JFET Input Operational Amplifiers

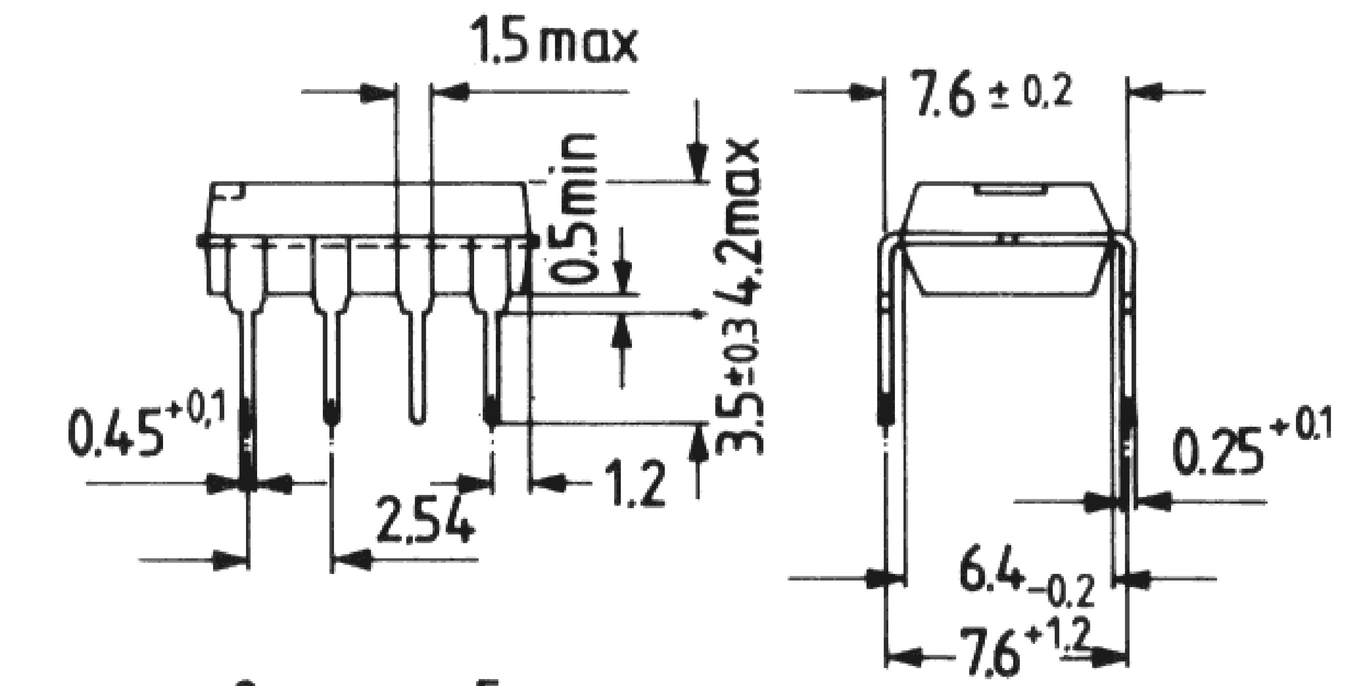
LF 355 N
LF 356 N
LF 357 N

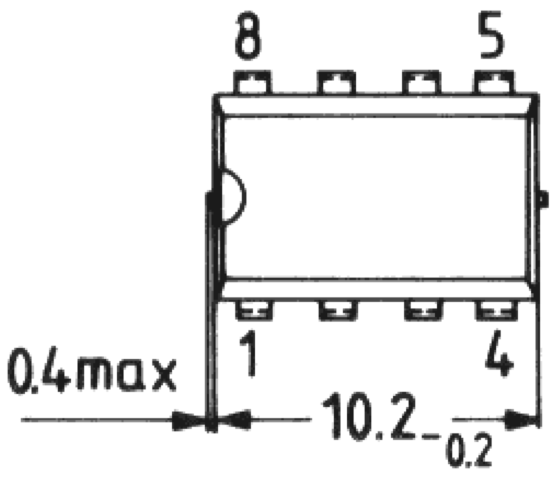
These operational amplifiers have JFET input transistors and are outstanding for very low input and offset currents. The output is designed for high capacitive load without any stability problems.

Further features:

- Extremely high input resistance
- Slight drifting at temperature changes
- Wide bandwidth
- High input voltage up to + V_S permitted
- Internal frequency compensation

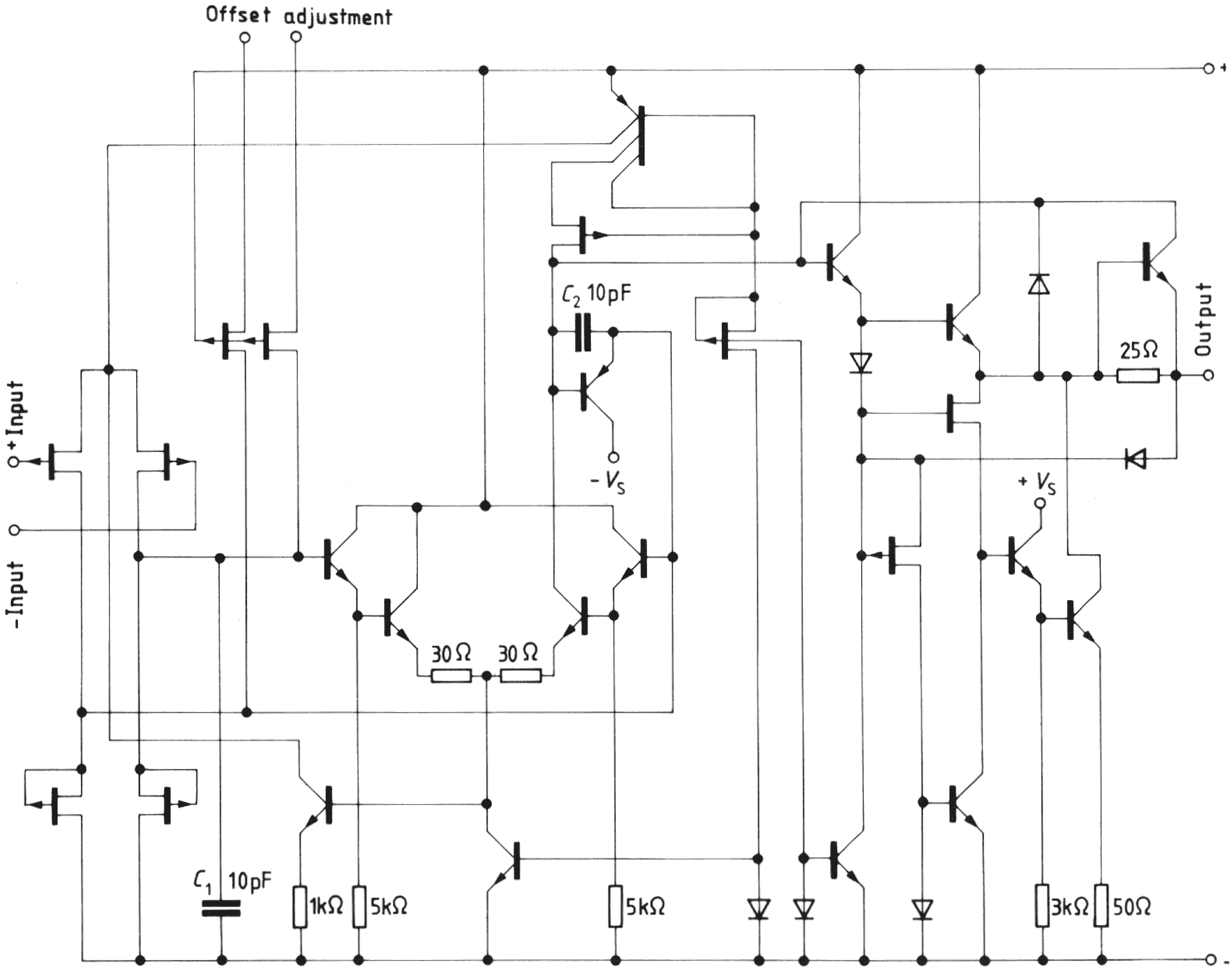
Type	Ordering code
LF 355 N	Q67000-A1397
LF 356 N	Q67000-A1404
LF 357 N	Q67000-A1399



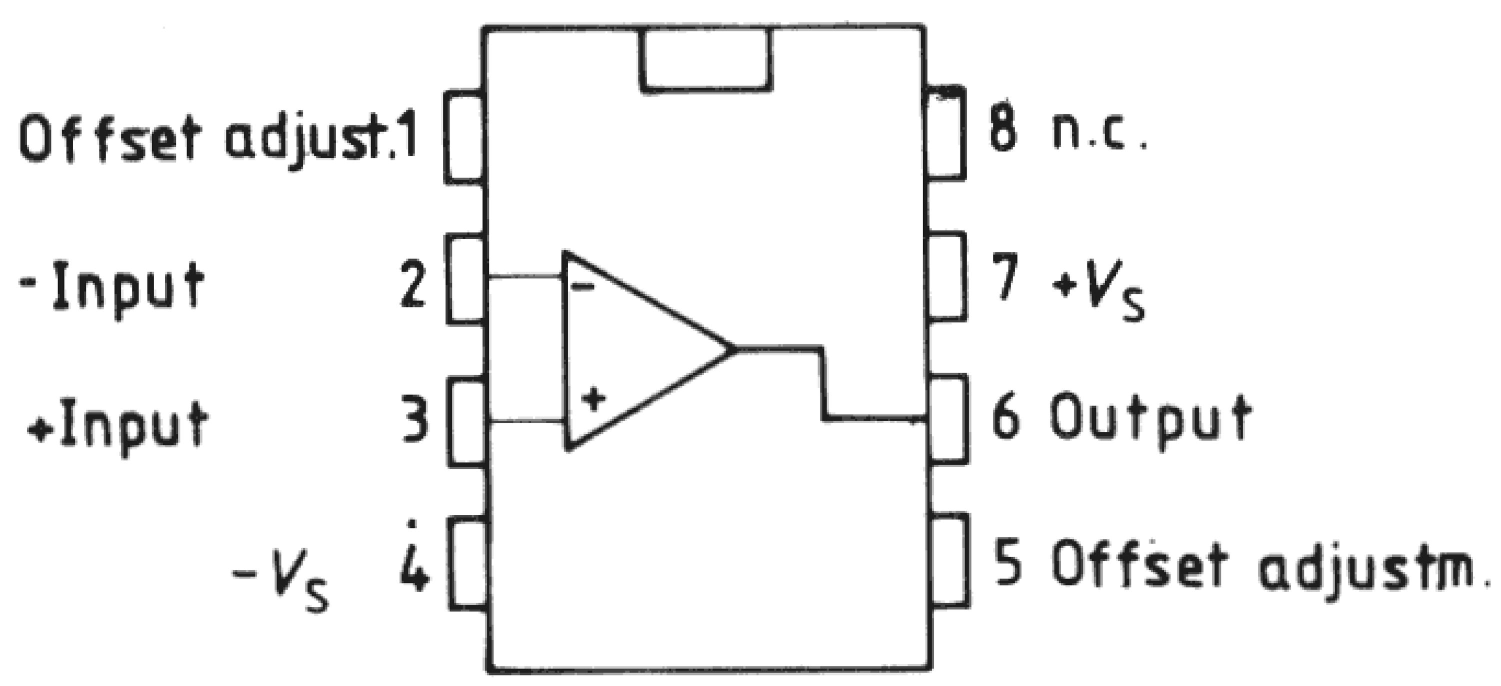


Plastic plug-in package
20 A 8 DIN 41 866
8 pins, dual-in-line
Approx. weight 0.7 g
Dimensions in mm

Circuit diagram



Pin configuration



Maximum ratings

Supply voltage	V_S	±18	V
Differential input voltage	V_{ID}	±30	V
Output short-circuit duration	t_{QSC}	∞	
Storage temperature range	T_s	−55 to +125	°C
Junction temperature	T_j	100	°C
Thermal resistance system – ambient air	R_{thsamb}	175	K/W

Range of operation

Supply voltage	V_S	±5 to ±18	V
Input voltage			
$-V_S$ = 18 to 16 V; $+V_S$ = 5 to 16 V	V_I	±16	V
$-V_S$ = 5 to 16 V; $+V_S$ = 5 to 16 V	V_I	$-V_S$ to 16	V
Ambient temperature	T_{amb}	0 to +70	°C

Electrical characteristics

V_S = ±15 V, T_{amb} = 25 °C

			min	typ	max	
Supply current	LF 355 N	I_S		2	4	mA
	LF 356 N, LF 357 N	I_S		5	10	mA
Input offset voltage	(R_G = 50 Ω)	V_{IO}		3	10	mV
Input offset current		I_{IO}		3	50	pA
Input current		I_I		30	200	pA
Input resistance		R_I		10^{12}		Ω
Open-loop voltage amplification		A_{VO}		80	106	dB
Rate of voltage rise						
	LF 355 N: A_V = 1	$\frac{dvq}{dtr}$		5		V/µs
	LF 356 N: A_V = 1			12		V/µs
	LF 357 N: A_V = 5			50		V/µs
Performance bandwidth	LF 355 N	f_p		2.5		MHz
	LF 356 N	f_p		5		MHz
	LF 357 N	f_p		20		MHz
Transient time (for 0.01%)						
	LF 355 N	t_r		4		µs
	LF 356 N, LF 357 N	t_r		1.5		µs
Input noise voltage						
R_S = 100 Ω; f = 100 Hz:	LF 355 N	V_{IN}		25		nV/√Hz
	LF 356 N, LF 357 N	V_{IN}		15		nV/√Hz
R_S = 100 Ω, f = 1000 Hz:	LF 355 N	V_{IN}		20		nV/√Hz
	LF 356 N, LF 357 N	V_{IN}		12		nV/√Hz
Input noise current						
f = 100 Hz, or 1000 Hz		I_{IN}		0.01		pA/√Hz
Input capacitance		C_I		3		pF

Characteristics

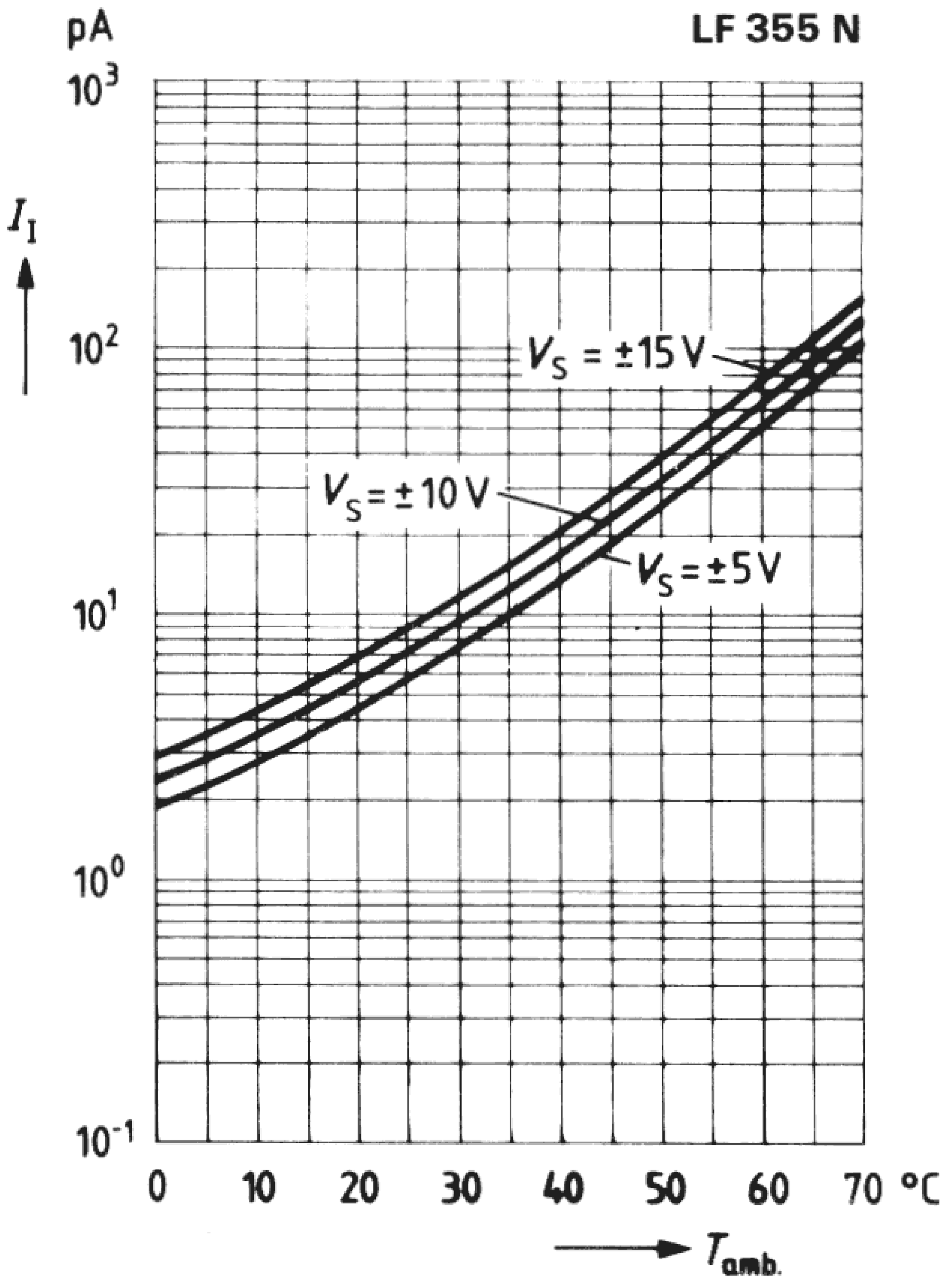
$V_S = \pm 15$ V; $T_{amb} = 0$ to $+70$ °C, unless otherwise specified		min	typ	max	
Input offset voltage $R_G = 50\ \Omega$	V_{IO}			14	mV
Temperature coefficient of V_{IO}: $R_S = 50\ \Omega$	α_{VIO}		5		µV/K
Change of α_{VIO} after a change of V_{IO} adjustment[1]	$\Delta\alpha_{VIO}$		0.5		per mV
Input offset current $T_j = 70$ °C	I_{IO}			2	nA
Input current[2] $T_j = 70$ °C	I_I			8	nA
Open-loop voltage amplification $R_L = 2$ kΩ, $V_{Qpp} = \pm 10$ V	A_{VO}	63			dB
Output voltage $R_L = 10$ kΩ	V_{Qpp}	12	±13	−12	V
$R_L = 2$ kΩ	V_{Qpp}	10	±12	−10	V
Input common mode range	V_{IC}	±11	−12		V
Common mode rejection	k_{CMR}	80	100		dB
Supply voltage rejection	k_{SVR}	80	100		dB

Remarks:

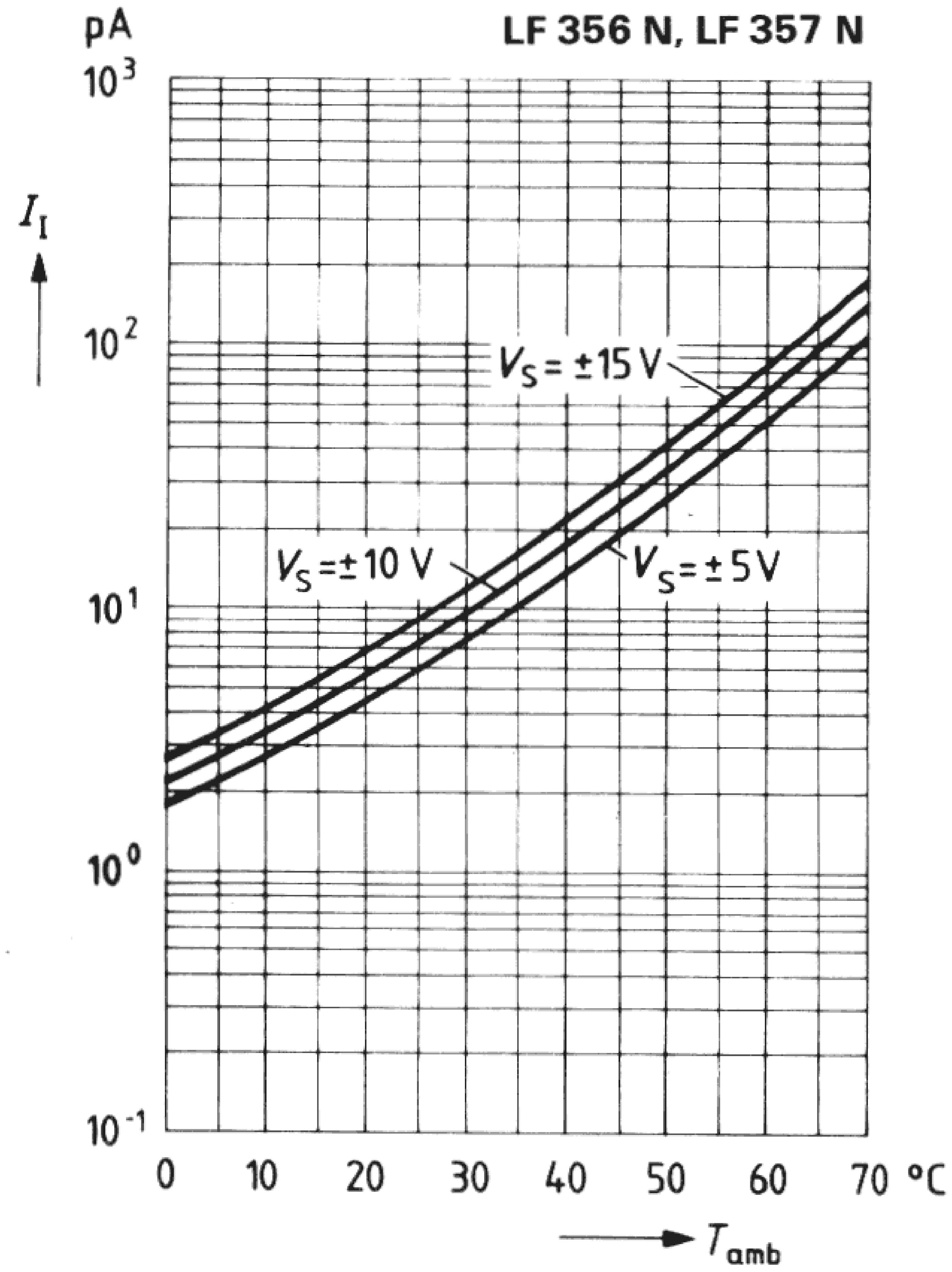
1) Compared to the originally non-adjusted value, the temperature coefficient of the adjusted input offset voltage only slightly changes (typ. 0.5 µV/K) for every mV of the setting range. Adjusting the offset voltage is of no effect on the common-mode rejection and open-loop voltage amplification.

