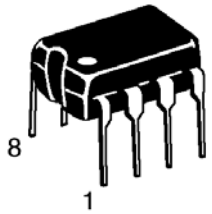
IL1776C

MICROPOWER PROGRAMMABLE OPERATIONAL AMPLIFIER

(equivalent of IC 1776C, Motorola)

IL1776C is a consumption current programmable operational amplifier with balancing of zero offset input voltage. This operational amplifier has low power consumption and high input resistance. Static currents inside the device may be programmed by external resistor nominal or by current source connected to input Iset. It allows to optimize the amplifier characteristics for input currents and power consumption within a wide range of IC operation supply voltages.



IL1776CN, Plastic, DIP8,
T_A = 0°C _ +70°C

IL1776CAN, Plastic, DIP8,
T_A = -40°C _ +85°C

IC characteristics

- Supply voltage from ±1.2 V to ±18 V
- Wide range of input programming
- Possibility for external adjustment of input offset voltage
- Internal frequency compensation
- Low input bias current
- Protection of output against short-circuit.

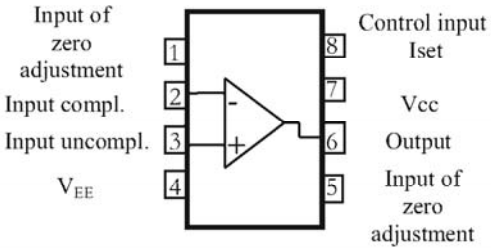
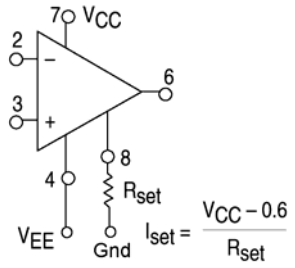


Fig. 1. Description of pins

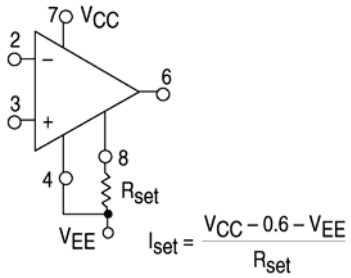
Resistive programming (see Fig. 3)

Connecting Rset to «ground»



Typical values of R_{set}		
V_{CC},V_{EE}	Iset=1.5mkA	Iset=15mkA
±6.0 V	3.6 MOhm	360 kOhm
±10 V	6.2 MOhm	620 kOhm
±12 V	7.5 MOhm	750 kOhm
±15 V	10 MOhm	1.0 MOhm

Connecting Rset to supply voltage (recommended for supply voltage lower than ±6.0 V)



Typical values of R_{set}		
V_{CC},V_{EE}	Iset=1.5mkA	Iset=15mkA
±1.5 V	1.6 MOhm	160 kOhm
±3.0 V	3.6 MOhm	360 kOhm
±6.0 V	7.5 MOhm	750 kOhm
±15 V	20 MOhm	2.0 MOhm

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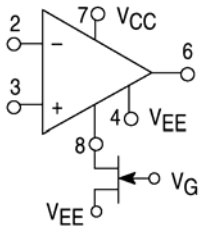
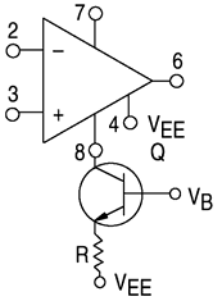
FET current source.



Current source on bipolar transistor.



The pins that are not shown are not connected.

