

# High Voltage Current Regulators

## Preliminary Data Sheet

The IXYS IXC series of high voltage current regulators consists of non-switchable, 2-terminal, AC and DC current regulators.

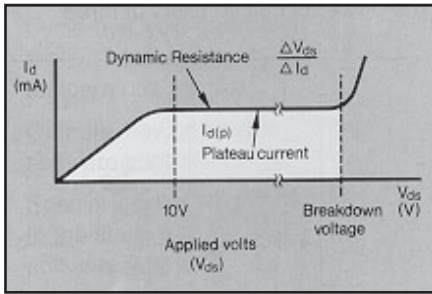


Fig. 1. Current Regulator Output Characteristics

### Non-switchable regulators

This is a family of extremely stable, high voltage current regulators with the typical output characteristic shown in Figure 1. The temperature stability is based on a threshold compensation technique and uses IXYS' most recently developed high voltage process. The complete family will be capable of providing other intermediate current levels which can be programmed on-chip during the manufacturing phase.

Specific applications are current sourcing in PABX applications, telephone line terminations, surge protection and voltage supply protection. Two devices in a back-to-back configuration will give bidirectional operation. Specific bidirectional applications would be series surge protection and soft start-up applications from AC mains.

## IXC Series

$$V_{AK} = 450 \text{ V}$$

$$I_{A(P)} = 2 - 60 \text{ mA}$$

$$R_{DYN} = 9 - 900 \text{ k}\Omega$$

### AC non-switchable regulators

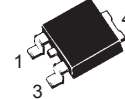
This family consists of two DC current regulators connected internally in series to regulate the current to a specified value in both directions. Its output characteristics in quadrants 1 and 3 are the same as shown in Figure 1 so that the current regulation is also the same in both directions. Parts are only available in the TO-220 package.

### Current Regulator Nomenclature

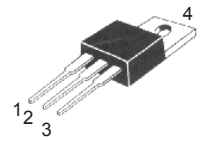
Parts can be ordered by using the following nomenclature:

<b>IXCP10M45A</b>	<b>(Example)</b>
<b>IX</b>	IXYS
<b>C</b>	Current Regulator
	Package style
<b>P</b>	TO-220 AB
<b>Y</b>	TO-252 (D-PAK)*
<b>10</b>	Current Rating, 10 = 10 mA
<b>M</b>	Current Level A = Amps, M = mA, U = $\mu$ A
<b>45</b>	Voltage rating 45 = 450 V

TO-252 AA  
(IXCY)



TO-220 AB  
(IXCP)



### Features

- Extremely stable current characteristics ( $\pm 50$  ppm/K)
- Minimum of 450 V breakdown
- Easily configured for bidirectional current sourcing
- 40 W continuous dissipation
- International standard packages JEDEC TO-220 and TO-252

### Applications

- PABX current sources
- Telephone line terminations in PABXs and modems
- Highly stable voltage sources
- Surge limiters and voltage protection (DC and AC)
- Instantaneously reacting resettable fuses
- Waveform synthesizers
- Soft start-up circuits

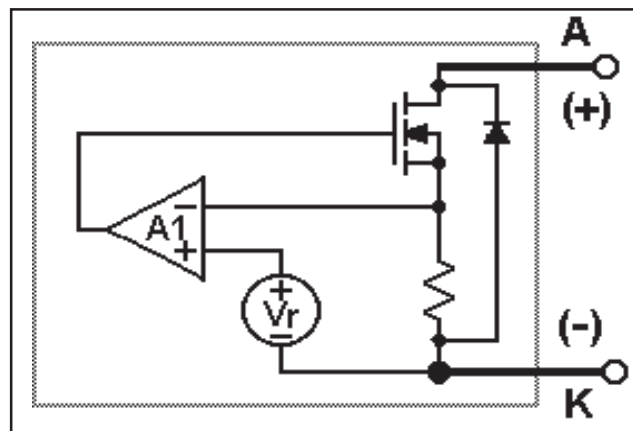


Fig. 2. Block diagram for the non-switchable regulator

# Non-Switchable DC Current Regulators

Symbol	Definition	Maximum Ratings	
$V_{AK}$	Drain Source Voltage	450	V
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	IXC_02M to IXC_50M	25 W
		IXC_60M & IXC_100M	40 W
$I_{RM}$	Maximum Reverse Current	1	A
$T_J$	Junction Operating Temperature	-55 to +150	$^\circ\text{C}$
$T_{stg}$	Storage Temperature	-55 to +150	$^\circ\text{C}$
$T_L$	Temperature for soldering (max. 10 s)	260	$^\circ\text{C}$
$M_D$	Mounting torque with screw M3 (TO-220) with screw M3.5 (TO-220)	0.45/4	Nm/lb.in.
		0.55/5	Nm/lb.in.