2) The input currents become approximately twice as great with every 10 K increase in junction temperature.

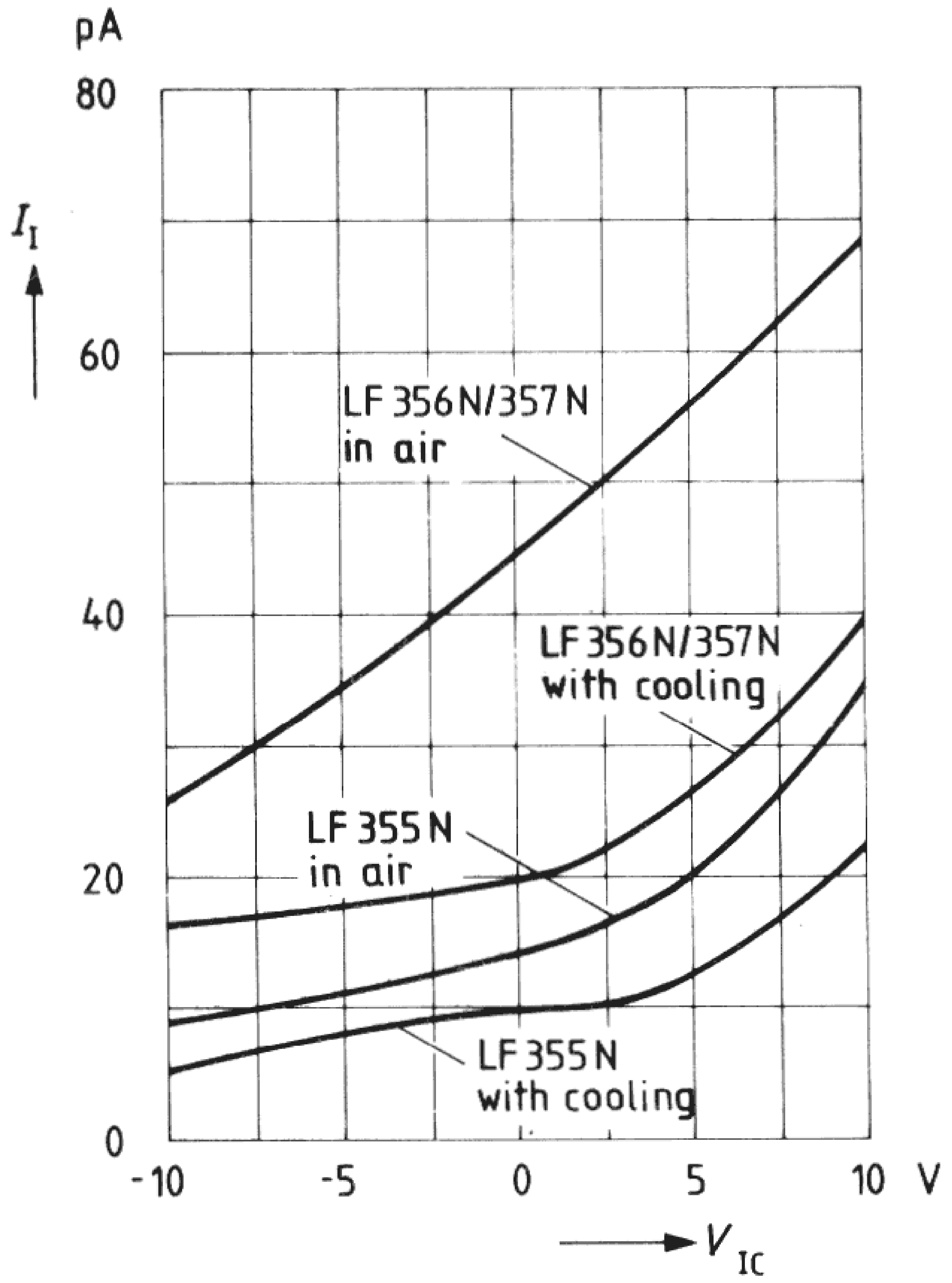
Input current $I_I = f(T_{amb})$



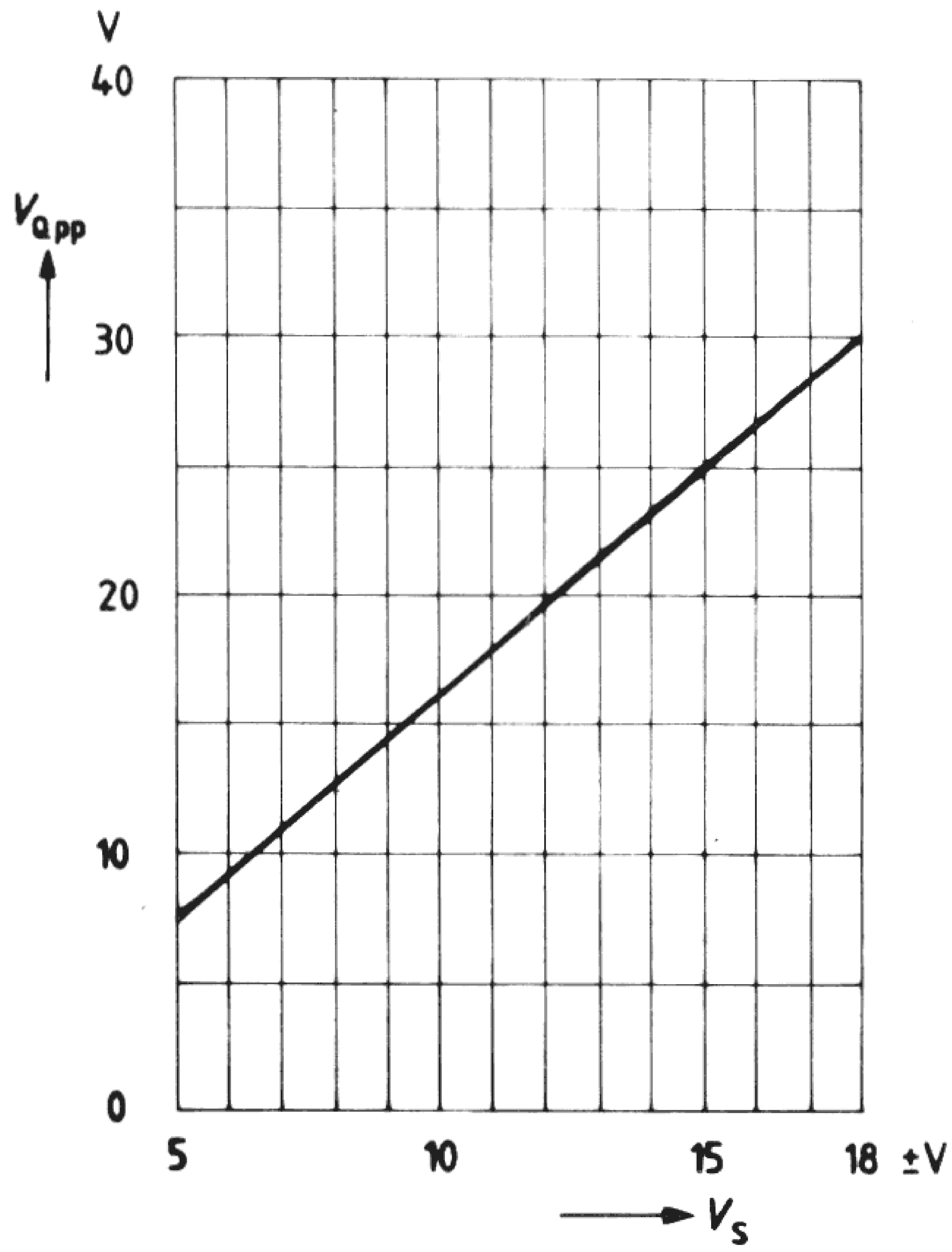
Input current $I_I = f(T_{amb})$



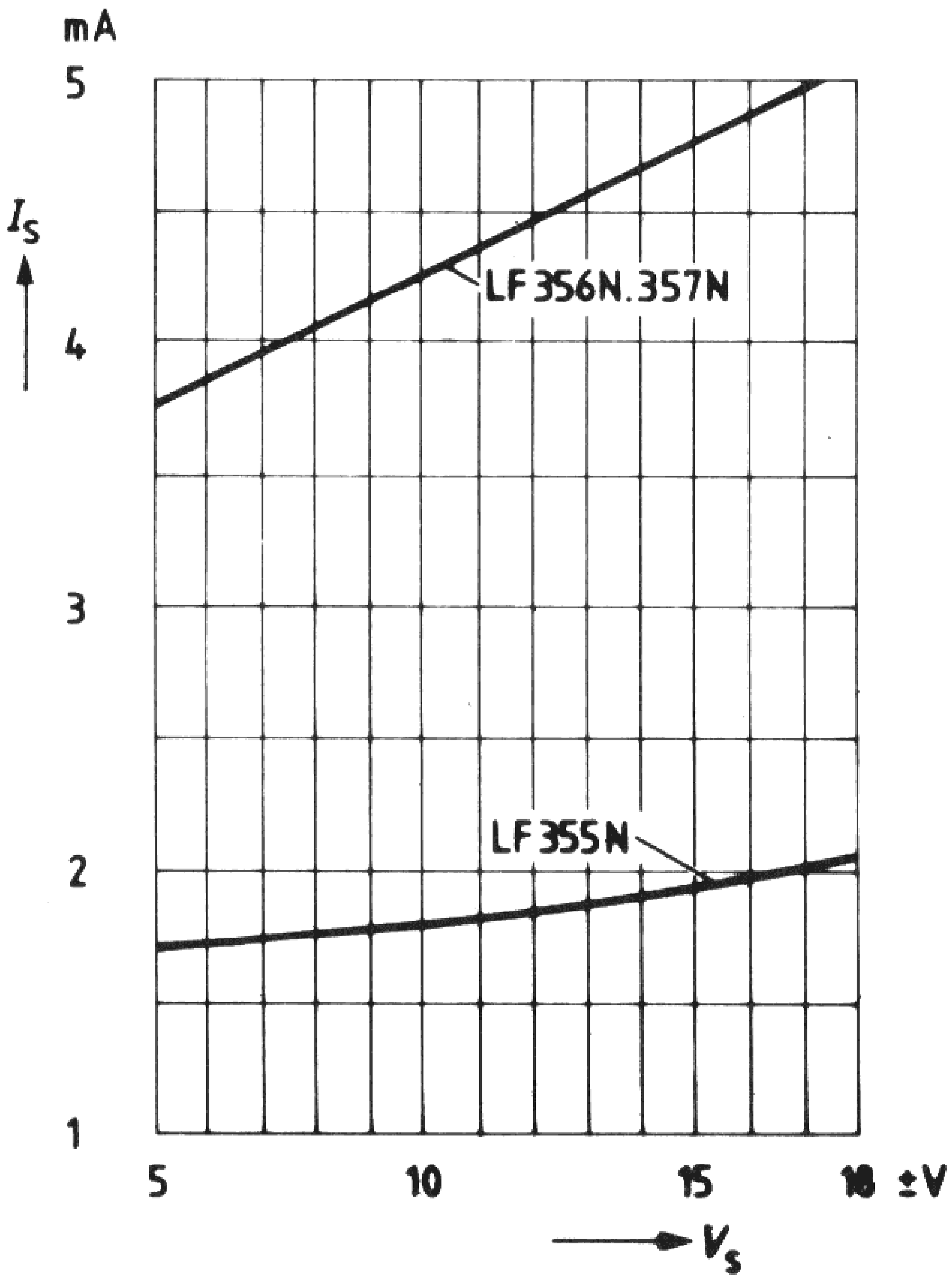
Input current $I_I = f(V_{IC})$
V_S = ±15 V, T_{amb} = 25 °C
R_L = 50 kΩ



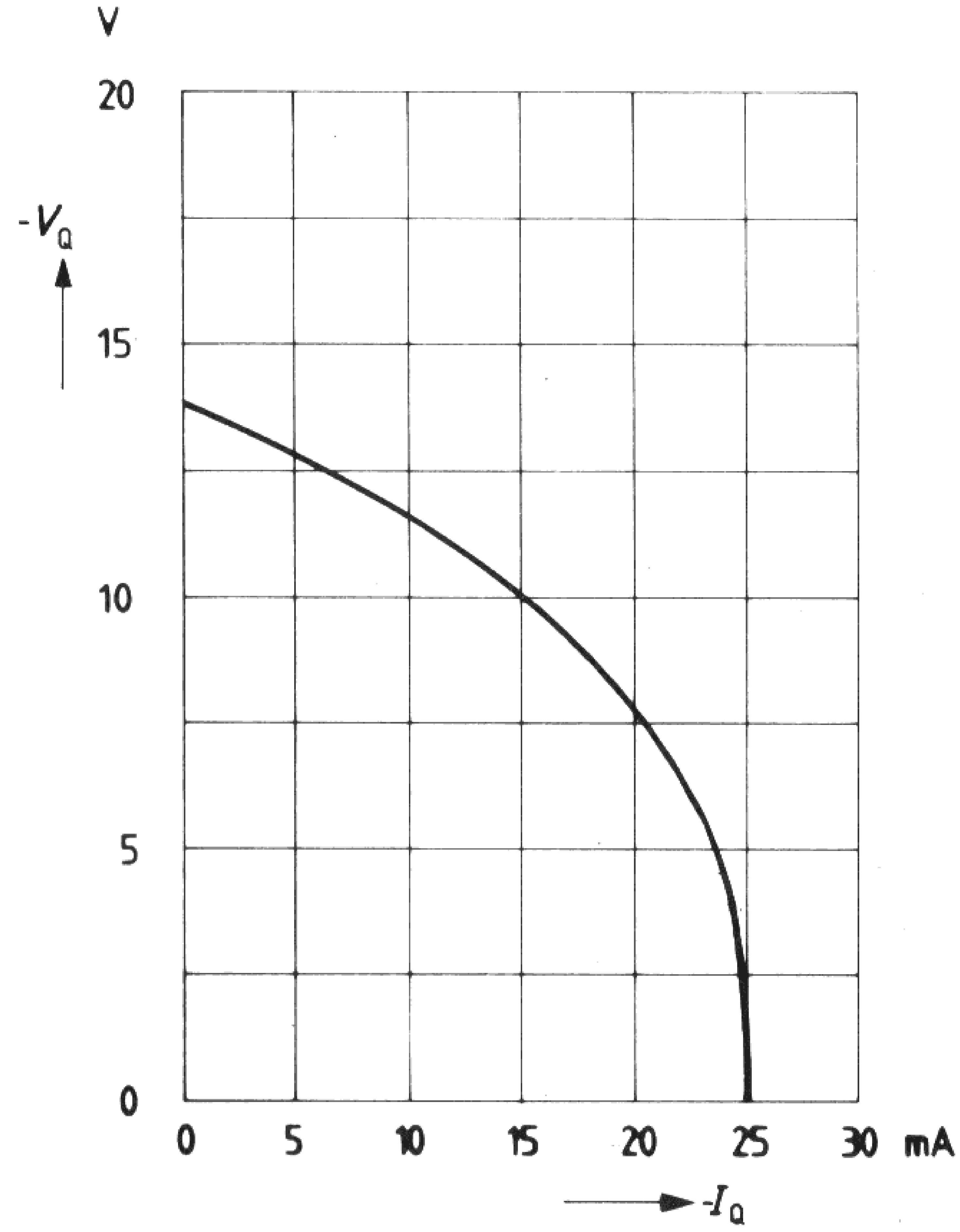
Output voltage $V_{Qpp} = f(V_S)$
T_{amb} = 25 °C; R_L = 2 kΩ



