

CA723 Types  
Voltage Regulators

For Regulated Output Voltages Adjustable from  
2 V to 37 V at Output Currents up to 150 mA  
Without External Pass Transistors

RCA-CA723 and CA723C are silicon mono-  
lithic integrated circuits designed for service  
as voltage regulators at output voltages  
ranging from 2 to 37 volts at currents up to  
150 milliamperes.

Each type includes a temperature-compensated  
reference amplifier, an error amplifier, a current-  
limiting circuit. They also provide inde-  
pendently accessible inputs for adjustable  
current limiting and remote shutdown and,  
in addition, feature low standby current  
drain, low temperature drift, and high ripple  
rejection.

The CA723 and CA723C may be used with  
positive and negative power supplies in a

wide variety of series, shunt, switching, and  
floating regulator applications. They can  
provide regulation at load currents greater  
than 150 milliamperes and in excess of  
10 amperes with the use of suitable n-p-n  
or p-n-p external pass transistors.

The CA723 and CA723C are supplied in the  
10-lead TO-5-style ceramic package (T suffix),  
and the 14-lead dual-in-line plastic package  
(E suffix), and are direct replacements for  
industry types 723, 723C,  $\mu$ A723, and  
 $\mu$ A723C in packages with similar terminal  
arrangements. They are also available in  
chip form ("H" suffix).

All types are rated for operation over the  
full military-temperature range of  $-55^{\circ}\text{C}$   
to  $+125^{\circ}\text{C}$ .

MAXIMUM RATINGS, Absolute-Maximum Values:

|                                                                                   |         |    |
|-----------------------------------------------------------------------------------|---------|----|
| DC SUPPLY VOLTAGE<br>(Between $V^{+}$ and $V^{-}$ Terminals)                      | 40      | V  |
| PULSE VOLTAGE FOR 50-ms<br>PULSE WIDTH<br>(Between $V^{+}$ and $V^{-}$ Terminals) | 50      | V  |
| DIFFERENTIAL INPUT-OUTPUT<br>VOLTAGE<br>(Between $V^{+}$ and $V^{-}$ Terminals)   | 40      | V  |
| DIFFERENTIAL INPUT<br>VOLTAGE:<br>Between Inverting and Non-<br>Inverting Inputs  | $\pm 5$ | V  |
| Between Non-Inverting<br>Input and $V^{-}$                                        | 8       | V  |
| CURRENT FROM ZENER DIODE<br>TERMINAL ( $V_Z$ )                                    | 25      | mA |
| CURRENT FROM VOLTAGE<br>REFERENCE TERMINAL<br>( $V_{REF}$ )                       | 15      | mA |

|                                                                                                                                       |                 |                        |
|---------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------|
| DEVICE DISSIPATION:<br>Up to $T_A = 25^{\circ}\text{C}$ —<br>CA723T, CA723CT                                                          | 800             | mW                     |
| CA723E, CA723CE                                                                                                                       | 1000            | mW                     |
| Above $T_A = 25^{\circ}\text{C}$ —<br>CA723T, CA723CT<br>Derate linearly                                                              | 6.3             | mW/ $^{\circ}\text{C}$ |
| CA723E, CA723CE<br>Derate linearly                                                                                                    | 8.3             | mW/ $^{\circ}\text{C}$ |
| AMBIENT TEMPERATURE<br>RANGE (All Types):<br>Operating                                                                                | $-55$ to $+125$ | $^{\circ}\text{C}$     |
| Storage                                                                                                                               | $-65$ to $+150$ | $^{\circ}\text{C}$     |
| LEAD TEMPERATURE<br>(During Soldering):<br>At a distance $1/16"$ $\pm 1/32"$<br>(1.59 $\pm 0.79$ mm) from case for<br>10 seconds max. | $+265$          | $^{\circ}\text{C}$     |

