Operational Amplifier

TBA 221; A; B; W; G-741
TBA 222; S1; Q1; Q2-741

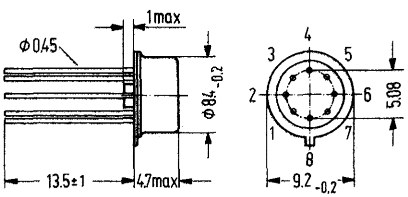
These operational amplifier are short circuit protected against $+V_{CC}$, $-V_{CC}$ and ground. No external components for frequency compensation are required. An internal gain reduction of 6 dB/octave yields maximum stability in feedback circuit applications.

- Simple handling
- Large input differential voltage
- Short circuit protected
- High open loop voltage gain
- Large supply voltage range

Type	Ordering codes
TBA 221	Q67000-A134
TBA 221 A	Q67000-A225
TBA 221 B	Q67000-A281
TBA 221 W	Q67000-A923
TBA 221 G	Q67000-A923 G
TBA 222	Q67000-A97
TBA 222 Q1	Q67000-A97-Q1
TBA 222 Q2	Q67000-A97-Q2
TBA 222 S1	Q67000-A97-S1

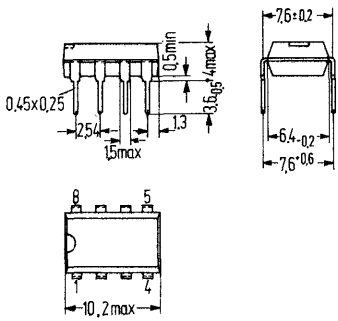
Package outlines

TBA 221, TBA 222



Case similar to 5 G 8 DIN 41873 (TO-99)
Weight approx. 1.2 g
Pin 4 and case connected

TBA 221 B

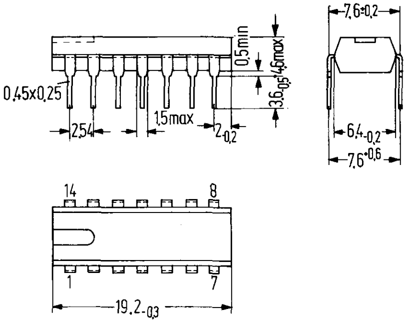


Plastic plug-in package, 8 pins
20 A 8 DIN 41866
Weight approx. .7 g

Dimensions in mm

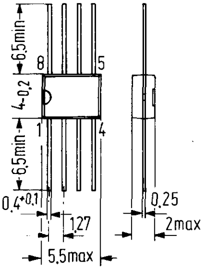
Package outlines

TBA 221 A



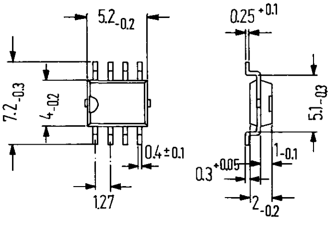
Plastic plug-in package, 14 pins
20 A 14 DIN 41866 (TO-116)
Weight approx. 1.1 g

TBA 221 W



Miniature plastic package, 8 pins
Weight approx. .15 g
Colour code brown/brown

TBA 221 G

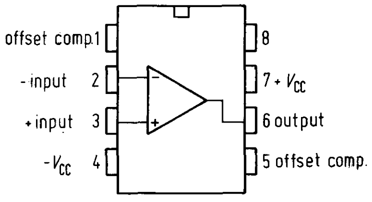


Miniature plastic package, 8 pins
Weight approx. .15 g

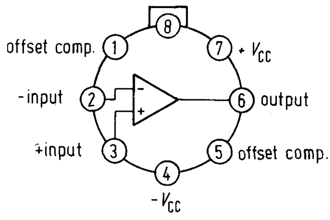
Dimensions in mm

Pin connection

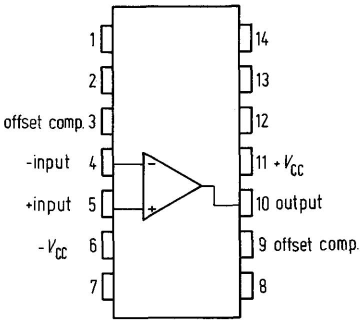
TBA 221 B



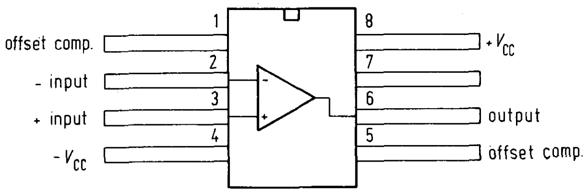
TBA 221, TBA 222, TBA 222 Q1, TBA 222 Q2
TBA 222 S1



