OPERATIONAL AMPLIFIER

The TBA221D is a silicon monolithic integrated operational amplifier for use at temperatures from −25 to +85 °C. Special features are:

- no frequency compensation required
- continuous short-circuit protection
- offset voltage adjustable to zero
- large input voltage range
- low power consumption
- no latch up

TBA221D is equivalent to µA741C, but has better specified d.c. parameters and lower noise.

QUICK REFERENCE DATA				
Positive supply voltage	V_P		15	V
Negative supply voltage	$-V_N$		15	V
Characteristics at T_{amb} = 25 °C				
Voltage gain at R_L = 2 kΩ; V_o = ±10 V	G_v	typ.	200 000	
Common mode rejection ratio	CMRR	typ.	90	dB
Differential input resistance	R_i	typ.	2	MΩ
Output voltage swing at R_L = 10 kΩ	V_o	>	±12	V
Input voltage range	V_i	>	±12	V

PACKAGE OUTLINE SO-8 (SOT-96A) (plastic 8-lead flat pack) (see general section).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Positive supply voltage	V_P	max.	20	V
Negative supply voltage	$-V_N$	max.	20	V
Common mode input voltage [1]	V_i	max.	±15	V
Differential input voltage	V_{2-3}	max.	±30	V

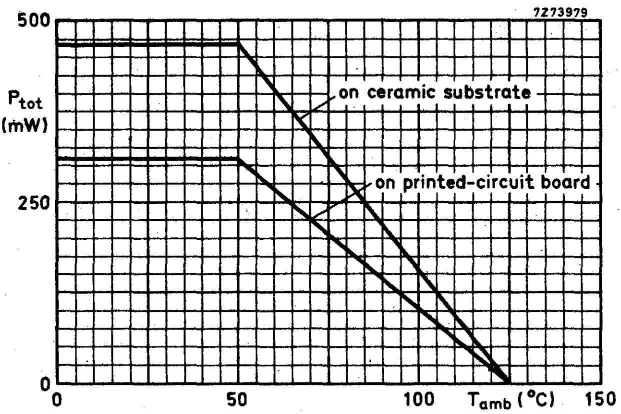
Power dissipation (see derating curve below)

Total power dissipation (free air, T_{amb} = 50 °C) mounted on a ceramic substrate (4 cm^2)	P_{tot}	max.	470	mW
mounted on printed-circuit board (4 cm^2)	P_{tot}	max.	310	mW

Output short-circuit duration [2] — indefinite

Temperatures

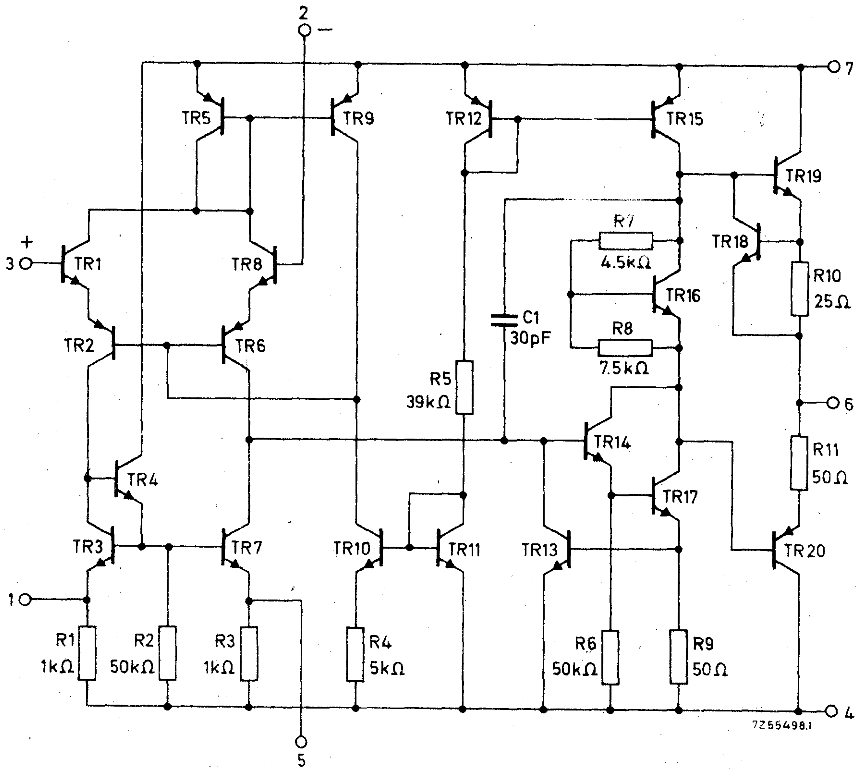
Operating ambient temperature see derating curve below	T_{amb}	−25 to +85	°C
Storage temperature	T_{stg}	−65 to +150	°C



