MIC861



Teeny[™] Ultra-Low-Power Op Amp

General Description

The MIC861 is a rail-to-rail output, input common-mode to ground, operational amplifier in Teeny[™] SC70 packaging. The MIC861 provides a 400kHz gain-bandwidth product while consuming an incredibly low 4.6µA supply current.

The SC70 packaging achieves significant board space savings over devices packaged in SOT-23 or MSOP-8 packaging. The SC70 occupies approximately half the board area of a SOT-23 package.

Datasheets and support documentation are available on Micrel's website at: <u>www.micrel.com</u>.

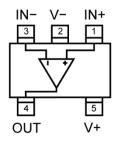
Features

- Teeny™ SC70 packaging
- 400kHz gain-bandwidth product
- 650kHz, -3dB bandwidth
- 4.6µA supply current
- Rail-to-rail output
- Ground sensing at input (common mode to GND)
- Drives large capacitive loads (1000pF)
- Unity gain stable

Applications

- Portable equipment
- PDAs
- Pagers
- Cordless phones
- Consumer electronics

Functional Pinout



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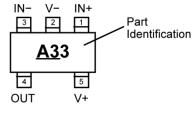
Ordering Information

Part Number	Marking ⁽¹⁾	Ambient Temperature Range	Package
MIC861YC5	<u>A3</u> 3	–40° to +85°C	5-Pin SC70

Note:

1. Underbar marking may not be to scale.

Pin Configuration



5-Pin SC70 (C5) (Top View)

Pin Description

Pin Number	Pin Name	Pin Function
1	IN+	Non-inverting input.
2	V-	Negative power supply connection. Connect a $10\mu F$ and $0.1\mu F$ capacitor in parallel to this pin for power supply bypassing.
3	IN-	Inverting input.
4	OUT	Output of operational amplifier.
5	V+	Positive power supply input. Connect a 10μ F and 0.1μ F capacitor in parallel to this pin for power supply bypassing.

Absolute Maximum Ratings⁽²⁾

Supply Voltage (V _{V+} – V _{V-})	+6.0V
Differential Input Voltage V _{IN+} - V _{IN-}	+6.0V
Input Voltage (V _{IN+} – V _{IN-})	. V ₊ + 0.3V, V ₋ - 0.3V
Lead Temperature (soldering, 5s)	
Output Short Circuit Current Duration	Indefinite
Storage Temperature (Ts)	150°C
ESD Rating	Note 4

Operating Ratings⁽³⁾

Supply Voltage $(V_{V+} - V_{V-})$	+2.43V to +5.25V
Ambient Temperature (T _A)	40°C to +85°C
Junction Thermal Resistance	
5-Pin SC70 (Θ _{JA})	450°C/W

Electrical Characteristics⁽⁵⁾

 $V+=+2.7V, V-=0V, V_{CM}=V+/2; R_L=500k\Omega \text{ to } V+/2; T_A=25^{\circ}C, \text{ bold } \text{values indicate } -40^{\circ}C \leq T_A \leq +85^{\circ}C, \text{ unless noted.}$

