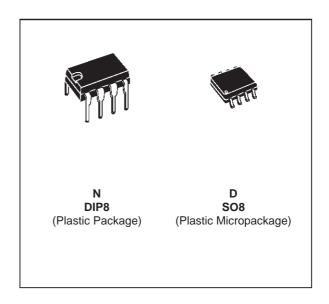


## **UA776**

# PROGRAMMABLE LOW POWER SINGLE OPERATIONAL AMPLIFIERS

- MICROPOWER OPERATION
- NO FREQUENCY COMPENSATION REQUIRED
- WIDE PROGRAMMING RANGE
- HIGH SLEW RATE
- SHORT-CIRCUIT PROTECTION
- PROGRAMMABLE SINGLE OP-AMP



#### **ORDER CODES**

Part	Temperature	Package				
Number	Range	N	D			
UA776C	0°C, +70°C	•	•			
UA776I	-40°C, +105°C	•				
UA776M	-55°C, +125°C	•				
Example: UA776CN						

#### **DESCRIPTION**

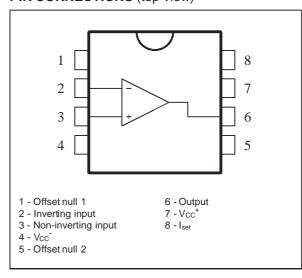
The UA776 programmable operational amplifier is characterized by low supply current and low equivalent input noise voltage over a wide range of operating supply voltages.

Coupled with programmable electrical characteristics, it is a versatile amplifier for use in high accuracy, low power consumption analog applications.

Input noise voltage and current, power consumption and input current can be optimized by a single resistor or current source that sets the chip quiescent current for nano-watt power consumption or for characteristics similar to the UA741.

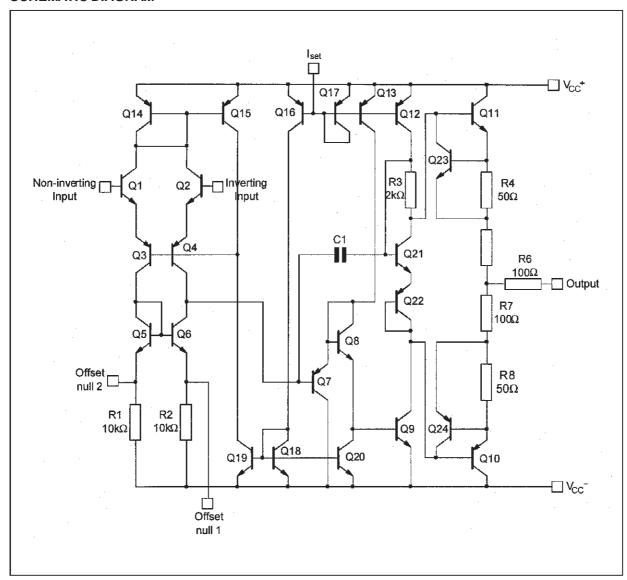
Internal frequency compensation, absence of latch up, high slew rate and short-circuit protection assure ease of use in long time integrators, active filters, and sample and hold circuits.

#### PIN CONNECTIONS (top view)



December 1997 1/8

#### **SCHEMATIC DIAGRAM**



#### **ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	UA776M	UA776I	UA776C	Unit
V <sub>cc</sub>	Supply Voltage		V		
V <sub>id</sub>	Differential Input Voltage		±30		V
Vi	Input Voltage - (note 1)		V		
P <sub>tot</sub>	Power Dissipation	500	310	310	mW
	Output Short-circuit Duration	it Duration			
T <sub>oper</sub>	Operating Free Air Temperature Range	-55 to +125	-40 to +105	0 to +70	°C
T <sub>stg</sub>	Storage Temperature Range	-65 to +150	-65 to +150	-65 to +150	°C