[1]) For supply voltages less than ±15 V, the absolute maximum input voltage is equal to the supply voltage.

[2]) Continuous short circuit is allowed to ground or either supply.

CIRCUIT DIAGRAM

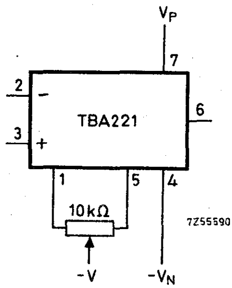


CHARACTERISTICS at V_P = 15 V; $-V_N$ = 15 V; T_{amb} = 25 °C unless otherwise specified

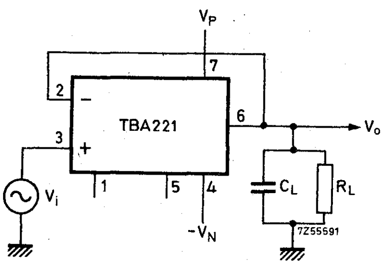
Input offset voltage	V_{io}	typ.	1	mV
		<	4	mV
Input offset voltage at V_P = 18 V; $-V_N$ = 18 V; V_i = ±15 V	V_{io}	<	8	mV
Input offset voltage drift	ΔV_{io}	typ.	5	μV/°C
Input bias current	I_i	typ.	50	nA
		<	150	nA
Input offset current	I_{io}	typ.	5	nA
		<	50	nA
Input voltage range	V_i	>	±12	V
		typ.	±13	V
Common mode rejection ratio	CMRR	>	75	dB
		typ.	90	dB
Differential input resistance	R_i	>	0,6	MΩ
		typ.	2,0	MΩ
Power supply voltage rejection ratio	PSRR	typ.	30	μV/V
		<	100	μV/V
Voltage gain at R_L = 2 kΩ; V_o = ±10 V	G_v	>	30 000	
		typ.	200 000	
Output voltage swing at R_L = 2 kΩ	V_o	>	±12	V
		typ.	±13	V
Output resistance at f = 1 kHz	R_o	typ.	60	Ω
		<	150	Ω
Output short-circuit current	I_{sc}	typ.	25	mA
Supply current at I_o = 0	$I_{P;N}$	typ.	1,7	mA
		<	2,8	mA
A.C. gain at f = 1 kHz; R_L = 2 kΩ	G_v	typ.	1000	
			700 to 1500	
Transient response (unity gain; voltage follower) V_i = 20 mV; R_L = 2 kΩ; C_L = 100 pF				
Rise time		typ.	0,25	μs
Overshoot		typ.	3	%
Slew rate (unity gain) at R_L = 2 kΩ	S	typ.	0,6	V/μs
Input noise voltage at f = 1 kHz	V_n	typ.	20	$nV/\sqrt{Hz}$
at f = 30 Hz	V_n	typ.	25	$nV/\sqrt{Hz}$
Input noise current at f = 1 kHz	I_n	typ.	0,15	$pA/\sqrt{Hz}$
at f = 30 Hz	I_n	typ.	0,6	$pA/\sqrt{Hz}$

