High Voltage Current Regulators

IXC Series

V_{AK} = 450/350 V
$I_{A(P)}$ = 2 - 100 mA
R_{DYN} = 9 - 900 kΩ

Preliminary Data Sheet

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

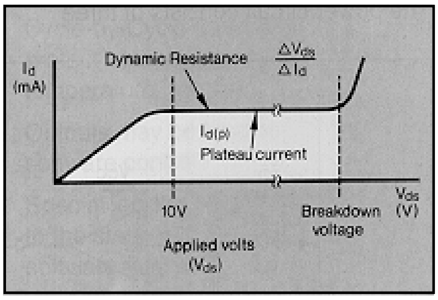


Fig. 1. Current Regulator Output Characteristics

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.

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.

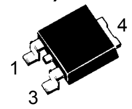
Current Regulator Nomenclature

Parts can be ordered by using the following nomenclature:

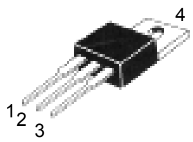
IXCY10M45A **(Example)**

IX	IXYS
C	Current Regulator
	Package style
P	TO-220 AB
Y	TO-252 (D-PAK)
10	Current Rating, 10 = 10 mA
M	Current Level A = Amps, M = mA, U = µA
45	Voltage rating 45 = 450 V
(Blank)	DC Non-switchable
A	AC non-switchable

TO-252 AA (IXCY)



TO-220 AB (IXCP)



Features

- Extremely stable current characteristics (±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 resetable fuses
- Waveform synthesizers
- Soft start-up circuits

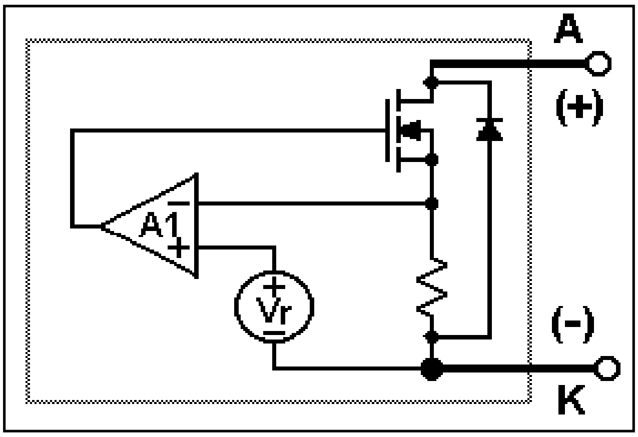


Fig. 2. Block diagram for the non-switchable regulator

DS98703 (04/25/2000)

Non-Switchable DC Current Regulators

Symbol	Definition		Maximum Ratings	
V_{AK}	Drain Source Voltage		450/350	V
P_D	Power Dissipation (T_C = 25°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	°C
T_{stg}	Storage Temperature		-55 to +150	°C
T_L	Temperature for soldering (max. 10 s)		260	°C
M_D	Mounting torque	with screw M3 (TO-220)	0.45/4	Nm/lb.in.
		with screw M3.5 (TO-220)	0.55/5	Nm/lb.in.

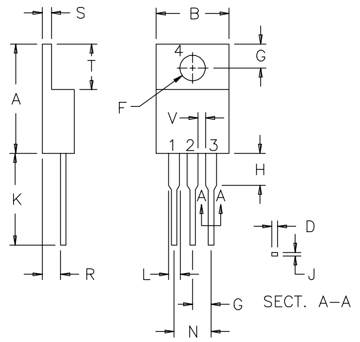
Characteristic Values (T_J = 25°C, unless otherwise specified)