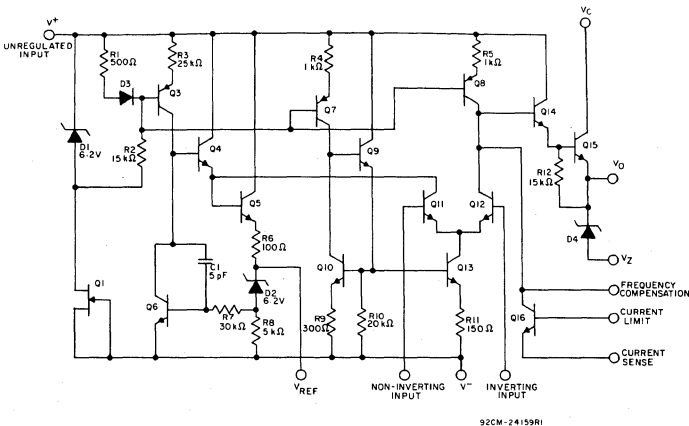


Fig. 4 — Equivalent schematic diagram of the CA723 and CA723C.

Features:

- Up to 150 mA output current
- Positive and negative voltage regulation
- Regulation in excess of 10A with suitable pass transistors
- Input and output short-circuit protection
- Load and line regulation: 0.03%
- Direct replacement for 723 and 723C industry types
- Adjustable output voltage: 2 to 37 V

Applications:

- Series and shunt voltage regulator
- Floating regulator
- Switching voltage regulator
- High-current voltage regulator
- Temperature controller

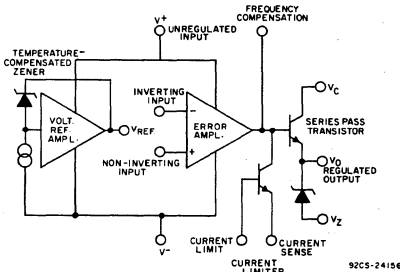


Fig. 1 — Functional diagram of the CA723 and CA723C.

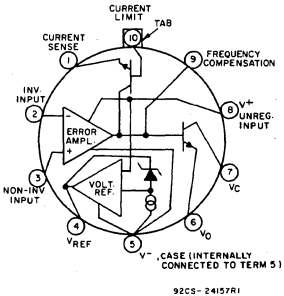


Fig. 2 — Terminal arrangement of the CA723T and CA723CT in the TO-5 style package.

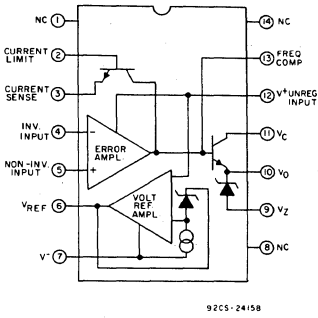


Fig. 3 — Terminal arrangement of the CA723E and CA723CE in the dual-in-line plastic package.

# CA723 Types

**ELECTRICAL CHARACTERISTICS** at  $T_A = 25^\circ\text{C}$ ,  $V^+ = V_C = V_I = 12\text{V}$ ,  $V^- = 0$ ,  $V_O = 5\text{V}$ ,  $I_L = 1\text{mA}$ ,  $C_1 = 100\text{pF}$ ,  $C_{REF} = 0$ ,  $R_{SCP} = 0$ , unless otherwise specified. Divider impedance  $R_1 R_2$  at non-inverting input, Term. 5, =  $10\text{k}\Omega$  (see Fig. 23).

