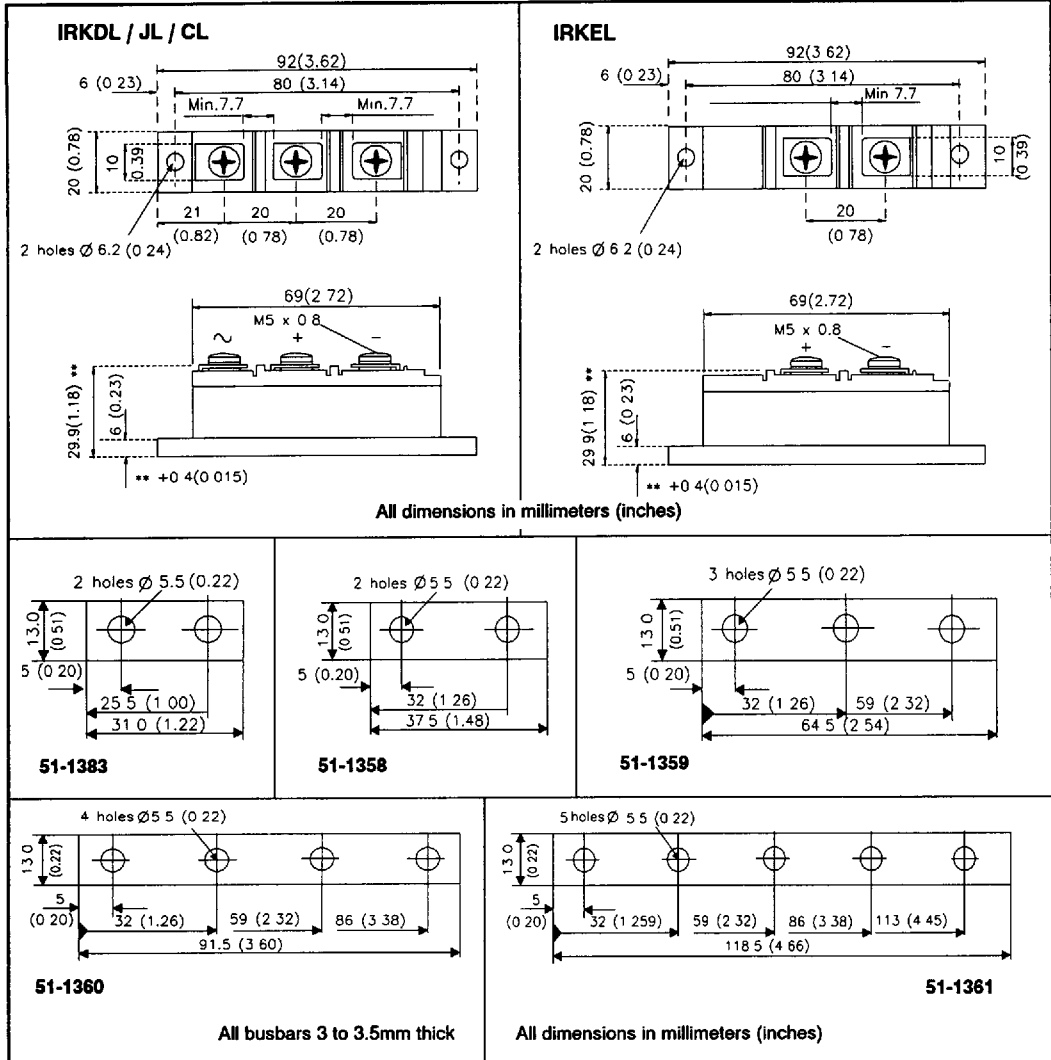
  

1	-	Module type
2	-	Circuit configuration (See table)
3	-	L = Fast recovery diode
4	-	Current code
5	-	Voltage code (See Voltage Ratings Table)
6	-	$t_{rr}$ code

Circuit Configurations	
D	= 2 diodes in series
E	= Single diode
J	= 2 diodes / Common anode
C	= 2 diodes / Common cathode

