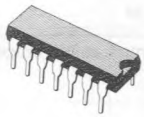
SGS-THOMSON MICROELECTRONICS

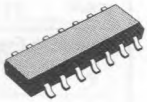
TEB4033
TEF4033 - TEC4033

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 µV/°C
- LONG TERM STABILITY : 8 µV/YEAR (for $T_{amb} \leq 50$ °C)
- THE TEB4033 AND TEF4033 ARE PIN TO PIN REPLACEMENT OF THE LS404C AND LS404 RESPECTIVELY



N
DIP14
(Plastic Package)



D
SO14
(Plastic Micropackage)

J
CERDIP14
(Cerdip Package)

GC
LCC20
(Tricecop (LCC))

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.

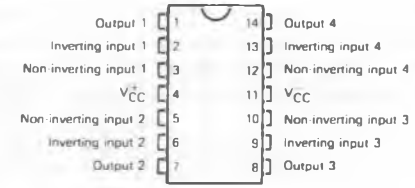
ORDERING INFORMATION

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)

DIP14/CERDIP14
SO14



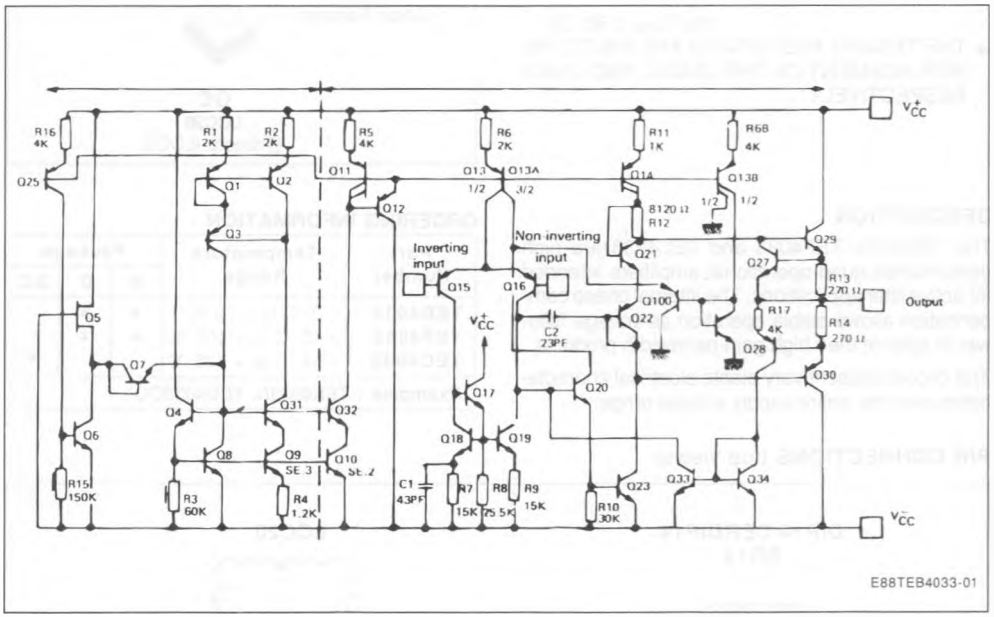
LCC20

1 - NC
2 - Output 1
3 - Inverting input 1
4 - Non-inverting input 1
5 - NC
6 - V_{CC}^-
7 - NC
8 - Non-inverting input 2
9 - Inverting input 2
10 - Output 2
11 - NC
12 - Output 3
13 - Inverting input 3
14 - Non-inverting input 3
15 - NC
16 - V_{CC}^+
17 - NC
18 - Non-inverting input 4
19 - Inverting input 4
20 - Output 4

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_{CC}	Supply Voltage		± 18	V
V_I	Input Voltage		± V_{CC}	V
V_{ID}	Differential Input Voltage		± (V_{CC} −1)	V
P_{tot}	Power Dissipation			mW
		TEB4033D, TEF4033D	400	
		TEB4033N, TEF4033N	665	
		TEC4033GC	665	
T_{oper}	Operating Free-air Temperature Range			°C
		TEB4033	0 to + 70	
		TEF4033	− 40 to + 105	
		TEC4033	− 55 to + 125	
T_{stg}	Storage Temperature Range		− 65 to + 150	°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.

