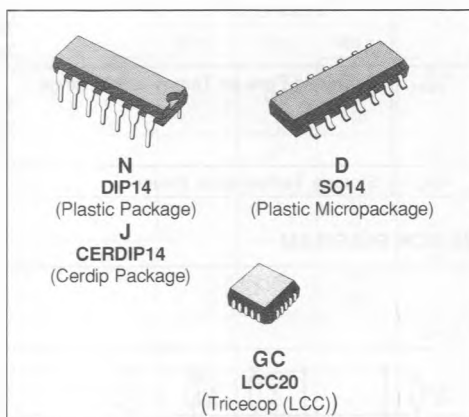


BIPOLAR QUAD OPERATIONAL AMPLIFIERS

- LOW DISTORTION RATIO
- LOW NOISE
- VERY LOW SUPPLY CURRENT
- LOW INPUT OFFSET CURRENT
- VERY LOW INPUT OFFSET VOLTAGE
- LARGE COMMON-MODE RANGE
- HIGH GAIN
- HIGH OUTPUT CURRENT
- GAIN-BANDWIDTH PRODUCT : 2.5 MHz
- TEMPERATURE DRIFT : $2 \mu\text{V}/^{\circ}\text{C}$
- LONG TERM STABILITY : $8 \mu\text{V}/\text{YEAR}$
(for $T_{\text{amb}} \leq 50^{\circ}\text{C}$)
- THE TEB4033 AND TEF4033 ARE PIN TO PIN REPLACEMENT OF THE LS404C AND LS404C RESPECTIVELY



DESCRIPTION

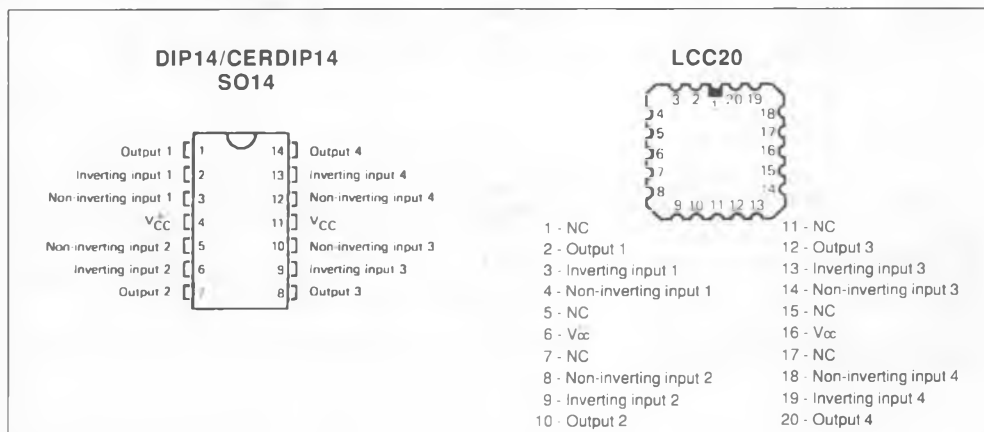
The TEB4033, TEF4033 and TEC4033 are high performance quad-operational amplifiers intended for active filter applications. The internal phase compensation allows stable operation as voltage follower in spite of their high gain-bandwidth products.

The circuits present very stable electrical characteristics over the entire supply voltage range.

ORDERING INFORMATION

Part Number	Temperature Range	Package		
		N	D	GC
TEB4033	0 °C to + 70 °C	•	•	
TEF4033	- 40 °C to + 105 °C	•	•	
TEC4033	- 55 °C to + 125 °C			•
Examples : TEB4033N, TEC4033GC				