Symbol	Parameter	Condition	Min.	Тур.	Max.	Units
V _{os}	Input Offset Voltage	Note 6	-10	2	10	mV
	Input Offset Voltage Temperature Coefficient			15		µV/°C
IB	Input Bias Current			20		pА
los	Input Offset Current			10		pА
V _{CM}	Input Voltage Range	CMRR >60dB		1.8		V
CMRR	Common Mode Rejection Ratio	0 < V _{CM} < 1.35V	45	77		dB
PSRR	Power Supply Rejection Ratio	Supply voltage change of 3V	50	83		dB
A _{VOL}	Large Signal Voltage Gain	$R_L = 100k\Omega$, $V_{OUT} = 2V$ peak-to-peak	60	74		dB
		$R_L = 500k\Omega$, $V_{OUT} = 2V$ peak-to-peak	73	83		dB
V _{OUT}	Maximum Output Voltage Swing	$R_L = 500 k\Omega$	V ±2mV	V ±0.7mV		V
V _{OUT}	Minimum Output Voltage Swing	$R_L = 500 k\Omega$		V ±0.2mV	V ±2mV	V
GBW	Gain-Bandwidth Product	$R_L = 200k\Omega, C_L = 2pF, V_{OUT} = 0$		350		kHz
BW	–3dB Bandwidth	$A_V = 1, C_L = 2pF, R_L = 1M\Omega$		500		kHz
SR	Slew Rate	$A_V = 1, C_L = 2pF, R_L = 1M\Omega$		0.12		V/µs
I _{SC}	Short-Circuit Output Current	Source		6		mA
		Sink		5		mA
ls	Supply Current	No load		4.2	9	μA

Notes:

2. Exceeding the absolute maximum ratings may damage the device.

3. The device is not guaranteed to function outside its operating ratings.

4. Devices are ESD sensitive. Handling precautions are recommended. Human body model, 1.5kΩ in series with 100pF. Pin 4 is ESD sensitive.

5. Specification for packaged product only. Exceeding the maximum differential input voltage will damage the input stage and degrade performance (in particular, input bias will likely increase).

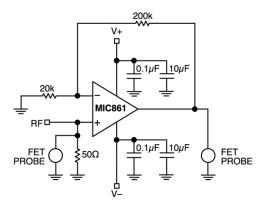
6. The offset voltage distribution is centered around 0V. The typical offset number shown is equal to the standard deviation of the voltage offset distribution.

Electrical Characteristics⁽⁵⁾ (Continued)

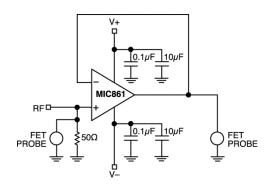
V+ = +5V, V- = 0V, V_{CM} = V+/2; R_L = 500kΩ to V+/2; T_A = 25°C, **bold** values indicate −40°C ≤ T_A ≤ +85°C, unless noted.

Symbol	Parameter	Condition	Min.	Тур.	Max.	Units
	Input Offset Voltage	Note 6	-10	2	10	mV
Vos	Input Offset Voltage Temperature Coefficient			15		µV/°C
I _B	Input Bias Current			20		pА
l _{os}	Input Offset Current			10		pА
V _{CM}	Input Voltage Range	CMRR >60dB		4.2		V
CMRR	Common Mode Rejection Ratio	0 < V _{CM} < 3.5V	60	80		dB
PSRR	Power Supply Rejection Ratio	Supply voltage change of 1V	45	85		dB
A _{VOL}	Large Signal Voltage Gain	$R_L = 100k\Omega$, $V_{OUT} = 4V$ peak-to-peak	60	76		dB
		$R_L = 500k\Omega$, $V_{OUT} = 4V$ peak-to-peak	68	83		dB
Vout	Maximum Output Voltage Swing	$R_L = 500 k\Omega$	V ±2mV	V ±0.7mV		V
V _{OUT}	Minimum Output Voltage Swing	$R_L = 500 k\Omega$		V ±0.7mV	V ±2mV	V
GBW	Gain-Bandwidth Product	$R_L = 200k\Omega, C_L = 2pF, V_{OUT} = 0$		400		kHz
BW	-3dB Bandwidth	$A_V = 1, C_L = 2pF, R_L = 1M\Omega$		650		kHz
SR	Slew Rate	$A_V = 1, C_L = 2pF, R_L = 1M\Omega$		0.12		V/µs
I _{SC}	Short-Circuit Output Current	Source	10	24		mA
		Sink	10	24		mA
ls	Supply Current	No load		4.6	9	μA