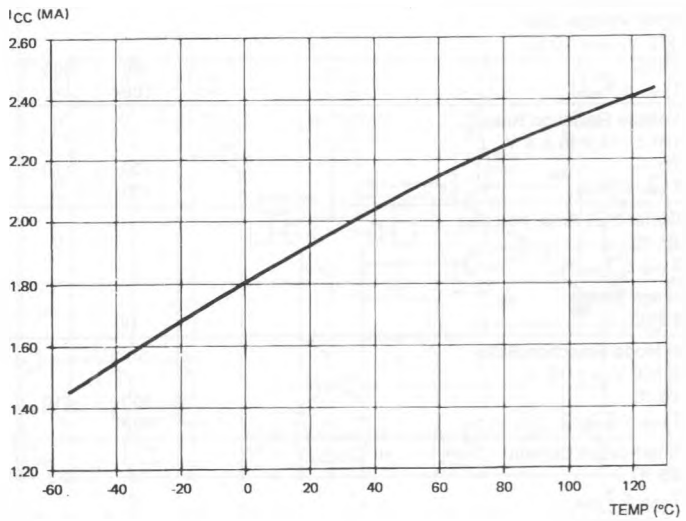
ELECTRICAL CHARACTERISTICS

V_{CC} = ± 15 V (unless otherwise specified)
TEC 4033 : $-55 \leq T_{amb} \leq +125$ °C
TEF 4033 : $-40 \leq T_{amb} \leq +105$ °C
TEB 4033 : $0 \leq T_{amb} \leq +70$ °C

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

ELECTRICAL CHARACTERISTICS (continued)

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



SUPPLY CURRENT VS. AMBIENT TEMPERATURE

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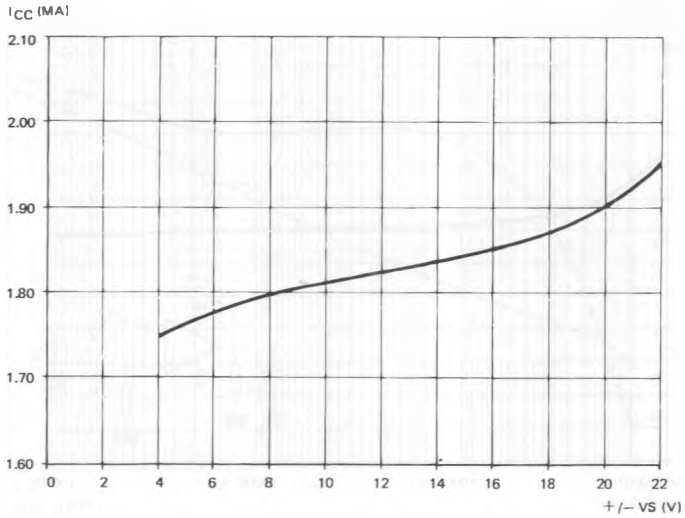

SUPPLY CURRENT VS. SUPPLY VOLTAGE

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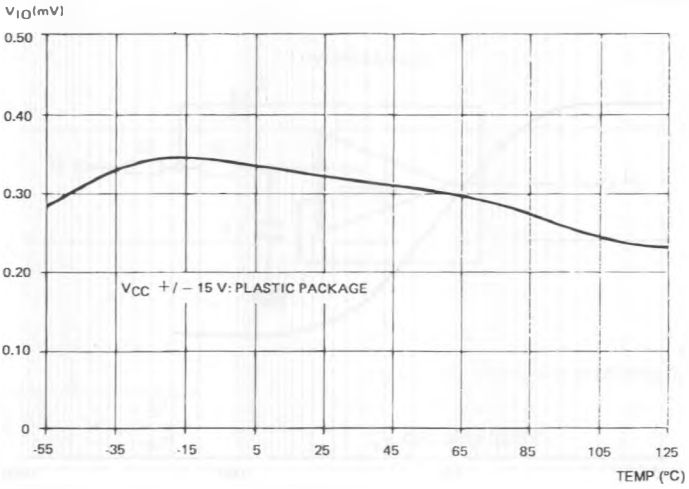