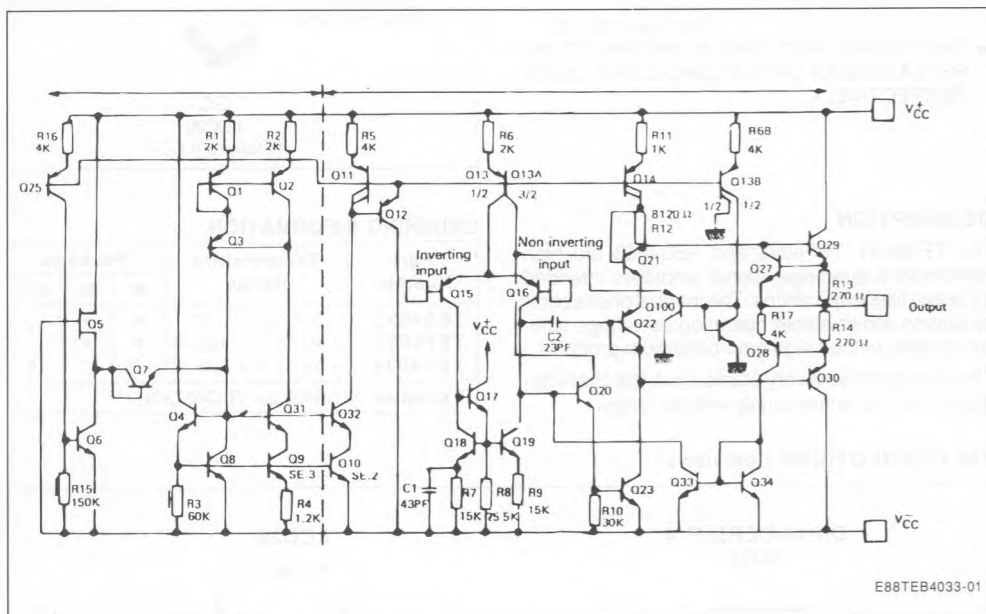
PIN CONNECTIONS (top views)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	± 18	V
V_I	Input Voltage	$\pm V_{CC}$	V
V_{ID}	Differential Input Voltage	$\pm (V_{CC} - 1)$	V
P_{tot}	Power Dissipation	TEB4033D, TEF4033D TEB4033N, TEF4033N TEC4033GC	mW
T_{oper}	Operating Free-air Temperature Range	TEB4033 TEF4033 TEC4033	$^{\circ}\text{C}$
T_{stg}	Storage Temperature Range		$^{\circ}\text{C}$

BLOCK DIAGRAM



Case	Outputs	Inverting Inputs	Non-inverting Inputs	V_{CC}^+	V_{CC}^-	N. C.
DIP14 CERDIP14 SO14	1, 7 8, 14	2, 6 9, 13	3, 5 10, 12	4	11	
LCC20	2, 10 12, 20	3, 9 13, 19	4, 8 14, 18	6	16	*

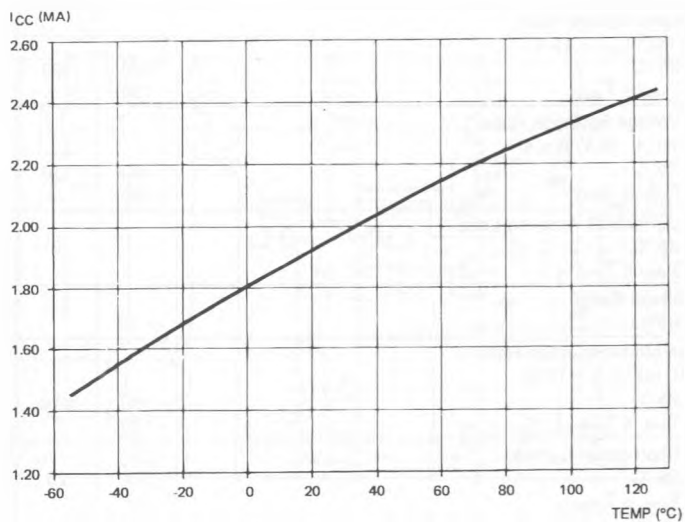
* LCC20 : Other pins are not connected.

