

# High-Voltage, High-Current Darlington Transistor Arrays

## GENERAL DESCRIPTION

The XR-2001/2002/2003/2004 are high-voltage, high-current Darlington transistor arrays consisting of seven silicon NPN Darlington pairs on a common monolithic substrate. All units feature open collector outputs and integral protection diodes for driving inductive loads. Peak inrush currents of up to 600 mA are allowed, which makes the arrays ideal for driving tungsten filament lamps. The outputs may be paralleled to achieve high load current capability although each driver has a maximum continuous collector current rating of 500 mA. The arrays are directly price competitive with discrete transistor alternatives.

## FEATURES

- Peak Inrush Current Capability of 600 mA.
- Internal Protection Diodes for Driving Inductive Loads
- Excellent Noise Immunity
- Direct Compatibility with Most Logic Families
- Opposing Pin Configuration Eases Circuit Board Layout

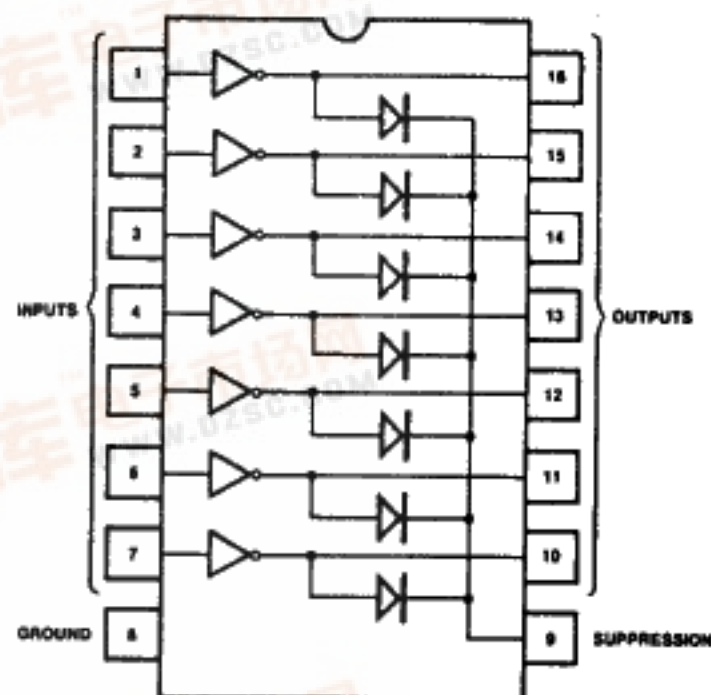
## APPLICATIONS

- Relay Drivers
- High Current Logic Drivers
- Solenoid Driver

## ABSOLUTE MAXIMUM RATINGS $T_A = 25^\circ\text{C}$

|   |   |
|---|---|
| Output Voltage, $V_{CE}$                                  | 50V   |
| Input Voltage, $V_{IN}$                                   | 30V   |
| Continuous Collector Current, $I_C$<br>(Each Driver)      | 500mA                                       |
| Continuous Base Current, $I_B$ (Each Driver)              | 25mA  |
| Power Dissipation, $P_D$ (Each Driver)<br>(Total Package) | 1.0W<br>See graph                           |
| Derate Above $25^\circ\text{C}$                           | 16 mW/ $^\circ\text{C}$                     |
| Storage Temperature Range                                 | $-55^\circ\text{C}$ to $+150^\circ\text{C}$ |

## FUNCTIONAL BLOCK DIAGRAM



## ORDERING INFORMATION

| Part Number | Package | Operating Temperature                    |
|-------------|---------|--|
| XR-2001CN   | Ceramic | $0^\circ\text{C}$ to $+70^\circ\text{C}$ |
| XR-2002CN   | Ceramic | $0^\circ\text{C}$ to $+70^\circ\text{C}$ |
| XR-2003CN   | Ceramic | $0^\circ\text{C}$ to $+70^\circ\text{C}$ |
| XR-2004CN   | Ceramic | $0^\circ\text{C}$ to $+70^\circ\text{C}$ |

## SYSTEM DESCRIPTION

The XR-2001 interfaces with bipolar digital logic (with external current limiting), or with CMOS or PMOS directly.