Symbol	Definition/Condition			min.	typ.	max.	
BV_{AK}*	Breakdown voltage	__M45	$I_D = 1.5\ I_{A(P)}$	450			V
		__M35	$I_D = 1.5\ I_{A(P)}$	350			V
$I_{A(P)}$	Plateau Current	02M__	V_{AK} = 10 V	1.9	2.0	2.5	mA
		10M__		9.0	10	11.8	mA
		20M__		18	20	22	mA
		30M__		28	30	35	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 V		±50		ppm/K
$\Delta V_{AK}/\Delta I_{A(p)}$	Dynamic Resistance	02M__	V_{AK} = 10 V	800	900		kΩ
		10M__		160	180		kΩ
		20M__		78	85		kΩ
		30M__		40	45		kΩ
		40M__		32	35		kΩ
		50M__		19	21		kΩ
		60M__		15	17		kΩ
		100M__		8	9		kΩ
V_F	Diode forward voltage drop; I_F = 50mA					1.8	V

Symbol	Definition			
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

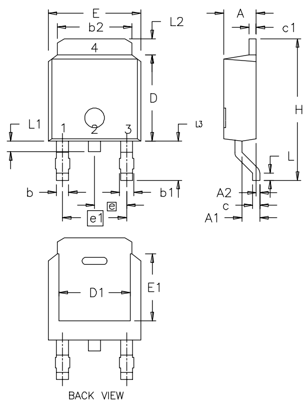
* Pulse test to limit power dissipation to within device capability.

TO-220 AB Outline



Dim.	Millimeter Min.	Max.	Inches 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 Min.	Max.	Inches 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

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

Non-Switchable AC Current Regulators

Symbol	Definition		Maximum Ratings	
V_{AK}	Drain Source Voltage		450/350	V
P_D	Power Dissipation T_C = 25°C)		25	W
T_J	Junction Operating Temperature		-55 to +150	°C
T_{stg}	Storage Temperature		-55 to +150	°C
T_L	Temperature for soldering (max. 10 s)		260	°C
M_D	Mounting torque	with screw M3 (TO-220)	0.45/4	Nm/lb.in.
		with screw M3.5 (TO-220)	0.55/5	Nm/lb.in.

Symbol	Definition/Condition			Characteristic Values (T_J = 25°C, unless otherwise specified) min.	typ.	max.	
BV_{AK}*	Breakdown voltage at	__M45A	$I_D = 1.5\ I_{A(P)}$	450			V
		__M35A	$I_D = 1.5\ I_{A(P)}$	350			V
$I_{A(P)}$	Plateau Current	02M__		1.8	2.0	2.5	mA
		10M__	V_{AK} = 10 V	9.0	10	11.8	mA
		20M__		18	20	22	mA
		30M__		28	30	35	mA
		40M__		36	40	44	mA
		50M__		45	50	55	mA
$\Delta I_{A(P)}/\Delta T$	Plateau Current Shift with Temperature		V_{AK} = 10 V		±50		ppm/K
$\Delta V_{AK}/\Delta I_{A(p)}$	Dynamic Resistance	02M__	V_{AK} = 10 V	800	900		kΩ
		10M__		160	180		kΩ
		20M__		78	85		kΩ
		30M__		40	45		kΩ
		40M__		32	35		kΩ
		50M__		19	21		kΩ
V_F	Diode forward voltage drop; I_F = 50mA					1.8	V
R_{thJC}	Thermal Resistance junction-to-case					5	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.
Device ratings and characteristics are per chip.

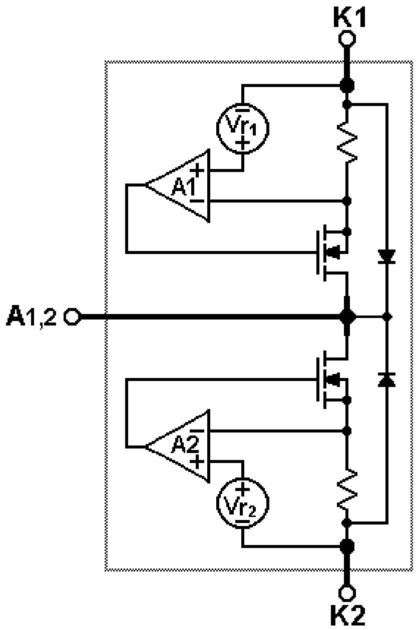


Fig. 3. Equivalent circuit for the AC current regulators.