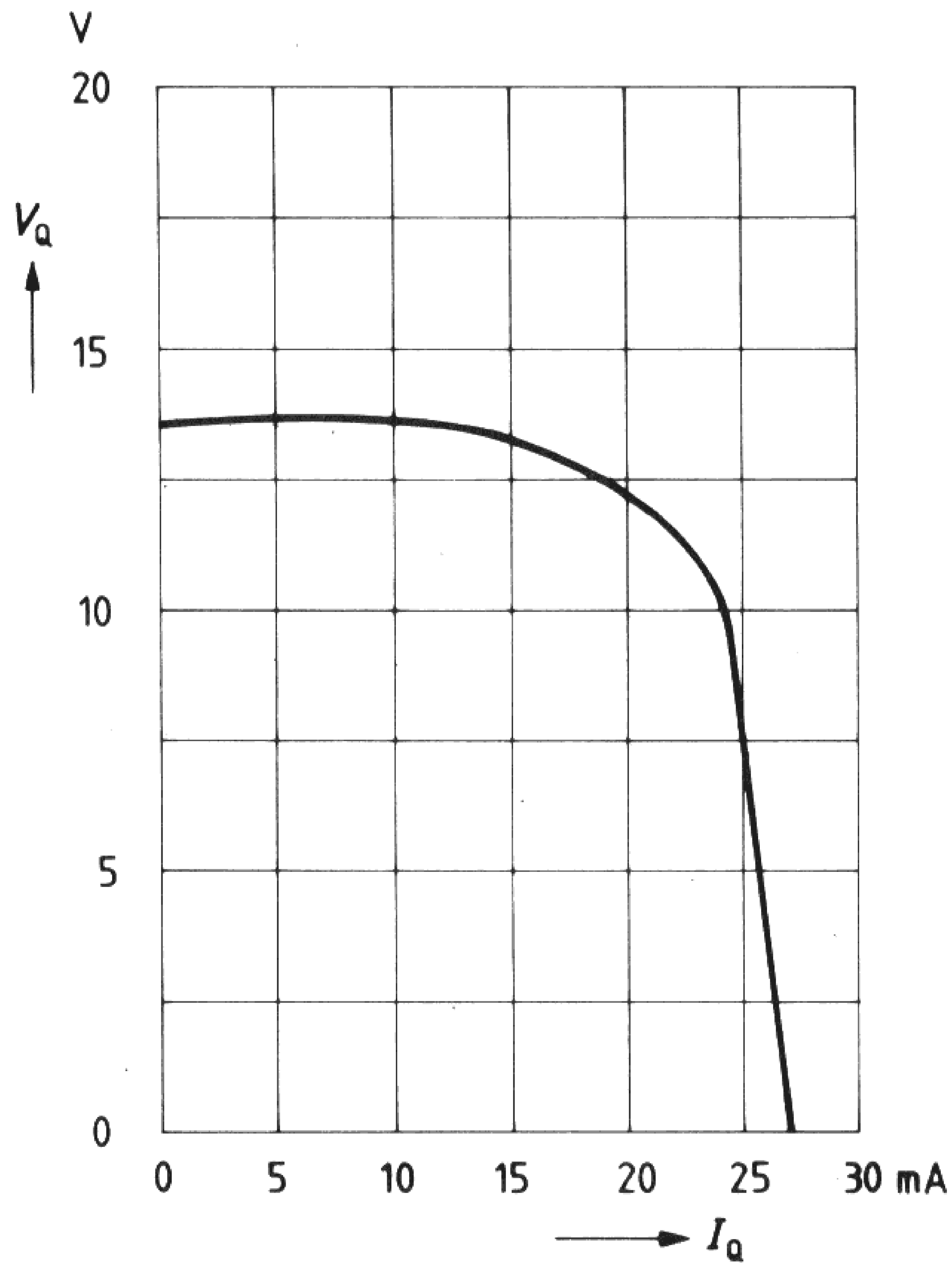
Supply current $I_S = f(V_S)$



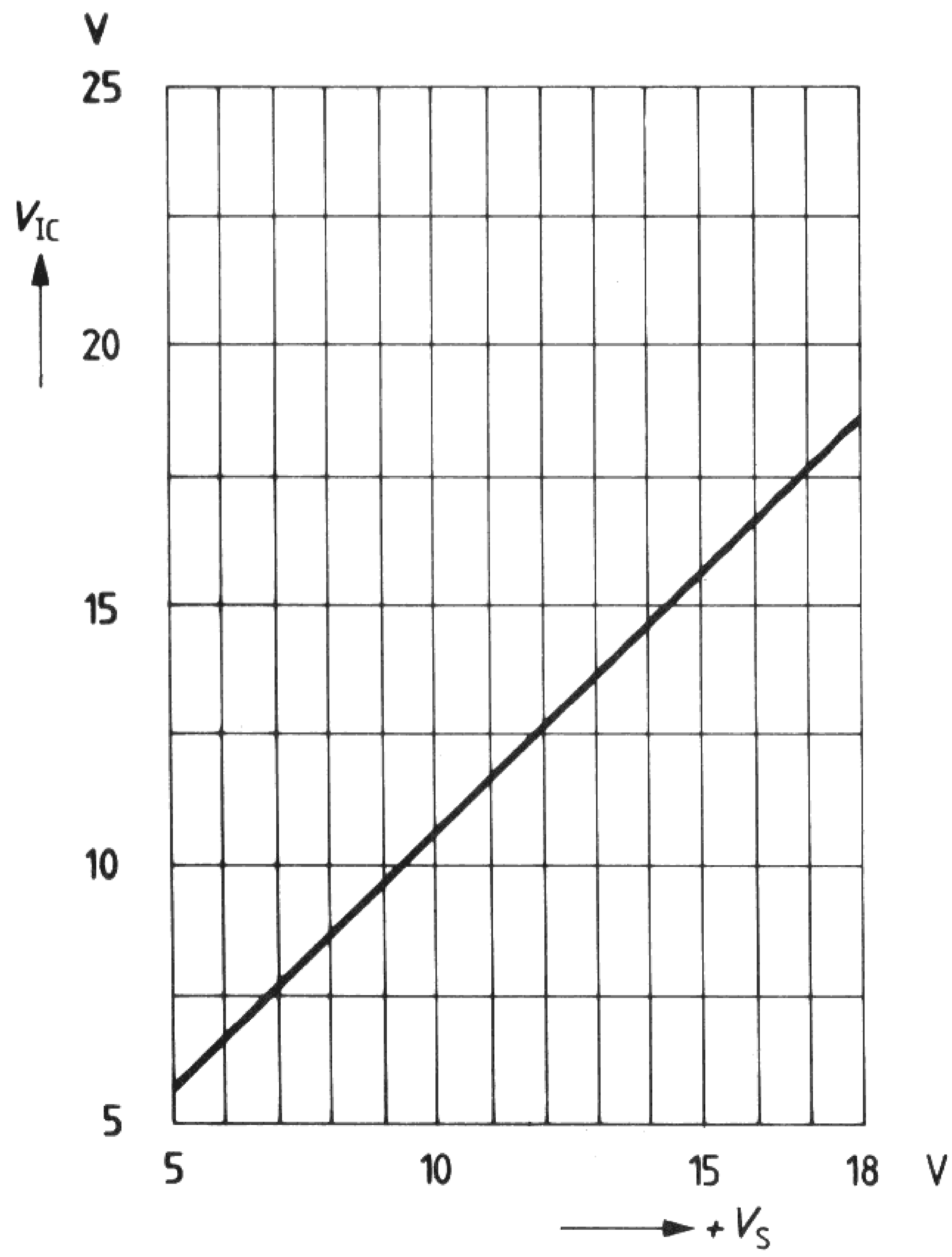
Negative short-circuit current
$-V_Q = f(-I_Q)$
$T_{amb} = 25\,°C$, $V_S = \pm15$ V



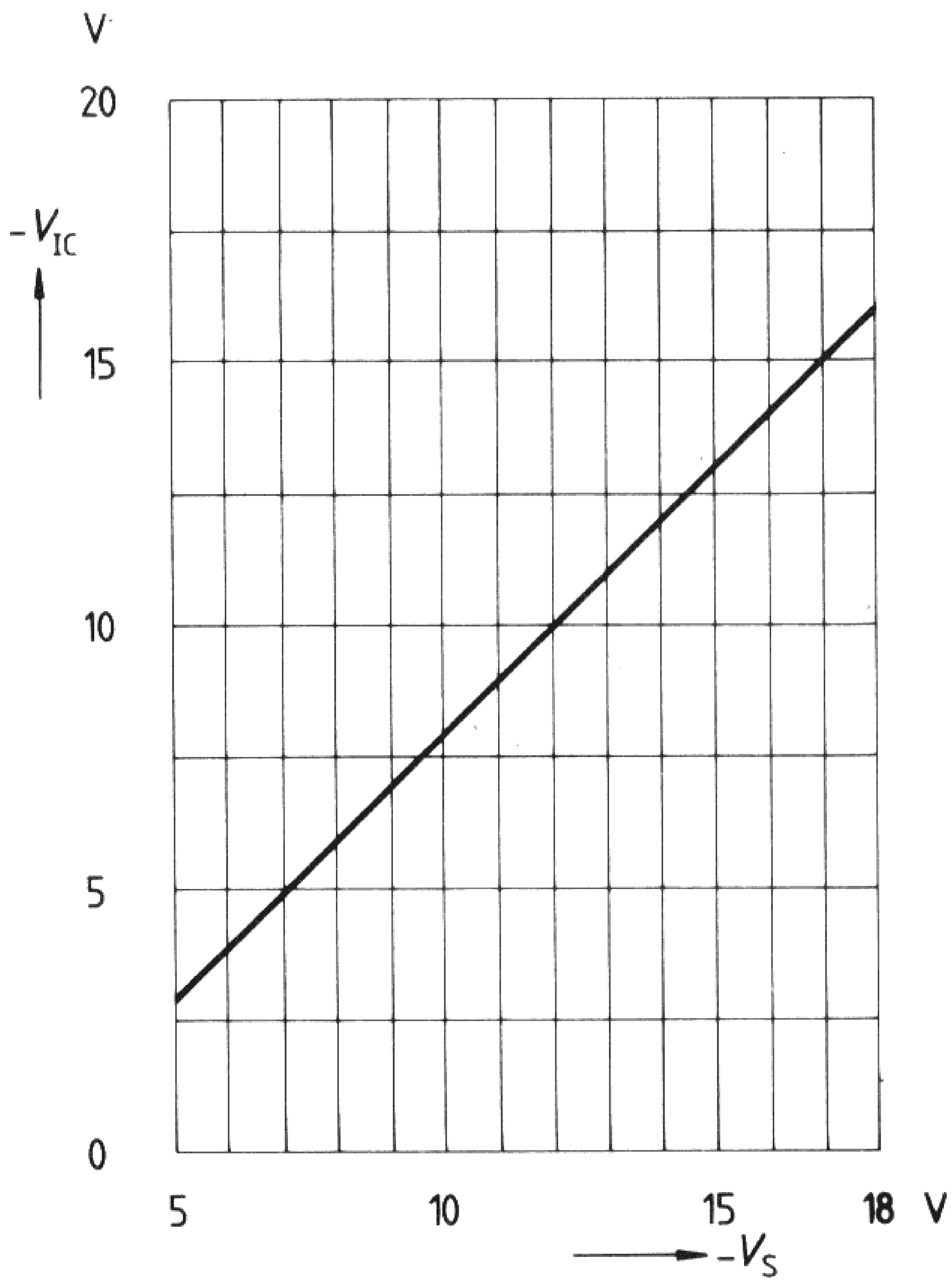
Positive short-circuit current
$V_Q = f(I_Q)$
$T_{amb} = 25\,°C$, $V_S = \pm15$ V



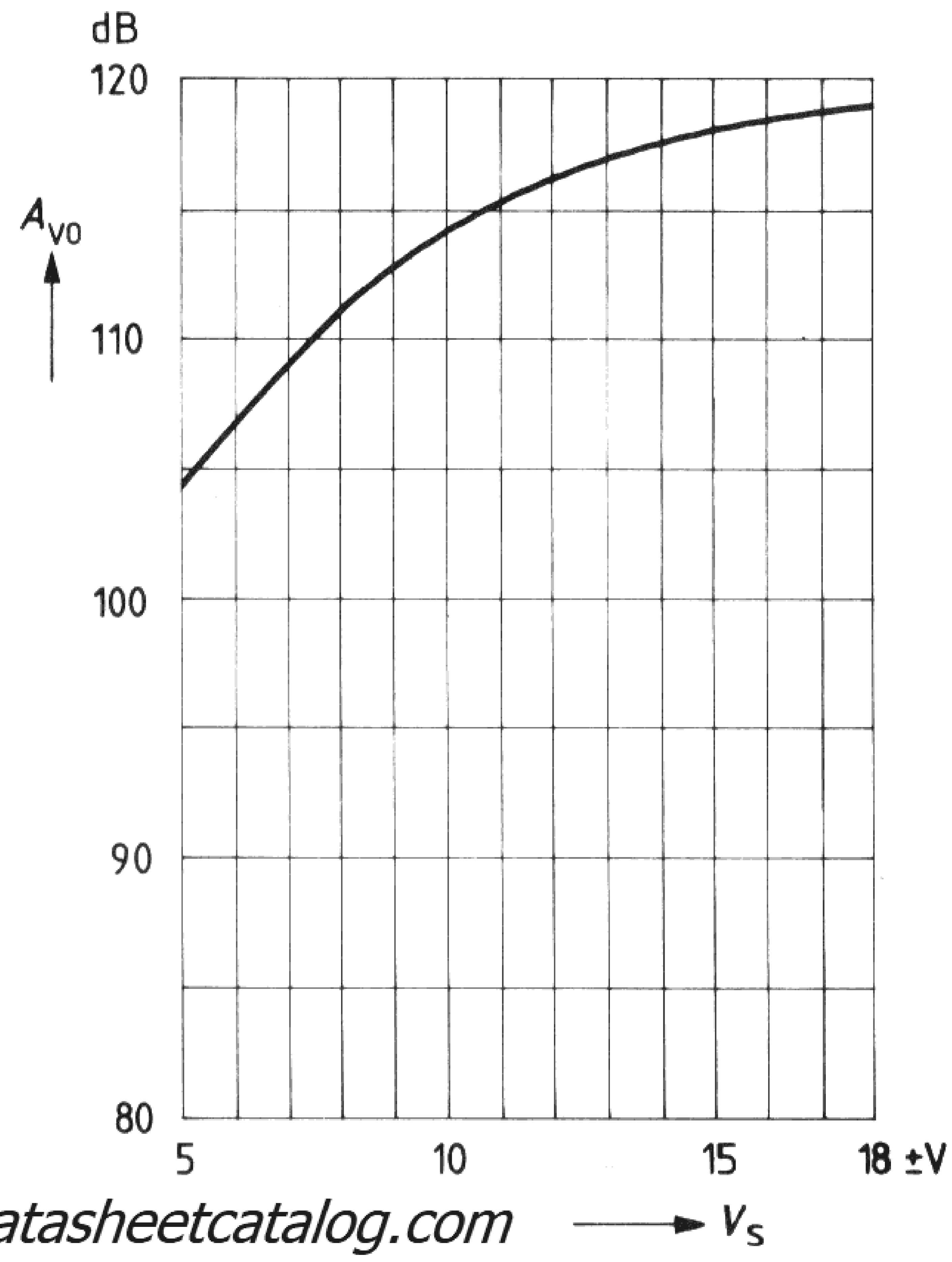
Positive input common mode voltage
$V_{IC} = f(V_S)$
$T_{amb} = 0$ to $70\,°C$



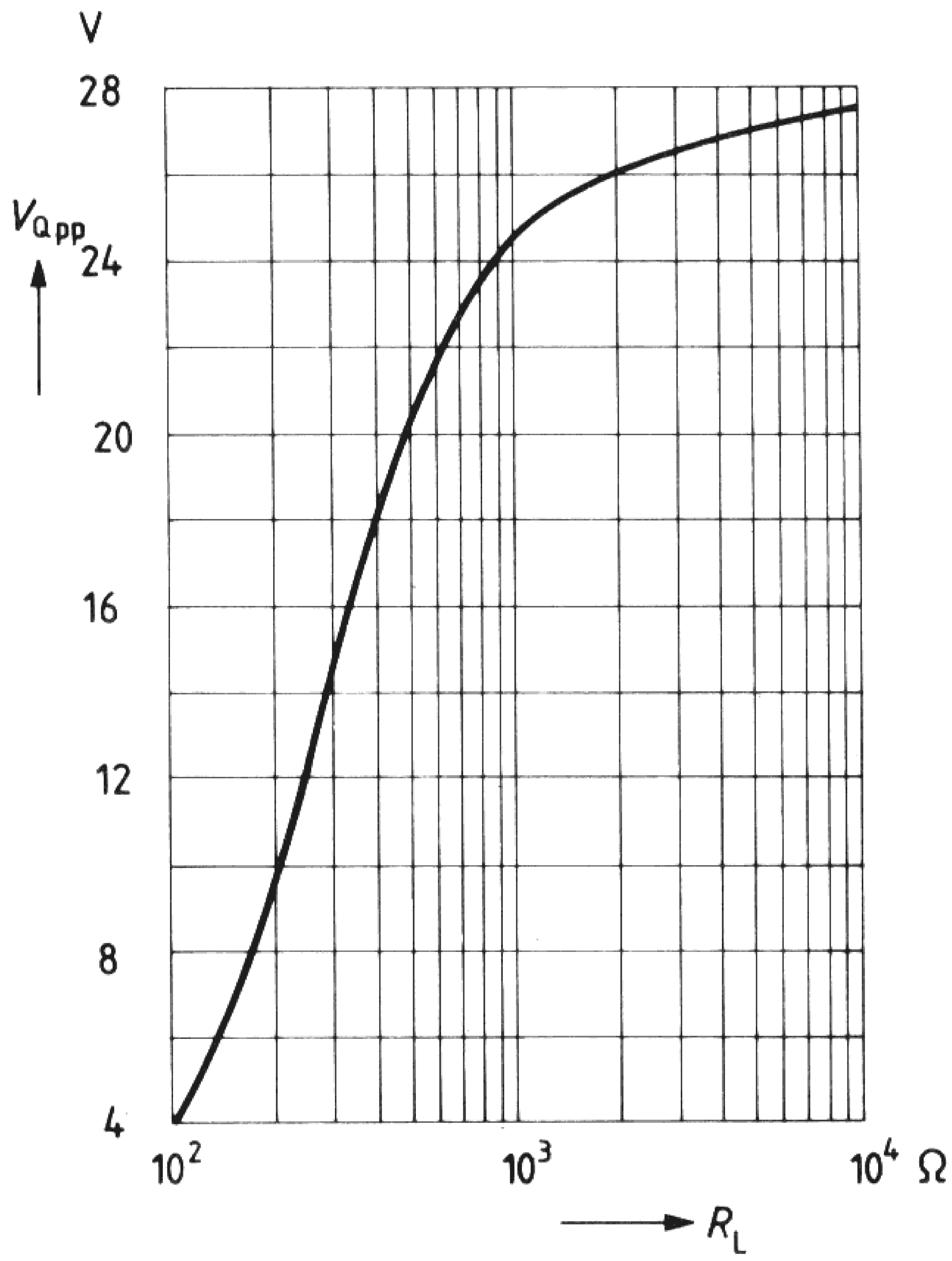
Negative input common mode voltage
$-V_{IC} = f(-V_S)$; $T_{amb} = 25\,°C$