Symbol	Definition/Condition	Characteristic Values ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)					
		min.	typ.	max.			
$BV_{AK}^*$	Breakdown voltage: ___M45	$I_D = 1.5 I_{A(P)}$	450			V	
$I_{A(P)}$	Plateau Current ___	$V_{AK} = 10\text{ V}$	02M	1.9	2.0	2.5	mA
			10M	9.0	10	11.8	mA
			20M	18	20	22	mA
			40M	36	40	44	mA
			50M	45	50	55	mA
			60M	56	60	64	mA
	100M	88	100	110	mA		
$\Delta I_{A(P)}/\Delta T$	Plateau Current Shift with Temperature	$V_{AK} = 10\text{ V}$		$\pm 50$		ppm/K	
$\Delta V_{AK}/\Delta I_{A(P)}$	Dynamic Resistance ___	$V_{AK} = 10\text{ V}$	02M	800	900		k $\Omega$
			10M	160	180		k $\Omega$
			20M	78	85		k $\Omega$
			50M	19	21		k $\Omega$
			60M	15	17		k $\Omega$
			100M	8	9		k $\Omega$
$V_F$	Diode forward voltage drop; $I_F = 50\text{mA}$			1.8		V	
$R_{thJC}$	Thermal Resistance junction-to-case	IXC_02M to IXC_50M	5.0			K/W	
		IXC_60M & IXC_100M	3.1			K/W	
$R_{thJA}$	Thermal Resistance junction-to-ambient	TO-220	80			K/W	
		TO-252	100			K/W	

\* Pulse test to limit power dissipation to within device capability.

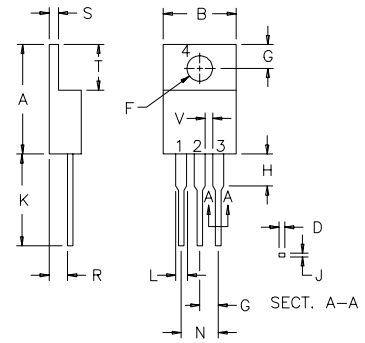
### Pin connections

- 1 = No connection
- 2, 4 = Positive terminal A
- 3 = Negative terminal K

### Product Marking

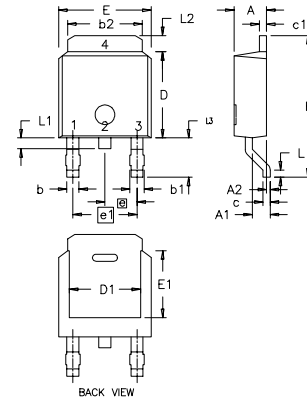
TO-220 types - full part number  
TO-252 - last 7 alpha-numeric characters of the part number, e.g. CY02M45

### TO-220 AB Outline



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	14.23	16.51	.560	.650
B	9.66	10.66	.380	.420
C	3.56	4.82	.140	.190
D	0.64	0.89	.025	.035
F	3.54	4.06	.139	.161
G	2.29	2.79	.090	.110
H	-	6.35	-	.250
J	0.51	0.76	.020	.030
K	12.70	14.73	.500	.580
L	1.15	1.77	.045	.070
N	4.83	5.33	.190	.210
Q	2.54	3.42	.100	.135
R	2.04	2.49	.080	.115
S	0.64	1.39	.025	.055
T	5.85	6.85	2.30	2.70
V	1.15	-	.045	-

### TO-252 AA Outline



Dim.	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	2.19	2.38	0.086	0.094
A1	0.89	1.14	0.035	0.045
A2	0	0.13	0	0.005
b	0.64	0.89	0.025	0.035
b1	0.76	1.14	0.030	0.045
b2	5.21	5.46	0.205	0.215
c	0.46	0.58	0.018	0.023
c1	0.46	0.58	0.018	0.023
D	5.97	6.22	0.235	0.245
D1	4.32	5.21	0.170	0.205
E	6.35	6.73	0.250	0.265
E1	4.32	5.21	0.170	0.205
e	2.28	BSC	0.090	BSC
e1	4.57	BSC	0.180	BSC
H	9.40	10.42	0.370	0.410
L	0.51	1.02	0.020	0.040
L1	0.64	1.02	0.025	0.040
L2	0.89	1.27	0.035	0.050
L3	2.54	2.92	0.100	0.115

## Application Examples

### DC and AC Overvoltage Suppression

The regulator can be used as a voltage surge suppressor. The device is again connected in series with the lead (Fig. 5) and would normally operate at a current level lower than the plateau (Fig. 6a). Any incoming voltage surge (Fig. 6b) less than the breakdown voltage of the regulator will be clamped by the IXCP regulator to voltage less than the plateau current times the effective resistance of the load.