The XR-2002 was specifically designed to interface with 14V to 25V PMOS devices.

The XR-2003 permits operation directly with CMOS or TTL operating at a supply voltage of 5 volts. Interface requirements beyond the scope of standard logic buffers are easily handled by the XR-2003.

The XR-2004 requires less input current than the XR-2003 and the input voltage is less than that required by the XR-2002. The XR-2004 operates directly from PMOS or CMOS outputs using supply voltages of 6 to 15 volts.

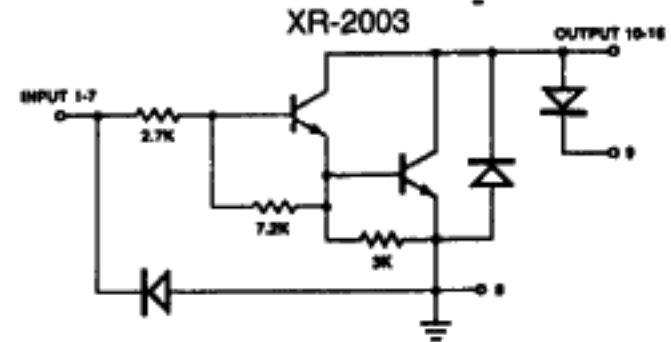
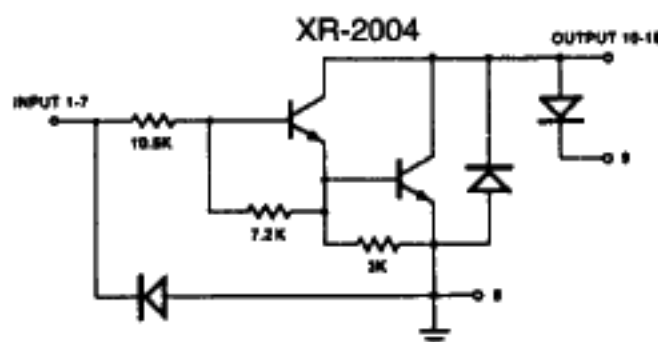
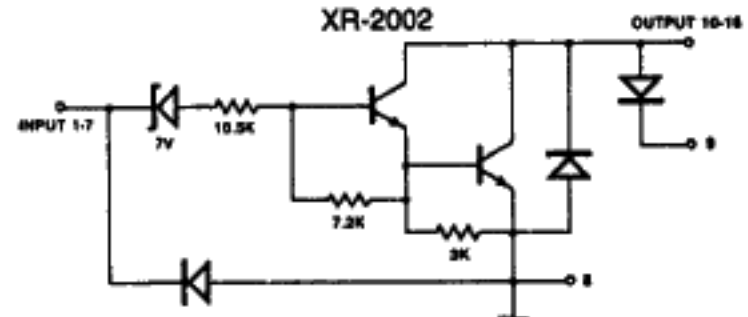
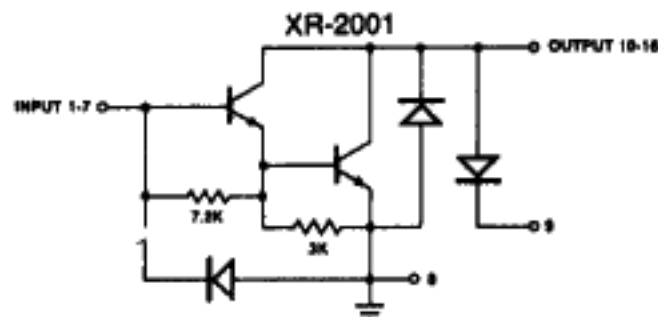
# XR-2001/2/3/4

## ELECTRICAL CHARACTERISTICS

Test Conditions:  $T_A$  25°C, unless otherwise specified.