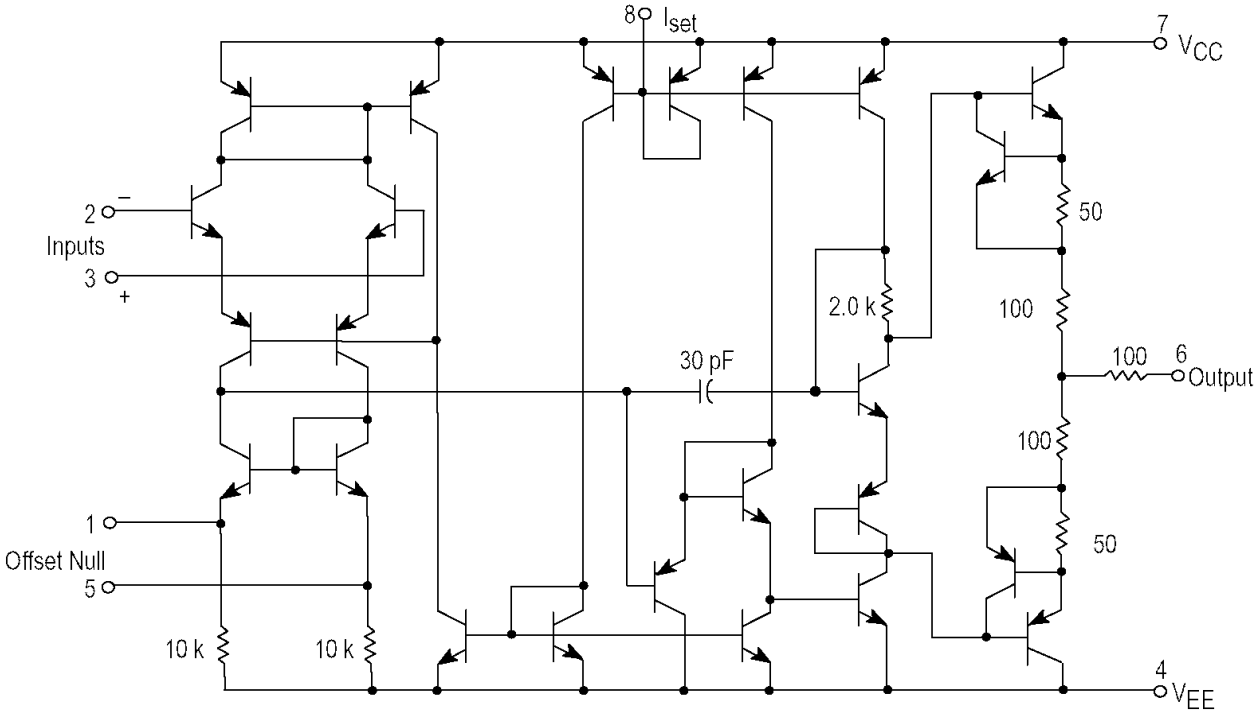
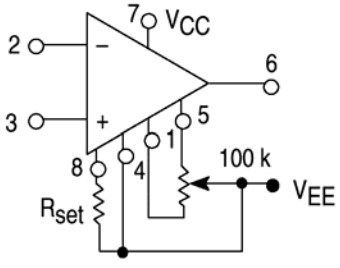
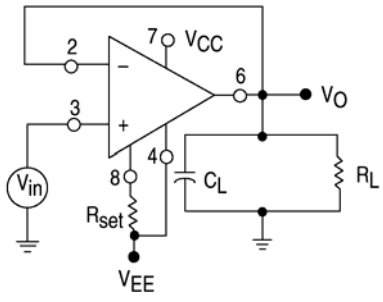


Fig.2 IL1776C connection layout.



Circuit of zero offset input voltage balancing



Test circuit for dynamic characterization.

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Table 1. Extreme electrical parameters.

Parameter, unit	Symbol	Extreme conditions	
		min	max
Supply voltage, V, bipolar	V_{CC}, V_{EE}	—	±18
Input voltage of differential signal, V	V_{ID}	—	±30
Input voltage of in-phase signal, V V_{CC} and $\lvert V_{EE} \rvert$ < 15V V_{CC} and $\lvert V_{EE} \rvert$ ≥ 15V	V_{ICM}	 — —	 V_{CC}, V_{EE} ±15
Balancing voltage to V_{EE}, V	V_{OFF}-V_{EE}	—	±0.5
Setting current, mkA	I_{SET}	—	500
Setting voltage, V, (voltage between output I_{SET} and output «ground»)	V_{SET}	V_{CC} – 2.0 V	V_{CC}
Duration of short-circuit output current input impact, c, I_{SET} ≤ 30 mkA.	t_{SC}		Not limited
Operation temperature range, °C IL1776CN IL1776CAN	T_A	 0 -40	 +70 +85
Storage temperature, °C	Tstg	-55	+125
Chip temperature, °C	Tj	—	150