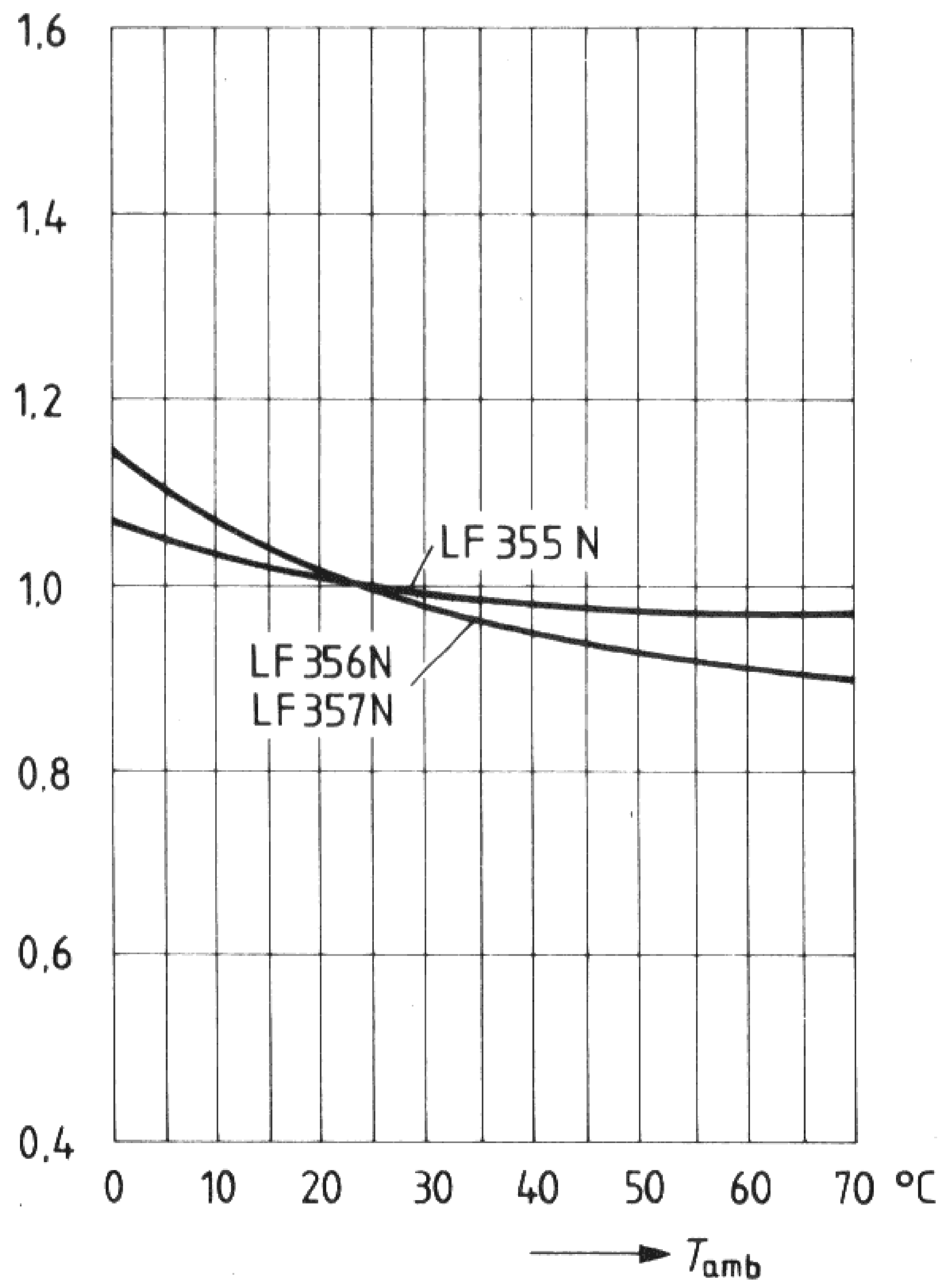
Open loop voltage amplification
$A_{VO} = f(V_S)$
$R_L = 2\,k\Omega$, $R_G = 50\,\Omega$, $T_{amb} = 25\,°C$



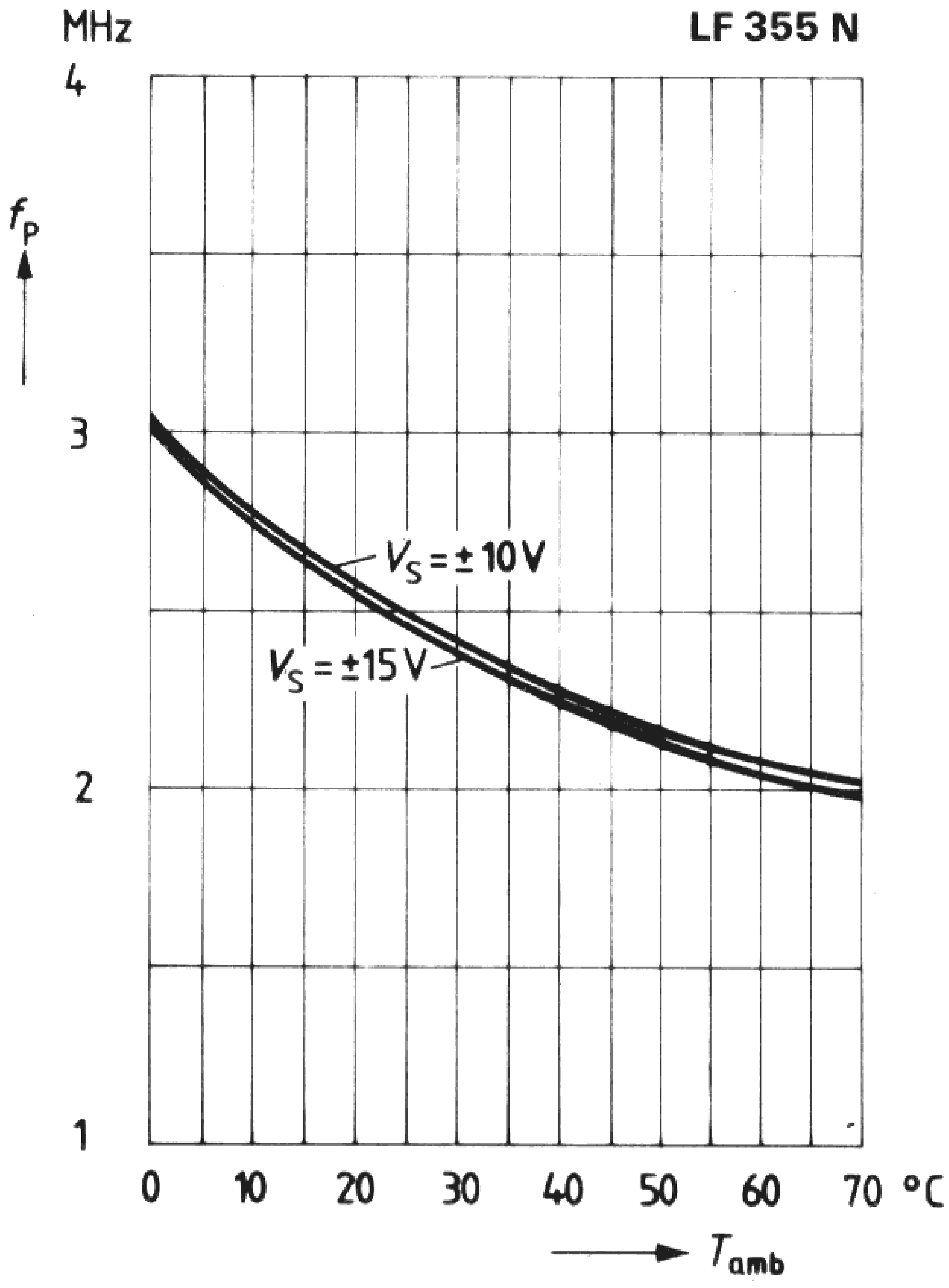
Output voltage $V_{Qpp} = f(R_L)$
$V_S = \pm 15\,V$; $T_{amb} = 25\,°C$



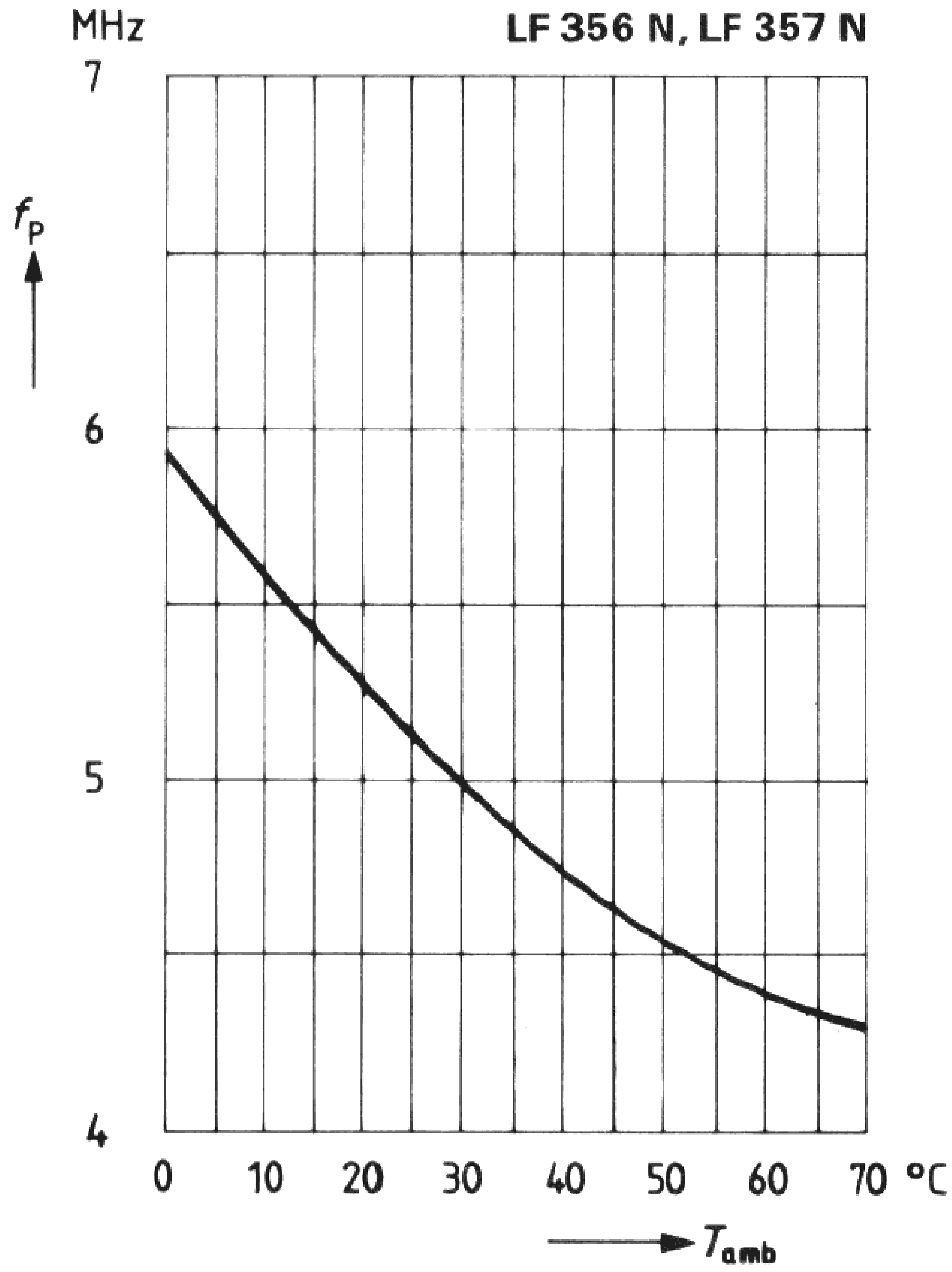
Standardized rise time
$V_S = \pm 15\,V$



Performance bandwidth $f_p = f(T_{amb})$

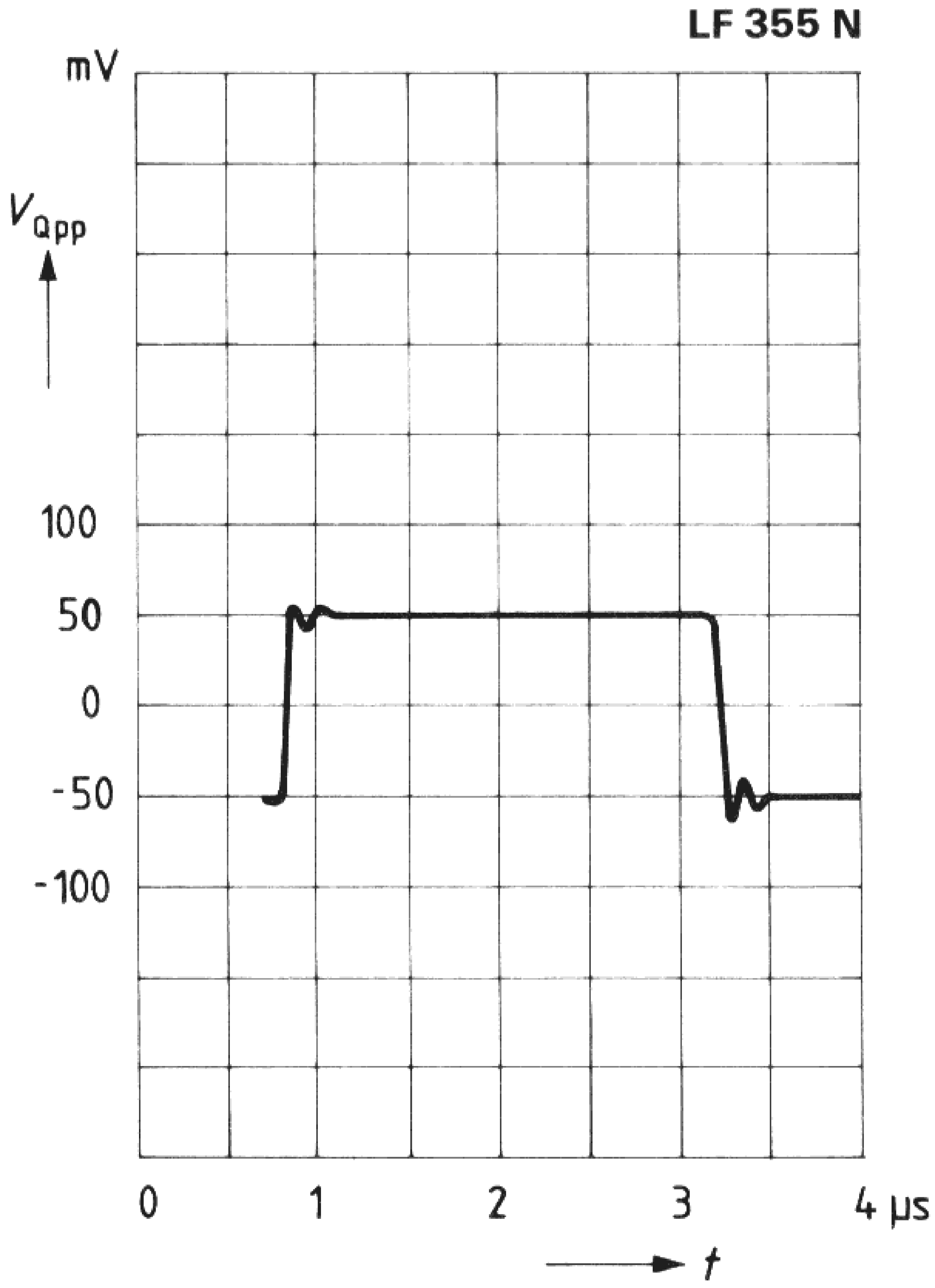


Performance bandwidth $f_p = f(T_{amb})$, $A_V = 1$

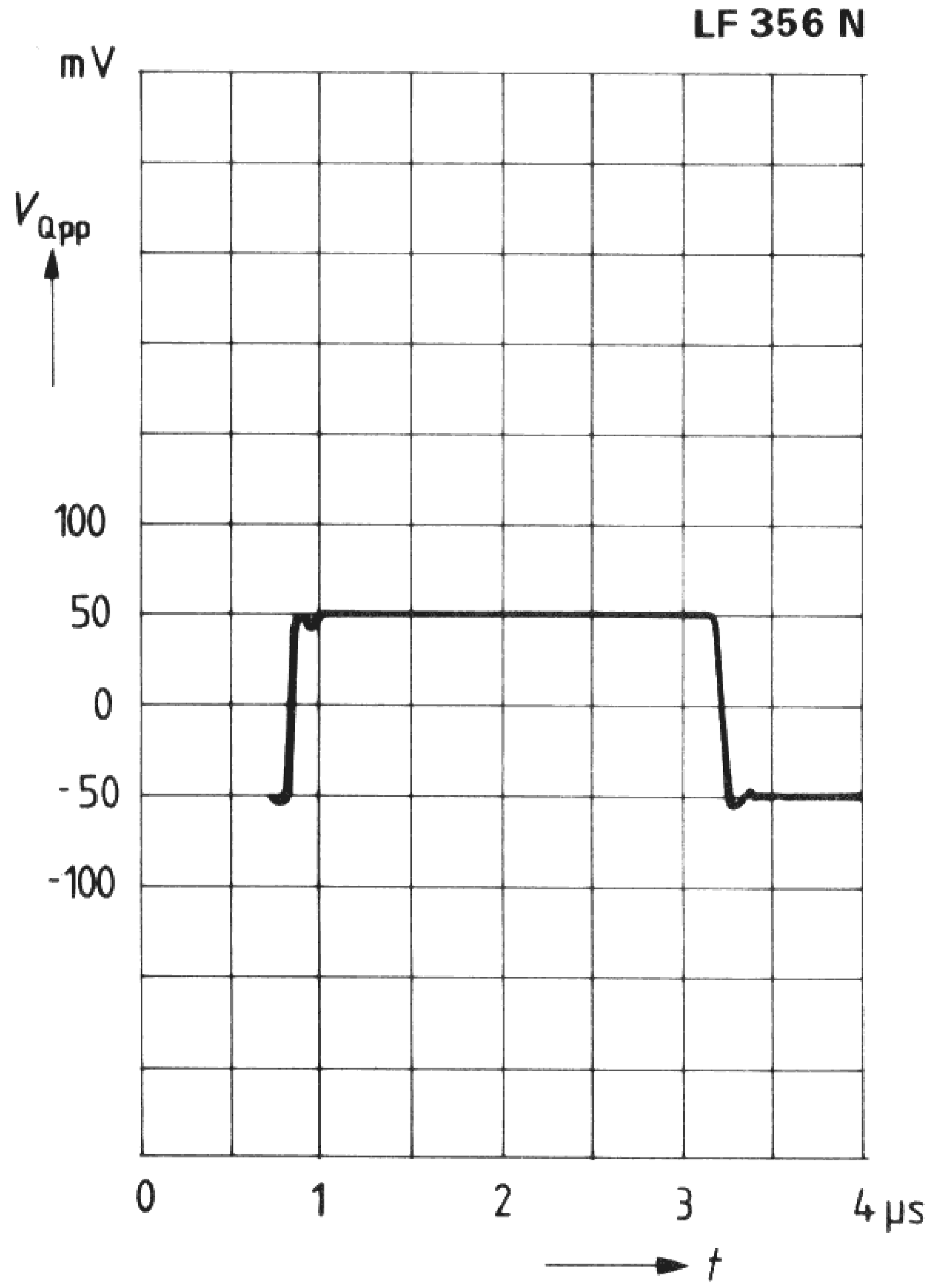


The curves for LF 357 N are multiplied by the factor 4.