| SYMBOL    | PARAMETERS  | LIMITS |                             |   | UNITS                                | CONDITIONS   |
|-----------|---|--------|-----------------------------|---|--------------------------------------|--|
|           |   | MIN    | TYP                         | MAX   |                                      |  |
| $I_{CEX}$ | Output Leakage Current<br>XR-2002<br>XR-2004        |        |                             | 100<br>500<br>500                                   | $\mu A$<br>$\mu A$<br>$\mu A$        | $V_{CE} = 50 V, T_A = 70^\circ C$<br>$V_{CE} = 50 V, T_A = 70^\circ C, V_{IN} = 6V$<br>$V_{CE} = 50 V, T_A = 70^\circ C, V_{IN} = 1V$  |
| $V_{CE}$  | Collector-Emitter Saturation Voltage                |        | 1.25<br>1.1<br>0.9          | 1.6<br>1.3<br>1.1                                   | V<br>V<br>V                          | $I_C = 350mA, I_B = 500\mu A$<br>$I_C = 200mA, I_B = 350\mu A$<br>$I_C = 100mA, I_B = 250\mu A$  |
| $I_{IN}$  | Input Current (on)<br>XR-2002<br>XR-2003<br>XR-2004 |        | 0.85<br>0.93<br>0.35<br>1.0 | 1.25<br>1.35<br>0.5<br>1.45                         | mA<br>mA<br>mA<br>mA                 | $V_{IN} = 17V$<br>$V_{IN} = 3.85V$<br>$V_{IN} = 5V$<br>$V_{IN} = 12V$  |
| $I_{IN}$  | Input Current (off)                                 | 50     | 65                          |   | $\mu A$                              | $I_C = 500\mu A, T_A = 70^\circ C$   |
| $V_{IN}$  | Input Voltage<br>XR-2002<br>XR-2003<br><br>XR-2004  |        |                             | 13<br>2.4<br>2.7<br>3.0<br>5.0<br>6.0<br>7.0<br>8.0 | V<br>V<br>V<br>V<br>V<br>V<br>V<br>V | $V_{CE} = 2 V, I_C = 300mA$<br>$V_{CE} = 2 V, I_C = 200mA$<br>$V_{CE} = 2 V, I_C = 250mA$<br>$V_{CE} = 2 V, I_C = 300mA$<br>$V_{CE} = 2 V, I_C = 125mA$<br>$V_{CE} = 2 V, I_C = 200mA$<br>$V_{CE} = 2 V, I_C = 275mA$<br>$V_{CE} = 2 V, I_C = 350mA$ |
| $h_{FE}$  | D-C Forward Current Transfer Ratio<br>XR-2001       | 1000   |                             |   |                                      | $V_{CE} = 2 V, I_C = 350mA$  |
| $C_{IN}$  | Input Capacitance                                   |        | 15                          | 30  | pF                                   |  |
| $I_R$     | Clamp Diode Leakage Current                         |        |                             | 50  | $\mu A$                              | $V_R = 50V$  |
| $V_F$     | Clamp Diode Forward Voltage                         |        | 1.7                         | 2.0   | V                                    | $I_F = 350mA$  |
| $t_{PLH}$ | Turn-On Delay                                       |        | 0.25                        | 1.0   | $\mu S$                              | 0.5 $E_{IN}$ to 0.5 $E_{OUT}$  |
| $t_{PHL}$ | Turn-Off Delay                                      |        | 0.25                        | 1.0   | $\mu S$                              | 0.5 $E_{IN}$ to 0.5 $E_{OUT}$  |

## SCHEMATIC DIAGRAMS (One of 7 Identical Drivers is shown for each device.)



# XR-2001/2/3/4

## CHARACTERISTIC CURVES

(a) XR-2002

(b) XR-2004

(c) XR-2003

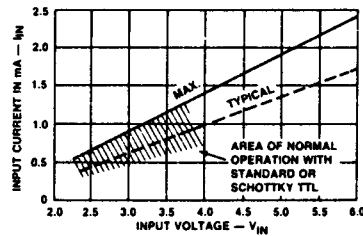
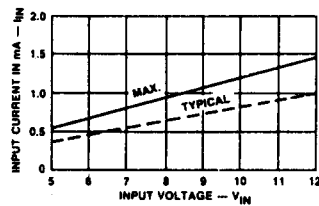
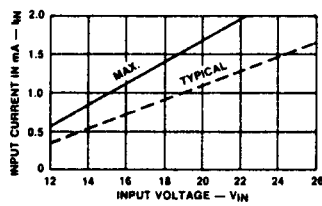