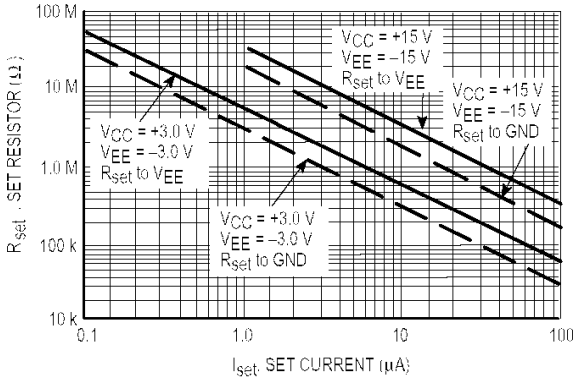

Fig.3 Setting current versus R_{SET}.resistor nominal

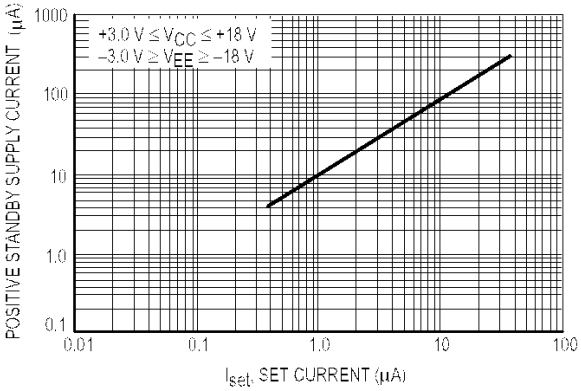

Fig.4 Consumption current versus setting current

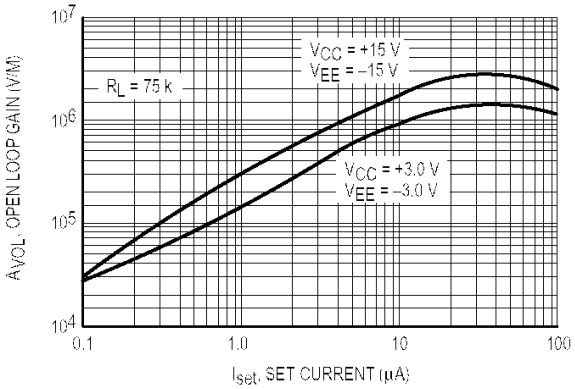

Fig.5 Amplification factor without feedback versus setting current.

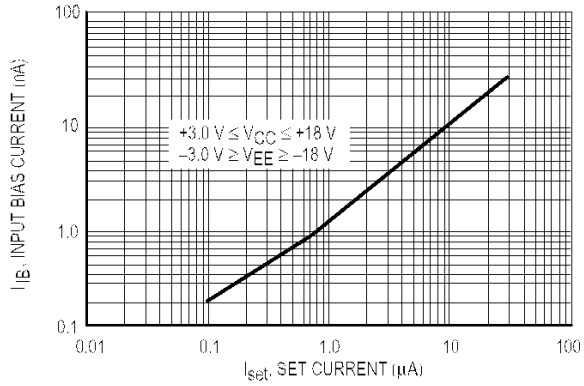

Fig.6 Input bias current versus setting current.

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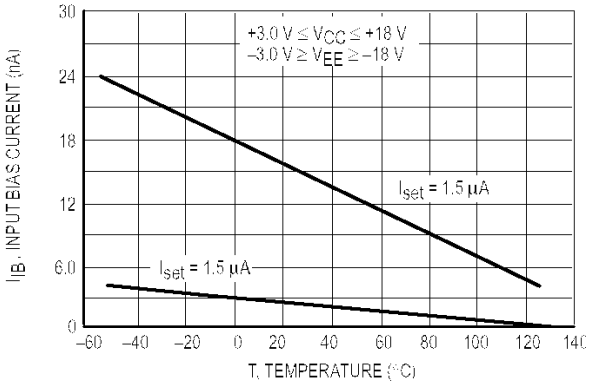

Fig.7 Input bias current versus temperature.

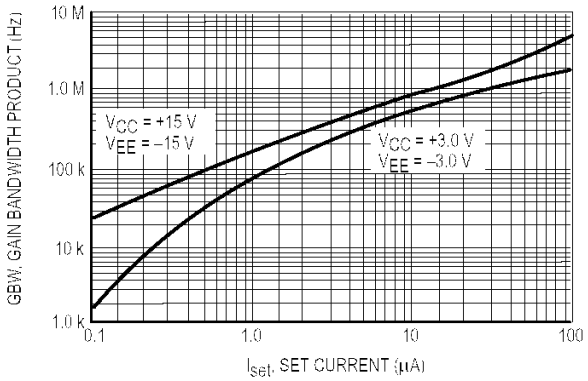

Fig.8 Bandwidth versus setting current.

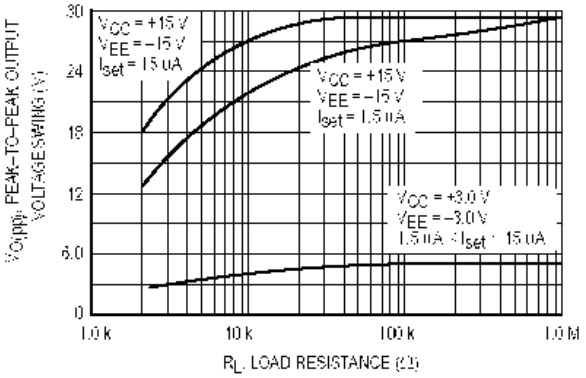

Fig.9 Output switching voltage (from max positive to max negative) versus load resistance.