Outlines Table



INTERNATIONAL RECTIFIER 65E D

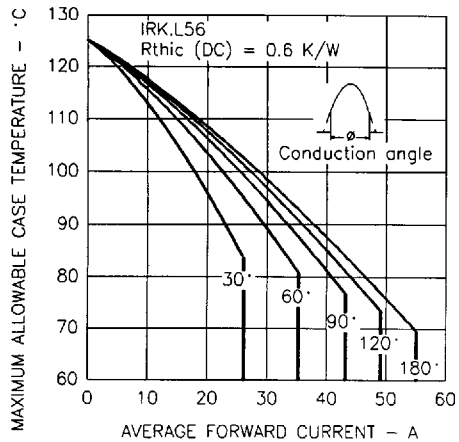


Fig. 1 - Current Ratings Characteristics

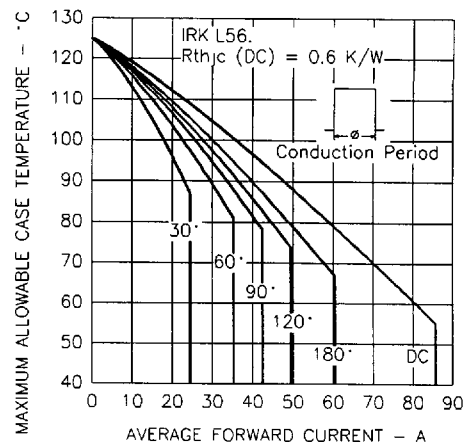


Fig. 2 - Current Ratings Characteristics

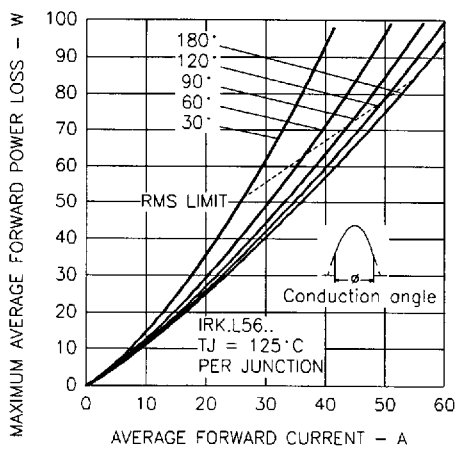


Fig. 3 - Forward Power Loss Characteristics

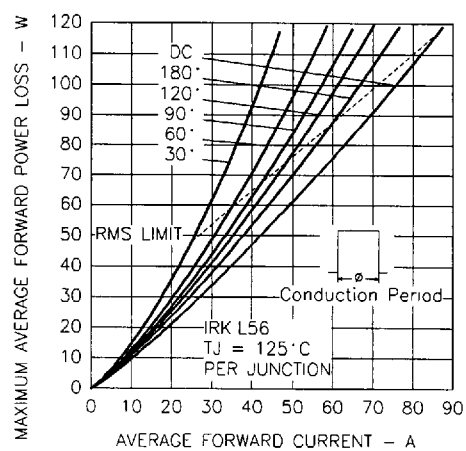


Fig. 4 - Forward Power Loss Characteristics

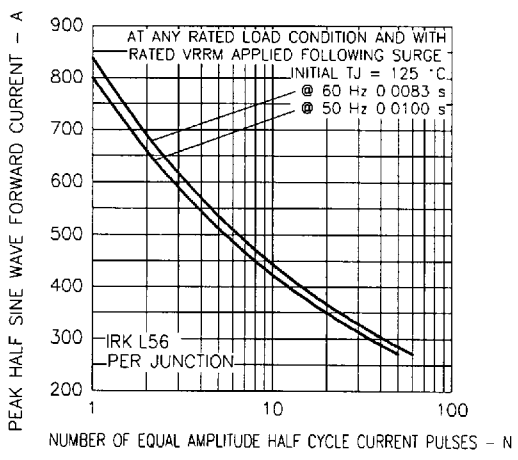


Fig. 5 - Maximum Non-Repetitive Surge Current

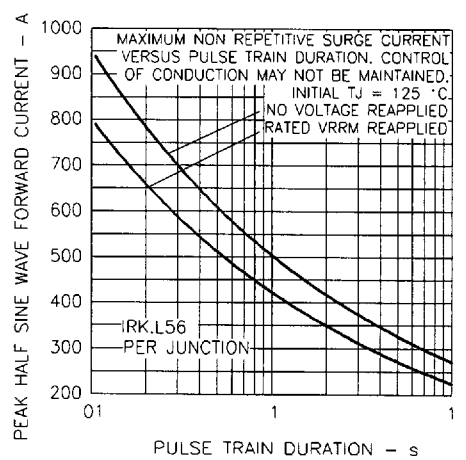


Fig. 6 - Maximum Non-Repetitive Surge Current

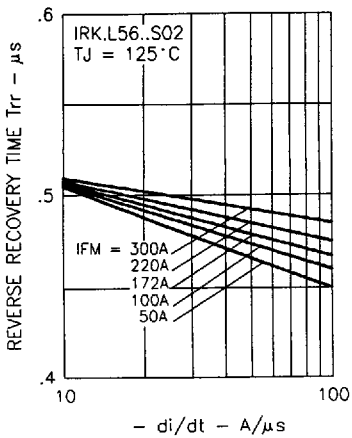


Fig. 7 - Recovery Time Characteristics

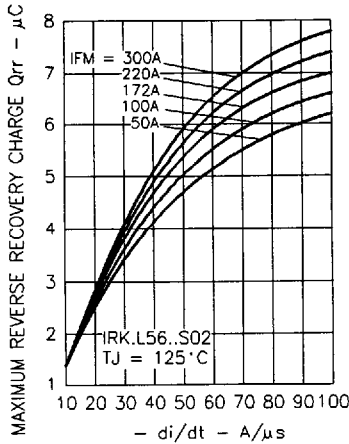


Fig. 8 - Recovery Charge Characteristics

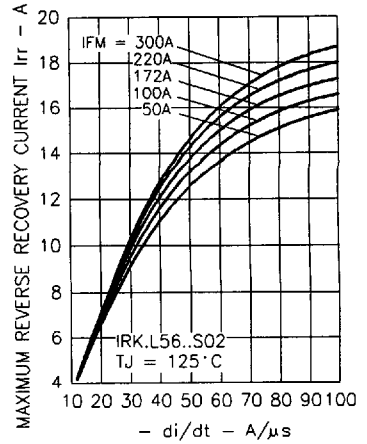