Figure 1. Input Current as a Function of Input Voltages

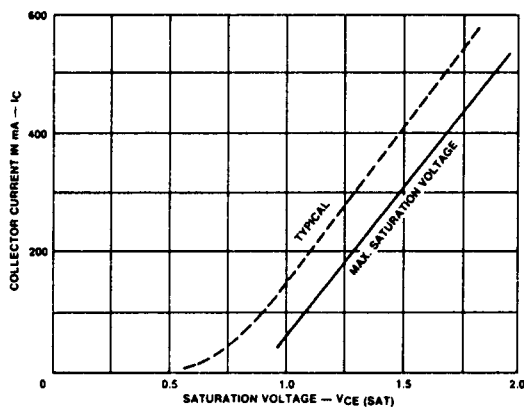


Figure 2. Collector Current as a Function of Saturation Voltage.

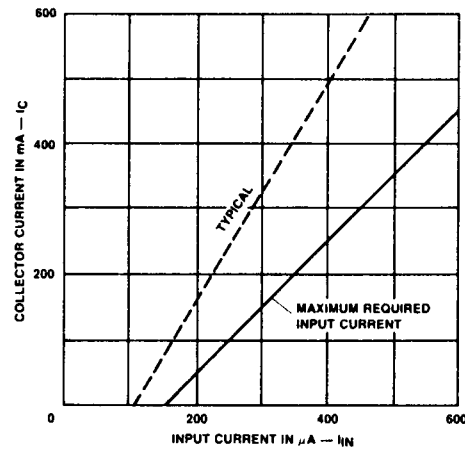


Figure 3. Collector Current as a Function of Input Current

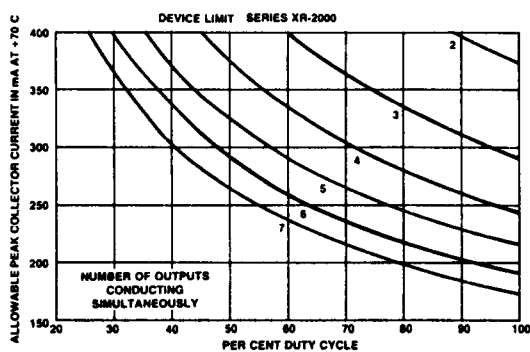


Figure 4. Peak Collector Current as a Function of Duty Cycle and Number of Outputs

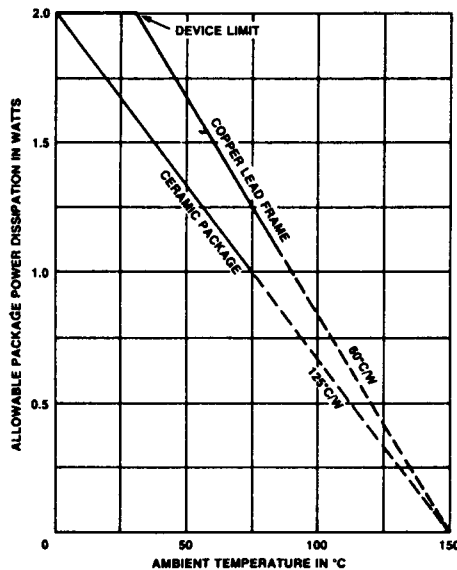


Figure 5. Allowable Average Power Dissipation as a Function of Ambient Temperature