ELECTRICAL CHARACTERISTICS $V_{CC} = \pm 15 \text{ V}$ (unless otherwise specified)TEC 4033 : $-55 \leq T_{amb} \leq +125 \text{ }^{\circ}\text{C}$ TEF 4033 : $-40 \leq T_{amb} \leq +105 \text{ }^{\circ}\text{C}$ TEB 4033 : $0 \leq T_{amb} \leq +70 \text{ }^{\circ}\text{C}$

Symbol	Parameter	TEB 4033 TEF 4033 TEC 4033			Unit
		Min.	Typ.	Max.	
V_{IO}	Input Offset Voltage $T_{amb} = 25 \text{ }^{\circ}\text{C}$ ($R_S \leq 10 \text{ k}\Omega$) $T_{min} \leq T_{amb} \leq T_{max}$		0.3	1 3	mV
DV_{IO}	Input Offset Voltage Drift		2		$\mu\text{V}/^{\circ}\text{C}$
I_{IO}	Input Offset Current $T_{amb} = 25 \text{ }^{\circ}\text{C}$ $T_{min} \leq T_{amb} \leq T_{max}$		5	20 40	nA
I_{IB}	Input Bias Current $T_{amb} = 25 \text{ }^{\circ}\text{C}$ $T_{min} \leq T_{amb} \leq T_{max}$		50	100 200	nA
A_{vd}	Large Signal Voltage Gain ($R_L = 2 \text{ k}\Omega$, $V_O = \pm 10 \text{ V}$) $T_{amb} = 25 \text{ }^{\circ}\text{C}$ $T_{min} \leq T_{amb} \leq T_{max}$	100 100	300		V/mV
SVR	Supply Voltage Rejection Ratio DV_{CC} from $\pm 15 \text{ V}$ to $\pm 4 \text{ V}$ $T_{amb} = 25 \text{ }^{\circ}\text{C}$ $T_{min} \leq T_{amb} \leq T_{max}$	100 100	110		dB
I_{CC}	Supply Current, all Amp, no Load $T_{amb} = 25 \text{ }^{\circ}\text{C}$ $T_{min} \leq T_{amb} \leq T_{max}$		2	3 4	mA
V_I	Input Voltage Range $T_{amb} = 25 \text{ }^{\circ}\text{C}$	- 12		+ 12	V
CMR	Common Mode Rejection Ratio ($R_S \leq 10 \text{ k}\Omega$, $V_I = \pm 10 \text{ V}$) $T_{amb} = 25 \text{ }^{\circ}\text{C}$ $T_{min} \leq T_{amb} \leq T_{max}$	100 100	110		dB
I_{OS}	Output Short-circuit Current $T_{amb} = 25 \text{ }^{\circ}\text{C}$ $T_{min} \leq T_{amb} \leq T_{max}$	10 10	23	40 40	mA
$\pm V_{opp}$	Output Voltage Swing $T_{amb} = 25 \text{ }^{\circ}\text{C}$ $R_L = 2 \text{ k}\Omega$ $T_{min} \leq T_{amb} \leq T_{max}$ $R_L = 2 \text{ k}\Omega$ $V_{CC} = \pm 4 \text{ V}$, $R_L = 2 \text{ k}\Omega$ $V_{CC} = \pm 6 \text{ V}$, $R_L = 600 \text{ }\Omega$	13 12 2.8 4.6	14 3		V
S_{vo}	Slew-rate ($V_I = \pm 10 \text{ V}$, $R_L = 2 \text{ k}\Omega$, $C_L \leq 100 \text{ pF}$, $T_{amb} = 25^{\circ}\text{C}$, unity gain)	0.6	1	3	V/ μs
GBP	Gain Bandwidth Product ($f = 100 \text{ kHz}$, $T_{amb} = 25 \text{ }^{\circ}\text{C}$, $V_{IN} = 10 \text{ mV}$, $R_L = 2 \text{ k}\Omega$, $C_L = 100 \text{ pF}$)	1.8	2.5	3.2	MHz
R_I	Input Resistance ($T_{amb} = 25 \text{ }^{\circ}\text{C}$)		1		M Ω