Fig. 9 - Recovery Current Characteristics

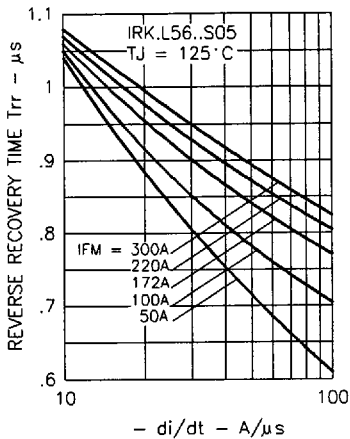


Fig. 10 - Recovery Time Characteristics

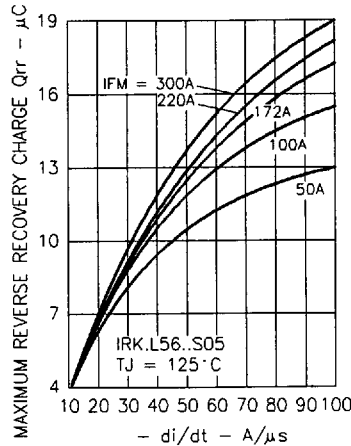


Fig. 11 - Recovery Charge Characteristics

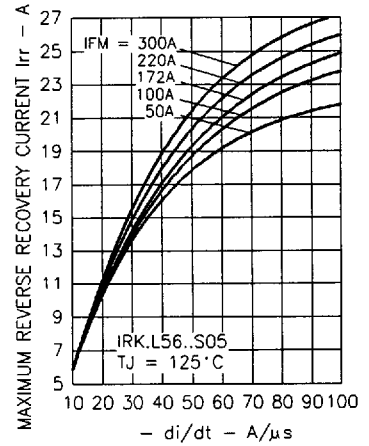


Fig. 12 - Recovery Current Characteristics

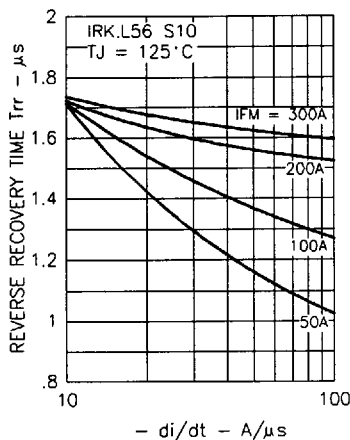


Fig. 13 - Recovery Time Characteristics

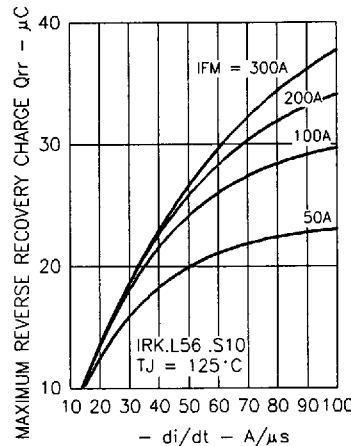


Fig. 14 - Recovery Charge Characteristics

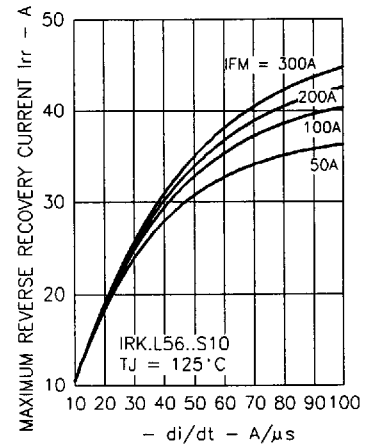


Fig. 15 - Recovery Current Characteristics

INTERNATIONAL RECTIFIER GSE D

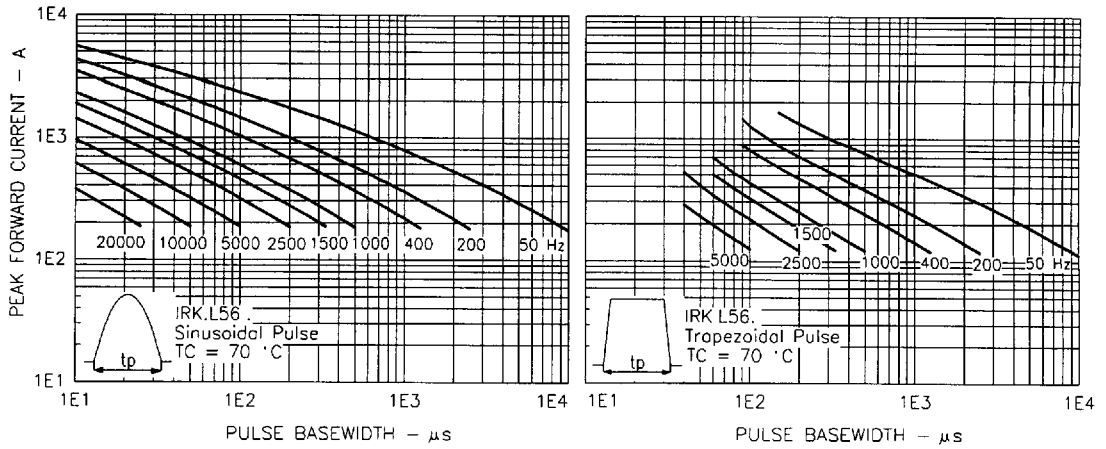


Fig. 16 - Frequency Characteristics

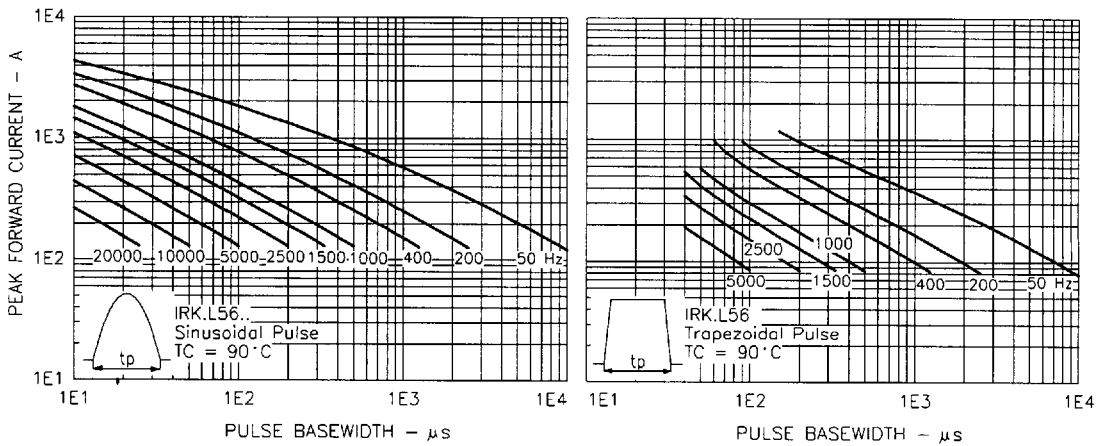


Fig. 17 - Frequency Characteristics

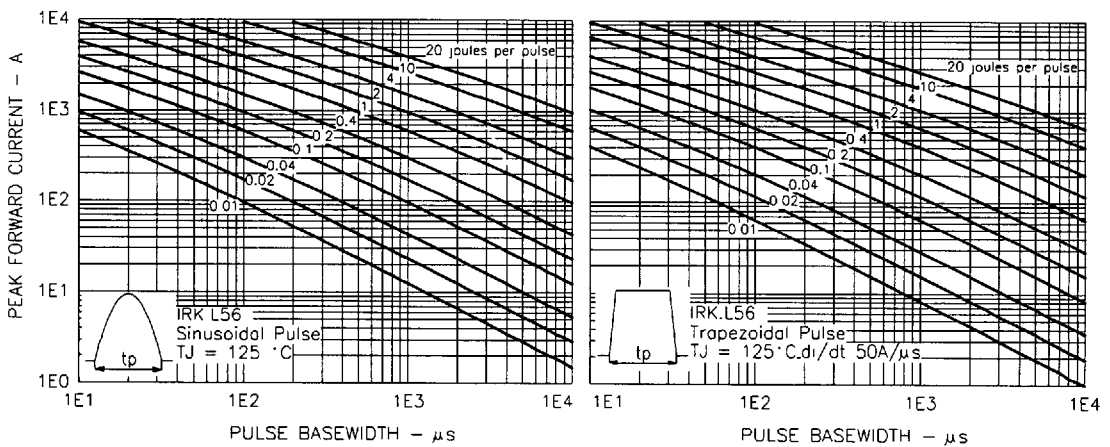