# XR-2001/2/3/4

## TYPICAL APPLICATIONS

### XR-2002

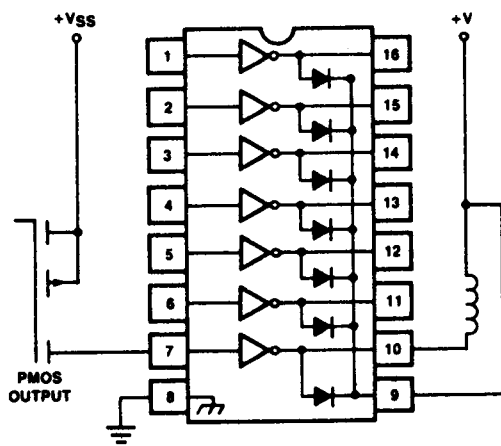


Figure 6. PMOS to Load

### XR-2003

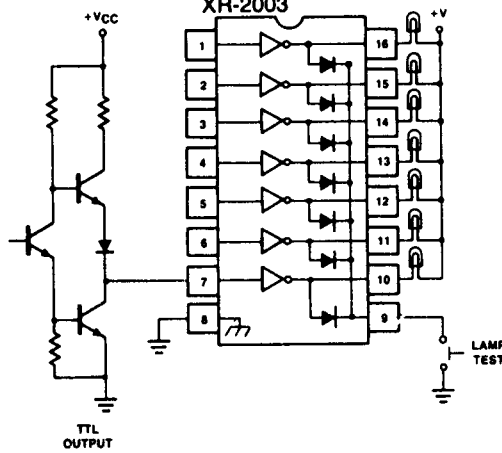


Figure 7. TTL to Load

### XR-2004

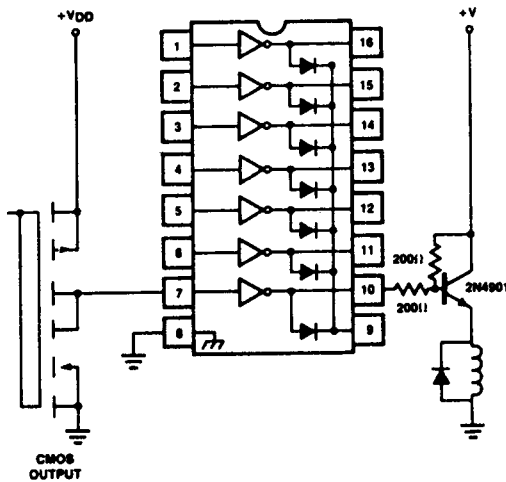


Figure 8. Buffer for Higher Current Loads

### XR-2003

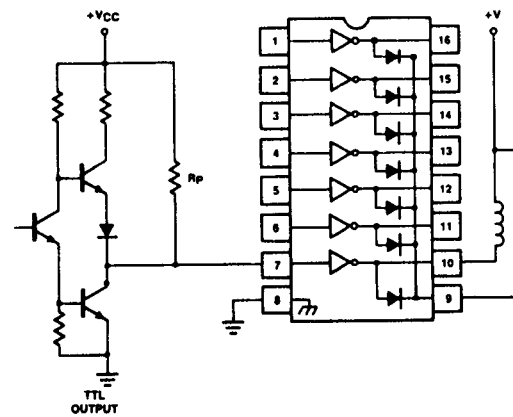


Figure 9. Use of Pull-up Resistors to Increase Drive Current

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**XR-1488/1489A**

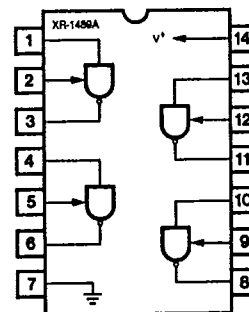
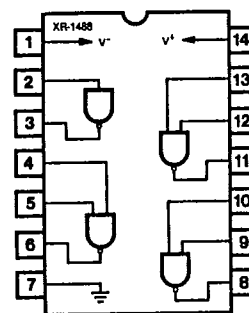
## Quad Line Driver/Receiver

### GENERAL DESCRIPTION

The XR-1488 is a monolithic quad line driver designed to interface data terminal equipment with data communications equipment in conformance with the specifications of EIA Standard No. RS232C. This extremely versatile integrated circuit can be used to perform a wide range of applications. Features such as output current limiting, independent positive and negative power supply driving elements, and compatibility with all DTL and TTL logic families greatly enhance the versatility of the circuit.

The XR-1489A is a monolithic quad line receiver designed to interface data terminal equipment with data communications equipment. The XR-1489A quad receiver along with its companion circuit, the XR-1488 quad driver, provide a complete interface system between DTL or TTL logic levels and the RS232C defined voltage and impedance levels.