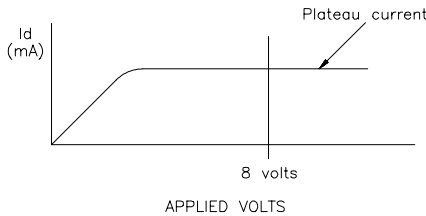


Fig. 6a. DC surge suppression

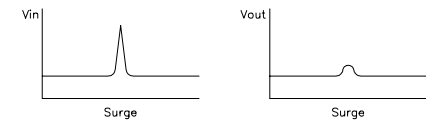


Fig. 6b. Incoming surge/output surge across load

### Soft Start-Up Circuits

Here the regulator characteristic will clamp initial current surges which can occur when power is initially applied to a load. The device, with its 450 V capability could, for example, be used with a DC power supply or with AC mains to limit the initial high inrush of current into lamp filaments, thereby increasing the filament life several times. It could, therefore, be used effectively in lighting displays and in the transportation lighting industries.

### Highly Stable Voltage Sources

Another obvious application would be to use the current regulator as a

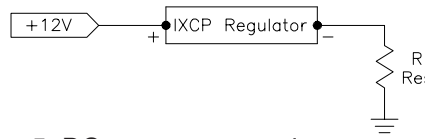
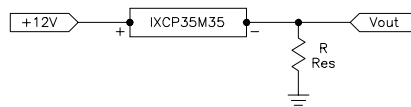


Fig. 5. DC surge suppression

source of a highly stable current to produce a usable voltage reference (Fig. 7). This would be effectively independent of temperature and a low cost approach. A high voltage reference is also possible, thanks to their high breakdown voltages.



R = 100 Ω	V <sub>out</sub> = 3.5 V nominal
R = 50 Ω	V <sub>out</sub> = 1.75 V nominal
R = 25 Ω	V <sub>out</sub> = 0.875 V nominal

Fig. 7. Simple voltage source with high stability

### Instantaneous "Fuse"

Another application would be protection against sudden voltage droops on voltage supply lines to logic cards in computing systems, resulting from one component suddenly shorting to ground. Normal fusing networks will draw considerable current during the time it takes for the fuse to clear. This could cause a sufficient dip in power rail voltage to cause malfunctions of the other logic cards, even with fast-blow fuses (Fig. 8). The current regulator in series with the logic card restricts the current to its own operating level (Fig. 9). Therefore the voltage supply does not become overloaded and the regulator remains intact.

The current regulator thus provides an "instantaneous fusing" function. When the logic component is replaced, the regulator resumes its normal functioning mode.

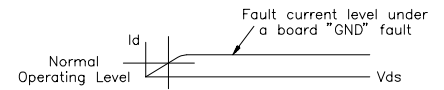
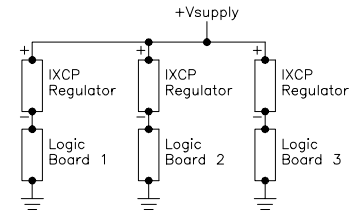


Fig. 8. Low cost current regulators instead of fuses

The obvious advantages to having this regulator as fuse substitute are:

- Prevents a "dip" in the power supply during a fault condition
- Regulator remains intact
- Can be easily tied in with logic to indicate a "down state" board

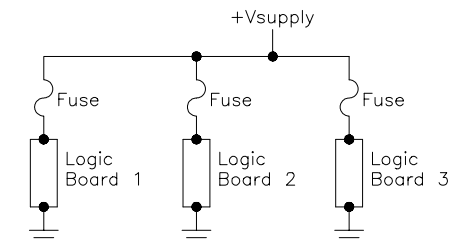


Fig. 9. Normal fusing links in series with each board

### Testing & Handling Recommendations

- For initial assessment of the parts where the customer may test the device characteristics in free air without heat sinking, the continuous power dissipation should be kept within 1.5 W at ambient of 25°C. ( $R_{thJA} = 80$  K/W for TO-220, and  $R_{thJA} = 100$  K/W for TO-252)
- Normal electrostatic handling precautions for MOS devices should be adhered to.

IXYS MOSFETs and IGBTs are covered by	4,835,592	4,931,844	5,049,961	5,237,481	6,162,665	6,404,065 B1	6,683,344	6,727,585
one or more of the following U.S. patents:	4,850,072	5,017,508	5,063,307	5,381,025	6,259,123 B1	6,534,343	6,710,405B2	6,759,692
	4,881,106	5,034,796	5,187,117	5,486,715	6,306,728 B1	6,583,505	6,710,463	