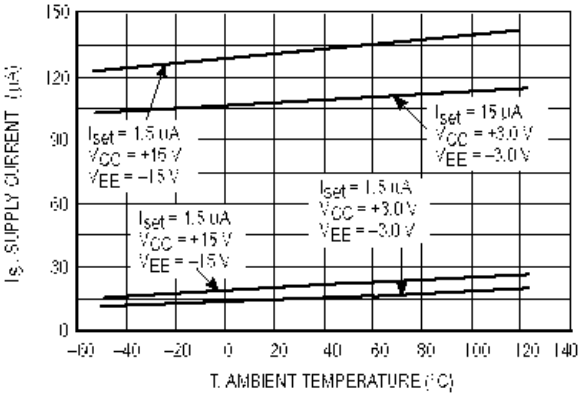

Fig.10 Consumption current versus ambient temperature.

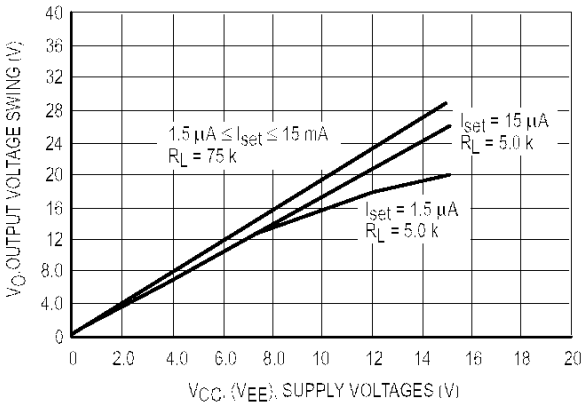

Fig.11 Output switching voltage versus supply voltage.

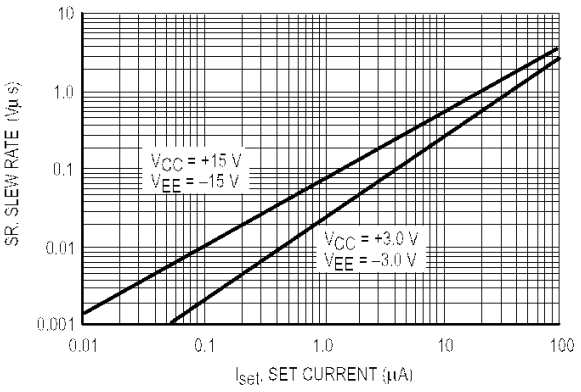

Fig.12 Output signal rising speed versus setting current

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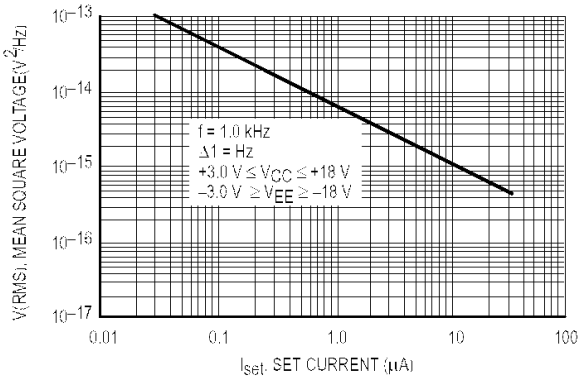


Fig.13 Input noise voltage versus setting current.

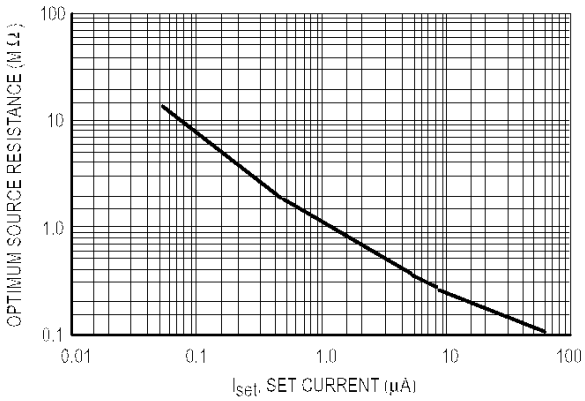
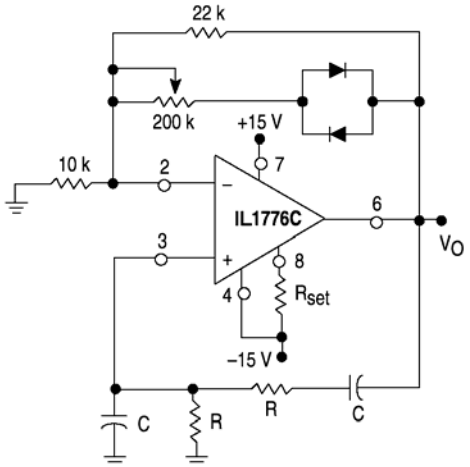
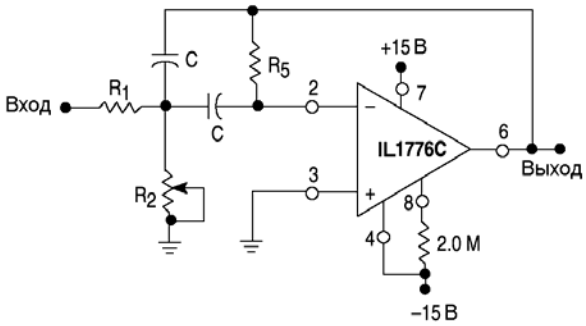


Fig.14 Optimum source resistance with min noises versus setting current.