Note: 1. For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

## **ELECTRICAL CHARACTERISTICS** $V_{CC} \pm 15V$ , $T_{amb} = +25^{\circ}C$ (unless otherwise specified)

Symbol	Parameter		I <sub>set</sub> = 1.5μA			I <sub>set</sub> = 15μA		
	Parameter	Min.	Тур.	Max.	Min.	Тур.	Max.	Unit
Vio	Input Offset Voltage							mV
	$T_{amb} = +25^{\circ}C$		2	5 6		2	5 6	
I.	T <sub>min.</sub> ≤ T <sub>amb</sub> ≤ T <sub>max.</sub>			0			0	n ^
l <sub>io</sub>	Input Offset Current T <sub>amb</sub> = +25°C		0.7	3		2	15	nA
	$T_{min.} \le T_{amb} \le T_{max.}$		0	10		_	40	
$I_{ib}$	Input Bias Current					4.5	<b>50</b>	nA
	T <sub>amb</sub> = +25°C UA776M UA776I,C		2 2	7.5 10		15 15	50 50	
	$T_{\text{min.}} \le T_{\text{amb}} \le T_{\text{max.}}$		_	20		.0	100	
$A_{vd}$	Large Signal Voltage Gain (V <sub>O</sub> ±10V)							V/mV
	$T_{amb} = +25^{\circ}C$ $R_{L} = 5kΩ$ $R_{L} = 75kΩ$	200	400		100	400		
	$T_{min.} \le T_{amb} \le T_{max.}$ $R_L = 75k\Omega$	100	400					
	$R_L = 5k\Omega$				75			
SVR	Supply Voltage Rejection Ratio ( $R_S \le 10k\Omega$ ) $T_{amb} = +25^{\circ}C$	77	92		77	92		dB
	$T_{amb} = +23 G$ $T_{min.} \le T_{amb} \le T_{max.}$	77	92		77	92		
Icc	Supply Current, no load							μΑ
	$T_{amb} = +25^{\circ}C$		20	25		160	180	
١/.	Tmin. ≤ Tamb ≤ Tmax.	±10		30	±10		200	V
V <sub>icm</sub> CMR	Input Common Mode Voltage Range  Common-mode Rejection Ratio (R <sub>S</sub> ≤ 10kΩ)	±10			±10			dB
CIVIN	$T_{amb} = +25^{\circ}C$							uБ
	$T_{min.}^{-} \le T_{amb} \le T_{max.}$	70	90		70	90		
1	Output Chart sireuit Current	70	2	4.5	70	10	20	A
los	Output Short-circuit Current	0.5	3	15	6	12	30	mA V
±V <sub>OPP</sub>	Output Voltage Swing $T_{amb} = +25^{\circ}C$ $R_{L} = 5k\Omega$							V
	$R_L = 75k\Omega$	40	4.4		10	13		
	$T_{min.} \le T_{amb} \le T_{max.}$ $R_L = 75k\Omega$	12 10	14		10			
Vior	Offset Voltage Adjustment Range		9			18		mV
SR	Slew Rate ( $V_i = \pm 10V$ , $C_L = 100pF$ , unity gain)							V/ms
	$R_L = 5k\Omega$				0.0	0.0		
	$R_L = 75k\Omega$	0.01	0.1		0.2	0.8		
t <sub>r</sub>	Rise Time ( $V_i = \pm 20$ mV, $C_L = 100$ pF, unity gain)	0.0.	0					ms
	$R_L = 5k\Omega$					0.05		
	$R_L = 75k\Omega$		1.6			0.35		
Kov	Overshoot ( $V_i = \pm 20$ mV, $CL = 100$ pF, unity gain)		1.0					%
01	$R_L = 5k\Omega$							, ,
	$R_L = 75k\Omega$		0			10		
Rı	Input Resistance		50			5		ΜΩ
C <sub>id</sub>	Differential Input Capacitance		2			2		pF
R <sub>o</sub>	Output Resistance		5			1		kΩ
GBP	Gain Bandwidth Product ( $C_L = 100pF, T_{amb} = 25^{\circ}C$ )					<u> </u>		MHz
- '-	$f = 100kHz$ $R_L = 5k\Omega$							
	$f = 10kHz$ $R_L = 75k\Omega$	0.3	0.1		0.4	0.7		
THD	Total Harmonic Distortion (f = 1kHz, A <sub>V</sub> = 20dB,	0.0	0.1					%
	$V_O = 2V_{PP}, C_L = 100pF, T_{amb} = 25^{\circ}C$							70
	$R_L = 5k\Omega$ $R_L = 75k\Omega$					0.025		
	17[ - 10/22		0.8			0.023		
en	Equivalent Input Noise Voltage							nV
	$(f = 1kHz, R_s = 100\Omega)$		40			20		√Hz