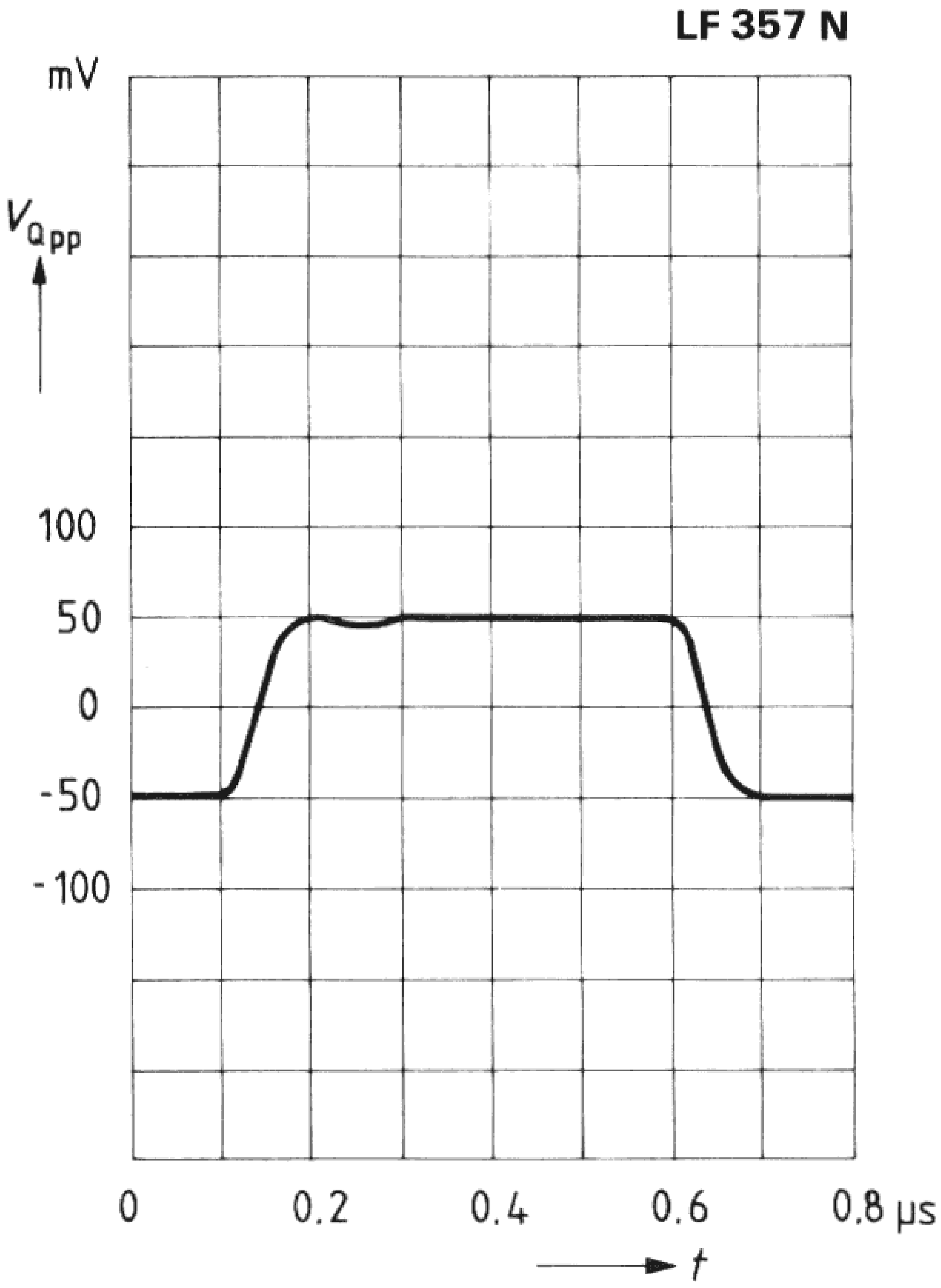
Small signal response $A_V = 1$



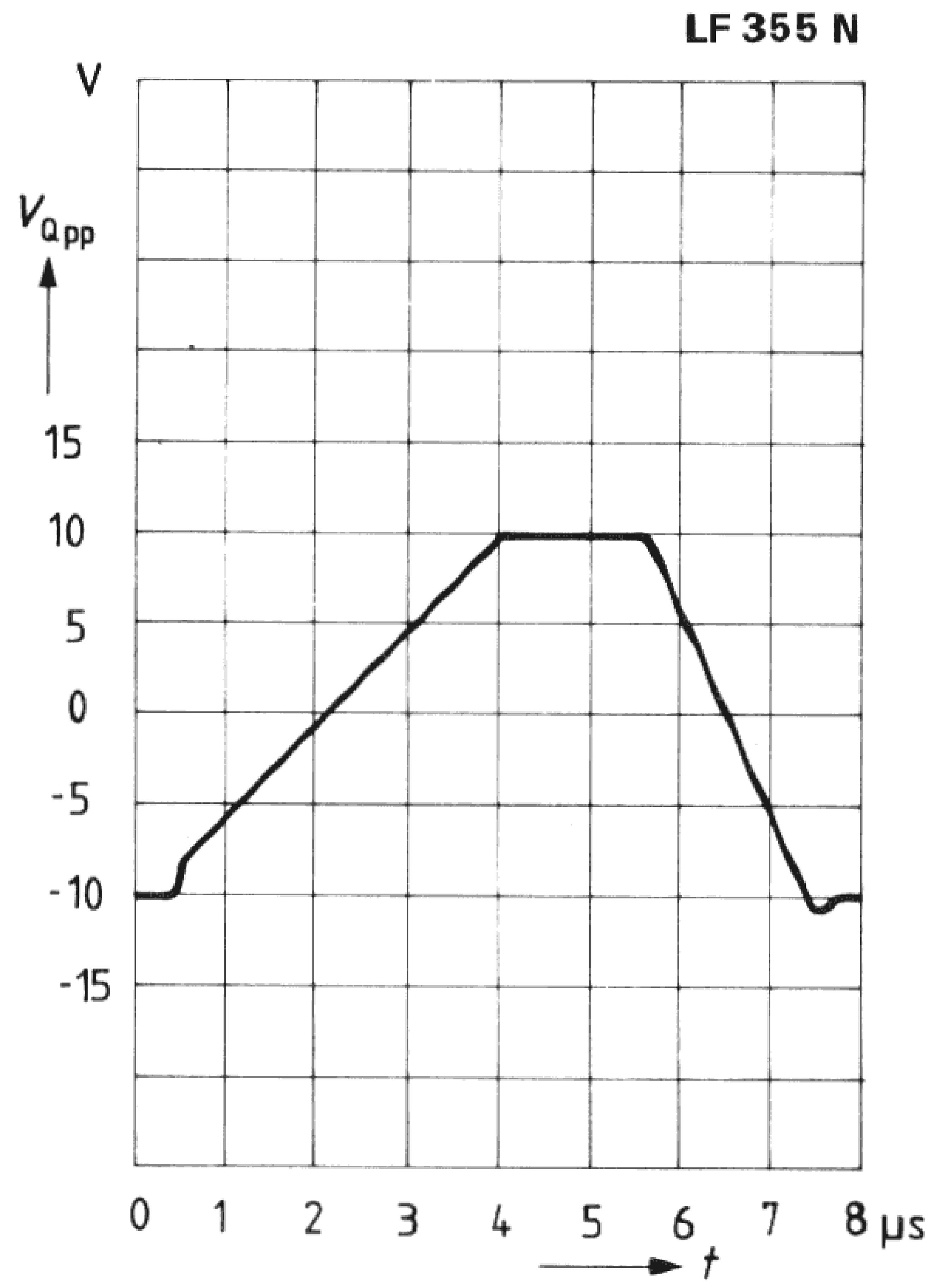
Small signal response $A_V = 1$



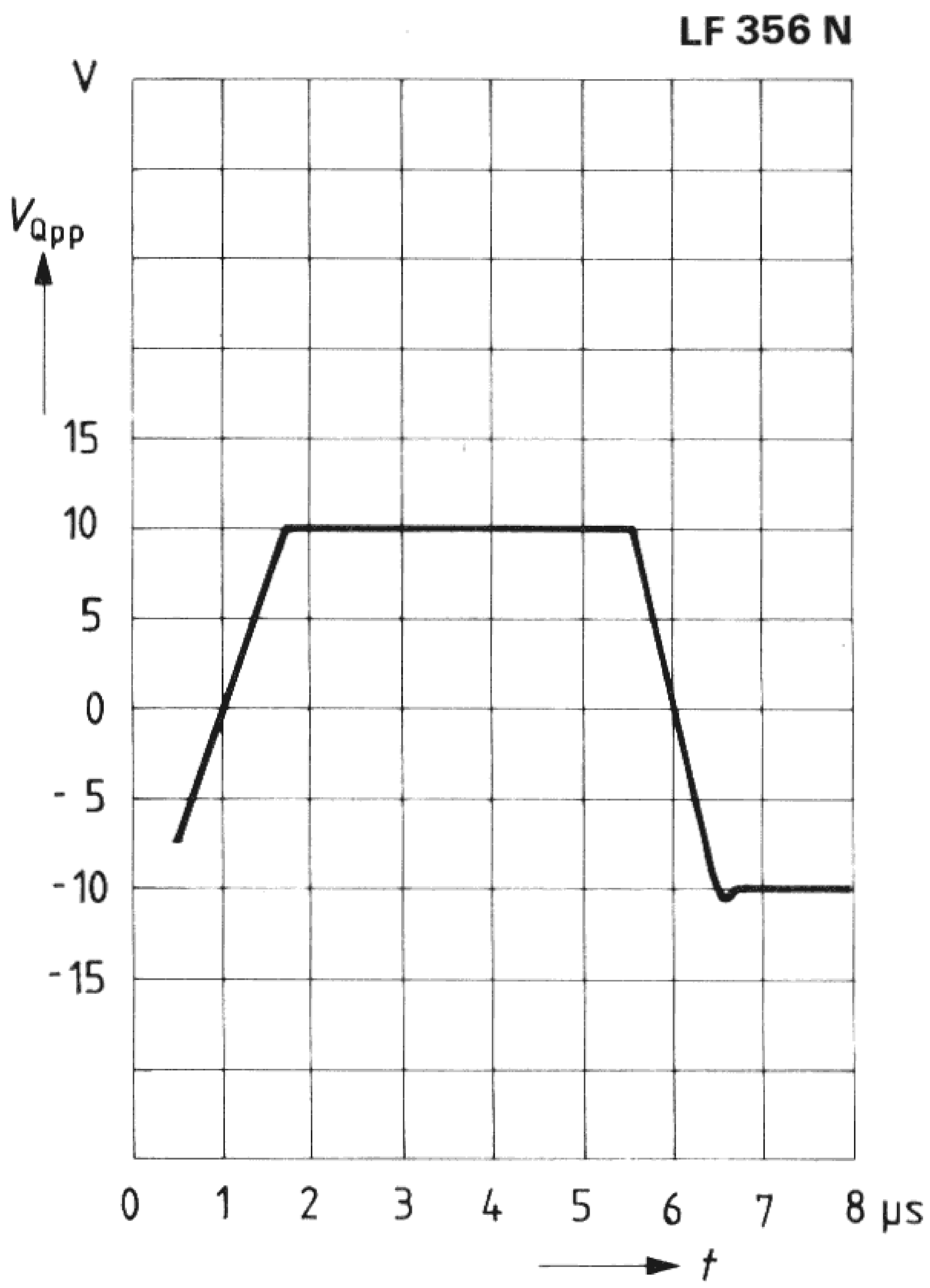
Small signal response A_V = 5



Large-signal response A_V = 1

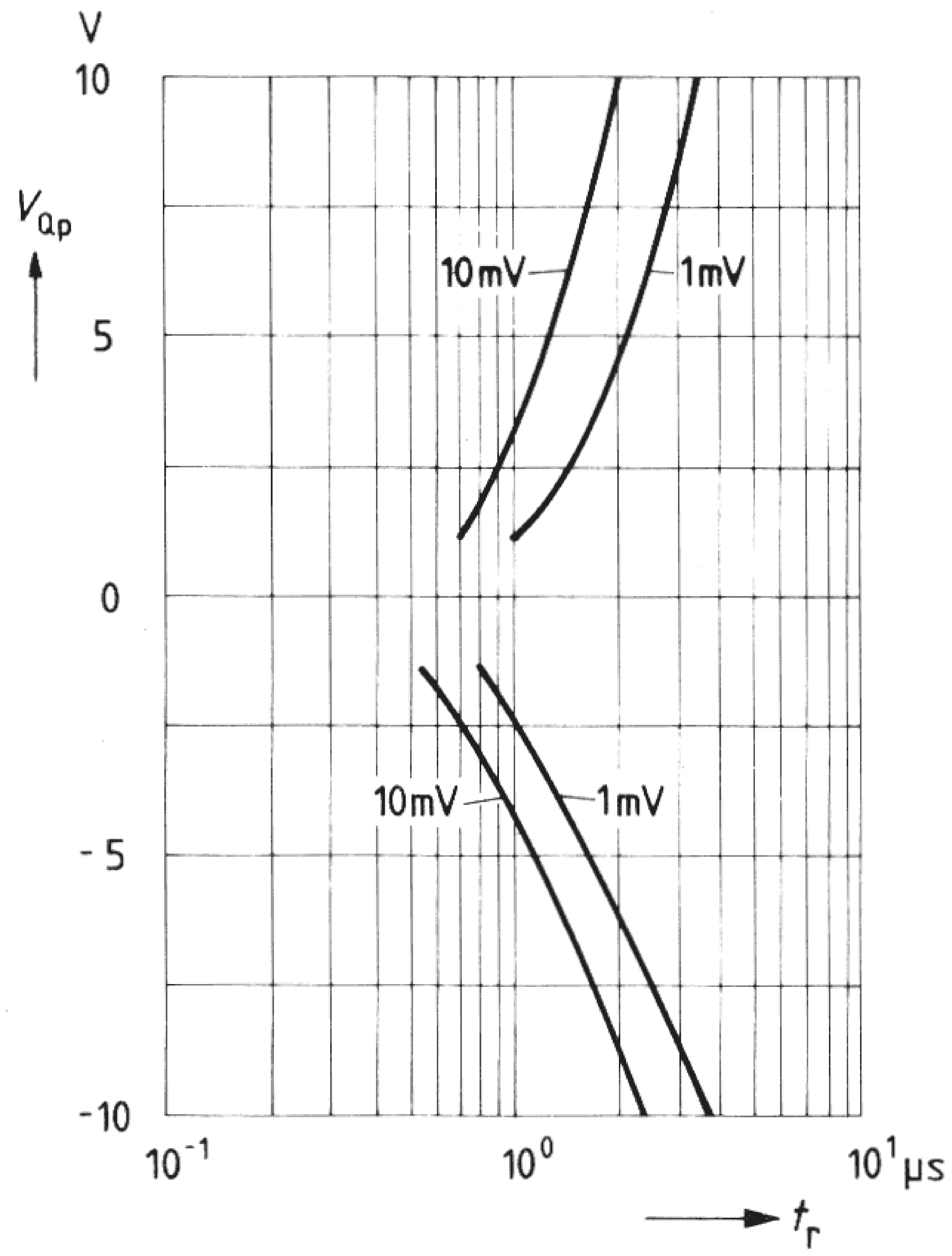


Large-signal response A_V = 1

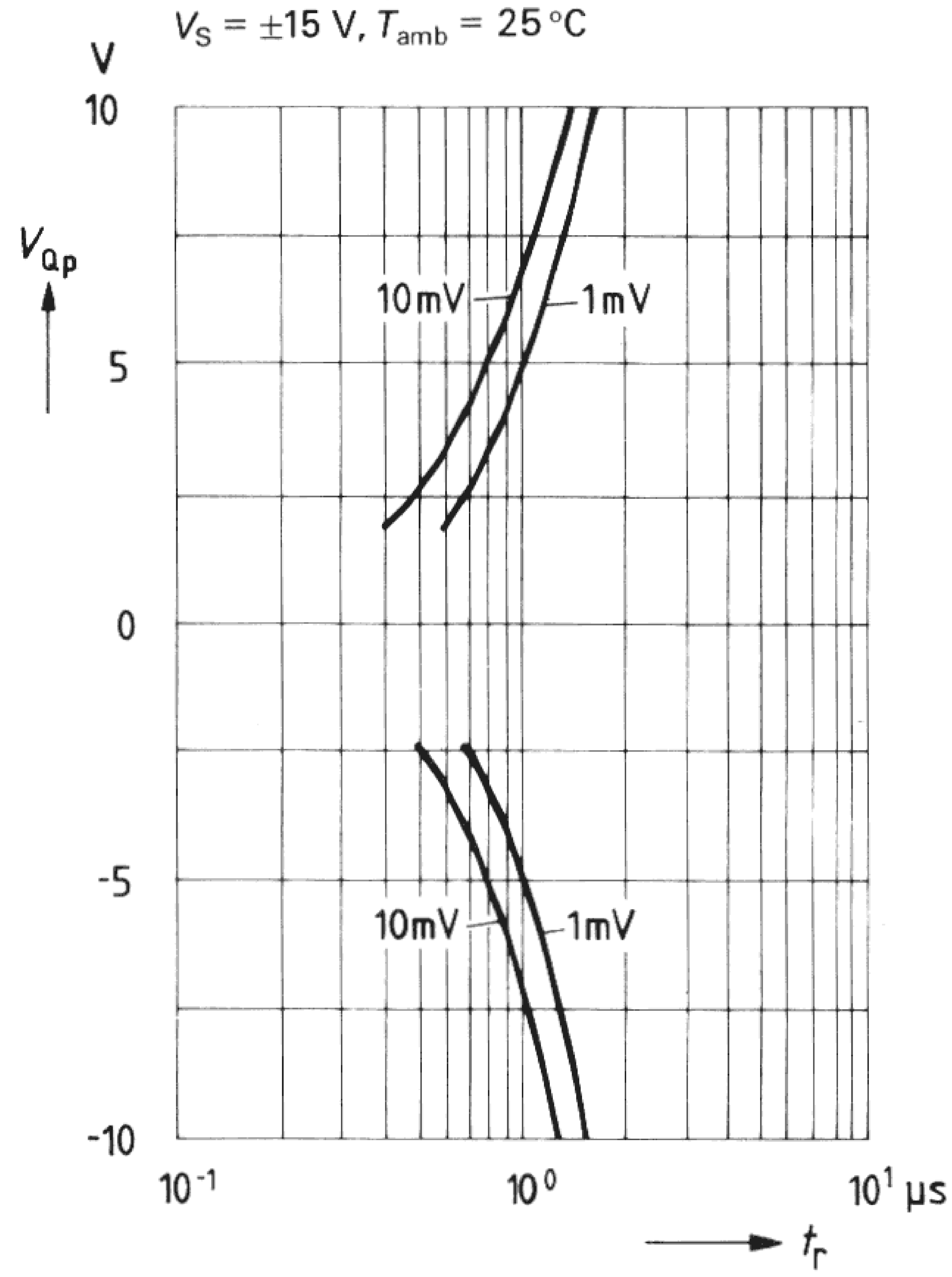


Large-signal response A_V = 5

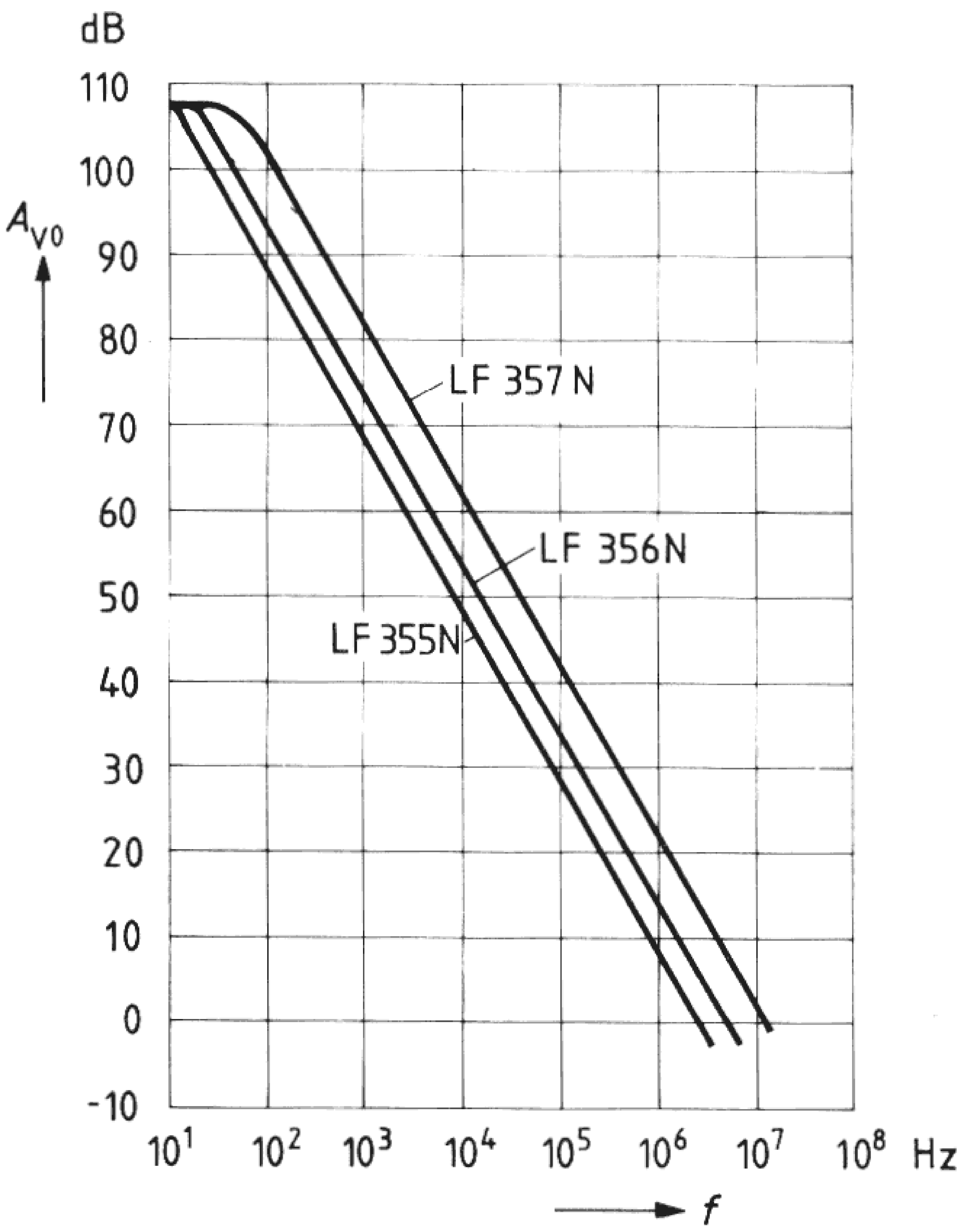
Transient time of inverter
LF 355 N; $V_S = \pm 15$ V,
$T_{amb} = 25\,°C$