CHARACTERISTICS at V_P = 15 V; $-V_N$ = 15 V; T_{amb} = −25 to +85 °C unless otherwise specified

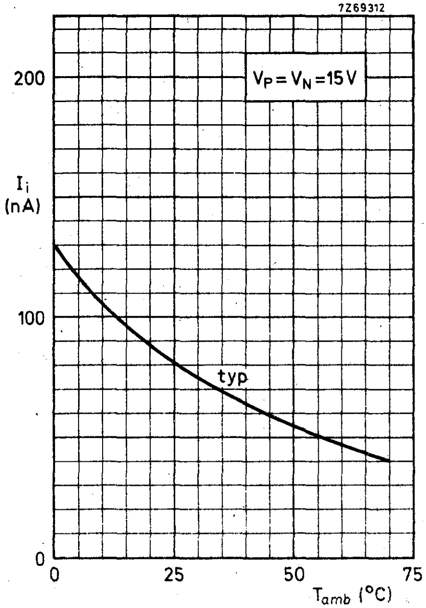
Voltage gain at R_L = 2 kΩ; V_o = ±10 V	G_V	>	20 000	
Input offset voltage	V_{io}	<	5,5	mV
Input bias current	I_i	<	0,3	µA
Input offset current	I_{io}	<	0,1	µA
Output voltage swing at R_L = 2 kΩ	V_o	>	11,5	V