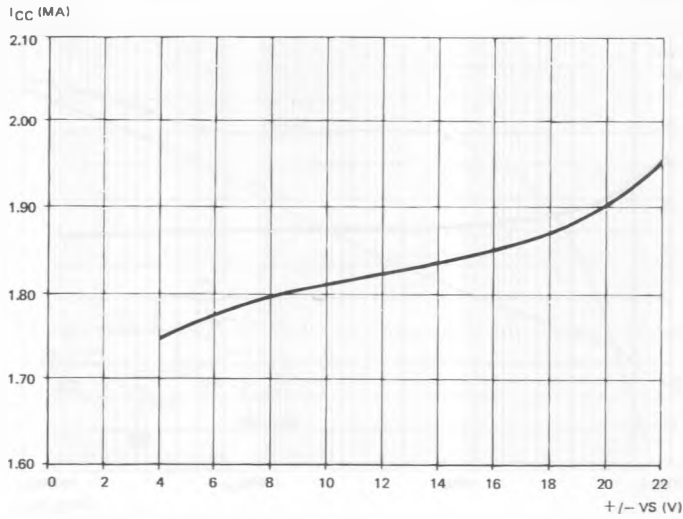
ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	TEB 4033 TEF 4033 TEC 4033			Unit
		Min.	Typ.	Max.	
THD	Total Harmonic Distortion ($f = 1\text{ KHz}$, $A_v = 20\text{ dB}$, $R_L = 2\text{ k}\Omega$ $C_L \leq 100\text{ pF}$, $T_{\text{amb}} = 25\text{ }^\circ\text{C}$, $V_o = 2\text{ V}_{\text{pp}}$)		0.008	0.05	%
V_n	Equivalent Input Noise Voltage ($f = 1\text{ KHz}$) $R_S = 50\text{ }\Omega$ $R_S = 1\text{ k}\Omega$ $R_S = 10\text{ k}\Omega$		8 10 18	15	$\text{nV}/\sqrt{\text{Hz}}$
V_{OPP}	Large Signal Voltage Swing $R_L = 10\text{ k}\Omega$, $f = 10\text{ KHz}$	26	28		V
ϕ_M	Phase Margin		45		Degrees
V_{o1}/V_{o2}	Channel Separation	100	120		dB