### FUNCTIONAL BLOCK DIAGRAMS



### ABSOLUTE MAXIMUM RATINGS

|                    |              |
|--------------------|--------------|
| Power Supply       |              |
| XR-1488            | $\pm 15$ Vdc |
| XR-1489A           | + 10 Vdc     |
| Power Dissipation  |              |
| Ceramic Package    | 1000 mW      |
| Derate above +25°C | 6.7 mW/°C    |
| Plastic Package    | 650 mW/°C    |
| Derate above +25°C | 5 mW/°C      |

### SYSTEM DESCRIPTION

The XR-1488 and XR-1489A are a matched set of quad line drivers and line receivers designed for interfacing between TTL/DTL and RS232C data communication lines.

The XR-1488 contains four independent split supply line drivers, each with a  $\pm 10$  mA current limited output. For RS232C applications, the slew rate can be reduced to the 30 V/ $\mu$ S limit by shunting the output to ground with a 410 pF capacitor. The XR-1489A contains four independent line receivers, designed for interfacing RS232C to TTL/DTL. Each receiver features independently programmable switching thresholds with hysteresis, and input protection to  $\pm 30$  V. The output can typically source 3 mA and sink 20 mA.

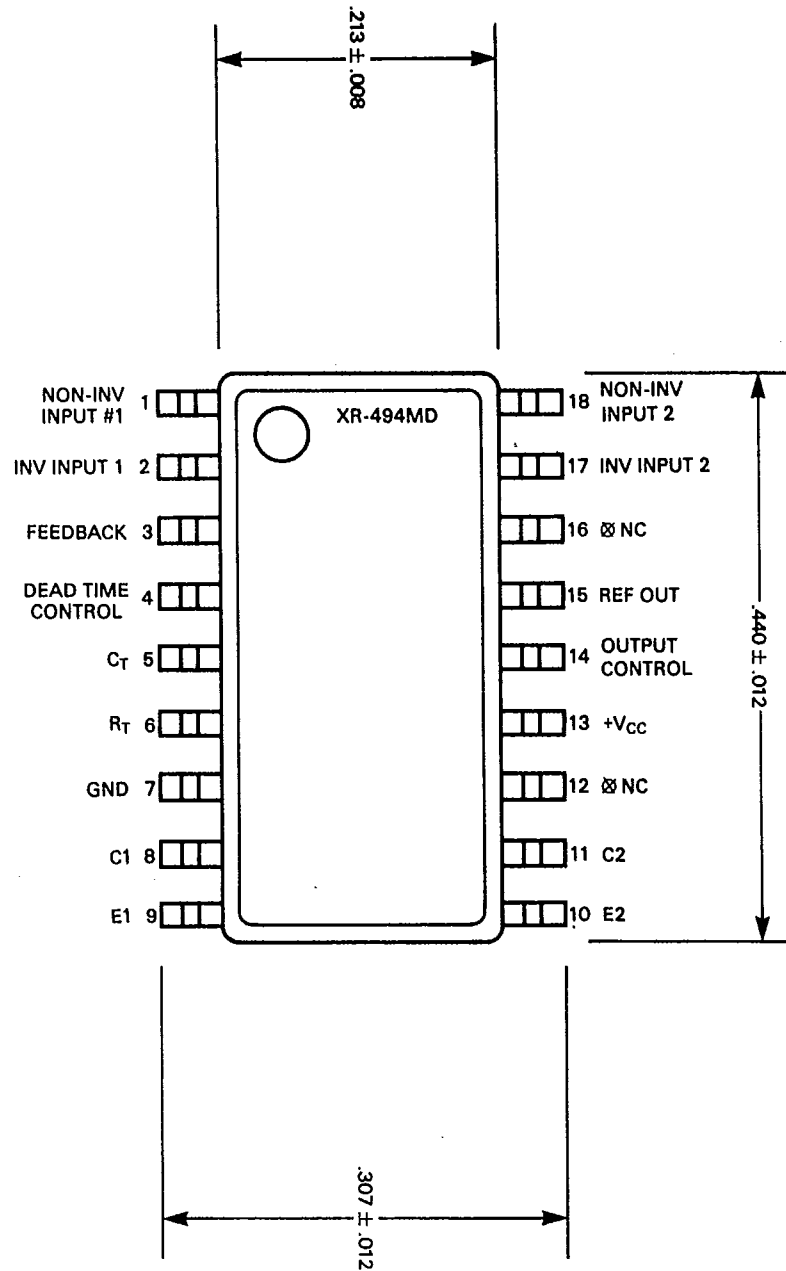
### ORDERING INFORMATION

| Part Number | Package | Operating Temperature |
|-------------|---------|-----------------------|
| XR-1488N    | Ceramic | 0°C to +70°C          |
| XR-1488P    | Plastic | 0°C to +70°C          |
| XR-1489AN   | Ceramic | 0°C to +70°C          |
| XR-1489AP   | Plastic | 0°C to +70°C          |