Standard application circuits.



R=16 kOhm, C=0.01mkF
Fig.15 Oscillator on Wien bridge.



for filter of 1.0 кHz R1=160 kOhm
with parameters R2=820
Q=10, A(fo)=1 R5=300 kOhm
C=0.01 mkF

Fig.17 Band filter (1.0 кHz)

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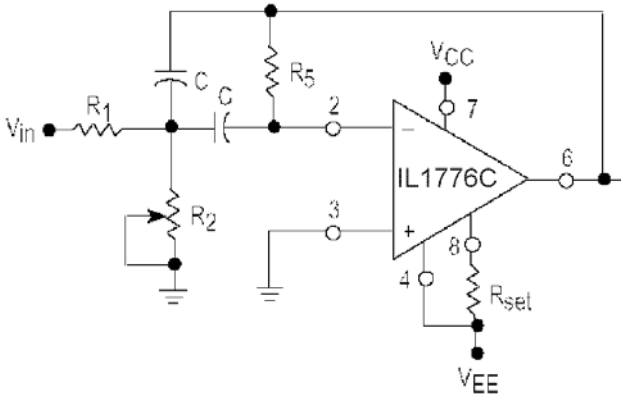

fo= central frequency;
A(fo)= amplification factor at central frequency;
Q= quality;
For circuit design, capacitance value C is to be determined then resistor nominals are calculated by the following formulas:

$$R_5=\frac{Q}{\pi foC},\ R_1=\frac{R5}{2A(fo)},\ R_2\ =\frac{R1,R5}{4Q^2R1-R5}$$

Conditions for error less than 10 % :

$$\frac{Qo\ fo}{GBW}\le 0,1$$

,where fo and GBW are in Hz.
Value of GBW is determined as per fig.8 as function of setting current I_{SET}.

Fig.16 Band filter.

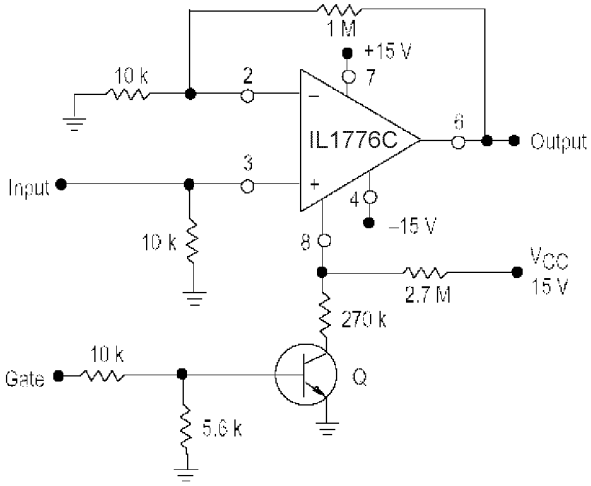

Fig.18 Amplifier with controlled programming input.

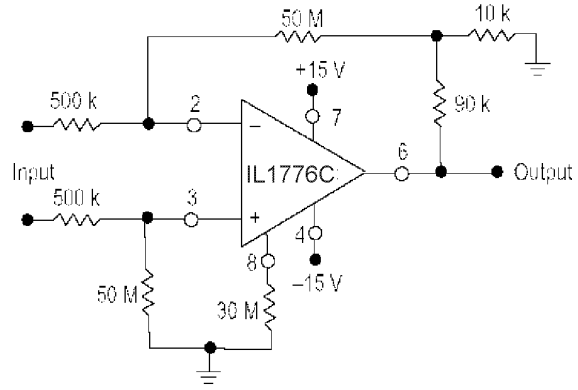

Fig.19 Amplifier with high input resistance.