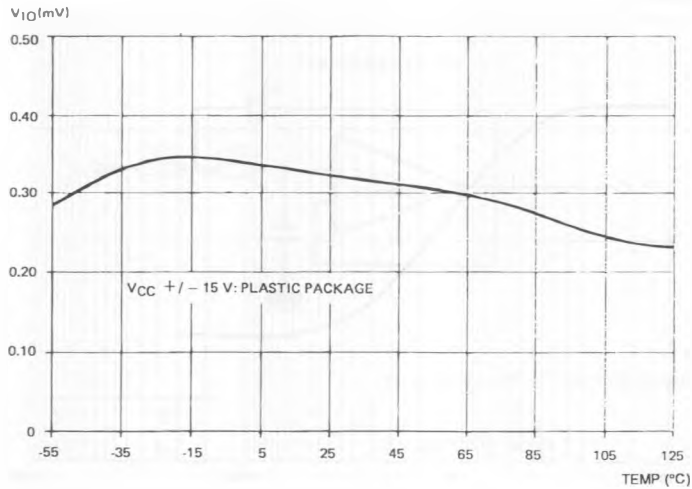
SUPPLY CURRENT VS. AMBIENT TEMPERATURE

E88TEB4033-02



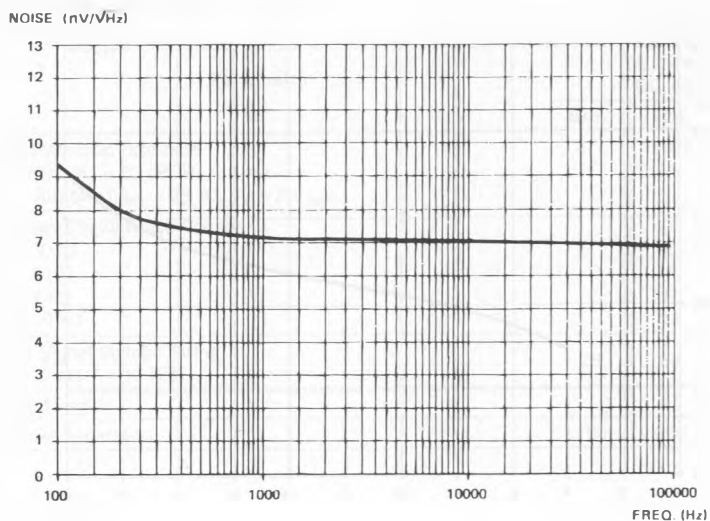
SUPPLY CURRENT VS. SUPPLY VOLTAGE

E88TEB4033-03



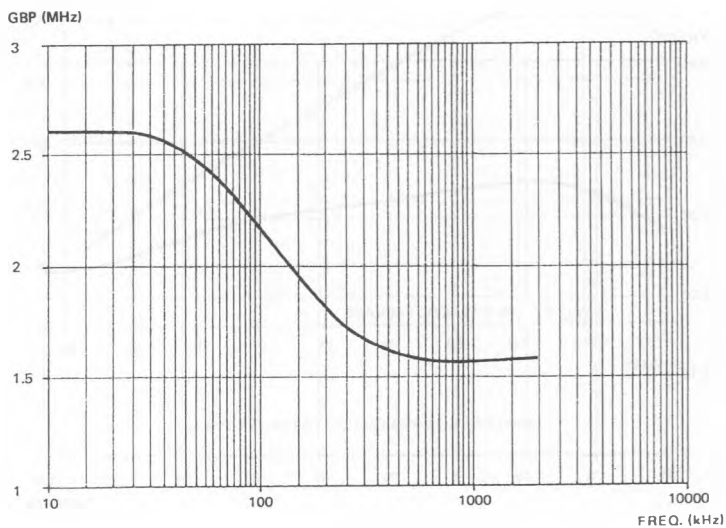
OFFSET VOLTAGE VS. AMBIENT TEMPERATURE

E88TEB4033-04



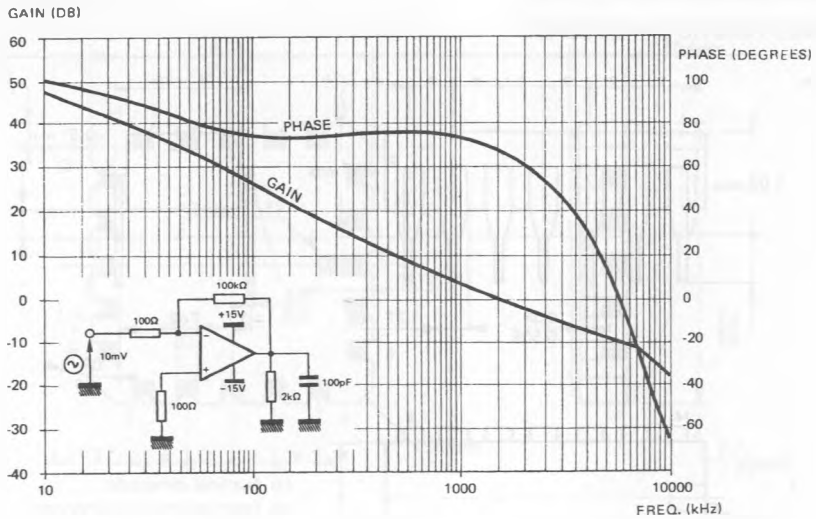
TOTAL INPUT NOISE VS. FREQUENCY

E88TEB4033-05



GAIN BANDWIDTH PRODUCT VS. FREQUENCY

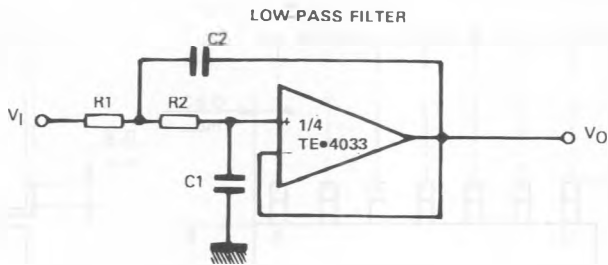