TBA 221 A



TBA 221 W, TBA 221 G



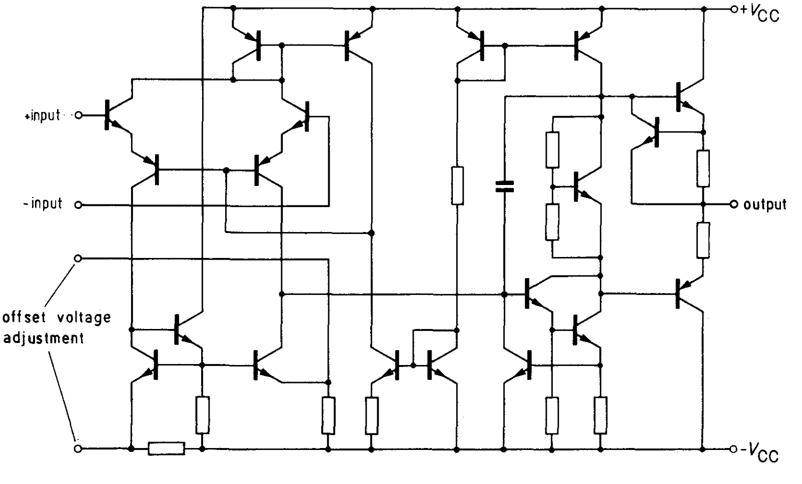
Maximum ratings		TBA 221 TBA 221 A TBA 221 B TBA 221 G TBA 221 W	TBA 222 TBA 222 Q 1 TBA 222 Q 2 TBA 222 S 1	
Supply voltage	V_{CC}	±18	±22	V
Input voltage (V_{CC} = ±4 to ±15 V)	V_I	$\pm V_{CC}$	$\pm V_{CC}$	V
Input voltage (V_{CC} = ±15 to ±18)	V_I	±15	±15	V
Differential input voltage	V_{ID}	±30	±30	V
Short circuit duration[1]	t_{SC}	∞	∞	
Storage temperature	T_S	−65 to +150	−65 to +150	°C
Junction temperature	T_j	150	150	°C
Thermal resistance:				
System-case (TBA 221/222)	$R_{thScase}$	80	80	K/W
System-ambient air (TBA 221/222)	R_{thSamb}	190	190	K/W
System-ambient air (TBA 221 A)	R_{thSamb}	120		K/W
System-ambient air (TBA 221 B)	R_{thSamb}	140		K/W
System-ambient air (TBA 221 W/G)	R_{thSamb}	200		K/W

Range of operation

Supply voltage	V_{CC}	±4 to ±18	±4 to ±22	V
Ambient temperature in operation	T_{amb}	0 to +70	−55 to +125	°C

[1]) *Short circuit may be ground or $\pm V_{CC}$, thereby the maximum ratings like T_j must not be exceeded.*

Circuit diagram



Operating characteristics
(V_{CC} = ±15 V, T_{amb} = 25 °C when not otherwise stated)