Fig. 18 - Maximum Forward Energy Loss Per Pulse Characteristics

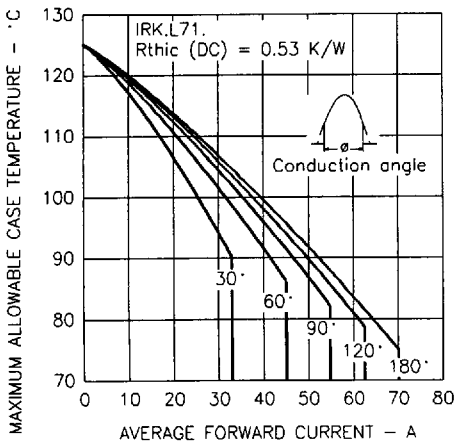


Fig. 19 - Current Ratings Characteristics

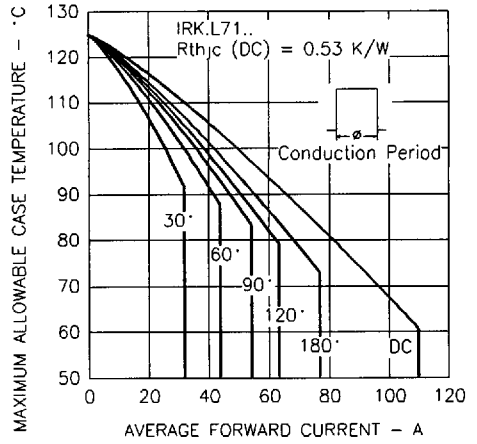


Fig. 20 - Current Ratings Characteristics

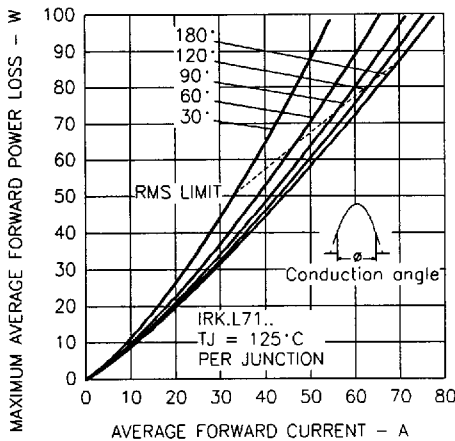


Fig. 21 - Forward Power Loss Characteristics

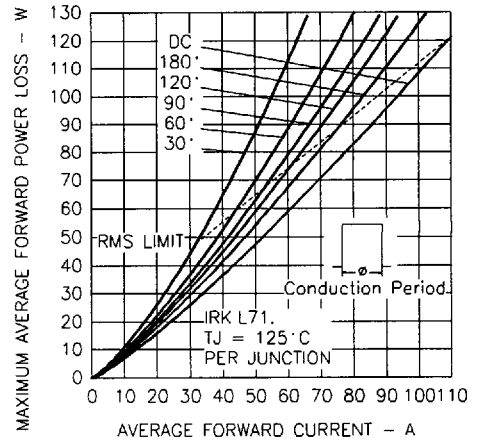


Fig. 22 - Forward Power Loss Characteristics

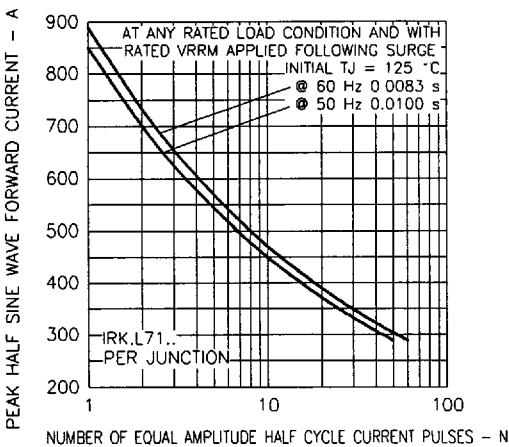


Fig. 23 - Maximum Non-Repetitive Surge Current

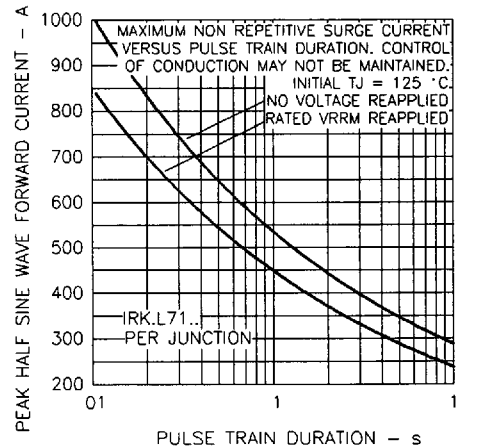


Fig. 24 - Maximum Non-Repetitive Surge Current



INTERNATIONAL RECTIFIER 65E D

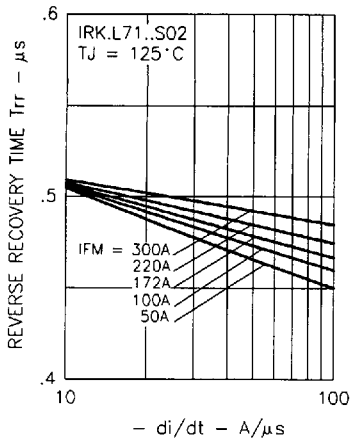


Fig. 25 - Recovery Time Characteristics

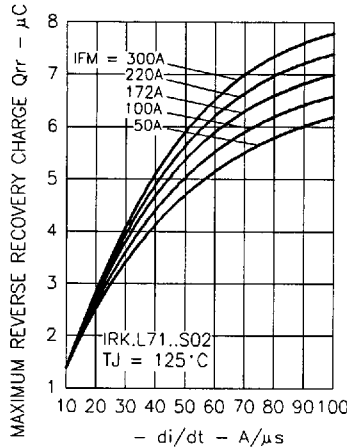