| CHARACTERISTIC                                             | TEST CONDITIONS                                                  | LIMITS |       |       |        |       |       | UNITS               |
|------------------------------------------------------------|------------------------------------------------------------------|--------|-------|-------|--------|-------|-------|---------------------|
|                                                            |                                                                  | CA723  |       |       | CA723C |       |       |                     |
|                                                            |                                                                  | Min.   | Typ.  | Max.  | Min.   | Typ.  | Max.  |                     |
| Quiescent Regulator Current, $I_Q$                         | $I_L = 0$ ,<br>$V_I = 30\text{ V}$                               | —      | 2.3   | 3.5   | —      | 2.3   | 4     | mA                  |
| Input Voltage Range, $V_I$                                 |                                                                  | 9.5    | —     | 40    | 9.5    | —     | 40    | V                   |
| Output Voltage Range, $V_O$                                |                                                                  | 2      | —     | 37    | 2      | —     | 37    | V                   |
| Differential Input-Output Voltage, $V_I - V_O$             |                                                                  | 3      | —     | 38    | 3      | —     | 38    | V                   |
| Reference Voltage, $V_{REF}$                               |                                                                  | 6.95   | 7.15  | 7.35  | 6.8    | 7.15  | 7.5   | V                   |
| Line Regulation<br>(See Note 1)                            | $V_I = 12$<br>to 40 V                                            | —      | 0.02  | 0.2   | —      | 0.1   | 0.5   | % $V_O$             |
|                                                            | $V_I = 12$<br>to 15 V                                            | —      | 0.01  | 0.1   | —      | 0.01  | 0.1   |                     |
|                                                            | $V_I = 12$<br>to 15 V,<br>$T_A = -55$ to<br>$+125^\circ\text{C}$ | —      | —     | 0.3   | —      | —     | —     |                     |
|                                                            | $V_I = 12$<br>to 15 V,<br>$T_A = 0$ to<br>$70^\circ\text{C}$     | —      | —     | —     | —      | —     | 0.3   |                     |
| Load Regulation<br>(See Note 1)                            | $I_L = 1$<br>to 50 mA                                            | —      | 0.03  | 0.15  | —      | 0.03  | 0.2   | % $V_O$             |
|                                                            | $I_L = 1$<br>to 50 mA,<br>$T_A = -55$ to<br>$+125^\circ\text{C}$ | —      | —     | 0.6   | —      | —     | —     |                     |
|                                                            | $I_L = 1$<br>to 50 mA,<br>$T_A = 0$<br>to $70^\circ\text{C}$     | —      | —     | —     | —      | —     | 0.6   |                     |
| Output Voltage Temp. Coefficient, $\Delta V_O$             | $T_A = -55$<br>to $+125^\circ\text{C}$                           | —      | 0.002 | 0.015 | —      | —     | —     | %/ $^\circ\text{C}$ |
|                                                            | $T_A = 0$<br>to $70^\circ\text{C}$                               | —      | —     | —     | —      | 0.003 | 0.015 |                     |
| Ripple Rejection<br>(See Note 2)                           | $f = 50\text{ Hz}$<br>to 10 kHz                                  | —      | 74    | —     | —      | 74    | —     | dB                  |
|                                                            | $f = 50\text{ Hz}$ to<br>10 kHz,<br>$C_{REF} = 5\mu\text{F}$     | —      | 86    | —     | —      | 86    | —     |                     |
| Short-Circuit Limiting Current, $I_{LIM}$                  | $R_{SCP} = 10\ \Omega$ ,<br>$V_O = 0$                            | —      | 65    | —     | —      | 65    | —     | mA                  |
| Equivalent Noise RMS Output Voltage, $V_N$<br>(See Note 2) | $BW = 100\text{ Hz}$<br>to 10 kHz,<br>$C_{REF} = 0$              | —      | 20    | —     | —      | 20    | —     | $\mu\text{V}$       |
|                                                            | $BW = 100\text{ Hz}$<br>to 10 kHz,<br>$C_{REF} = 5\mu\text{F}$   | —      | 2.5   | —     | —      | 2.5   | —     |                     |

Note 1: Line and load regulation specifications are given for condition of a constant chip temperature. For high-dissipation conditions, temperature drifts must be separately taken into account.

Note 2: For  $C_{REF}$ , see Fig. 23.