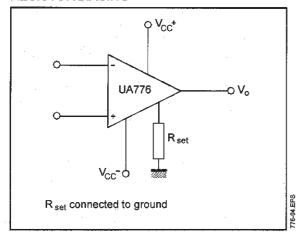


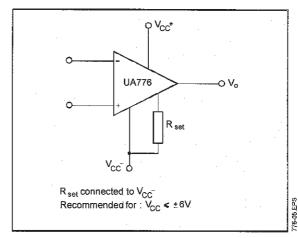
## **ELECTRICAL CHARACTERISTICS** $V_{CC} \pm 3V$ , $T_{amb} = +25^{\circ}C$ (unless otherwise specified)

Symbol	Parameter		I <sub>set</sub> = 1.5μA			I <sub>set</sub> = 15μA		
Jynnoon	Faranietei	Min.	Тур.	Max.	Min.	Тур.	Max.	Unit
V <sub>io</sub>	Input Offset Voltage			_			_	mV
	$T_{amb} = +25^{\circ}C$ $T_{min.} \le T_{amb} \le T_{max.}$		2	5 6		2	5 6	
lio	Input Offset Current							nA
	$ T_{amb} = +25^{\circ}C $ $ T_{min.} \le T_{amb} \le T_{max}. $		0.7	3 10		2	15 40	
l <sub>ib</sub>	$ \begin{array}{ll} \text{Input Bias Current} \\ T_{amb} = +25^{\circ}\text{C} & \text{UA776M} \\ \text{UA776I,C} \\ T_{min.} \leq T_{amb} \leq T_{max.} \end{array} $		2 2	7 10 20		15 15	50 50 100	nA
A <sub>vd</sub>	$ \begin{array}{ll} \text{Large Signal Voltage } \text{Gain} \left( V_O \pm 10 V \right) \\ \text{$T_{amb} = +25^{\circ}$C} & \text{$R_L = 5$k$\Omega} \\ \text{$R_L = 75$k$\Omega} & \text{$T_{min.} \leq T_{amb} \leq T_{max.}$} \\ \text{$R_L = 5$k$\Omega} & \text{$R_L = 75$k$\Omega} \\ \end{array} $	50	200		50 25	200		V/mV
SVR	Supply Voltage Rejection Ratio (R <sub>S</sub> ≤ 10kΩ)	20						dB
	$T_{amb} = +25 ^{\circ} C$ $T_{min.} \leq T_{amb} \leq T_{max.}$	77 77	92		77 77	92		42
Icc	Supply Current, no load $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		13	20 25		130	160 180	μΑ
$V_{\text{icm}}$	Input Common Mode Voltage Range	±1			±1			V
CMR	Common-mode Rejection Ratio (R <sub>S</sub> ≤ 10kΩ)							dB
	$T_{amb} = +25^{\circ}C$ $T_{min.} \le T_{amb} \le T_{max.}$	70 70	90		70 70	90		
los	Output Short-circuit Current	0.5	3	15	2	5	20	mA
±V <sub>OPP</sub>		2 2	2.4		2 1.9 2 1.9	2.4 2.1		V
V <sub>ior</sub>	Offset Voltage Adjustment Range		9		1.0	18		mV
SR	Slew Rate (V <sub>i</sub> = ±10V, C <sub>L</sub> = 100pF, unity gain)	+	<u> </u>			10		V/ms
OIX	$R_{L} = 5k\Omega$ $R_{L} = 75k\Omega$		0.03			0.35		V/III3
t <sub>r</sub>	Rise Time (V <sub>i</sub> = $\pm 20$ mV, C <sub>L</sub> = 100pF, unity gain) R <sub>L</sub> = $5$ k $\Omega$ R <sub>L</sub> = $75$ k $\Omega$		3			0.6		μs
K <sub>OV</sub>	Overshoot (V <sub>i</sub> = $\pm 20$ mV, CL = 100pF, unity gain) R <sub>L</sub> = $5$ k $\Omega$ R <sub>L</sub> = $75$ k $\Omega$		0			5		%
Rı	Input Resistance		50			5		MΩ
$C_{id}$	Differential Input Capacitance		2			2		pF
Ro	Output Resistance		5			1		kΩ
GBP	$ \begin{array}{ll} \text{Gain Bandwidth Product ($C_L$= 100pF,$T_{amb}$ = $25^{\circ}$C) \\ \text{f} = 100\text{kHz} & \text{R}_L = 5\text{k}\Omega \\ \text{f} = 10\text{kHz} & \text{R}_L = 75\text{k}\Omega \end{array} $		0.075			0.5		MHz
THD	Total Harmonic Distortion (f = 1kHz, A $_V$ = 20dB, $V_O$ = 2 $V_{PP}$ , $C_L$ = 100pF, $T_{amb}$ = 25 $^{\circ}$ C) $R_L$ = 5k $\Omega$ $R_L$ = 75k $\Omega$		1			0.03		%
en	Equivalent Input Noise Voltage $(f = 1kHz, R_s = 100\Omega)$		20			20		$\frac{\text{nV}}{\sqrt{\text{Hz}}}$