Fig. 26 - Recovery Charge Characteristics

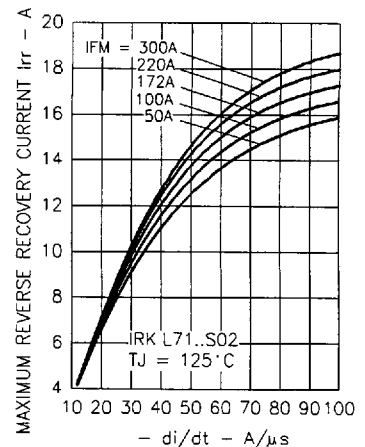


Fig. 27 - Recovery Current Characteristics

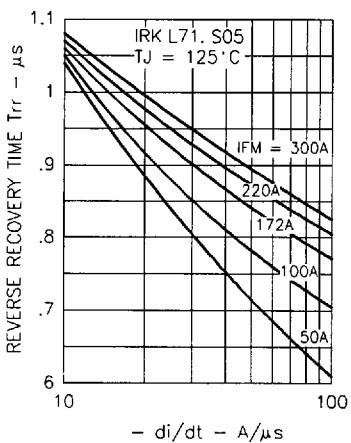


Fig. 28 - Recovery Time Characteristics

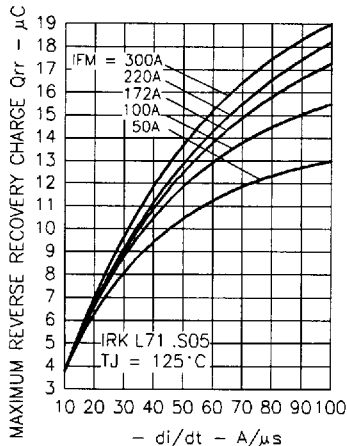


Fig. 29 - Recovery Charge Characteristics

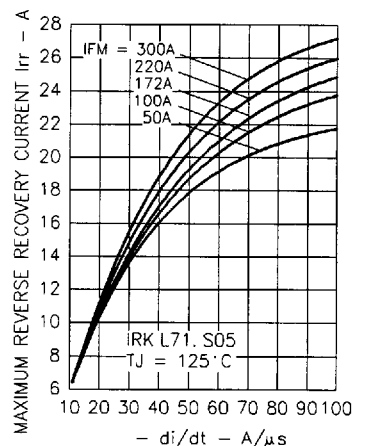


Fig. 30 - Recovery Current Characteristics

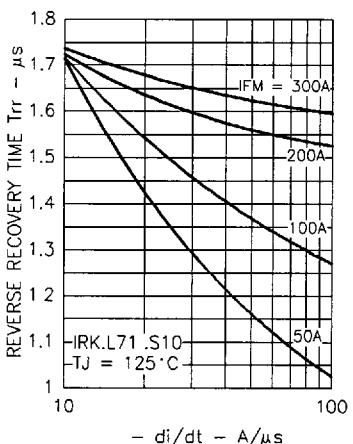


Fig. 31 - Recovery Time Characteristics

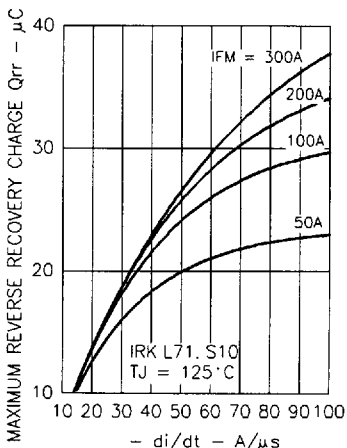


Fig. 32 - Recovery Charge Characteristics

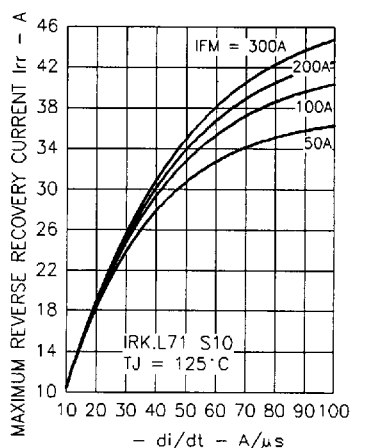


Fig. 33 - Recovery Current Characteristics

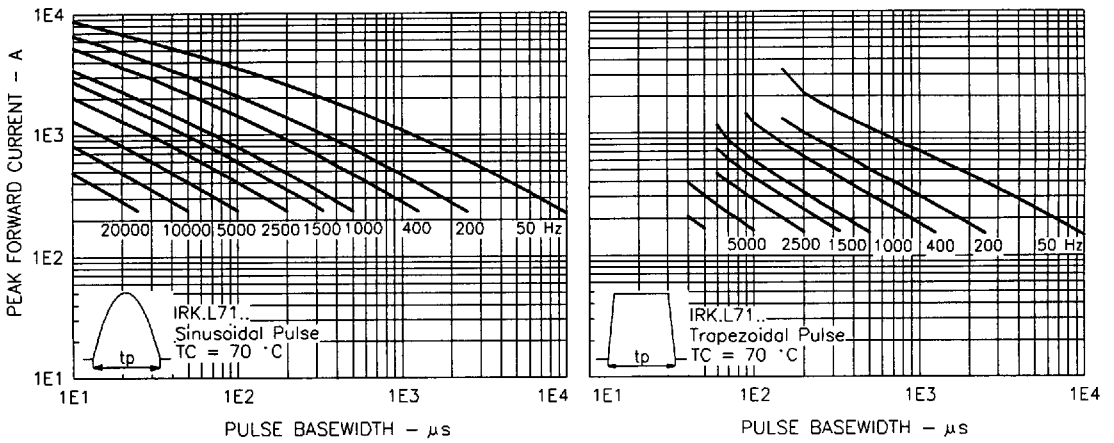


Fig. 34 - Frequency Characteristics

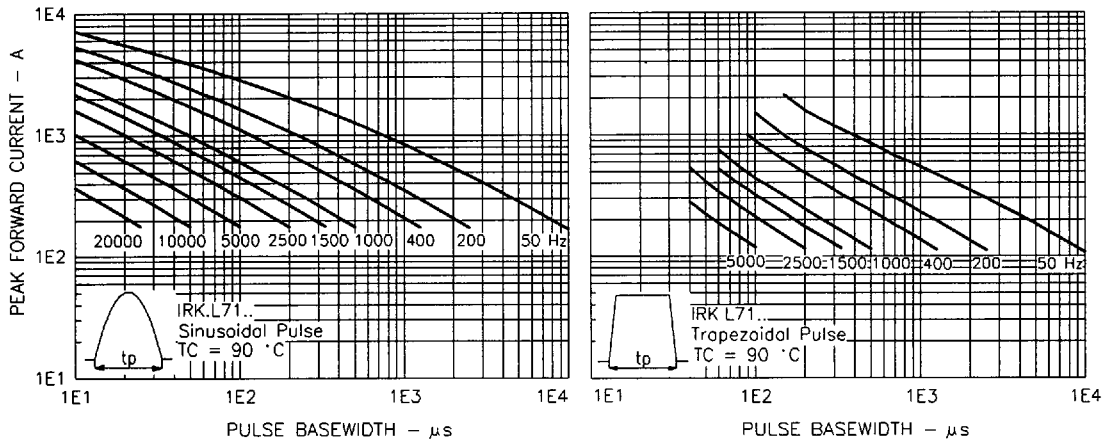


Fig. 35 - Frequency Characteristics