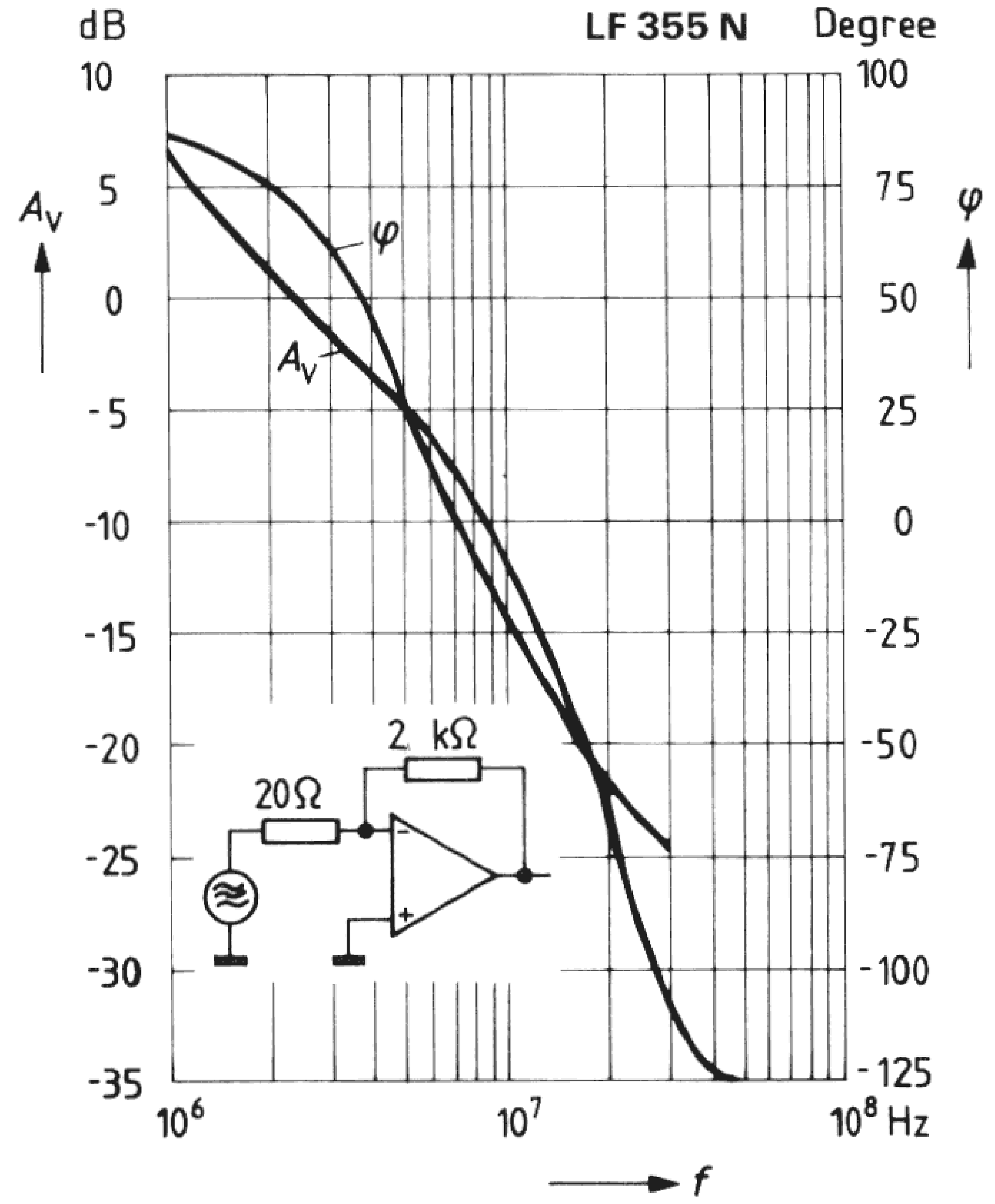
Transient time of inverter
LF 356 N; $A_V = -1$
LF 357 N; $A_V = -5$
$V_S = \pm 15$ V, $T_{amb} = 25\,°C$



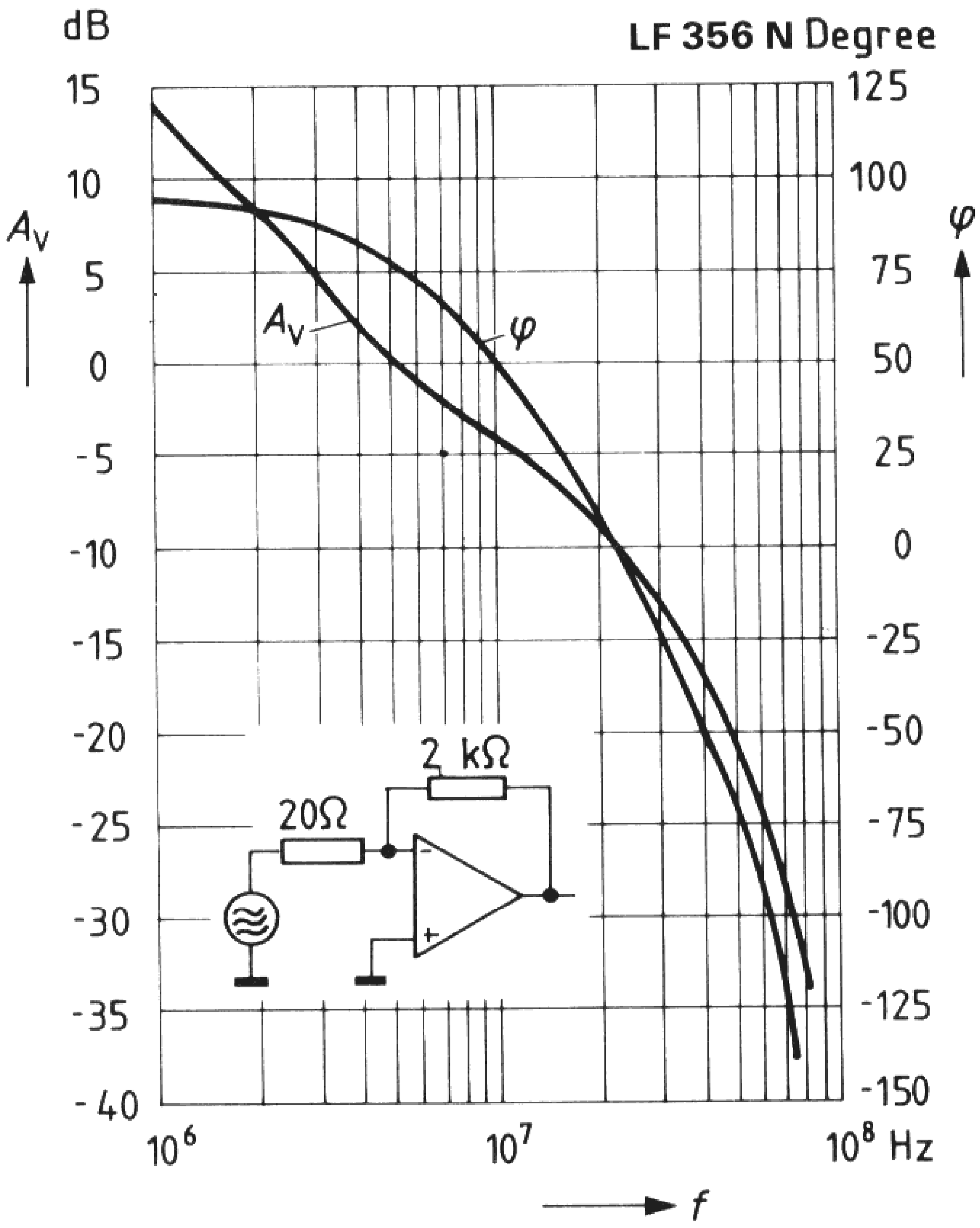
Open-loop voltage amplification
$A_{VO} = f\,(f)$
$V_S = \pm 15$ V



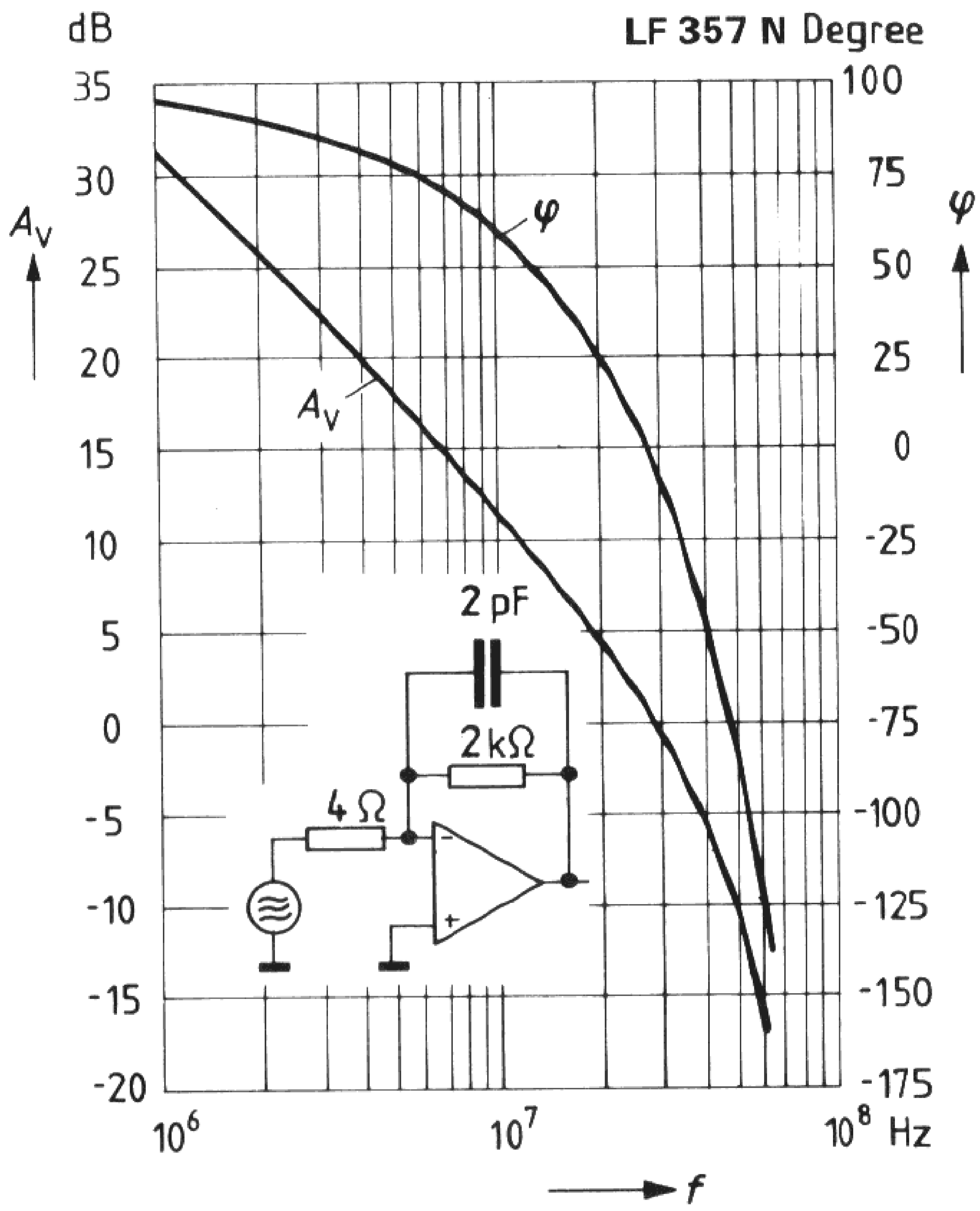
Bode diagram
$A_V = f\,(f)$ or $\varphi = f\,(f)$
$V_S = \pm 15$ V



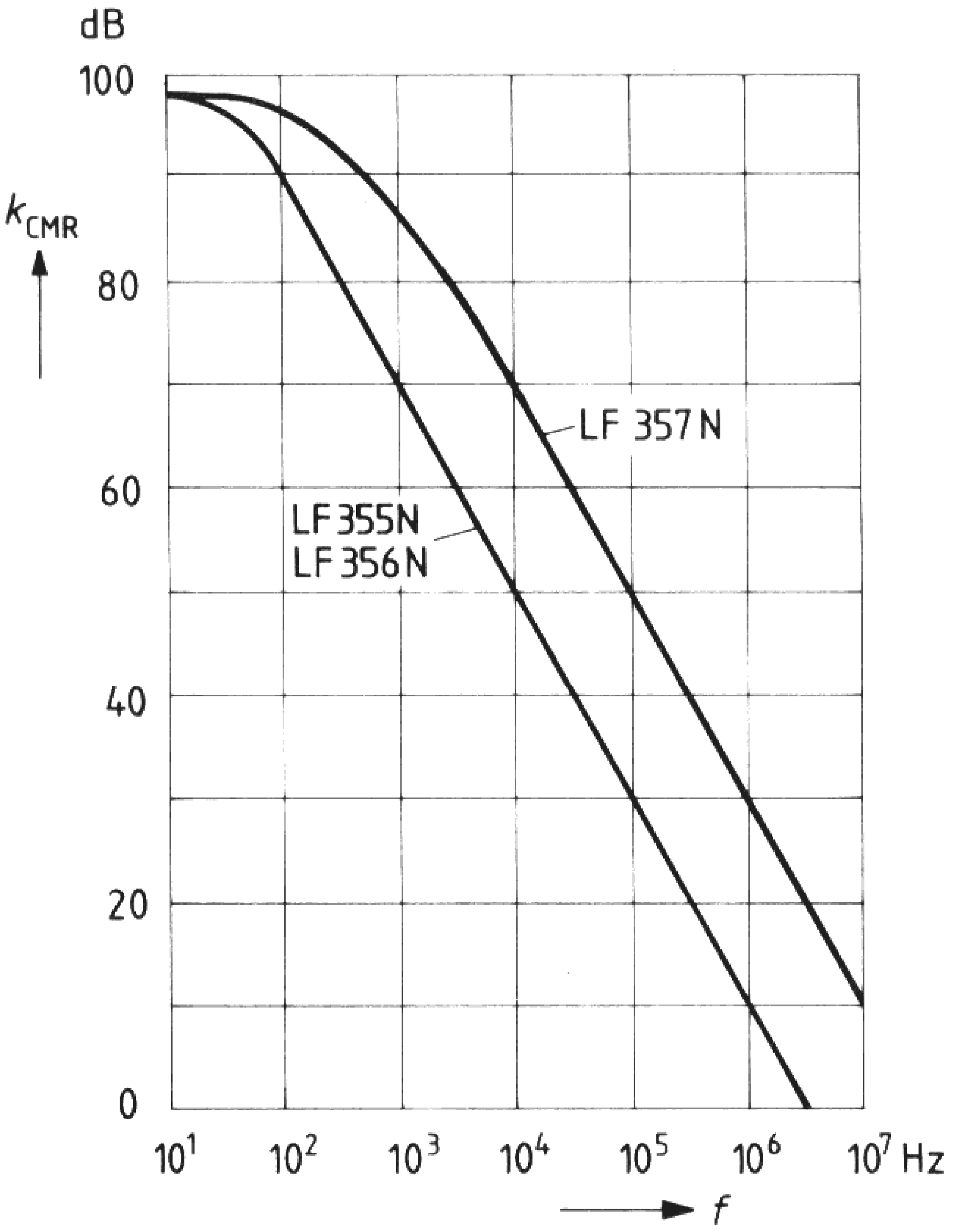
Bode diagram
$A_V = f(f)$ or $\varphi = f(f)$
$V_S = \pm 15$ V



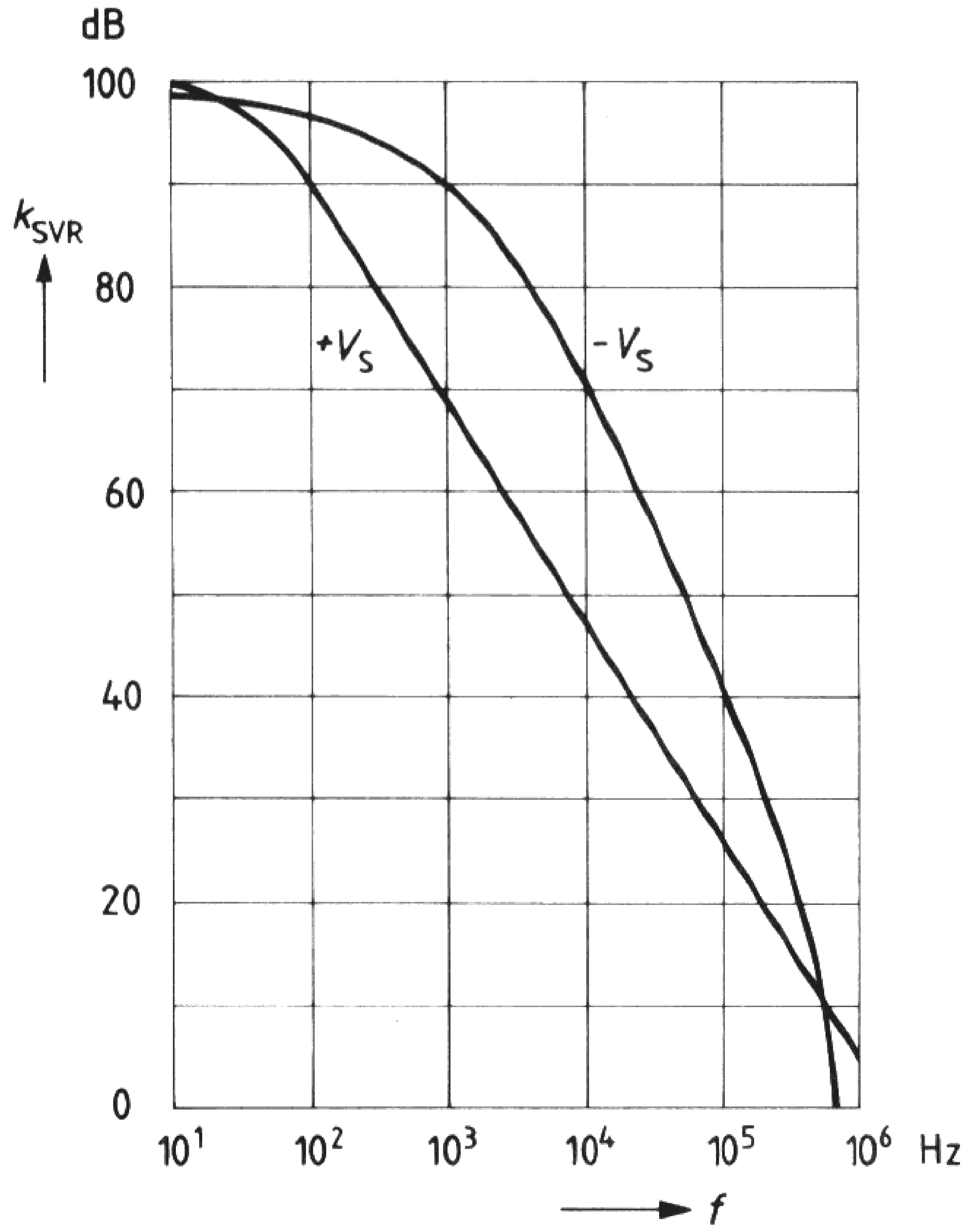
Bode diagram
$A_V = f(f)$ or $\varphi = f(f)$
$V_S = \pm 15$ V