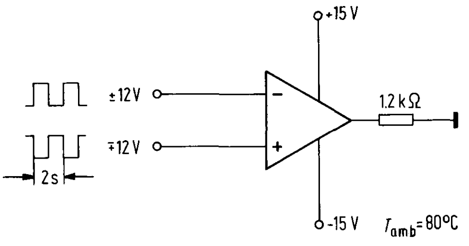
		TBA 221 TBA 221 A TBA 221 B TBA 221 G TBA 221 W			TBA 222 TBA 222 Q 1 TBA 222 Q 2 TBA 222 S 1			
		min	typ	max	min	typ	max	
Input offset voltage	V_{io}	−6		6	−4		4	mV
($R_G \leq 10$ kΩ, T_{amb} = 0 to 70°C)	V_{io}	−7.5		7.5				mV
($R_G \leq 10$ kΩ, T_{amb} = −55 to +125°C)	V_{io}				−5.5		5.5	mV
Adjustable range of input offset voltage	ΔV_{io}	6	±15	−6	6	±15	−6	mV
Input offset current	I_{io}	−200	±20	200	−100	±20	100	nA
(T_{amb} = 0 to 70 °C)	I_{io}	−300		300				nA
(T_{amb} = −55 to +125 °C)	I_{io}				−400		400	nA
Input current	I_i		80	500		80	350	nA
(T_{amb} = 0 to 70 °C)	I_i			800				nA
(T_{amb} = −55 to +125 °C)	I_i					.3	1.2	µA
Current supply	I_{CC}		1.7	2.8		1.7	2.8	mA
Positive output short circuit current	I_{qsc+}	15	20	25	15	20	25	mA
Negative output short circuit current	I_{qsc-}	−25	−20	−15	−25	−20	−15	mA
Input resistance	R_i	300	2000		300	2000		kΩ
Input capacitance	C_i		1.4			1.4		pF
Output resistance	R_q		75			75		Ω
Output voltage ($R_L \geq 10$ kΩ)	V_{qpp}	12	±14	−12	13	±14	−12.5	V
($R_L \geq 2$ kΩ)	V_{qpp}	10	±13	−10	11	±13	−11	V
Common mode input voltage range	V_{iCM}	12	±13	−12	12	±13	−12	V
Voltage gain (V_{qpp} = ±10 V, $R_L \geq 2$ kΩ)	G_V	86	100		94	106		dB
(V_{qpp} = ±10 V, $R_L \geq 2$ kΩ, T_{amb} = 0 to 70 °C)	G_V	83.5						dB
(V_{qpp} = ±10 V, $R_L \geq 2$ kΩ, T_{amb} = −55 to +125 °C)	G_V				88			dB
Common-mode rejection ratio	$CMRR$	70	90		80	90		dB
Sensitivity to supply voltage variations	$\frac{\Delta V_{io}}{\Delta V_{cc}}$		30	150		30	150	µV/V
Transient behaviour of the output voltage at G_V = 1:								
Rise time (V_i = 20 mV, R_L = 2 kΩ, C_L <100 pF)	t_r		.3			.3		µs
Overshoot			5			5		%
Leading edge slope ($R_L \geq 2$ kΩ)	$\frac{dV_{qpp}}{dt}$		.5			.5		V/µs
Temperature coefficient of V_{io}	α_{Vio}					3		µV/K
Temperature coefficient of I_{io}	α_{Iio}					.4		nA/K

TBA 222 Q 1: similar to TBA 222, however with special quality features
1. Burn-in at T_{amb} = 80 °C, 168 hours; V_{CC} = ± 15 V according to the test-circuit
2. Noise voltage < 5 μV_p, according to the test-circuit and DIN 45405
3. AQL, critical electrical defects: 0.25

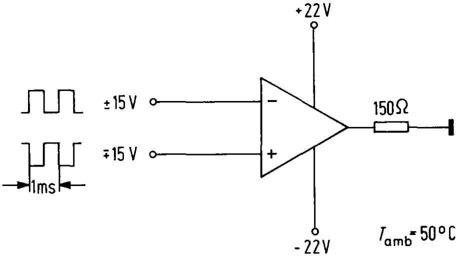
TBA 222 Q 2: similiar to TBA 222, however with guaranteed noise voltage < 5μV_p according to the test circuit AQL, critical electrical defects: 0.25

TBA 222 S 1: similiar to TBA 222 Q 1, however with another burn-in.
1. Burn-in at T_{amb} = 50 °C, 168 hours, V_{CC} = ± 22 V according to the test-circuit
2. Noise voltage < 5 μV_{pp}
3. AQL, critical electrical defects: 0.25