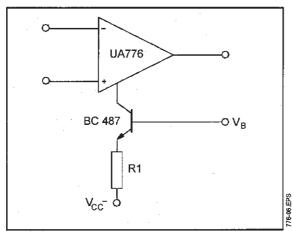
#### **BIASING CIRCUITS**

#### **RESISTOR BIASING**

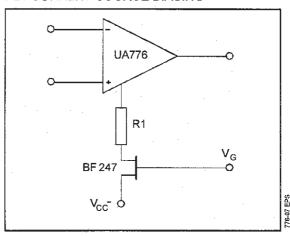




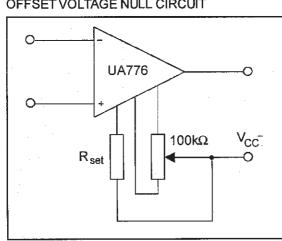
#### TRANSISTOR CURRENT SOURCE BIASING



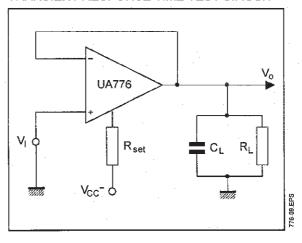
#### FET CURRENT SOURCE BIASING



#### OFFSET VOLTAGE NULL CIRCUIT

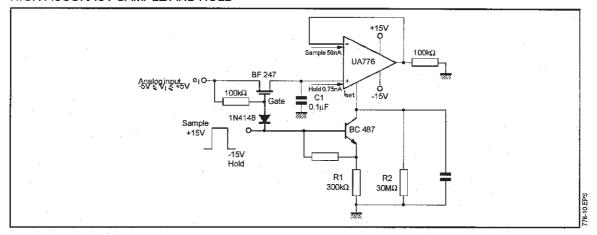


#### TRANSIENT RESPONSE TIME TEST CIRCUIT

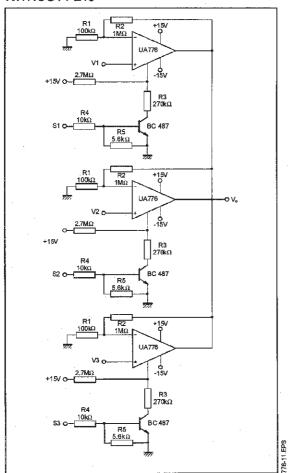


#### **TYPICAL APPLICATIONS**

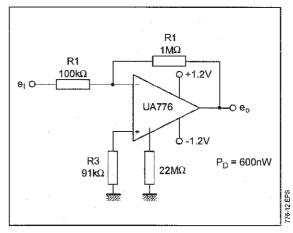
#### HIGH ACCURACY SAMPLE AND HOLD



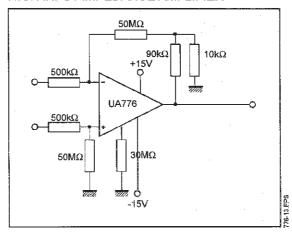
## MULTIPLEXING AND SIGNAL CONDITIONING WITHOUT FETS



#### NANO-WATT AMPLIFIER

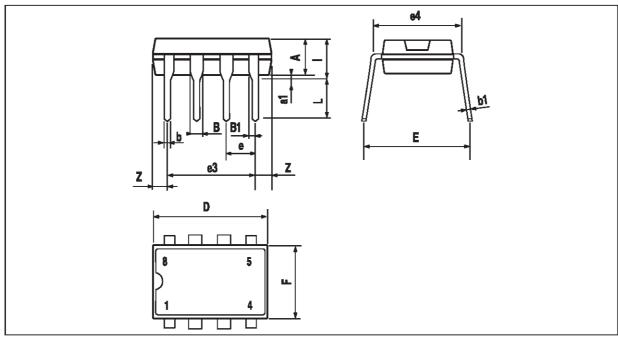


#### HIGH INPUT IMPEDANCE AMPLIFIER



#### **PACKAGE MECHANICAL DATA**

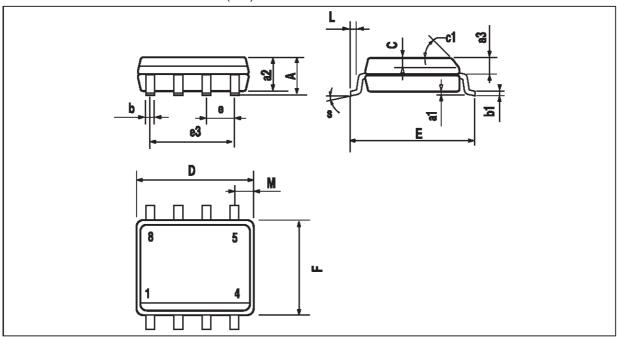
8 PINS - PLASTIC DIP



Dim.	Millimeters			Inches				