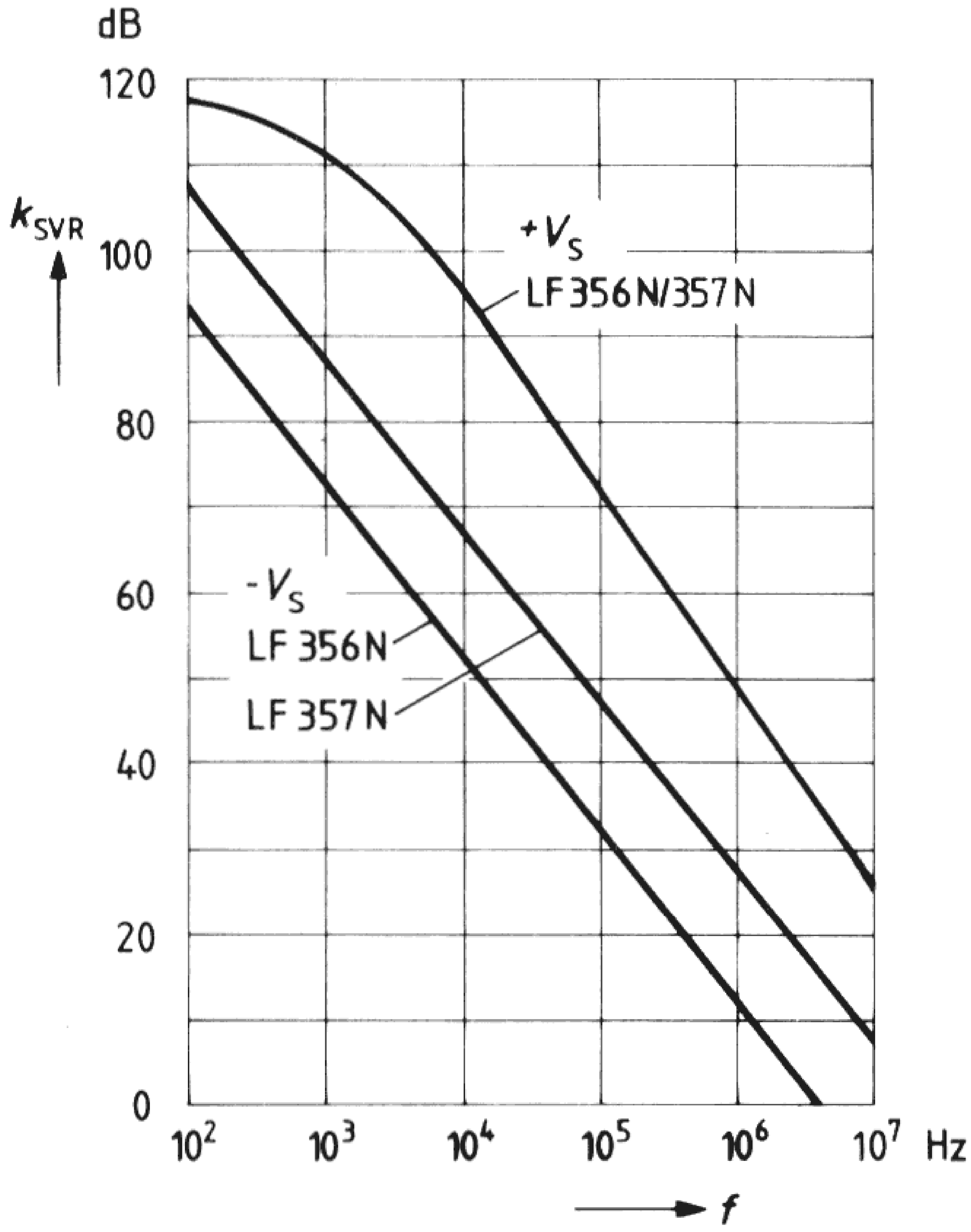
Common mode rejection
$k_{CMR} = f(f)$, $R_L = 2$ kΩ
$V_S = \pm 15$ V, $T_{amb} = 25$ °C



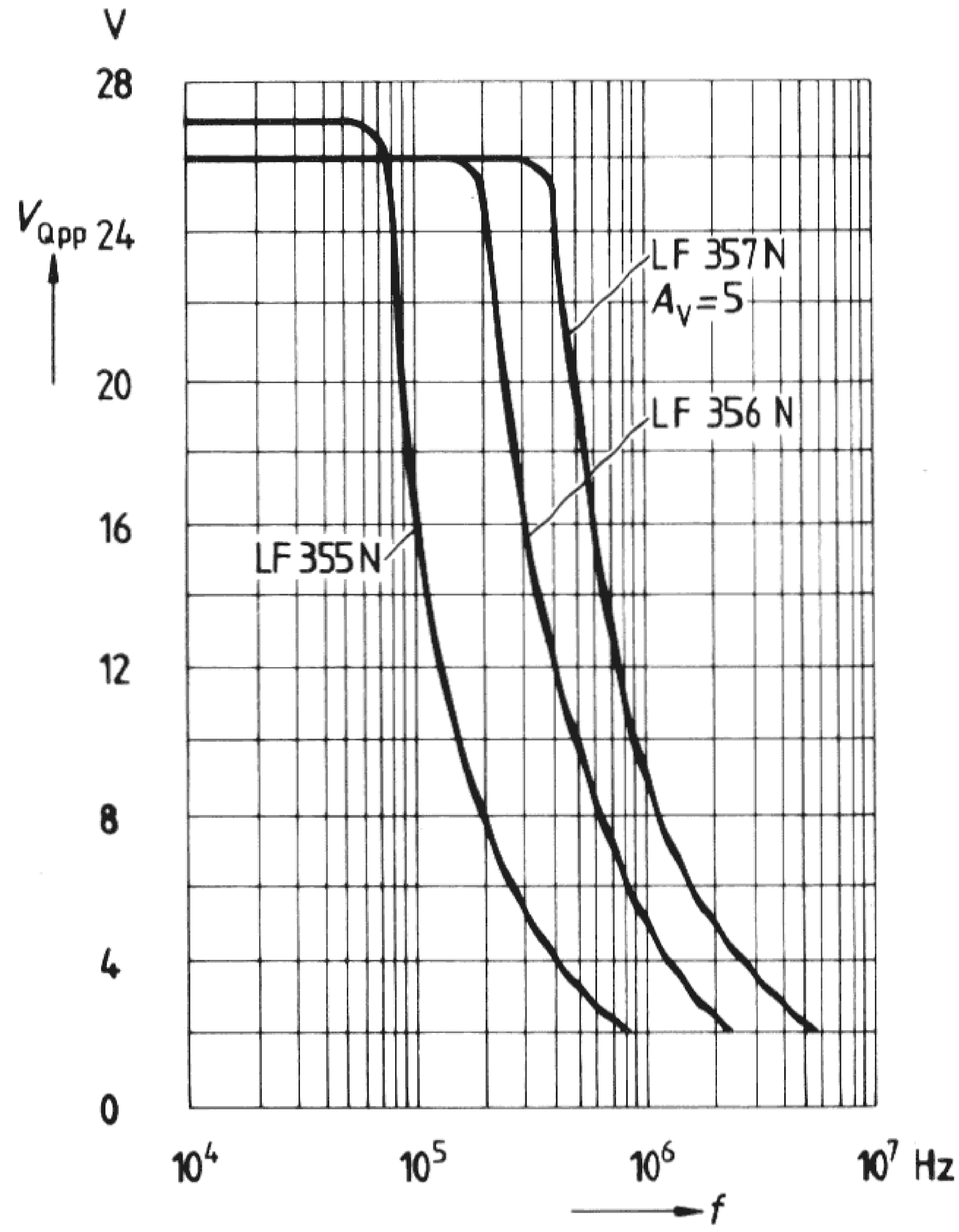
Supply voltage rejection
$k_{SVR} = f(f)$
$V_S = \pm 15$ V; $T_{amb} = 25$ °C



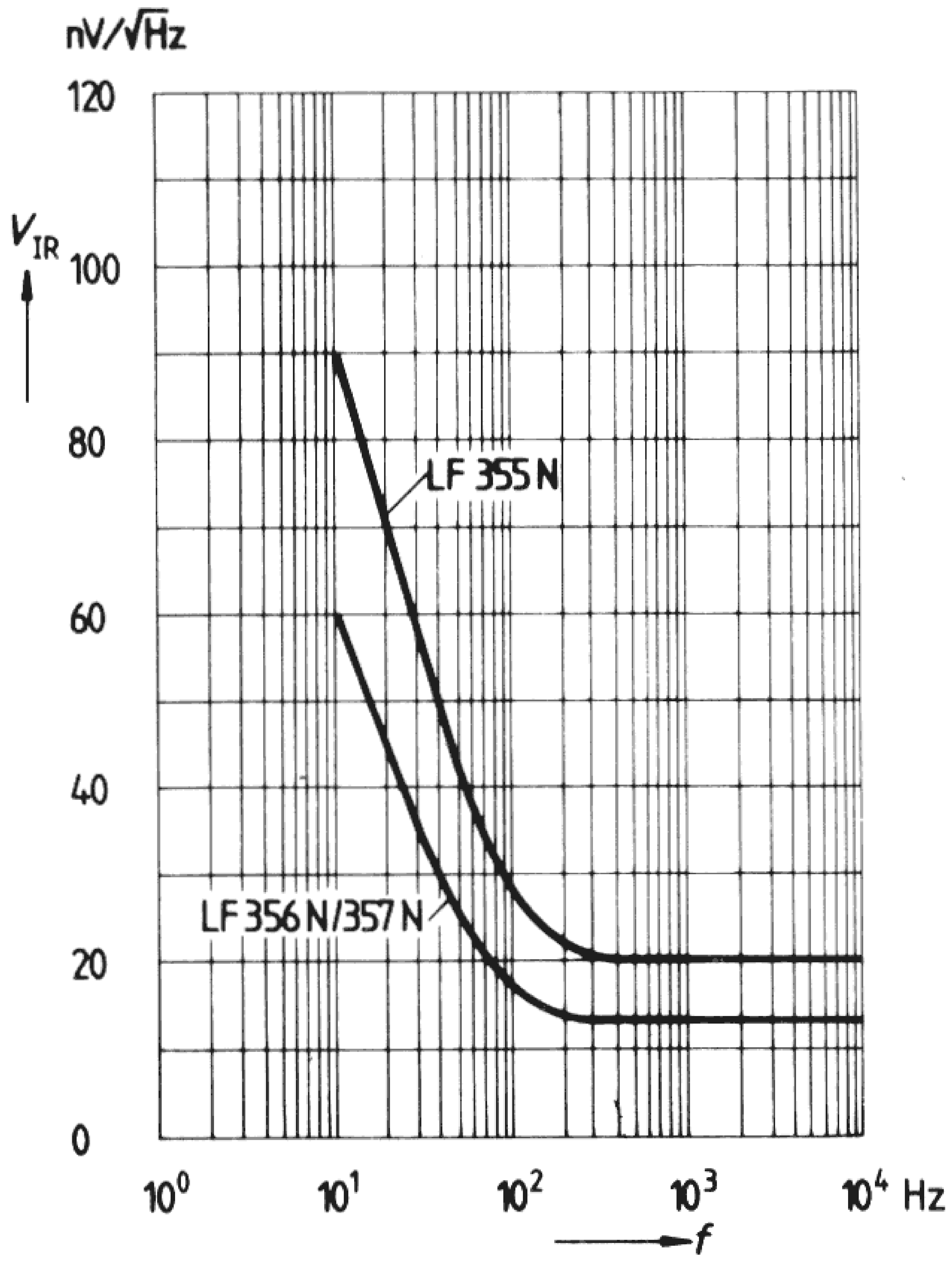
Supply voltage rejection
$k_{SVR} = f(f)$
$V_S = \pm 15$ V, $T_{amb} = 25$ °C



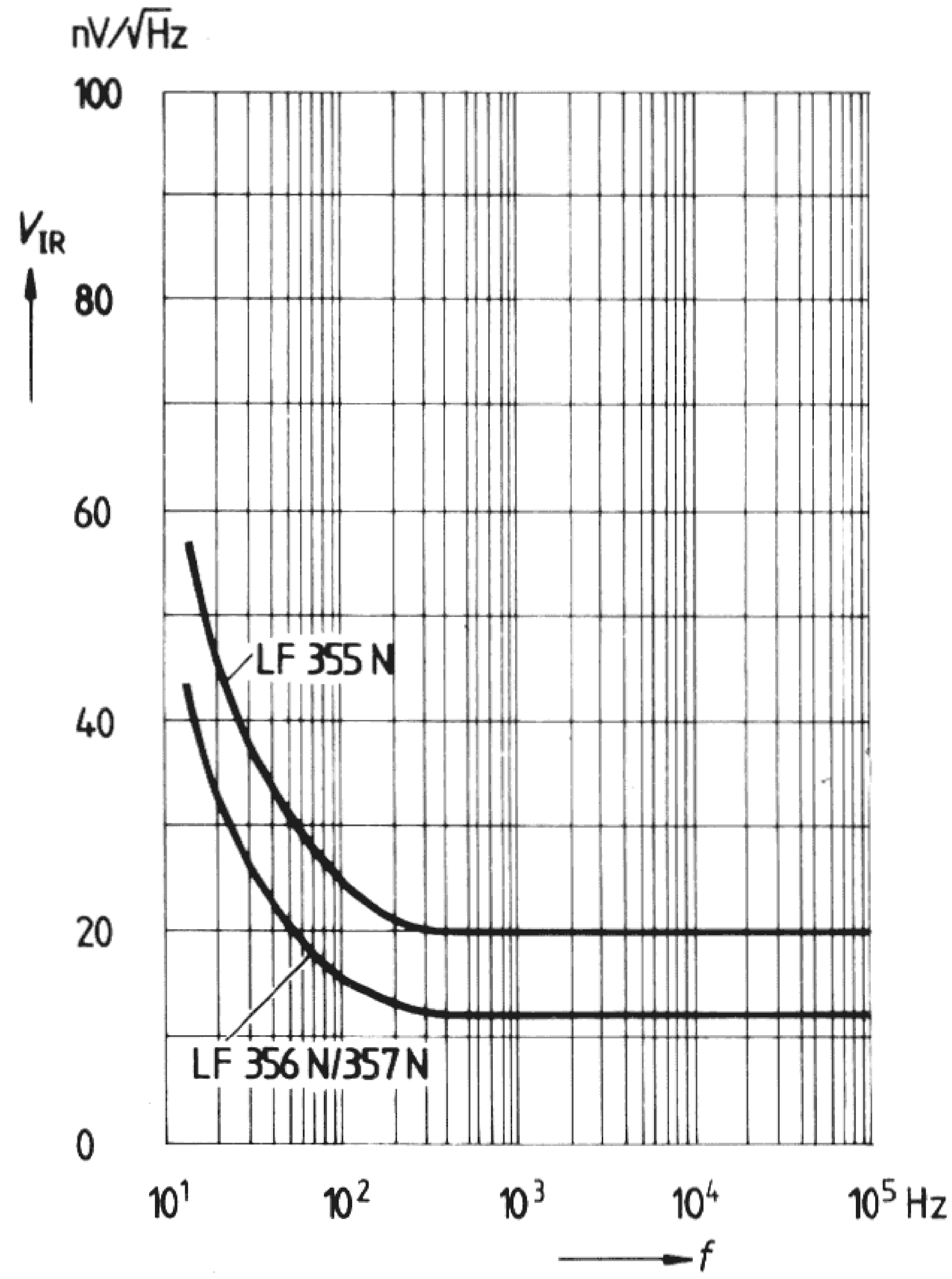
Output voltage versus frequency
$V_{Qpp} = f(f)$; $R_L = 2$ kΩ, $A_V = 1$
Distortion factor <1% $V_S = \pm 15$ V,
$T_{amb} = 25$ °C



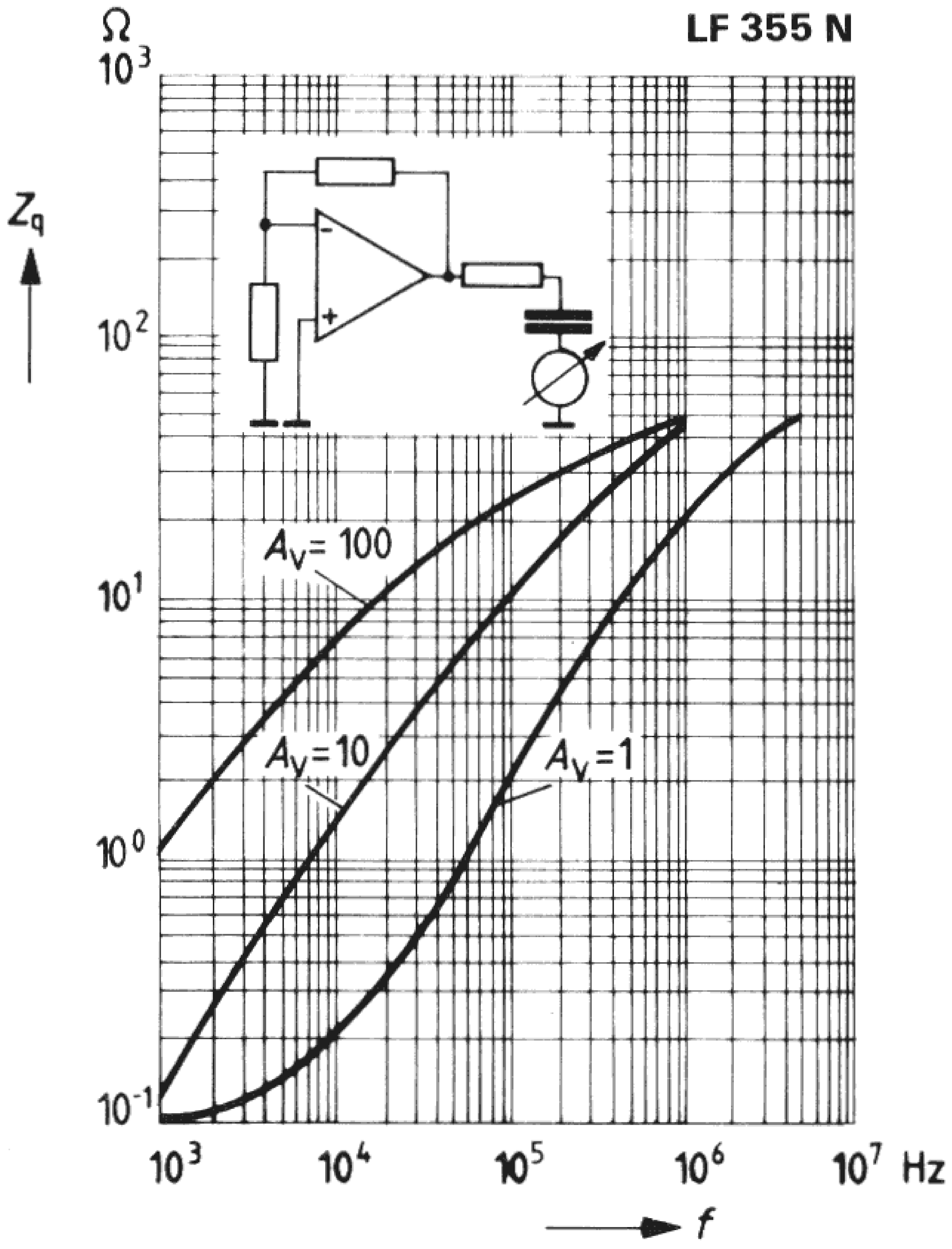
Input noise voltage versus frequency
$V_{IN} = f(f)$
$V_S = \pm 15$ V, $T_{amb} = 25$ °C