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# XR-1468/1568

## Dual-Polarity Tracking Voltage Regulator

### GENERAL DESCRIPTION

The XR-1468/1568 is a dual polarity tracking voltage regulator, internally trimmed for symmetrical positive and negative 15V outputs. Current output capability is 100 mA, and may be increased by adding external pass transistors. The device is intended for local "on-card" regulation, which eliminates the distribution problems associated with single point regulation.

The XR-1468CN and XR-1568N are guaranteed over the 0°C to 70°C commercial temperature range. The XR-1568M is rated over the full military temperature range of -55°C to +125°C.

### FEATURES

Internally Set for  $\pm 15V$  Outputs  
 $\pm 100$  mA Peak Output Current  
 Output Voltages Balanced Within 1% (XR-1568)  
 0.06% Line and Load Regulation  
 Low Stand-By Current  
 Output Externally Adjustable from  $\pm 8$  to  $\pm 20$  Volts  
 Externally Adjustable Current Limiting  
 Remote Sensing

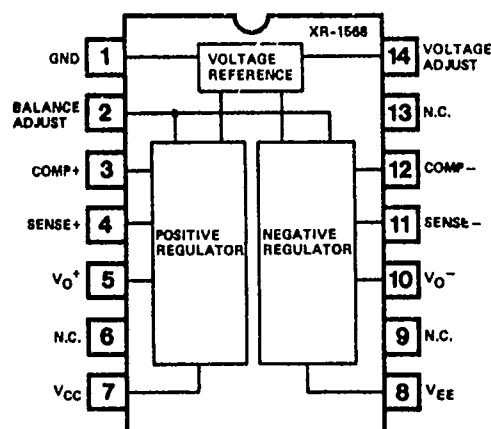
### APPLICATIONS

Main Regulation in Small Instruments  
 On-Card Regulation in Analog and Digital Systems  
 Point-of-Load Precision Regulation

### ABSOLUTE MAXIMUM RATINGS

|                                  |                 |
|----------------------------------|-----------------|
| Power Supply                     | $\pm 30$ Volts  |
| Minimum Short-Circuit Resistance | 4.0 Ohms        |
| Load Current, Peak               | $\pm 100$ mA    |
| Power Dissipation                |                 |
| Ceramic (N) Package              | 1.0 Watt        |
| Derate Above +25°C               | 6.7 mW/°C       |
| Operating Temperature            |                 |
| XR-1568M                         | -55°C to +125°C |
| XR-1568/XR-1468C                 | 0°C to +70°C    |
| Storage Temperature              | -65°C to +150°C |

### FUNCTIONAL BLOCK DIAGRAM



5

### ORDERING INFORMATION

| Part Number | Temperature     | Output Offset    | Package |
|-------------|-----------------|------------------|---------|
| XR-1568M    | -55°C to +125°C | $\pm 150$ mV max | Ceramic |
| XR-1568N    | 0°C to +70°C    | $\pm 150$ mV max | Ceramic |
| XR-1468CN   | 0°C to +70°C    | $\pm 300$ mV max | Ceramic |

### SYSTEM DESCRIPTION

The XR-1468/1568 is a dual polarity tracking voltage regulator combining two separate regulators with a common reference element in a single monolithic circuit, thus providing a very close balance between the positive and negative output voltages. Outputs are internally set to  $\pm 15$  Volts but can be externally adjusted between  $\pm 8.0$  to  $\pm 20$  Volts with a single control. The circuit features  $\pm 100$  mA output current, with externally adjustable current limiting, and provision for remote voltage sensing.