Dilli.	Min.	Тур.	Max.	Min.	Тур.	Max.		
Α		3.32			0.131			
a1	0.51			0.020				
В	1.15		1.65	0.045		0.065		
b	0.356		0.55	0.014		0.022		
b1	0.204		0.304	0.008		0.012		
D			10.92			0.430		
E	7.95		9.75	0.313		0.384		
е		2.54			0.100			
e3		7.62			0.300			
e4		7.62			0.300			
F			6.6			0260		
i			5.08			0.200		
L	3.18		3.81	0.125		0.150		
Z			1.52			0.060		

#### **PACKAGE MECHANICAL DATA**

8 PINS - PLASTIC MICROPACKAGE (SO)



Dim.	Millimeters			Inches			
Dilli.	Min.	Тур.	Max.	Min.	Тур.	Max.	
Α			1.75			0.069	
a1	0.1		0.25	0.004		0.010	
a2			1.65			0.065	
a3	0.65		0.85	0.026		0.033	
b	0.35		0.48	0.014		0.019	
b1	0.19		0.25	0.007		0.010	
С	0.25		0.5	0.010		0.020	
c1		•	45°	(typ.)	•		
D	4.8		5.0	0.189		0.197	
E	5.8		6.2	0.228		0.244	
е		1.27			0.050		
e3		3.81			0.150		
F	3.8		4.0	0.150		0.157	
L	0.4		1.27	0.016		0.050	
М			0.6			0.024	
S	8° (max.)						

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