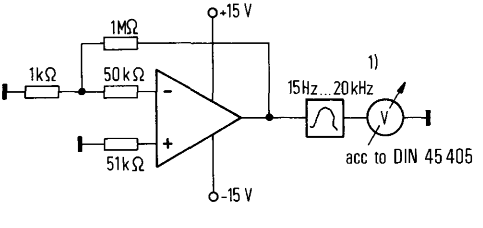
Burn-in circuit for TBA 222 Q 1



Burn-in circuit for TBA 222 S 1

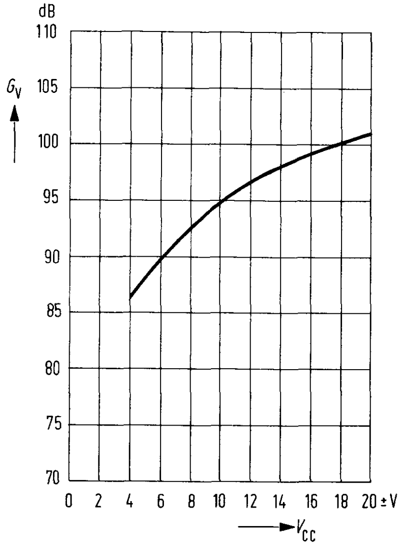


Test circuit for noise voltage: TBA 222 Q 1
TBA 222 Q 2
TBA 222 S 1

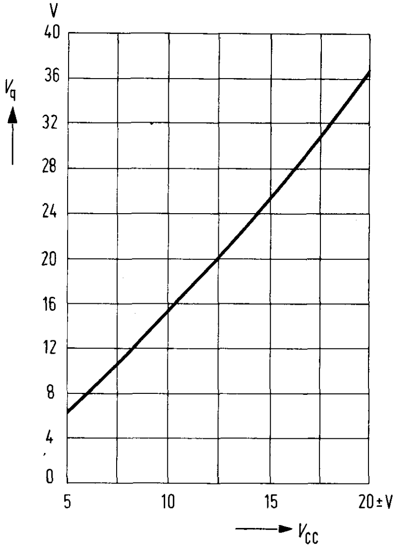


[1]) for TBA 222 S 1: 0.1 Hz to 20 kHz

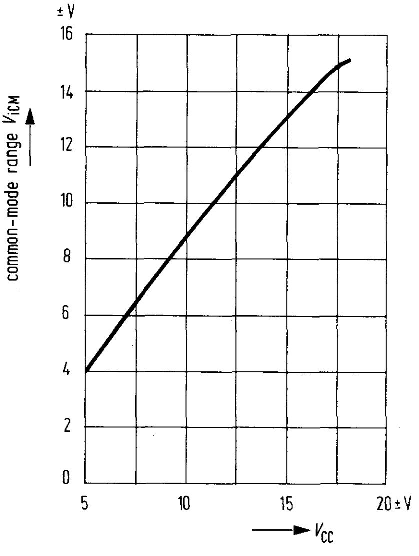
Open-loop voltage gain
$G_V = f(V_{CC})$



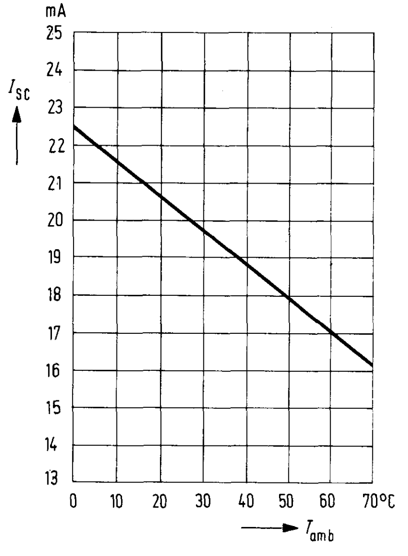
Output voltage $V_q = f(V_{CC})$
$R_L \geq 2\ k\Omega$



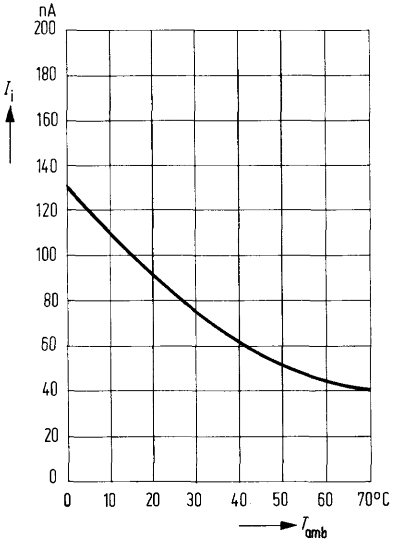
Common mode voltage range $V_{ICM} = f(V_{CC})$
$R_L = 2\ k\Omega$