E88TEB4033-06



BODE PLOT

E88TEB4033-07

TYPICAL APPLICATION



E88TEB4033-08

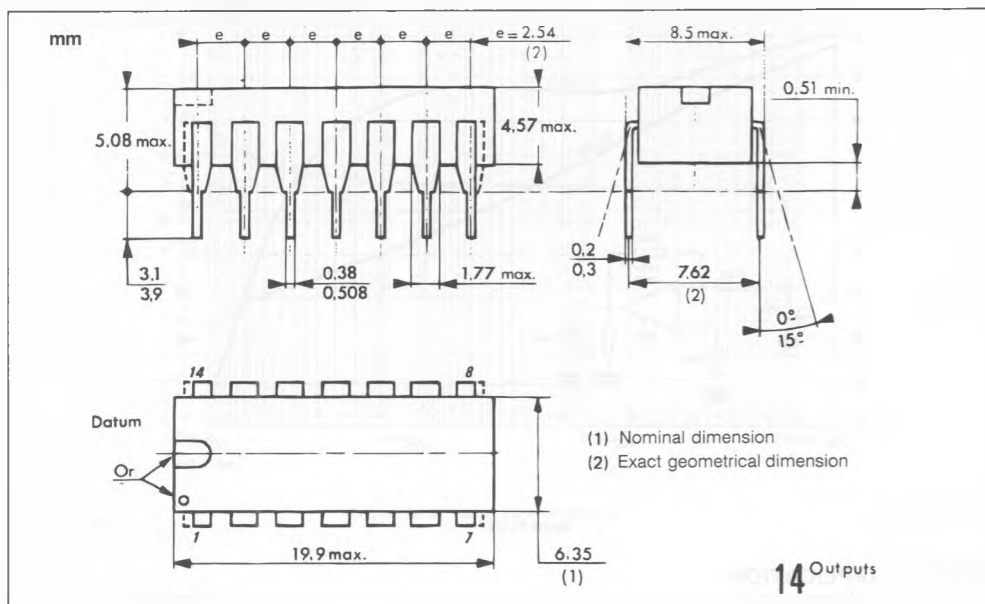
$$\frac{V_o}{V_i} = \frac{1}{1 + 2\xi \frac{S}{\omega_c} + \frac{S^2}{\omega_c^2}}$$

 $\omega_c = 2\pi f_c$, with f_c = cutt-off frequency

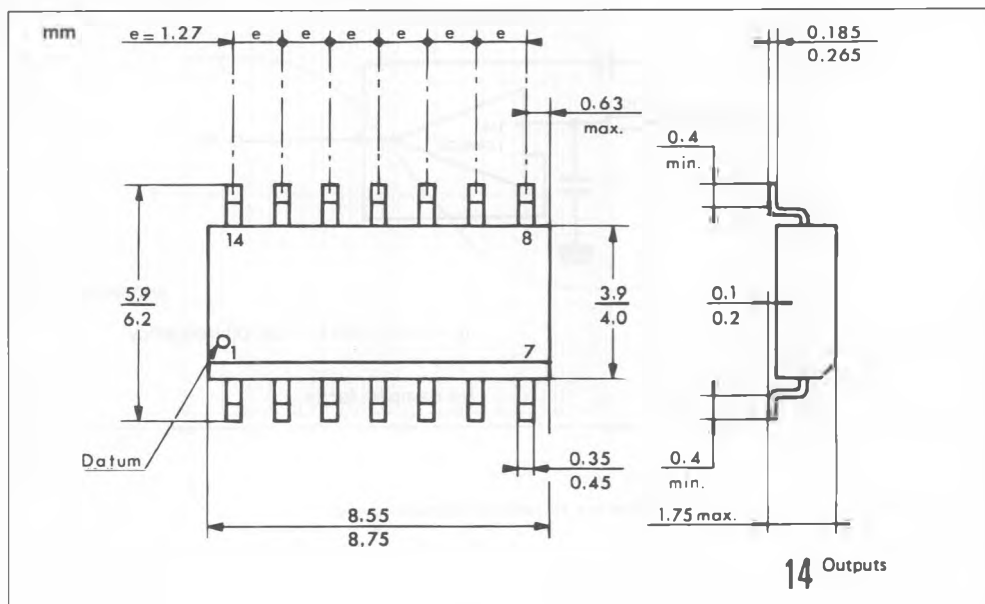
 ξ = damping factor

PACKAGE MECHANICAL DATA

14 PINS – PLASTIC DIP OR CerdIP



14 PINS – PLASTIC MICROPACKAGE (SO)



20 PINS – TRICECOP (LCC)