OFFSET VOLTAGE VS. AMBIENT TEMPERATURE

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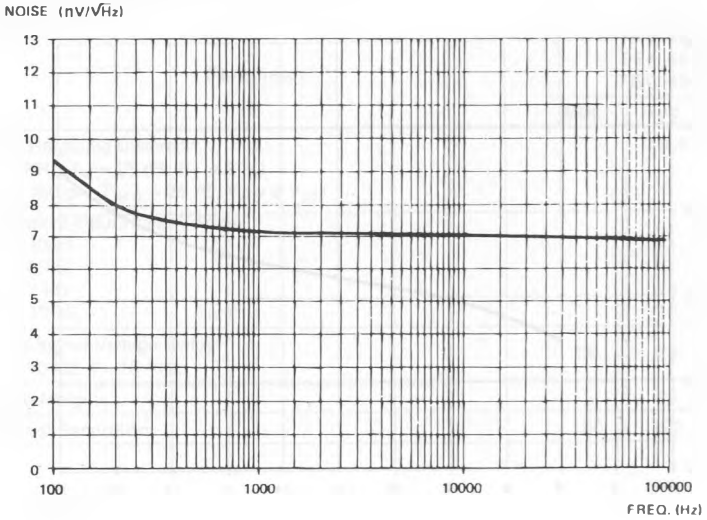

TOTAL INPUT NOISE VS. FREQUENCY

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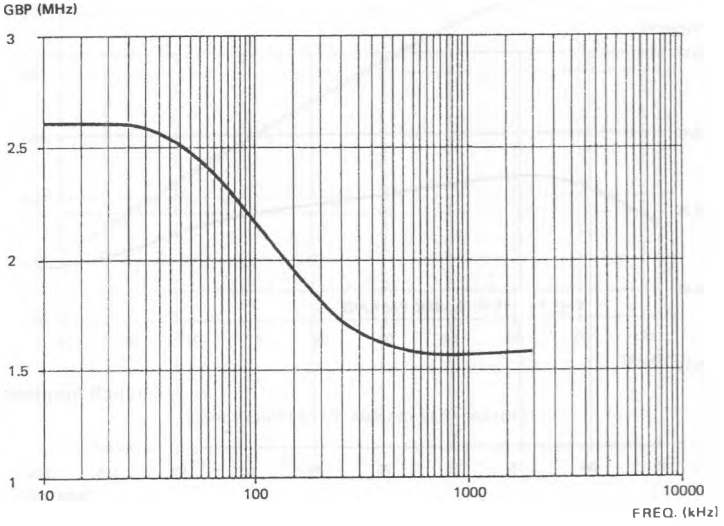

GAIN BANDWIDTH PRODUCT VS. FREQUENCY

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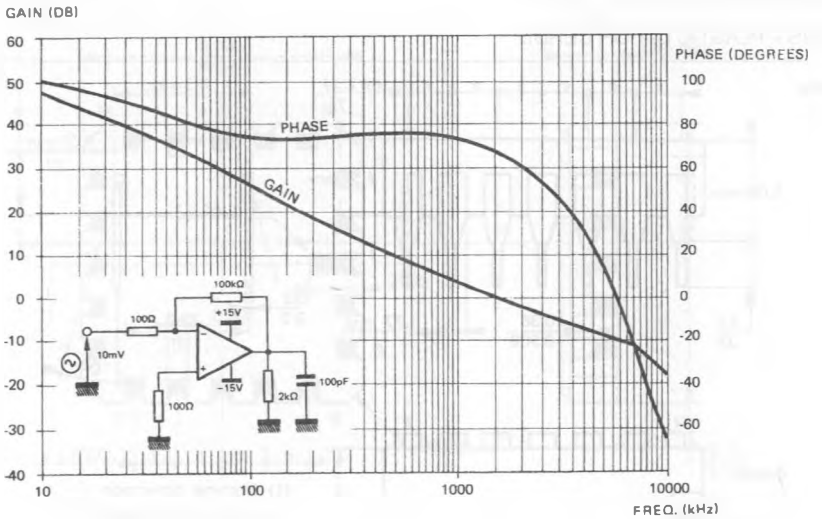
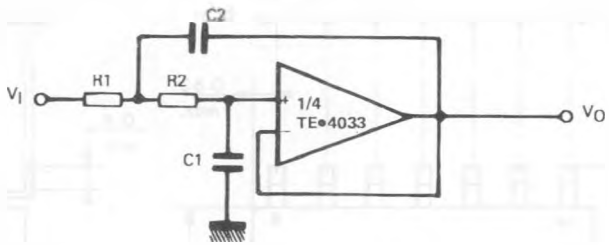