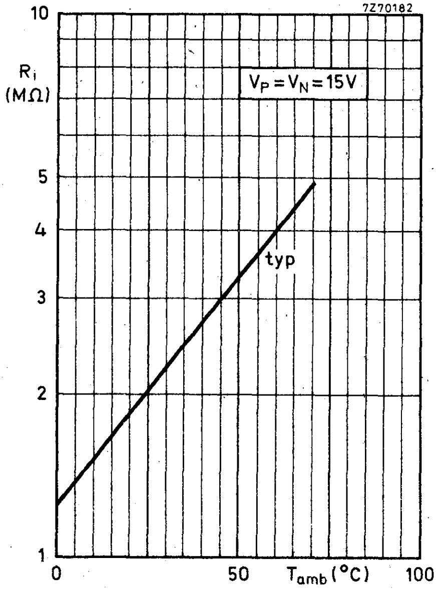


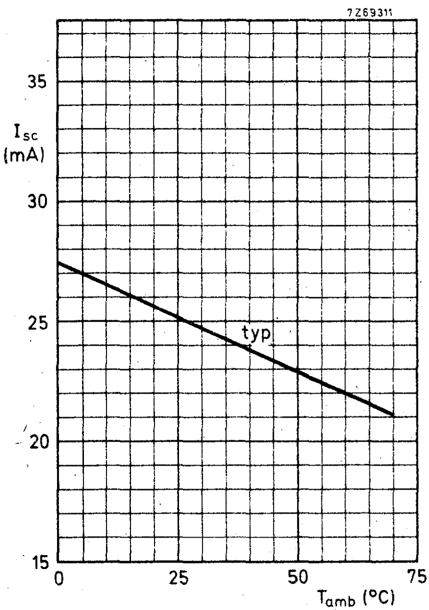
Offset voltage zeroing circuit

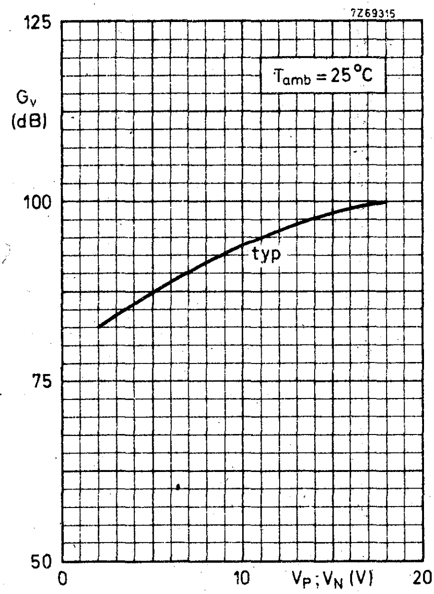


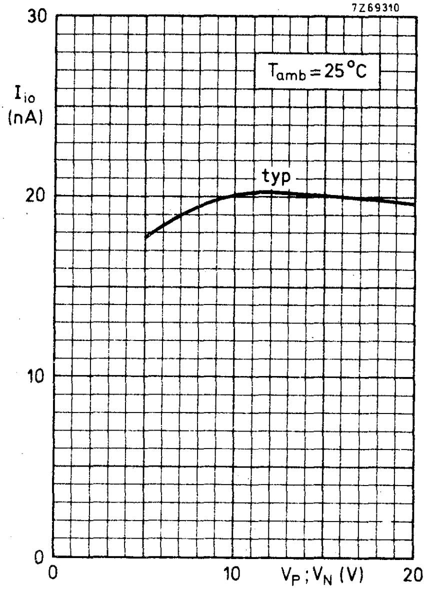
Transient response test circuit

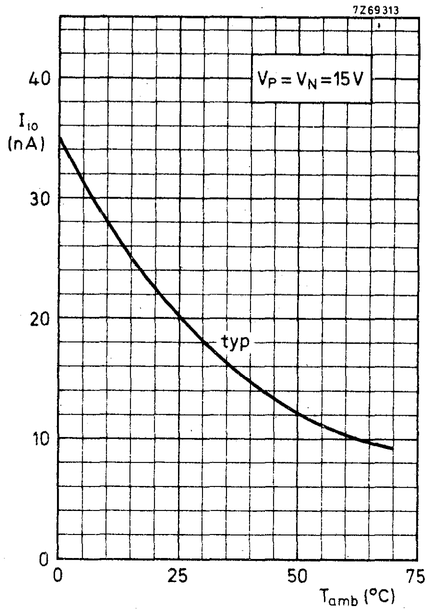

7Z69312
$V_P = V_N = 15\,V$
200
I_i (nA)
100
typ
0
0
25
50
75
T_{amb} (°C)

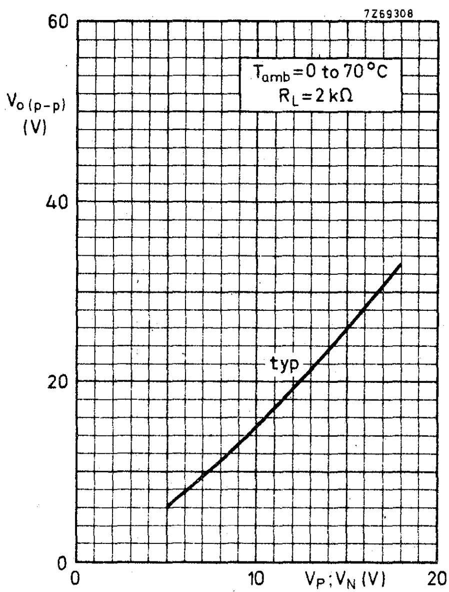

7Z70182
10
R_i (MΩ)
$V_P = V_N = 15\,V$
5
4
typ
3
2
1
0
50
T_{amb} (°C)
100

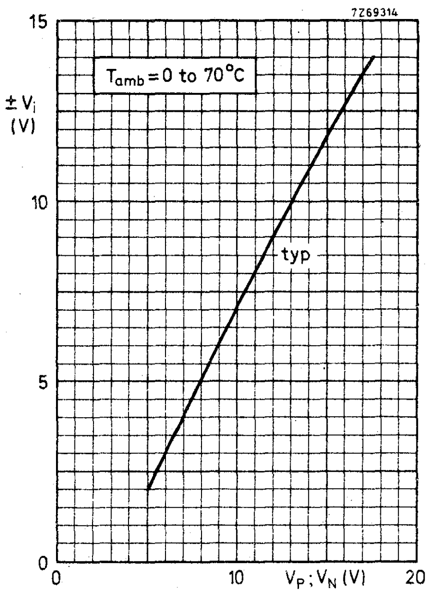

7Z69311
35
I_{sc} (mA)
30
25
typ
20
15
0
25
50
75
T_{amb} (°C)