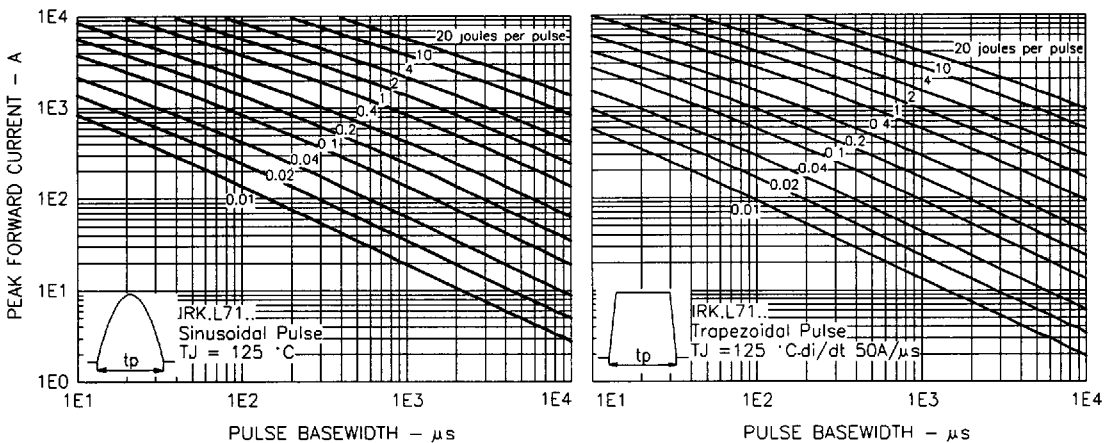


Fig. 36 - Maximum Forward Energy Loss Per Pulse Characteristics

INTERNATIONAL RECTIFIER

65E D

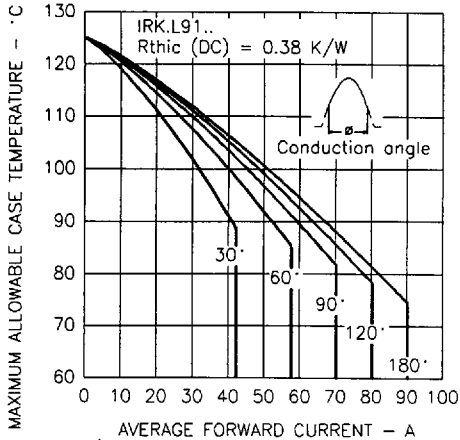


Fig. 37 - Current Ratings Characteristics

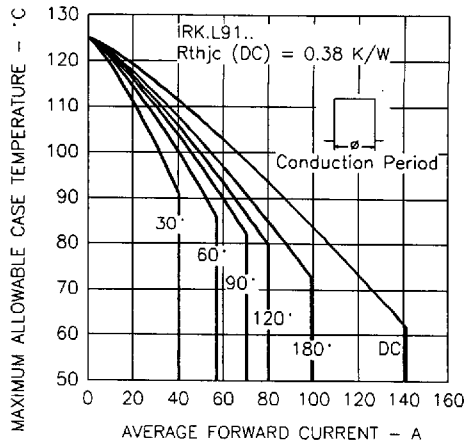


Fig. 38 - Current Ratings Characteristics

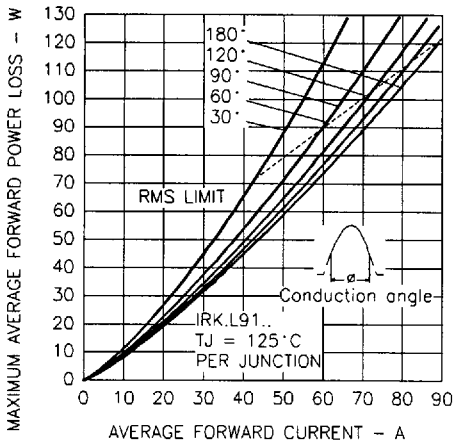


Fig. 39 - Forward Power Loss Characteristics

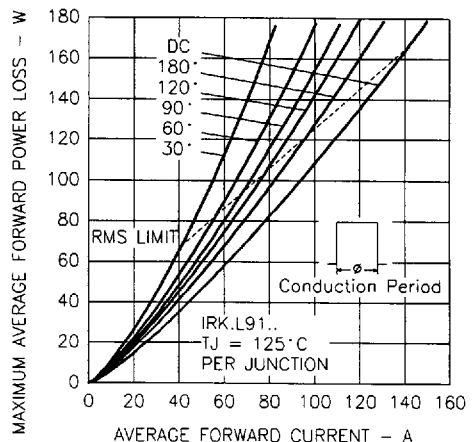


Fig. 40 - Forward Power Loss Characteristics

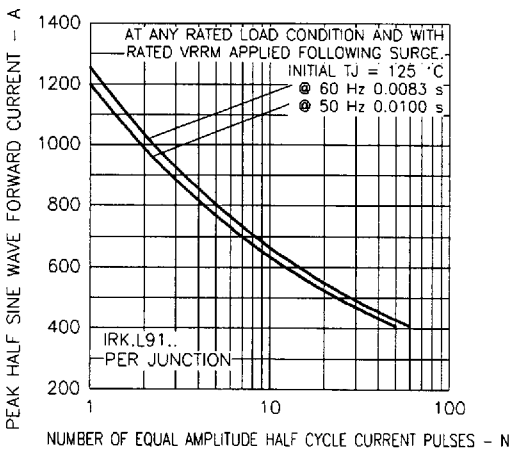


Fig. 41 - Maximum Non-Repetitive Surge Current

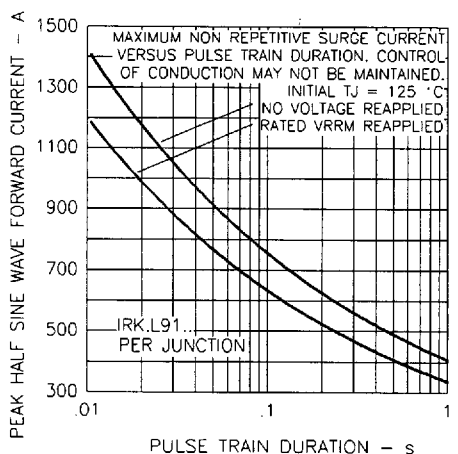


Fig. 42 - Maximum Non-Repetitive Surge Current

DATA SHEETS

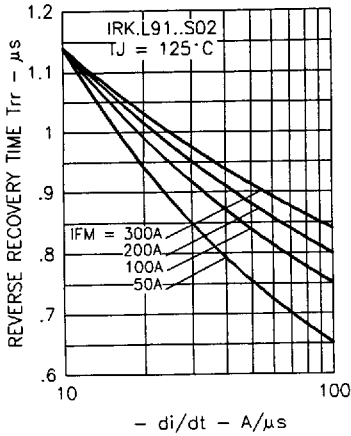


Fig. 43 - Recovery Time Characteristics