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Table 2. Electrical parameters (V_{CC}= +3.0V, V_{EE}= −3.0V, I_{SET}= 1.5mkA, T_A= +25^{O}C, if another is not specified)

Name of parameter unit of measurement	Symbol	Standard IL1776CN			IL1776CAN		
		min	Type	max	min	Type	max
zero offset Input voltage, mV, Rs ≤ 10 kOhm	V_{IO}						
T_A= +25 ^{O}C		—	2.0	6.0	—	2.0	6.0
$T_{LOW} \le T_A \le T_{HIGH}$		—	—	7.5	—	—	7.5
Input offset voltage regulation range, mV	V_{IOR}	—	9.0	—	—	9.0	—
Difference of input currents , nA	I_{IO}						
T_A= +25 ^{O}C		—	0.7	6.0	—	0.7	6.0
T_A= T_{HIGH}		—	—	6.0	—	—	6.0
T_A= T_{LOW}		—	—	10	—	—	10
input bias current , nA	I_{IB}						
T_A= +25 ^{O}C		—	2.0	10	—	2.0	10
T_A= T_{HIGH}		—	—	10	—	—	10
T_A= T_{LOW}		—	—	20	—	—	20
input resistance , MOhm	r_I	—	50	—	—	50	—
input capacity , pF	c_I	—	2.0	—	—	2.0	—
differential signal input voltage range, V,	V_{ID}						
$T_{LOW} \le T_A \le T_{HIGH}$		±1.0	—	—	±1.0	—	—
amplification factor without feedback in large signal mode , V/V,	A_{VOL}			—	+25		
$R_L \ge$ 75 kOhm, V_O= ± 1.0 V, T_A= +25 ^{O}C		25к	200к	—	25к	200к	—
$R_L \ge$75kOhm, V_O= ±1.0V, $T_{LOW} \le T_A \le T_{HIGH}$		25к	—	—	25к	—	—
output voltage of switching , V, $R_L \ge$ 75 kOhm, $T_{LOW} \le T_A \le T_{HIGH}$	V_O	±2.0	±2.4	—	±1.9	±2.4	—
output resistance, kOhm	r_O	—	5.0	—	—	5.0	—
short-circuit output current , mA	I_{SC}	—	3.0	—	—	3.0	—
in-phase signal attenuation factor, dB, Rs≤10kOhm, $T_{LOW} \le T_A \le T_{HIGH}$	CMR	70	86	—	70	86	—
attenuation factor of supply voltage change, mkV/V, Rs≤10kOhm, $T_{LOW} \le T_A \le T_{HIGH}$	PSRR	—	25	200	—	25	200
consumption current , mkA	I_{CC},I_{EE}						
T_A= +25 ^{O}C		—	13	20	—	13	20
$T_{LOW} \le T_A \le T_{HIGH}$		—	—	25	—	—	25
dispersal power , mkW	P_D						
T_A= +25 ^{O}C		—	78	120	—	78	120
$T_{LOW} \le T_A \le T_{HIGH}$		—	—	150	—	—	150
dynamic characteristics (with single amplification factor) Vin=20 mV, $R_L \ge$5.0 kOhm, C_L=100 pF							
output signal rise time ,mks,	t_{TLH}	—	3.0	—	—	3.0	—
output signal release amplitude, %	OS	—	0	—	—	0	—
output signal rising speed, V/mkC, $R_L \ge$ 5.0 kOhm	S_R	—	0.03	—	—	0.03	—

T_{LOW} = -40^{O}C for IL1776CAN T_{HIGH}= +85^{O}C for IL1776CAN
0^{O}C for IL1776CN +70^{O}C for IL1776CN

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Table 3. Electrical parameters (V_{CC}= +3.0V, V_{EE}= –3.0V, I_{SET}= 15mkA, T_A= +25^{O}C, if another is not specified)