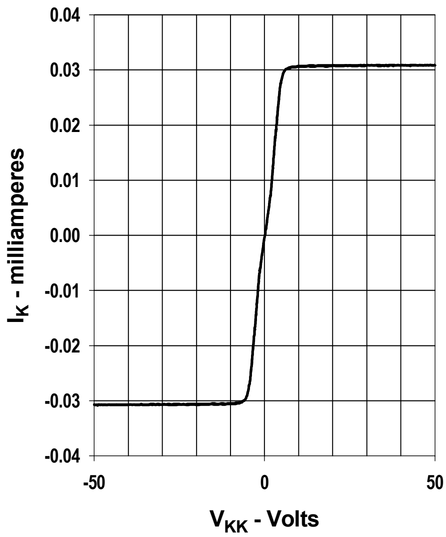


Fig. 4. Output Characteristics for the IXCP30M45A current regulator.

Pin connections

1 = Terminal K1
2, 4 = Terminal A1, 2
3 = Terminal K2

Product Marking

TO-220 types - full part number
TO-252 - last 8 alpha-numeric characters of the part number, e.g. CY02M45A

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.

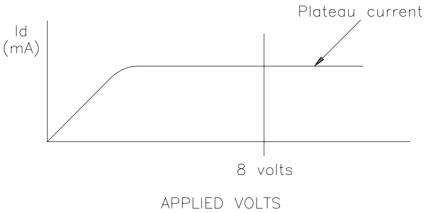


Fig. 6a. DC surge suppression

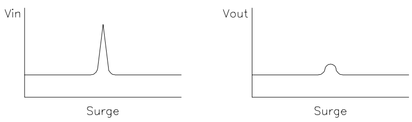


Fig. 6b. Incoming surge/output surge across load

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 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.

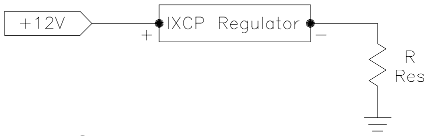
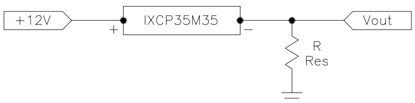


Fig. 5. DC surge suppression



R = 100 Ω V_{out} = 3.5 V nominal
R = 50 Ω V_{out} = 1.75 V nominal
R = 25 Ω V_{out} = 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.

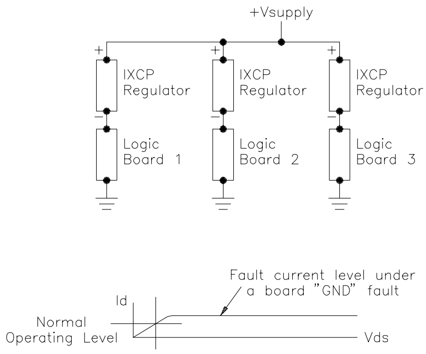


Fig.8. Low cost current regulators instead of fuses

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

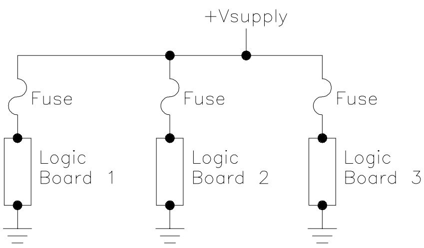


Fig. 9. Normal fusing links in series with each board

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 Corporation
3540 Bassett St. Santa Clara, CA 95054
Tel: 408-982-0700; Fax: 408-496-0670

IXYS Semiconductor GmbH
Edisonstr. 15; D-68623 Lampertheim, Germany
Tel: +49-6206-503-0; Fax: +49-6206-503627