IXYS

# High Voltage Current Regulators

# IXC Series

$V_{AK}$ = 450 V
$I_{A(P)}$ = 2 - 60 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.

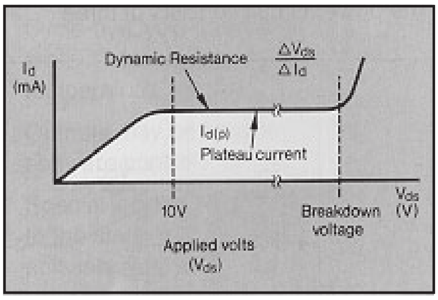



Fig. 1. Current Regulator Output Characteristics

### 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. Parts are only available in the TO-220 package.

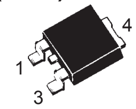
### Current Regulator Nomenclature

Parts can be ordered by using the following nomenclature:

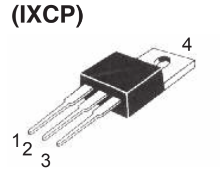
**IXCP10M45A (Example)**

| | |
|---|---|
| **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 |

**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

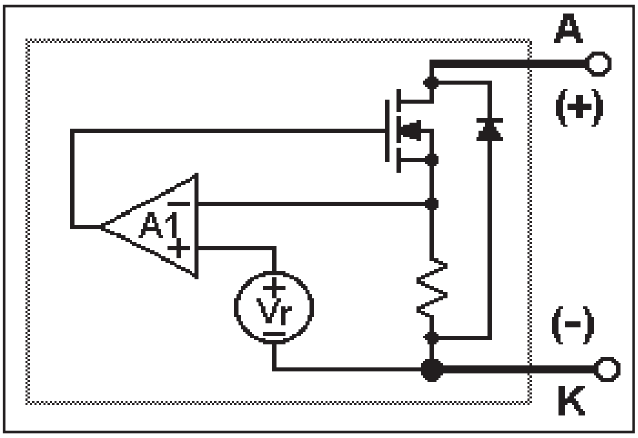



Fig. 2. Block diagram for the non-switchable regulator

# Non-Switchable DC Current Regulators

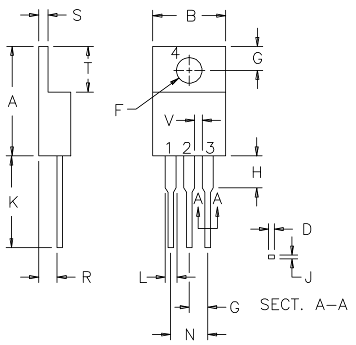
| Symbol | Definition | | Maximum Ratings | |
|---|---|---|---|---|
| $V_{AK}$ | Drain Source Voltage | | 450 | V |
| $P_D$ | Power Dissipation ($T_C$ = 25°C) | IXC_02M to IXC_50M | 25 | W |
| | | IXC_60M & IXC_100M | 40 | W |
| $I_{RM}$ | Maximum Reverse Current | | 1 | A |
| $T_J$ | Junction Operating 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 |
| $I_{A(P)}$ | 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 |
| | | 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 |
| | | 50M__ | | 19 | 21 | | kΩ |
| | | 60M__ | | 15 | 17 | | kΩ |
| | | 100M__ | | 8 | 9 | | kΩ |
| $V_F$ | Diode forward voltage drop; $I_F$ = 50mA | | | | | 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 |

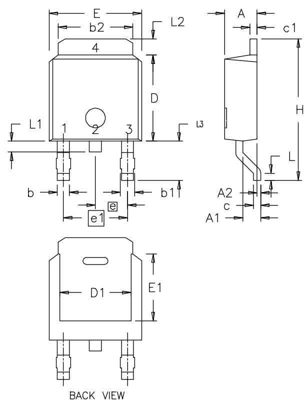
* Pulse test to limit power dissipation to within device capability.

## TO-220 AB Outline




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

# 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.

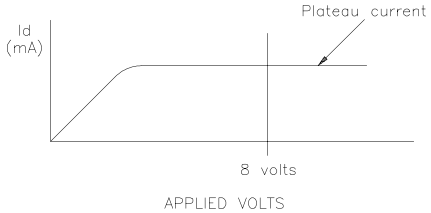



Fig. 6a. DC surge suppression

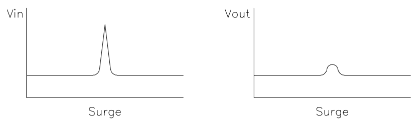



Fig. 6b. Incoming surge/output surge across load

### 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.

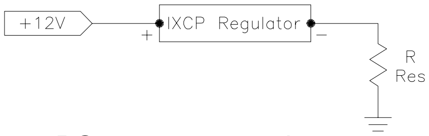
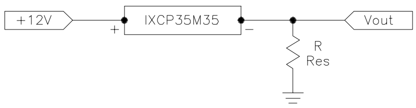



Fig. 5. DC surge suppression




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.

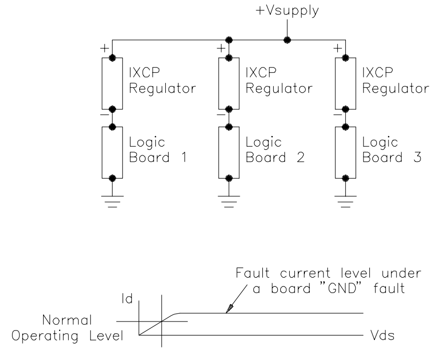



Fig.8. Low cost current regulators instead of fuses

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

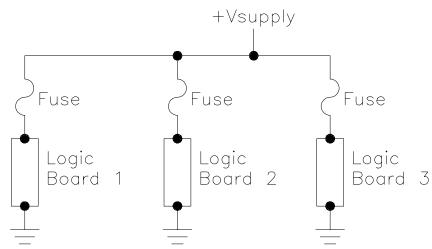



Fig. 9. Normal fusing links in series with each board

### 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.