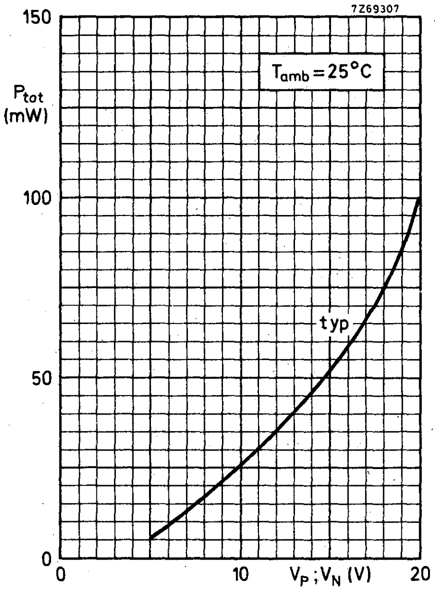

7Z69315
125
$T_{amb} = 25\,°C$
G_v (dB)
100
typ
75
50
0
10
V_P; V_N (V)
20

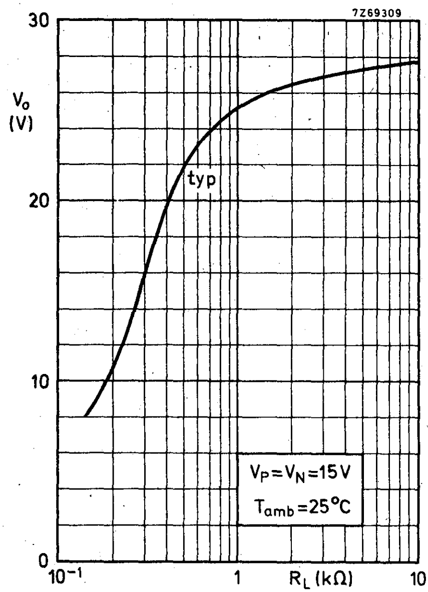

7Z69310
30
20
10
0
I_{io} (nA)
$T_{amb} = 25\,^{\circ}C$
typ
0
10
20
V_P; V_N (V)

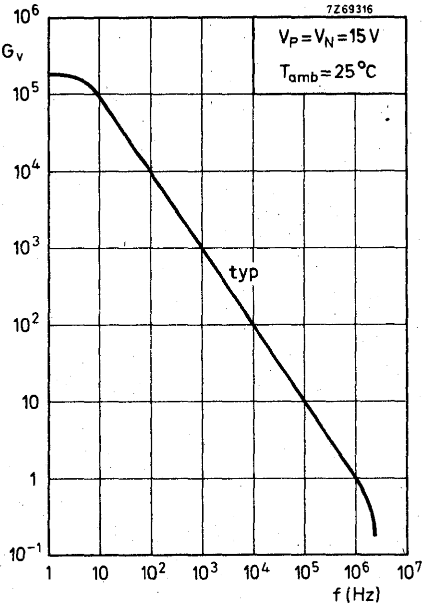

7Z69313
40
30
20
10
0
I_{io} (nA)
$V_P = V_N = 15\,V$
typ
0
25
50
75
T_{amb} (°C)

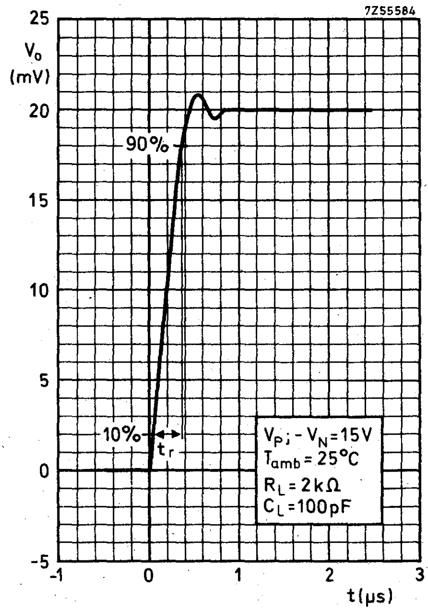

7Z69308
60
40
20
0
$V_{o(p-p)}$ (V)
$T_{amb} = 0$ to $70\,^{\circ}C$
$R_L = 2\,k\Omega$
typ
0
10
20
V_P; V_N (V)