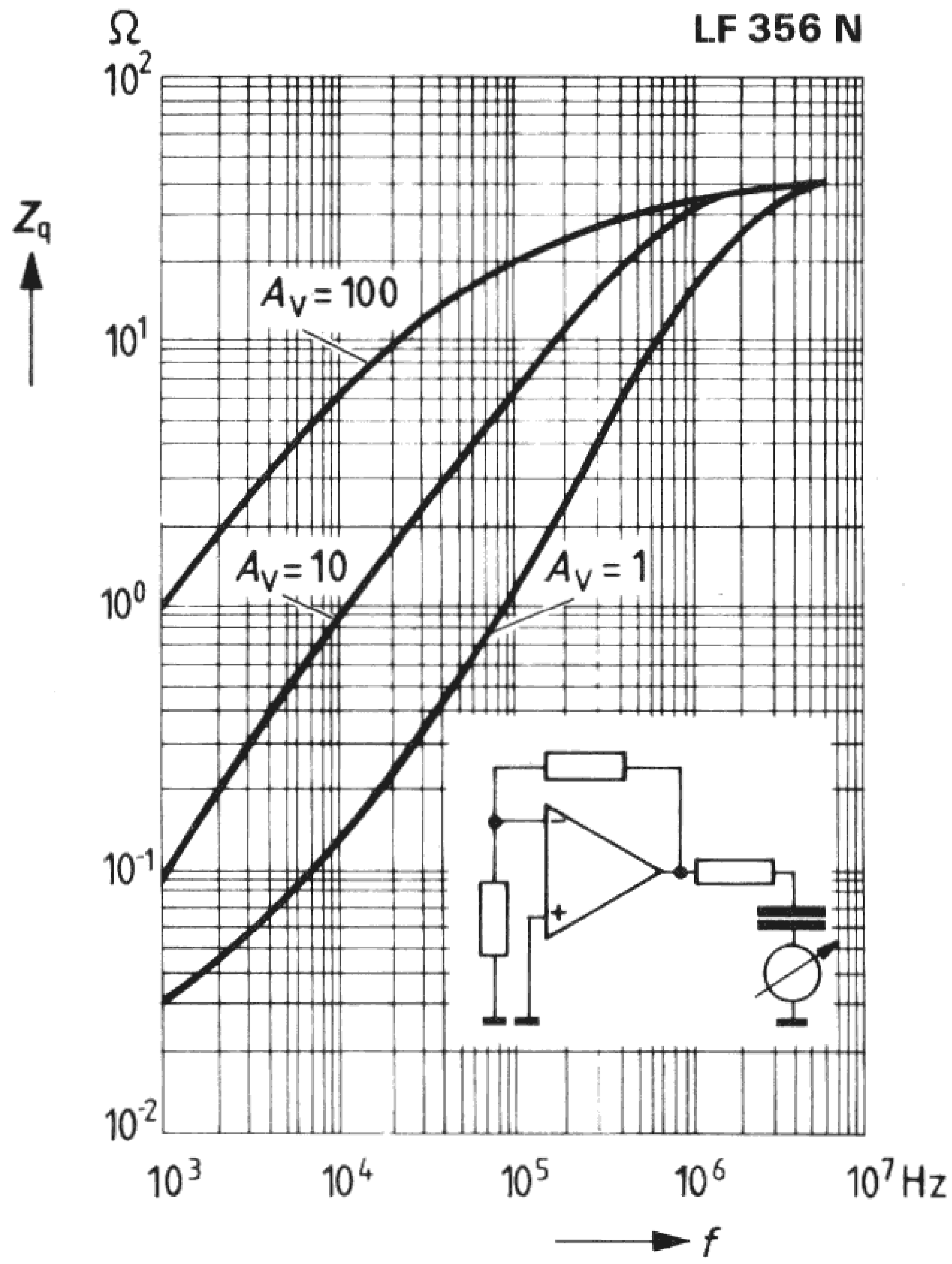
Input noise voltage versus frequency
$V_{IN} = f(f)$
$V_S = \pm 15$ V, $T_{amb} = 25$ °C



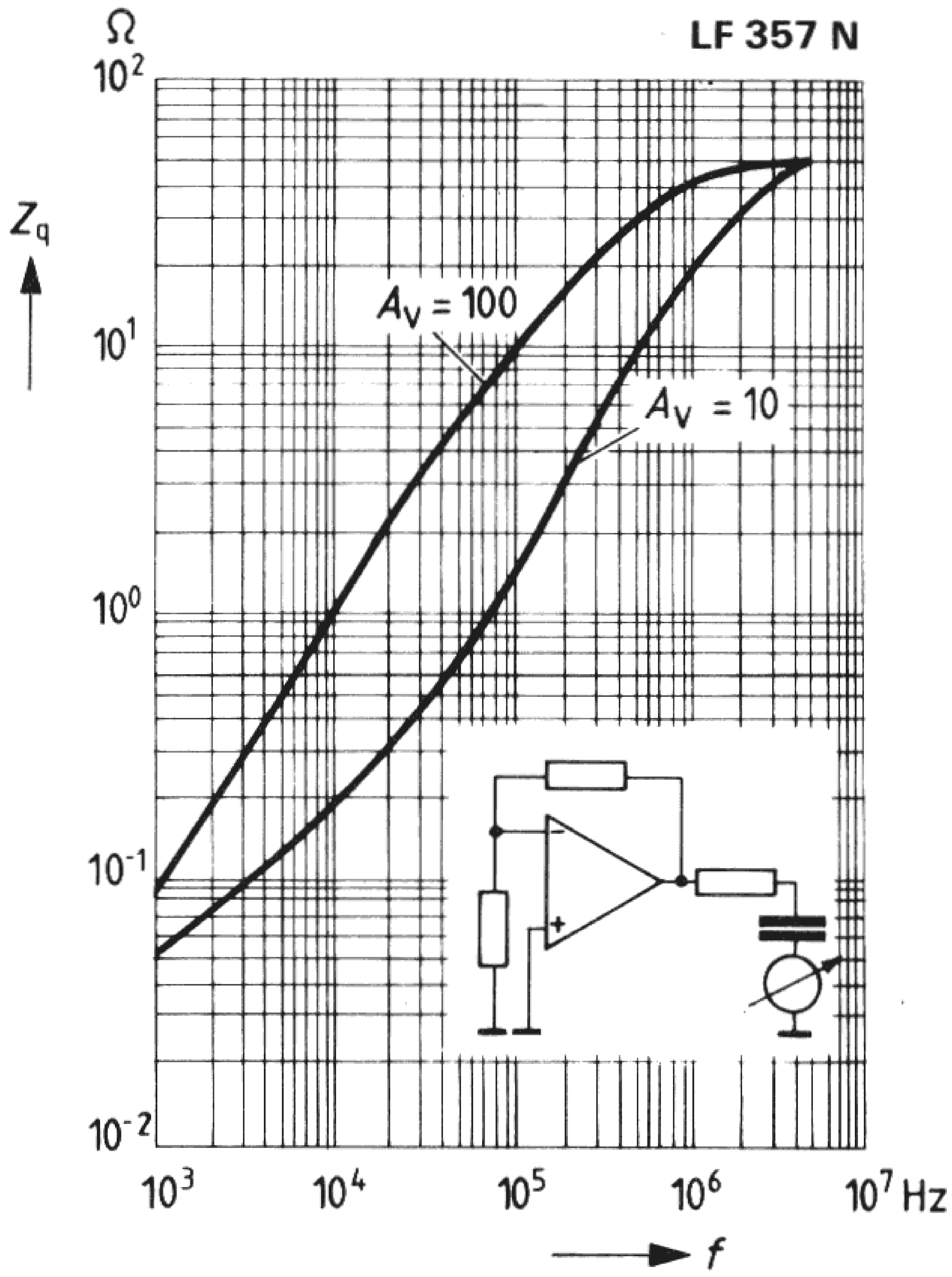
Output impedance $Z_q = f(f)$
$V_S = \pm 15$ V, $T_{amb} = 25$ °C



Output impedance $Z_q = f(f)$
$V_S = \pm 15$ V, $T_{amb} = 25$ °C

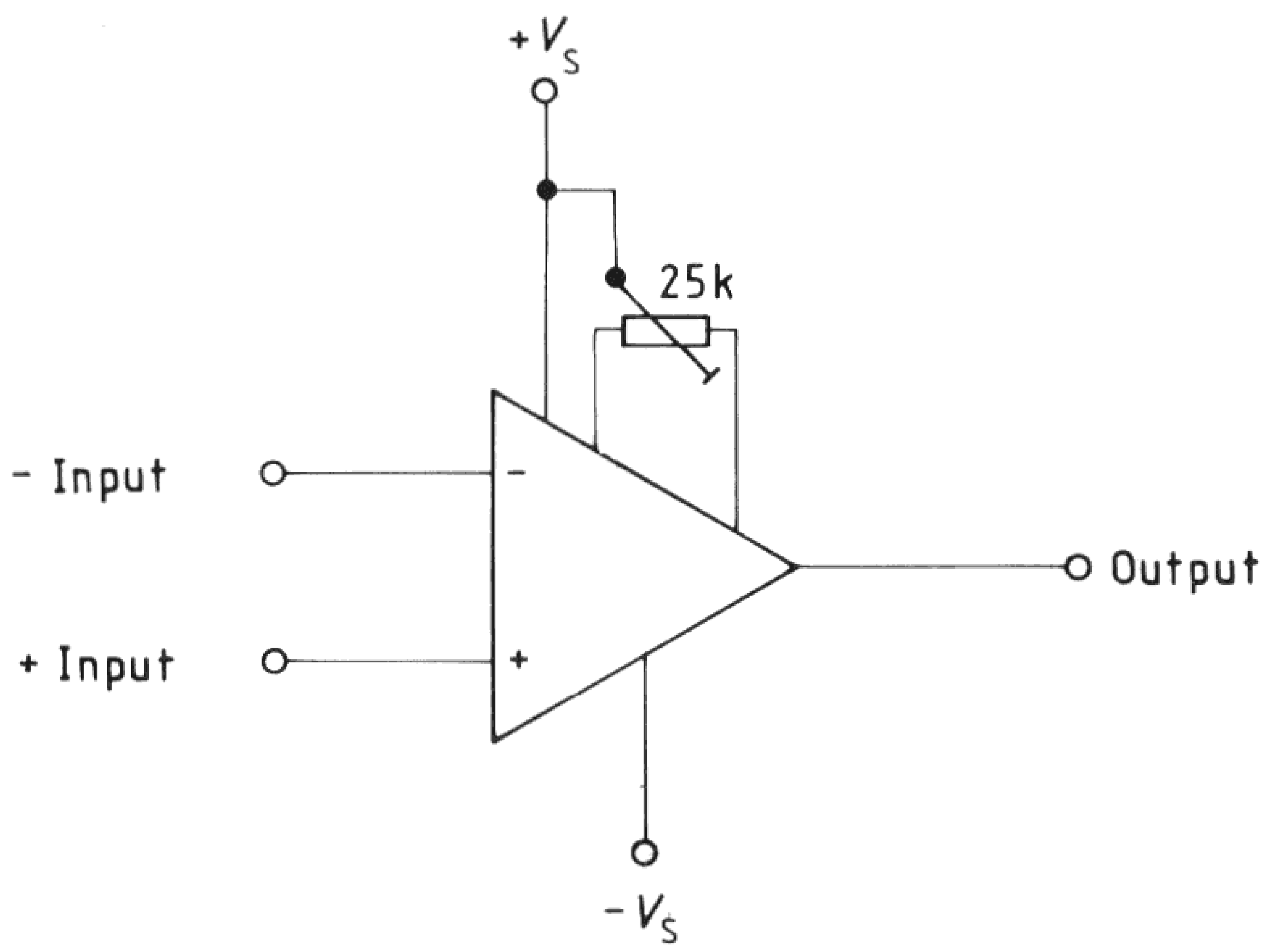


Output impedance $Z_q = f(f)$
$V_S = \pm 15$ V, $T_{amb} = 25$ °C



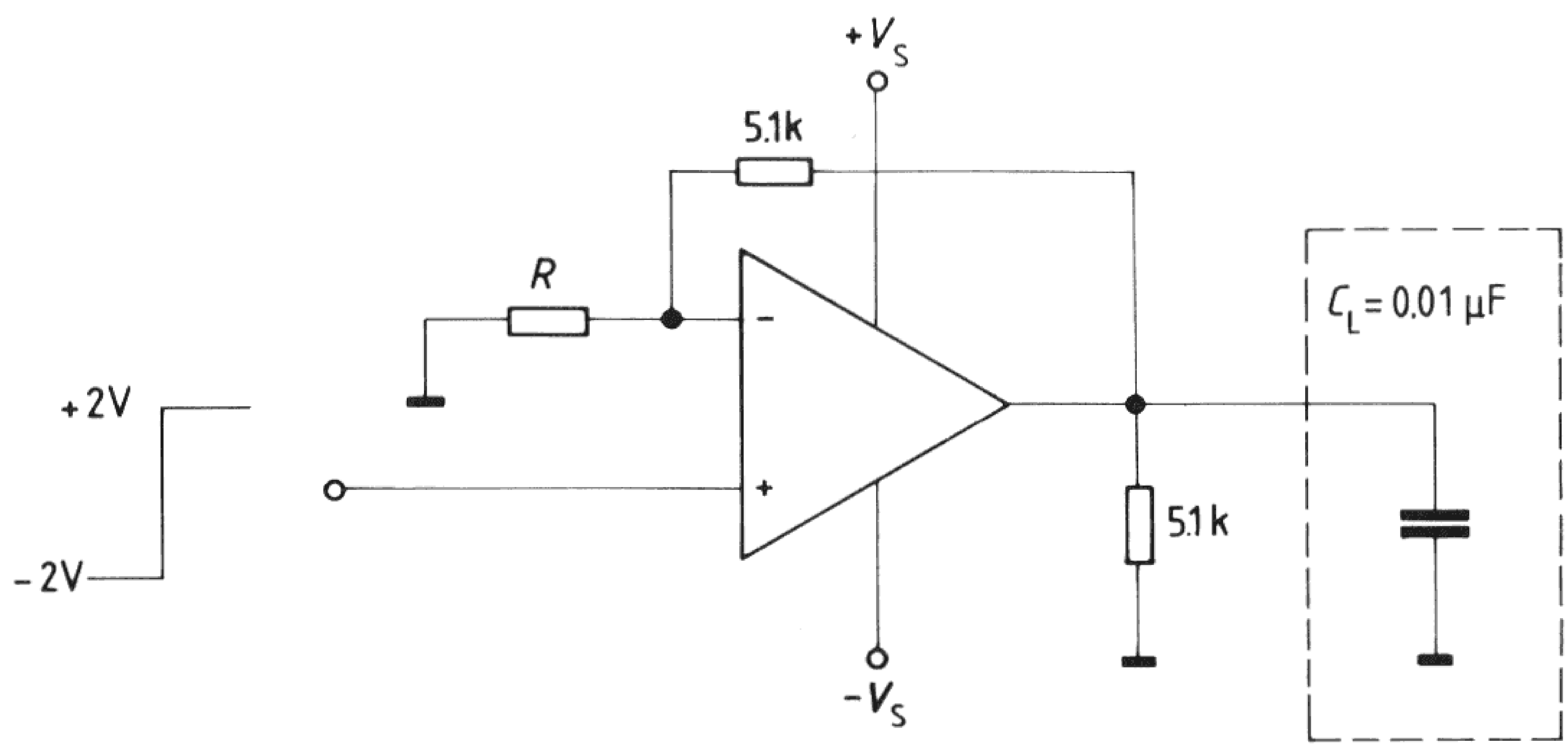
Hints for application

1. Offset voltage compensation



The input offset voltage is compensated with a 25 k potentiometer. The potentiometer wiper is connected to positive supply voltage $+V_S$.

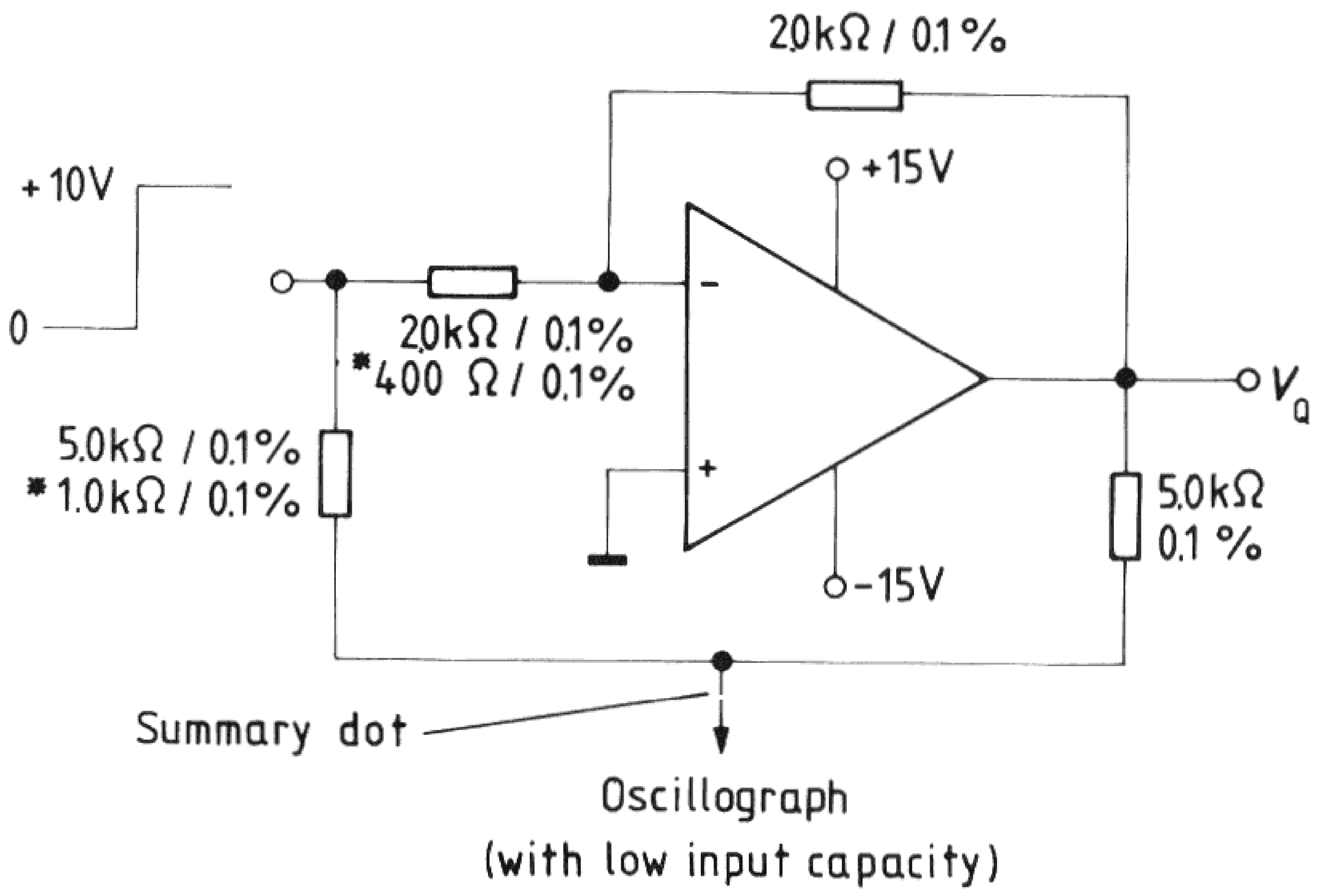
2. Capacitive output load



R = 5.1 k for LF 355 N/LF 356 N
R = 1.3 k for LF 357

Provided the stability remains constant, high capacitances can be loaded by amplifiers with $A_V = 1$. $C_{Lmax} \geqq 0.01$ µF, overshoot $\leqq$ 20%, transient time $\approx$ 5 µs.

3. Circuit for transient time measurements



*for A_V = 5 of the LF 357 N.

The transient time for the LF 355 N/LF 356 N is measured with A_V = 1, and for the LF 357 N with A_V = 5.