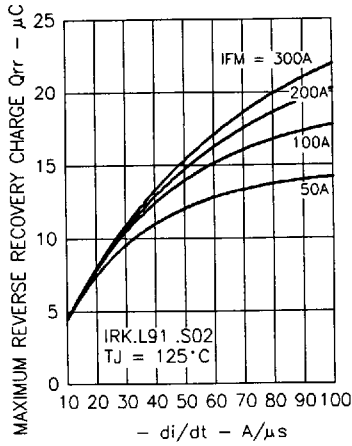


Fig. 44 - Recovery Charge Characteristics

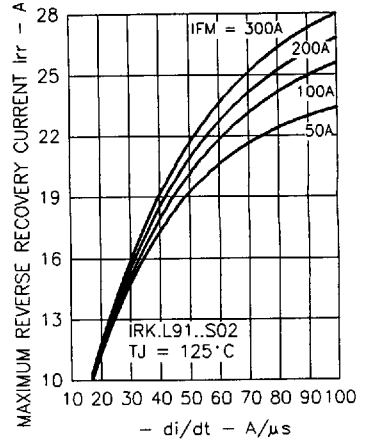


Fig. 45 - Recovery Current Characteristics

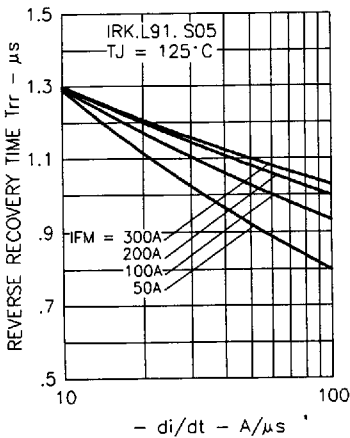


Fig. 46 - Recovery Time Characteristics

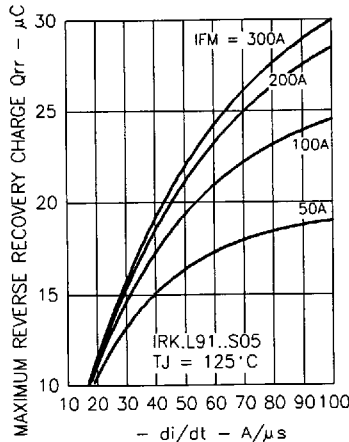


Fig. 47 - Recovery Charge Characteristics

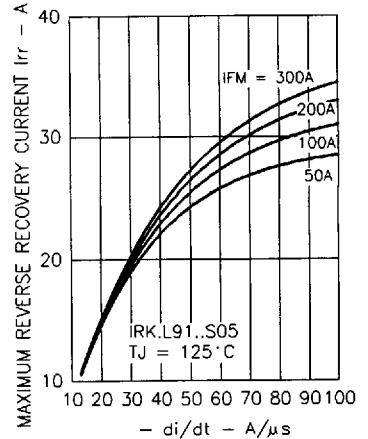


Fig. 48 - Recovery Current Characteristics

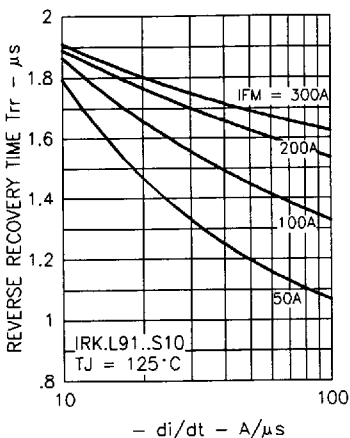


Fig. 49 - Recovery Time Characteristics

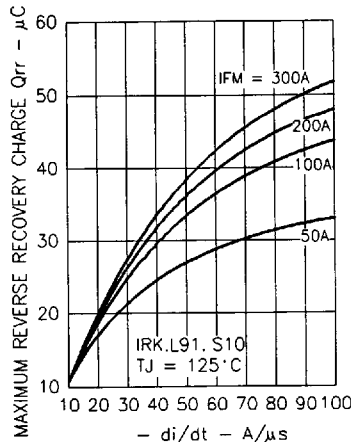


Fig. 50 - Recovery Charge Characteristics

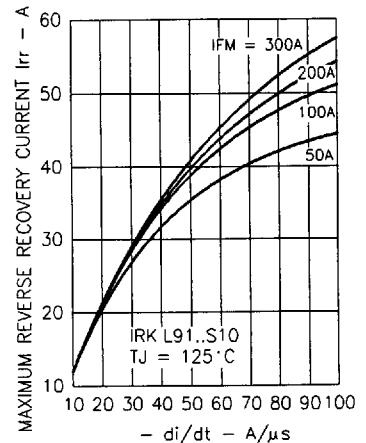


Fig. 51 - Recovery Current Characteristics

INTERNATIONAL RECTIFIER

65E D

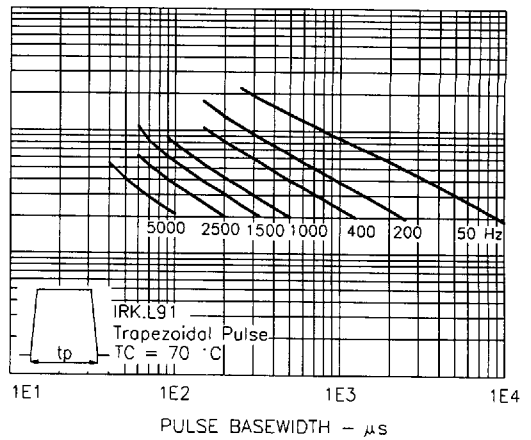
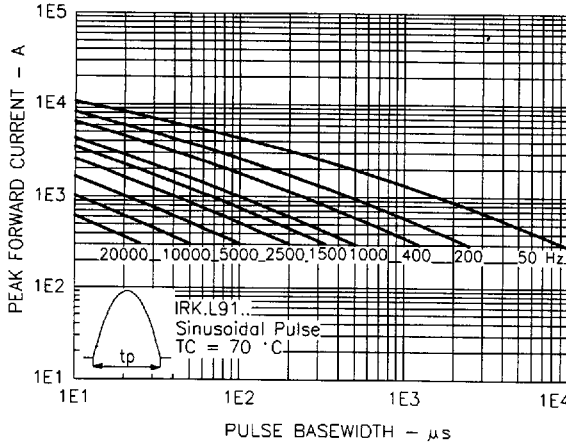