name of parameter, unit of measurement	symbol	standard IL1776CN			IL1776CAN		
		min	Type	max	min	Type	max
zero offset Input voltage, mV, Rs ≤ 10 kOhm	V_{IO}						
T_A= +25 ^{O}C		—	2.0	6.0	—	2.0	6.0
$T_{LOW} \le T_A \le T_{HIGH}$		—	—	7.5	—	—	7.5
Input offset voltage regulation range, mV	V_{IOR}	—	18	—	—	18	—
Difference of input currents, nA	I_{IO}						
T_A= +25 ^{O}C		—	2.0	25	—	2.0	25
T_A= T_{HIGH}		—	—	25	—	—	25
T_A= T_{LOW}		—	—	40	—	—	40
input bias current, nA	I_{IB}						
T_A= +25 ^{O}C		—	15	50	—	15	50
T_A= T_{HIGH}		—	—	50	—	—	50
T_A= T_{LOW}		—	—	100	—	—	100
input resistance, MOhm	r_I	—	5.0	—	—	5.0	—
input capacity, pF	c_I	—	2.0	—	—	2.0	—
differential signal input voltage range, V,	V_{ID}						
$T_{LOW} \le T_A \le T_{HIGH}$		±1.0	—	—	±1.0	—	—
amplification factor without feedback in large signal mode , V/V,	A_{VOL}			—	+25		
R_L ≥5.0кOhm, V_O=±1.0V, T_A=+25^{O}C		25к	200к	—	25к	200к	—
R_L ≥5.0кOhm, V_O=±1.0 V, $T_{LOW} \le T_A \le T_{HIGH}$		25к	—	—	25к	—	—
output voltage of switching,V, $R_L \ge$ 5.0 kOhm, $T_{LOW} \le T_A \le T_{HIGH}$	V_O	±2.0	±2.1	—	±1.9	±2.1	—
output resistance, kOhm	r_O	—	1.0	—	—	1.0	—
short-circuit output current, mA	I_{SC}	—	5.0	—	—	5.0	—
in-phase signal attenuation factor, dB, Rs ≤ 10 kOhm, $T_{LOW} \le T_A \le T_{HIGH}$	CMR	70	86	—	70	86	—
attenuation factor of supply voltage change, mkV/V, Rs≤10kOhm, $T_{LOW} \le T_A \le T_{HIGH}$	PSRR	—	25	200	—	25	200
consumption current, mkA	I_{CC},I_{EE}						
T_A= +25 ^{O}C		—	130	170	—	130	170
$T_{LOW} \le T_A \le T_{HIGH}$		—	—	180	—	—	180
dispersal power, mkW	P_D						
T_A= +25 ^{O}C		—	780	1020	—	780	1020
$T_{LOW} \le T_A \le T_{HIGH}$		—	—	1080	—	—	1080
dynamic characteristics (with single amplification factor) Vin=20 mV, $R_L \ge$ 5.0kOhm, C_L=100 pF							
output signal rise time ,mks,	t_{TLH}	—	0.6	—	—	0.6	—
output signal release amplitude, %	OS	—	5.0	—	—	5.0	—
output signal rising speed, V/mkC, $R_L \ge$ 5.0 kOhm	S_R	—	0.35	—	—	0.35	—

T_{LOW} = -40^{O}C for IL1776CAN
0^{O}C for IL1776CN

T_{HIGH}= +85^{O}C for IL1776CAN
+70^{O}C for IL1776CN

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Table 4. Electrical parameters (V_{CC}= +15V, V_{EE}= −15V, I_{SET}= 1.5mkA, T_A= +25^{O}C, if another is not specified)

Name of parameter, unit of measurement	Symbol	Standard IL1776CN			IL1776CAN		
		min	Type	max	min	Type	max
zero offset Input voltage, mV, Rs ≤ 10 kOhm	V_{IO}						
T_A= +25 ^{O}C		—	2.0	6.0	—	2.0	6.0
$T_{LOW} \le T_A \le T_{HIGH}$		—	—	7.5	—	—	7.5
Input offset voltage regulation range, mV	V_{IOR}	—	9.0	—	—	9.0	—
Difference of input currents, nA	I_{IO}						
T_A= +25 ^{O}C		—	0.7	6.0	—	0.7	6.0
T_A= T_{HIGH}		—	—	6.0	—	—	6.0
T_A= T_{LOW}		—	—	10	—	—	10
input bias current, nA	I_{IB}						
T_A= +25 ^{O}C		—	2.0	10	—	2.0	10
T_A= T_{HIGH}		—	—	10	—	—	10
T_A= T_{LOW}		—	—	20	—	—	20
input resistance, MOhm	r_I	—	50	—	—	50	—
input capacity, pF	c_I	—	2.0	—	—	2.0	—
differential signal input voltage range, V,	V_{ID}						
$T_{LOW} \le T_A \le T_{HIGH}$		±10	—	—	±10	—	—
amplification factor without feedback in large signal mode , V/V,	A_{VOL}			—	+25		
$R_L \ge$ 75 kOhm, V_O= ± 10 V, T_A= +25 ^{O}C		50к	400к	—	50к	400к	—
$R_L \ge$ 75 kOhm, V_O= ±10 V, $T_{LOW} \le T_A \le T_{HIGH}$		50к	—	—	50к	—	—
output voltage of switching, V,	V_O						
$R_L \ge$ 75 kOhm, T_A= +25 ^{O}C		±12	±14	—	±12	±14	—
$R_L \ge$ 75 kOhm, $T_{LOW} \le T_A \le T_{HIGH}$		±10	—		±10	—	
output resistance, kOhm	r_O	—	5.0	—	—	5.0	—
short-circuit output current, mA	I_{SC}	—	3.0	—	—	3.0	—
in-phase signal attenuation factor, dB, Rs ≤ 10 kOhm, $T_{LOW} \le T_A \le T_{HIGH}$	CMR	70	90	—	70	90	—
attenuation factor of supply voltage change, mkV/V, Rs ≤ 10 kOhm, $T_{LOW} \le T_A \le T_{HIGH}$	PSRR	—	25	200	—	25	200
consumption current, mkA	I_{CC},I_{EE}						
T_A= +25 ^{O}C		—	20	30	—	20	30
$T_{LOW} \le T_A \le T_{HIGH}$		—	—	35	—	—	35
dispersal power, mkW	P_D						
T_A= +25 ^{O}C		—	0.78	0.9	—	0.78	0.9
$T_{LOW} \le T_A \le T_{HIGH}$		—	—	1.05	—	—	1.05
dynamic characteristics (with single amplification factor) Vin=20mV, $R_L \ge$ 5.0 kOhm, C_L=100 pF							
output signal rise time ,mks,	t_{TLH}	—	1.6	—	—	1.6	—
output signal release amplitude, %	OS	—	0	—	—	0	—
output signal rising speed, V/mkC, $R_L \ge$ 5.0 kOhm	S_R	—	0.1	—	—	0.1	—