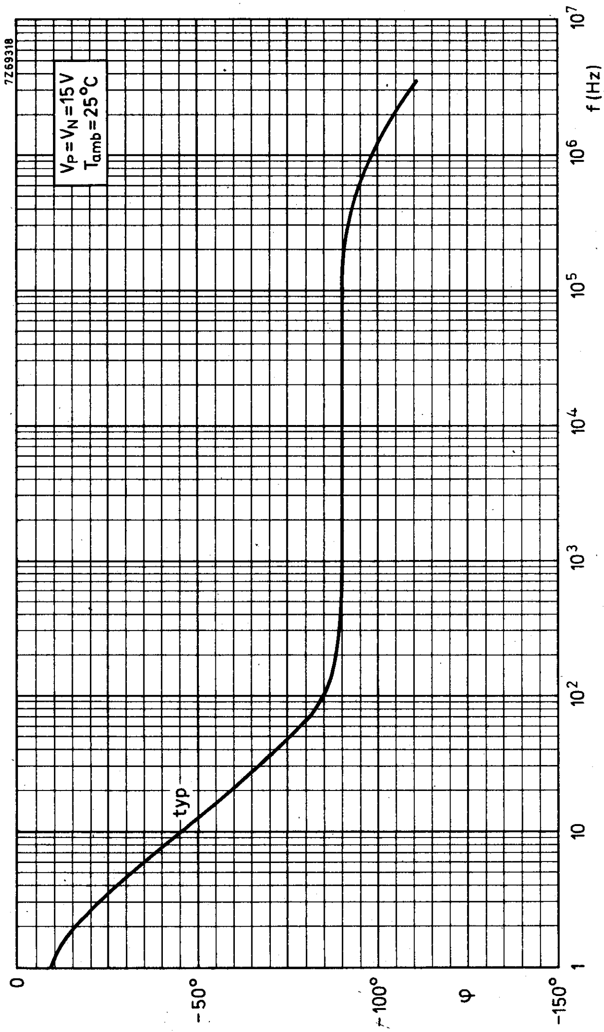

7Z69314
15
10
5
0
$\pm V_i$ (V)
$T_{amb} = 0$ to $70\,^{\circ}C$
typ
0
10
20
V_P; V_N (V)