## TYPICAL CHARACTERISTICS CURVES FOR TYPE CA723

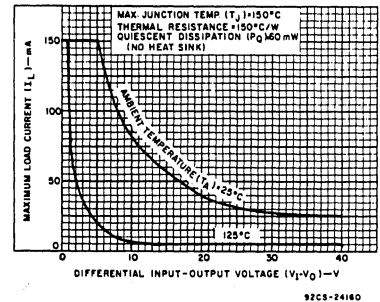


Fig. 5 — Max. load current vs differential input-output voltage.

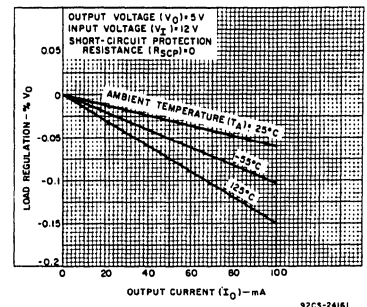


Fig. 6 — Load regulation without current limiting.

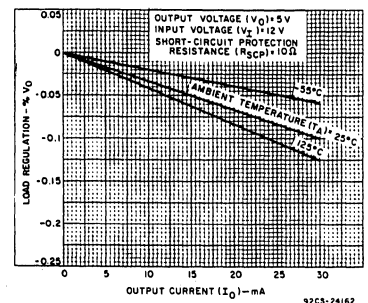


Fig. 7 — Load regulation with current limiting.

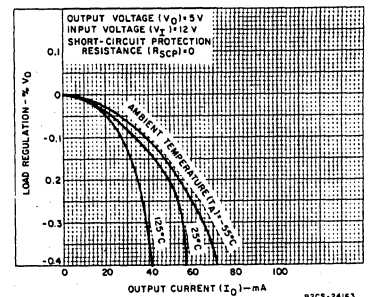


Fig. 8 — Load regulation with current limiting.

CA723 Types

TYPICAL CHARACTERISTICS CURVES FOR TYPE CA723 (Cont'd)

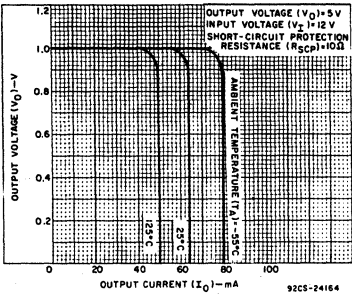


Fig. 9 - Current limiting characteristics.

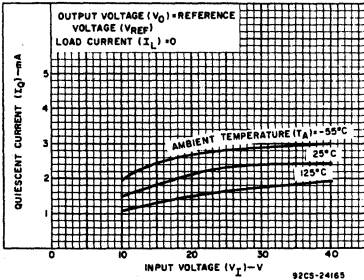


Fig. 10 - Quiescent current vs. input voltage.

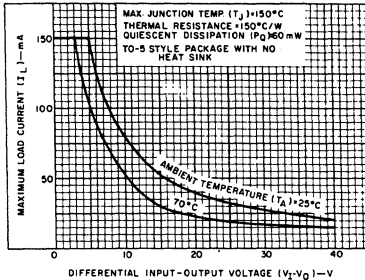


Fig. 11 - Max. load current vs differential input-output voltage CA723CT.

TYPICAL CHARACTERISTICS CURVES FOR TYPE CA723C

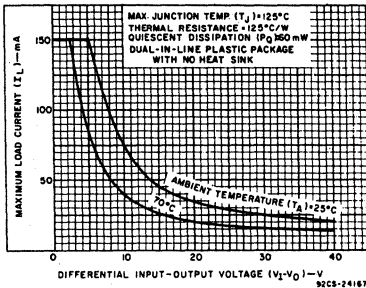


Fig. 12 - Max. load current vs differential input-output voltage for CA723CE.