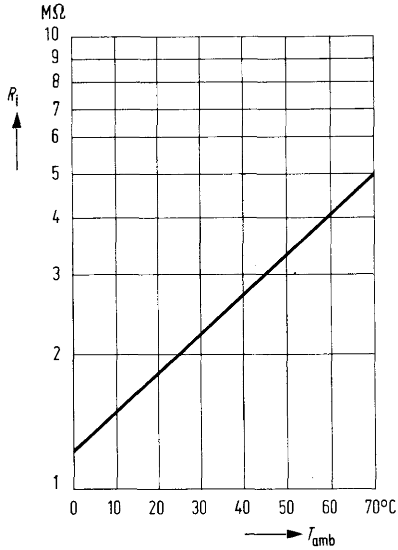
Short circuit current $I_{SC} = f(T_{amb})$



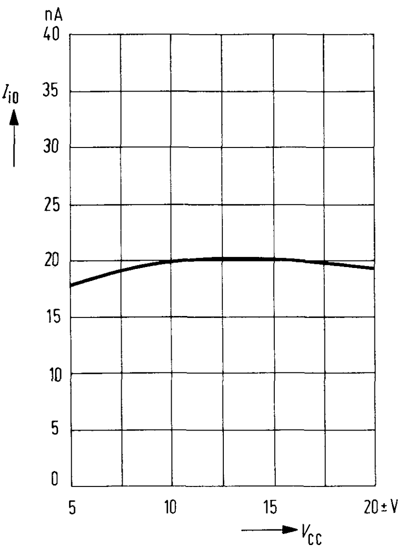
Input current $I_I = f(T_{amb})$
$V_{CC} = \pm 15$ V



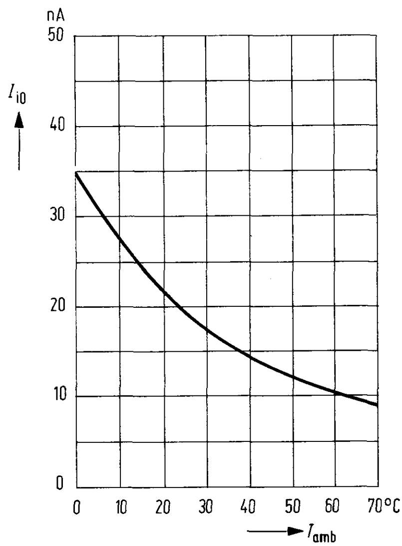
Input resistance $R_I = f(T_{amb})$
$V_{CC} = \pm 15$ V



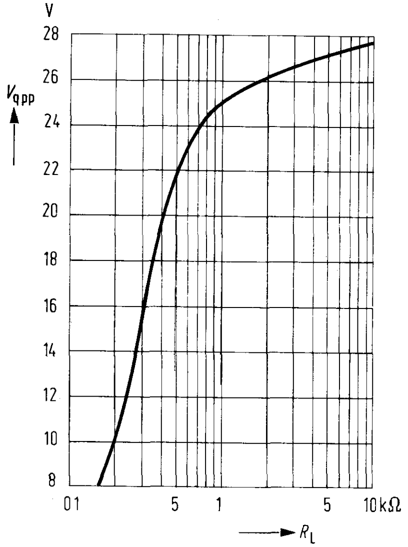
Input offset current $I_{IO} = f(V_{CC})$



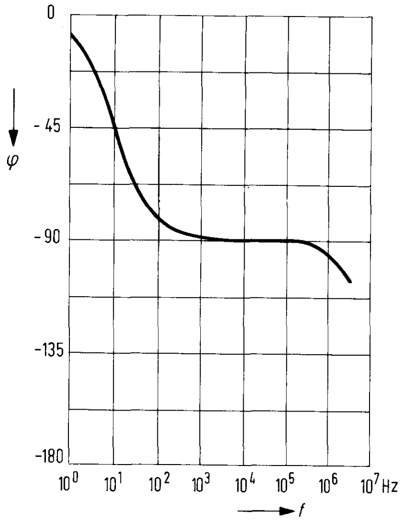
Input offset current $I_{IO} = f(T_{amb})$
$V_{CC} = \pm 15$ V



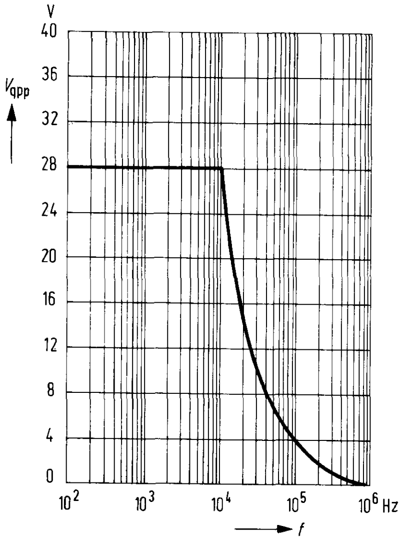
Output voltage $V_{qpp} = f\,(R_L)$
$V_{CC} = \pm 15$ V