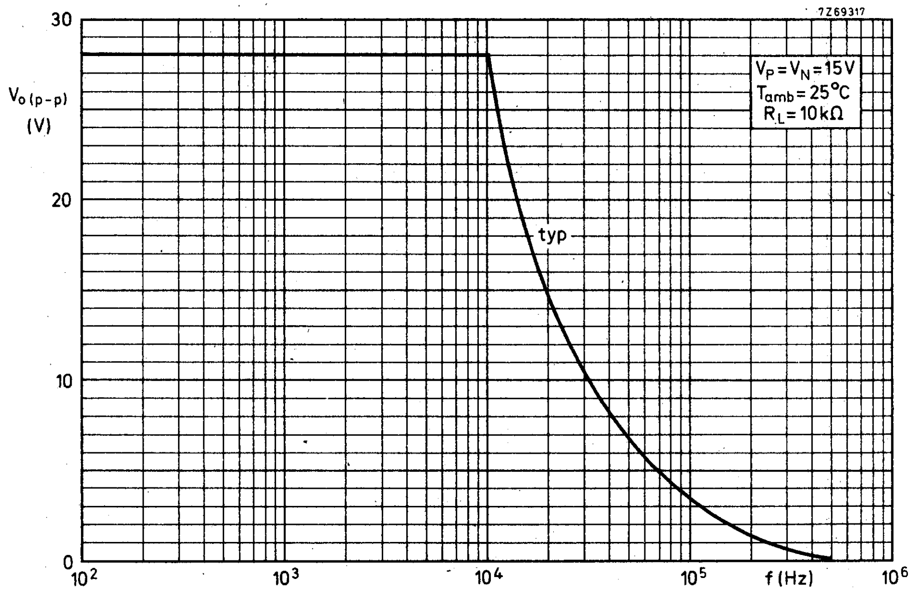

7Z69307
150
Ptot
(mW)
Tamb = 25°C
100
typ
50
0
0
10
VP ; VN (V)
20

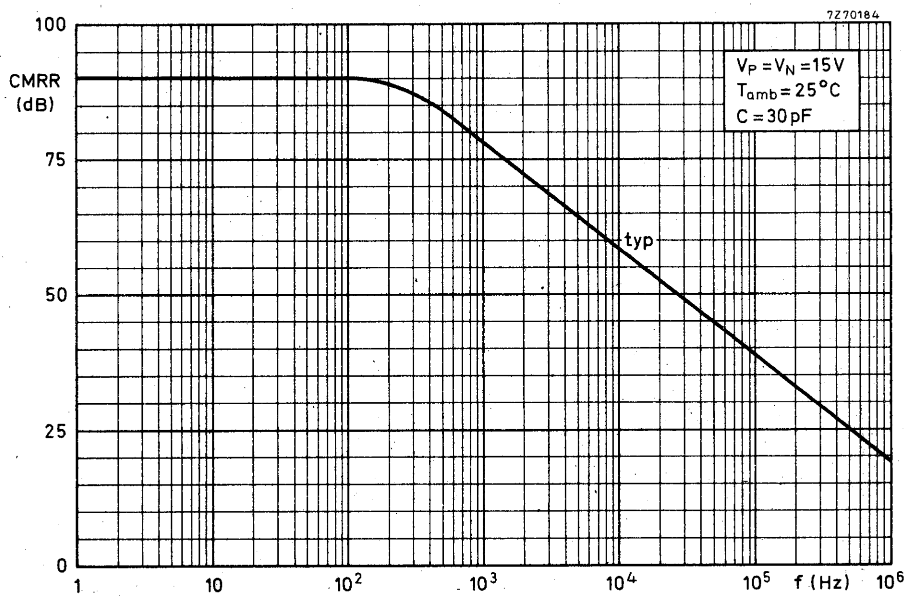

7Z69309
30
Vo
(V)
typ
20
10
VP = VN = 15 V
Tamb = 25°C
0
10−1
1
RL (kΩ)
10


7Z69316
10^6
Gv
VP = VN = 15 V
Tamb = 25°C
10^5
10^4
10^3
typ
10^2
10
1
10−1
1
10
10^2
10^3
10^4
10^5
10^6
10^7
f (Hz)


7Z55584
25
Vo
(mV)
20
90%
15
10
5
10%
tr
VP ; − VN = 15 V
Tamb = 25°C
RL = 2 kΩ
CL = 100 pF
0
−5
−1
0
1
2
3
t (μs)


7Z69318
VP = VN = 15 V
Tamb = 25 °C
typ
f (Hz)
1
10
10^2
10^3
10^4
10^5
10^6
10^7
0
−50°
−100°
φ
−150°


7Z69317
30
20
10
0
$V_{o(p-p)}$
(V)
$V_P = V_N = 15 V$
$T_{amb} = 25 °C$
$R_L = 10 kΩ$
typ
10^2
10^3
10^4
10^5
f (Hz)
10^6


7Z70184
100
75
50
25
0
CMRR
(dB)
$V_P = V_N = 15 V$
$T_{amb} = 25 °C$
C = 30 pF
typ
1
10
10^2
10^3
10^4
10^5
f (Hz)
10^6