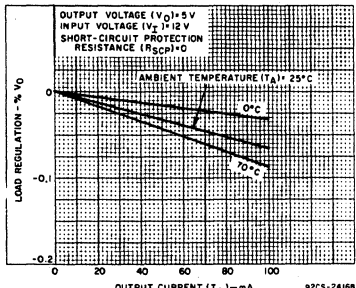


Fig. 13 - Load regulation without current limiting.

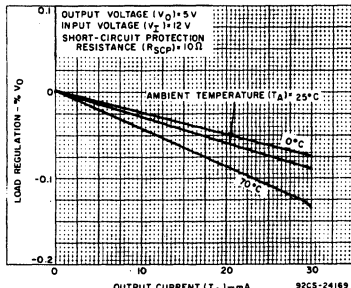


Fig. 14 - Load regulation with current limiting.

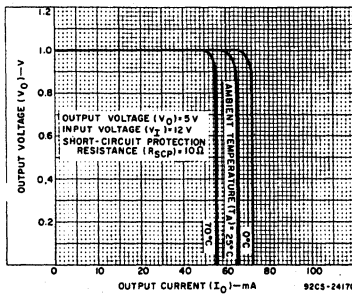


Fig. 15 - Current limiting characteristics.

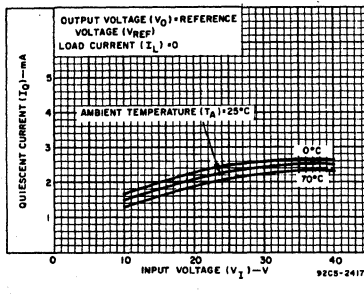


Fig. 16 - Quiescent current vs. input voltage.

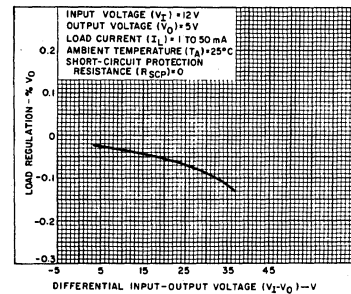


Fig. 17 - Load regulation vs. differential input-output voltage.

TYPICAL CHARACTERISTICS CURVES FOR TYPES CA723 AND CA723C

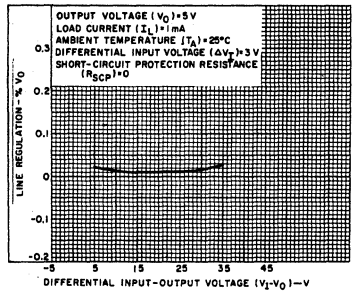


Fig. 18 - Line regulation vs. differential input-output voltage.

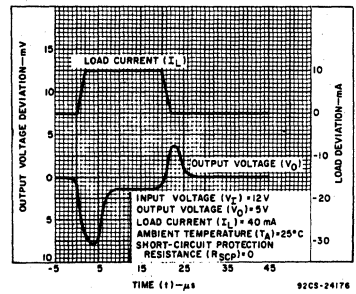


Fig. 19 - Line transient response.

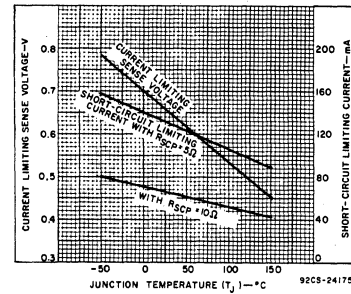


Fig. 20 - Current limiting characteristics vs. junction temperature.

# CA723 Types

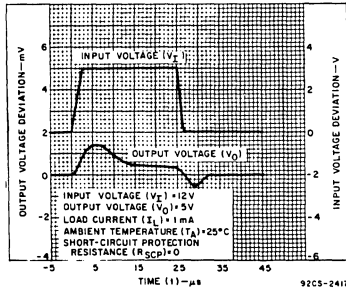


Fig. 21 - Load transient response.