BODE PLOT

E88TEB4033-07

TYPICAL APPLICATION

LOW PASS FILTER



E88TEB4033-08

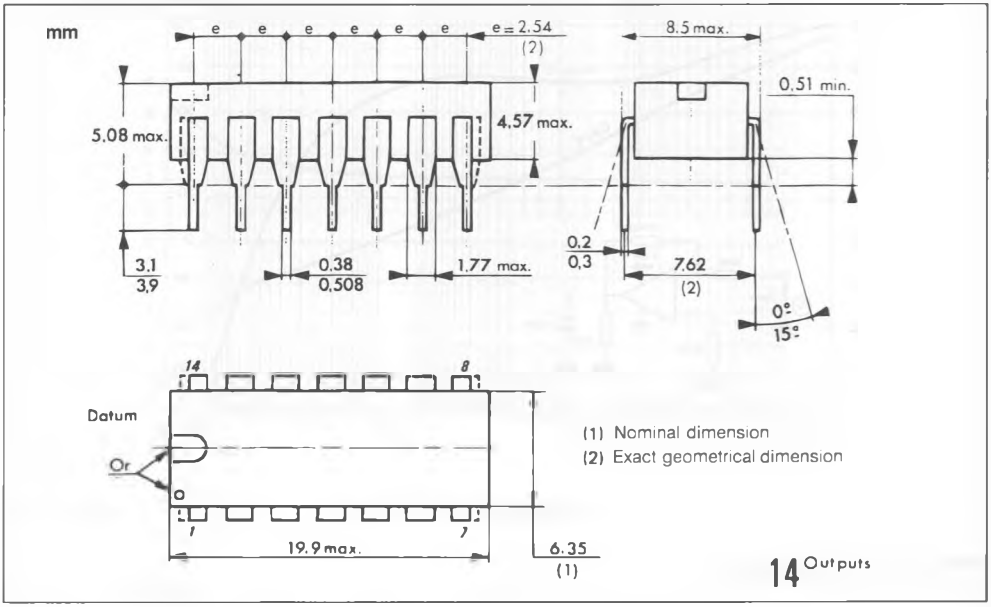
$$\frac{V_o}{V_i} = \frac{1}{1 + 2\xi\frac{S}{\omega_c} + \frac{S^2}{\omega_c^2}}$$

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

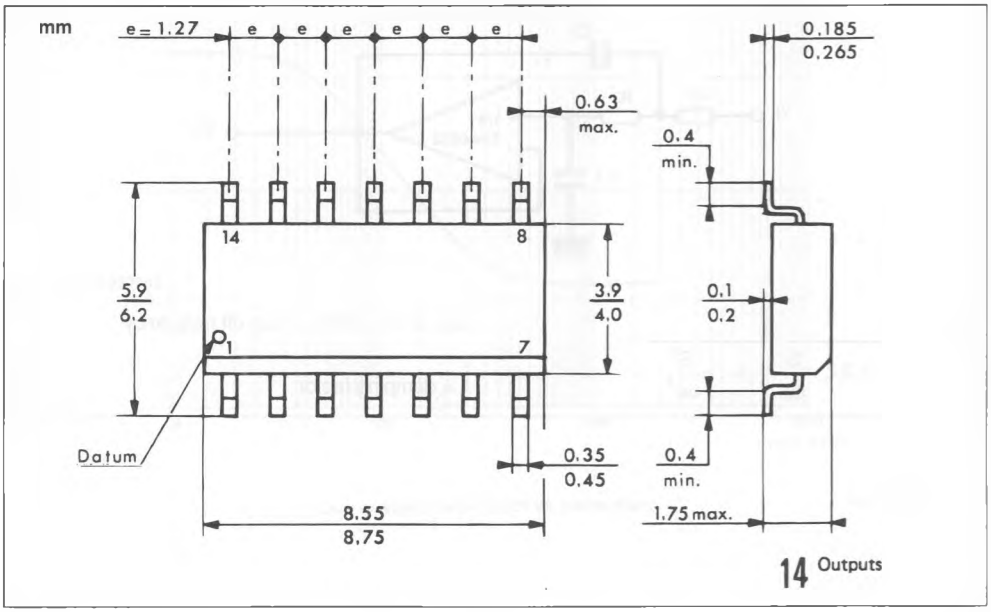
ξ = damping factor

PACKAGE MECHANICAL DATA

14 PINS – PLASTIC DIP OR CERDIP



14 PINS – PLASTIC MICROPACKAGE (SO)



20 PINS – TRICECOP (LCC)