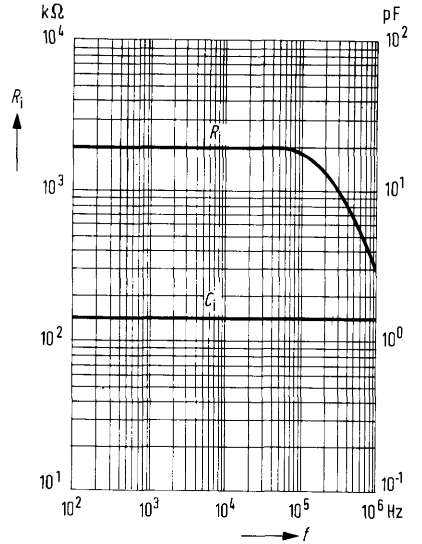
Phase of open-loop voltage gain
$\varphi = f\,(f)$; $V_{cc} = \pm 15$ V



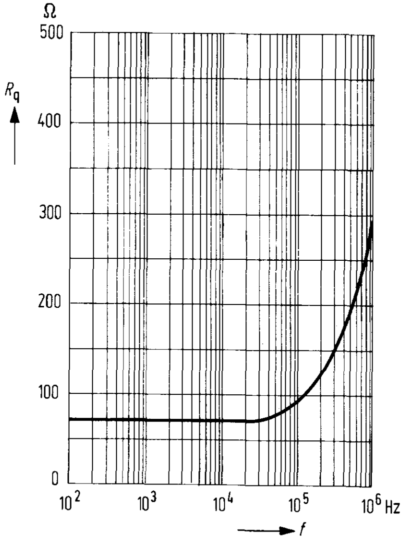
Output voltage $V_{qpp} = f\,(f)$
$V_{CC} = \pm 15$ V; $R_L = 10$ kΩ



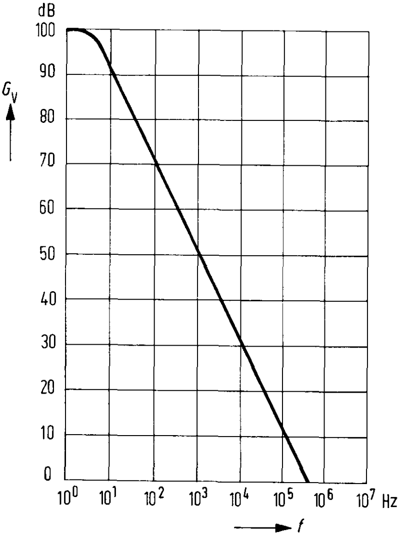
Input resistance $R_i = f\,(f)$
Input capacitance $C_i = f\,(f)$



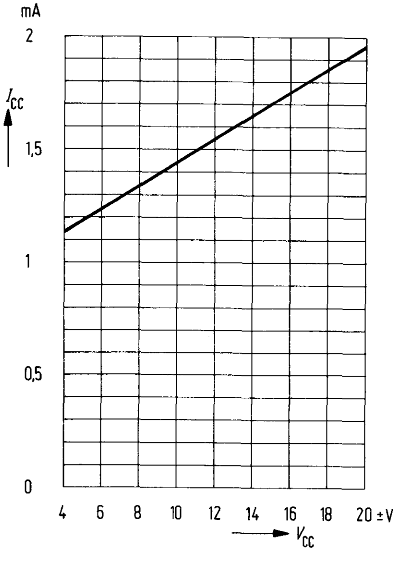
Output resistance $R_q = f(f)$



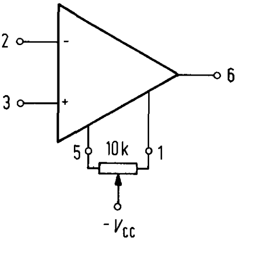
Open-loop voltage gain
$G_V = f(f)$



Supply current $I_{CC} = f(V_{CC})$



Offset voltage adjustment circuit



Test circuit for the transient behavior of V_{qpp}