Fig. 52 - Frequency Characteristics

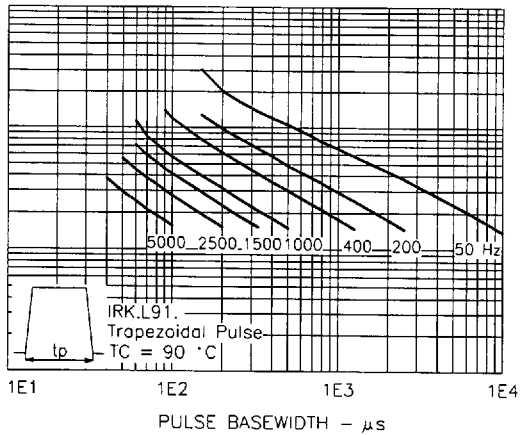
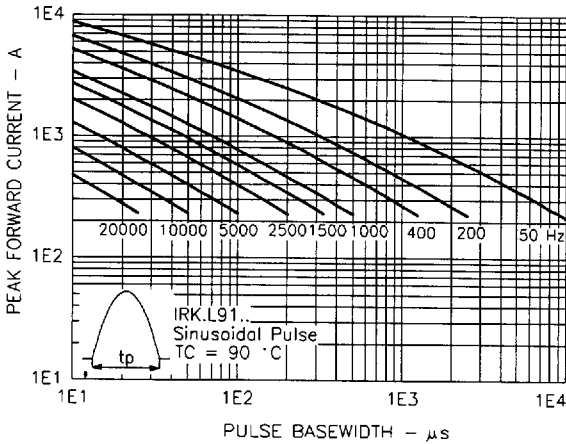


Fig. 53 - Frequency Characteristics

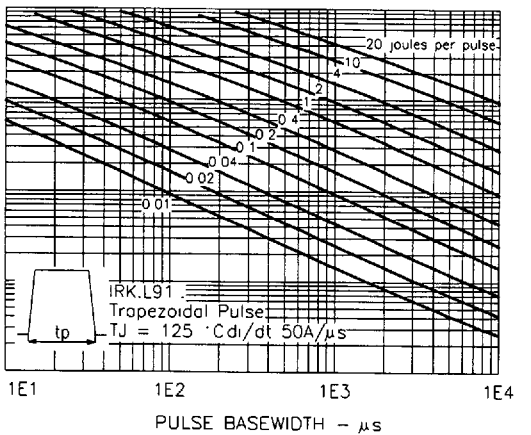
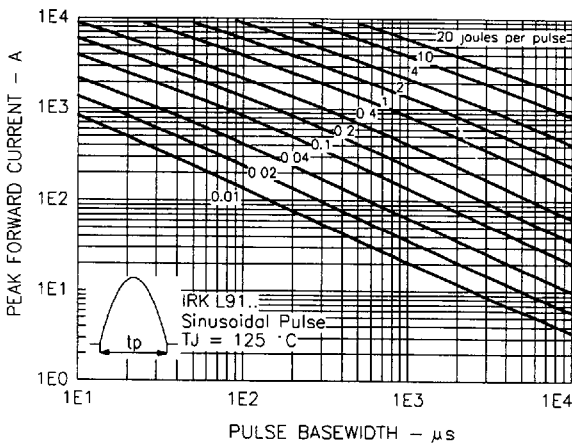


Fig. 54 - Maximum Forward Energy Loss Per Pulse Characteristics

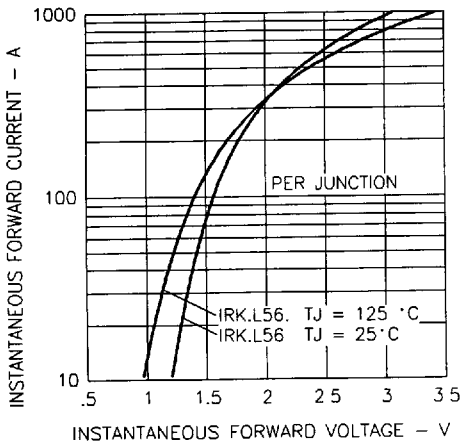


Fig. 55 - Forward Voltage Drop Characteristics

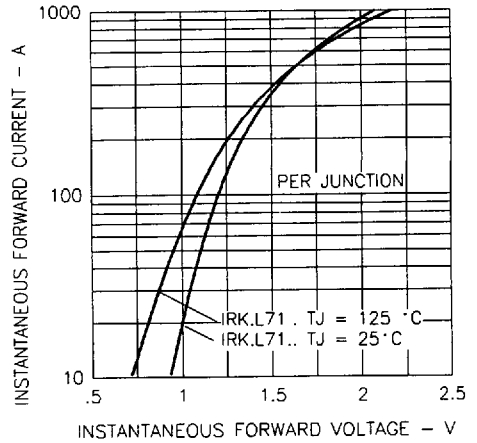


Fig. 56 - Forward Voltage Drop Characteristics

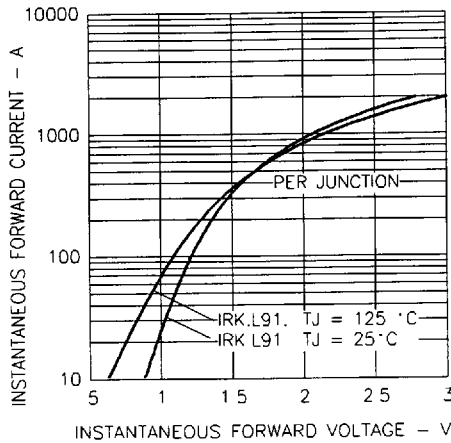


Fig. 57 - Forward Voltage Drop Characteristics

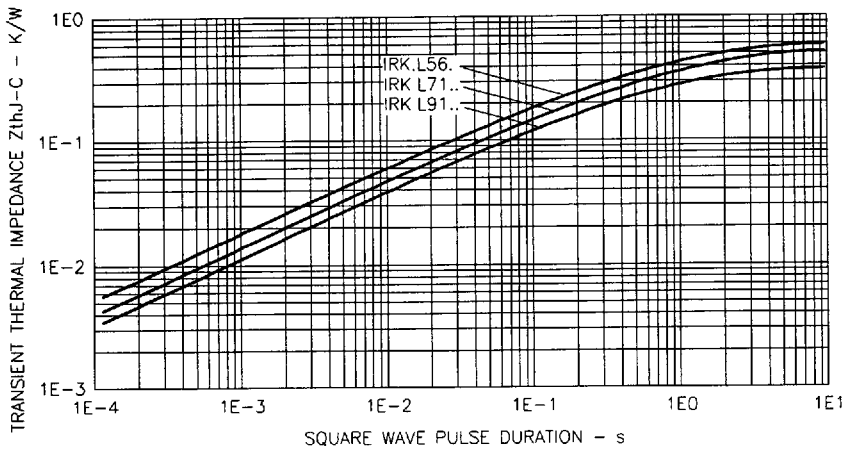


Fig. 58 - Maximum Forward Energy Loss Per Pulse Characteristics