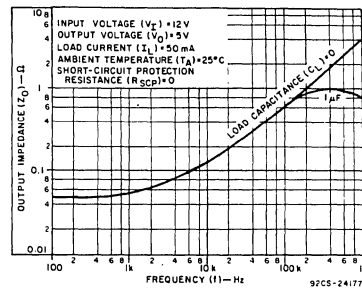


Fig. 22 - Output impedance vs. frequency.

## TYPICAL APPLICATION CIRCUITS

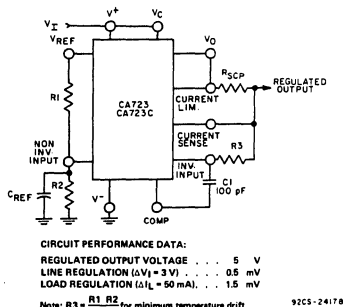


Fig. 23 - Low-voltage regulator circuit ( $V_O = 2$  to 7 volts).

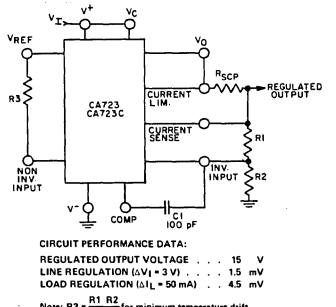


Fig. 24 - High-voltage regulator circuit ( $V_O = 7$  to 37 volts).

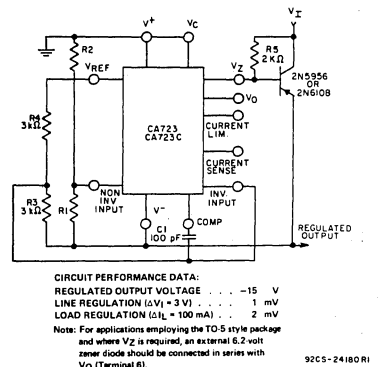


Fig. 25 - Negative-voltage regulator circuit.

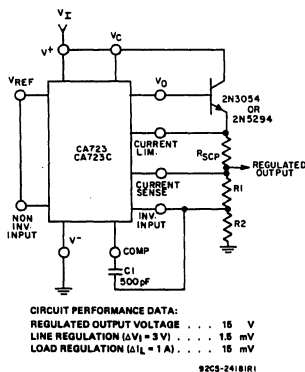


Fig. 26 - Positive-voltage-regulator circuit (with external n-p-n pass transistor).

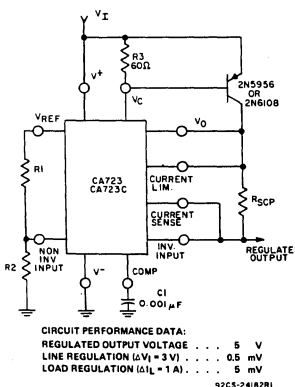


Fig. 27 - Positive voltage-regulator circuit (with external p-n-p pass transistor).

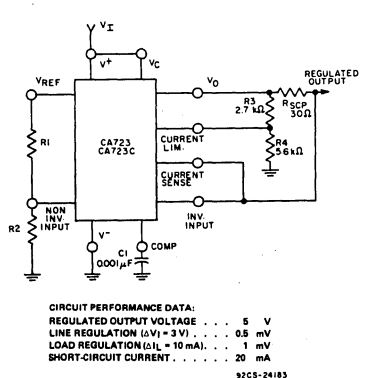
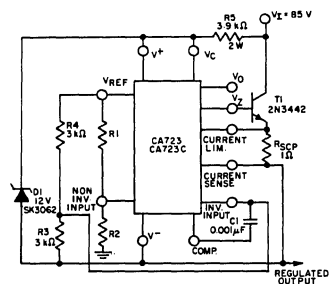


Fig. 28 - Foldback current-limiting circuit.



Note: For applications employing the TO-8 style package and where  $V_Z$  is required, an external 6.2-volt zener diode should be connected in series with  $V_O$  (Terminal 6).

Fig. 29 - Positive-floating regulator circuit.