T_{LOW} = -40^{O}C for IL1776CAN T_{HIGH}= +85^{O}C for IL1776CAN
0^{O}C forIL1776CN +70^{O}C for IL1776CN

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Table 5. Electrical parameters (V_{CC}= +15V, V_{EE}= –15V, I_{SET}= 15mkA, T_A= +25^{O}C, if another is not specified)

Name of parameter, unit of measurement	symbol	Standard IL1776CN			IL1776CAN		
		min	Type	max	min	Type	max
zero offset Input voltage, mVB, Rs ≤ 10 kOhm	V_{IO}						
T_A= +25 ^{O}C		—	2.0	6.0	—	2.0	6.0
$T_{LOW} \le T_A \le T_{HIGH}$		—	—	7.5	—	—	7.5
Input offset voltage regulation range, mV	V_{IOR}	—	18	—	—	18	—
Difference of input currents, nA	I_{IO}						
T_A= +25 ^{O}C		—	2.0	25	—	2.0	25
T_A= T_{HIGH}		—	—	25	—	—	25
T_A= T_{LOW}		—	—	40	—	—	40
input bias current, nA	I_{IB}						
T_A= +25 ^{O}C		—	15	50	—	15	50
T_A= T_{HIGH}		—	—	50	—	—	50
T_A= T_{LOW}		—	—	100	—	—	100
input resistance, MOhm	r_I	—	5.0	—	—	5.0	—
input capacity, pF	c_I	—	2.0	—	—	2.0	—
differential signal input voltage range, V,	V_{ID}						
$T_{LOW} \le T_A \le T_{HIGH}$		±10	—	—	±10	—	—
amplification factor without feedback in large signal mode , V/V	A_{VOL}			—	+25		
$R_L \ge$ 5.0 kOhm, V_O= ± 10 V, T_A= +25 ^{O}C		50к	400к	—	50к	400к	—
$R_L \ge$ 75 kOhm, V_O= ± 10 V, $T_{LOW} \le T_A \le T_{HIGH}$		50к	—	—	50к	—	—
output voltage of switching, V,	V_O						
$R_L \ge$ 5.0 kOhm, T_A= +25 ^{O}C		±10	±13	—	±10	±13	—
$R_L \ge$ 75 kOhm, $T_{LOW} \le T_A \le T_{HIGH}$		±10	—		±10	—	
output resistance, kOhm	r_O	—	1.0	—	—	1.0	—
short-circuit output current, mA	I_{SC}	—	12	—	—	12	—
in-phase signal attenuation factor, dB, Rs ≤ 10 kOhm, $T_{LOW} \le T_A \le T_{HIGH}$	CMR	70	90	—	70	90	—
attenuation factor of supply voltage change, mkV/V, Rs ≤ 10 kOhm, $T_{LOW} \le T_A \le T_{HIGH}$	PSRR	—	25	200	—	25	200
consumption current, mkA	I_{CC},I_{EE}						
T_A= +25 ^{O}C		—	160	190	—	160	190
$T_{LOW} \le T_A \le T_{HIGH}$		—	—	200	—	—	200
dispersal power, mkW	P_D						
T_A= +25 ^{O}C		—	—	5.7	—	—	5.7
$T_{LOW} \le T_A \le T_{HIGH}$		—	—	6.0	—	—	6.0
dynamic characteristics (with single amplification factor) Vin=20mV, $R_L \ge$ 5.0 kOhm, C_L=100 pF							
output signal rise time ,mks,	t_{TLH}	—	0.35	—	—	0.35	—
output signal release amplitude, %	OS	—	10	—	—	10	—
output signal rising speed, V/mkC, $R_L \ge$ 5.0 kOhm	S_R	—	0.8	—	—	0.8	—

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