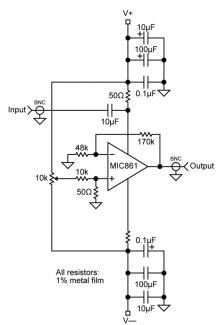
Test Circuits



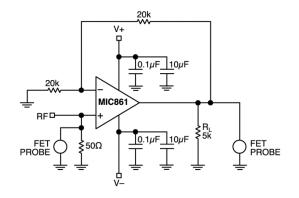




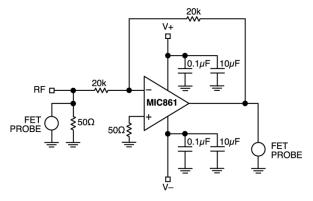
Test Circuit 3. A_V = 1



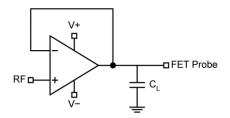
Test Circuit 5. Positive Power Supply Rejection Ratio Measurement

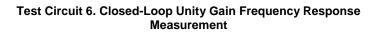




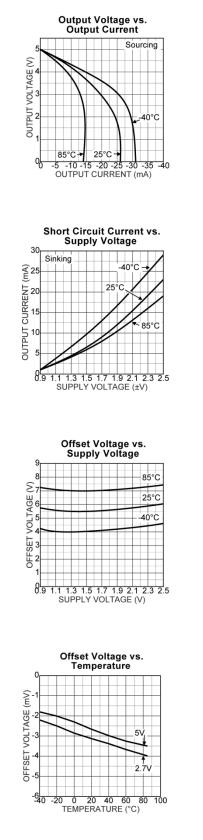


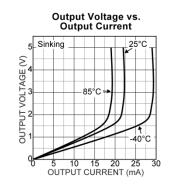
Test Circuit 4. A_V = -1

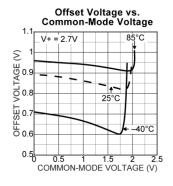




DC Typical Characteristics







Open Loop Gain vs. Resistive Load

2 7

100 1000 10000

Sourcing

5V

2.7V

100

20 40 60 80

TEMPERATURE (°C)

10

RESISTIVE LOAD (kΩ)

Short Circuit Current

vs. Temperature

100

60

4(

20

8.1

(F) 30

20

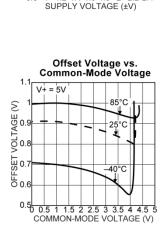
0<u>40</u>

20 0

SHORT CIRCUIT CURRENT

(gg) 80

OPEN LOOP GAIN



1.2 1.4 1.6 1.8 2

Short Circuit Current vs. Supply Voltage

40

25°(

₹ 85°C

2.2 2.4

30

(mA)

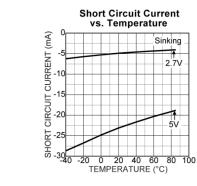
CURRENT (

OUTPUT

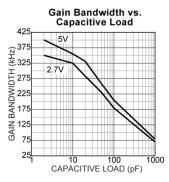
0.8

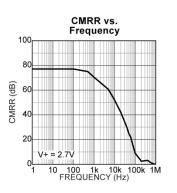
Sourcing

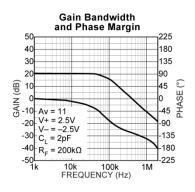
Supply Current vs. Temperature

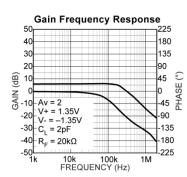


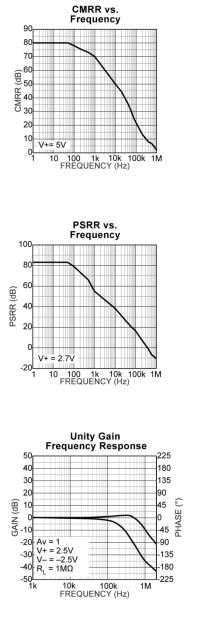
AC Typical Characteristics

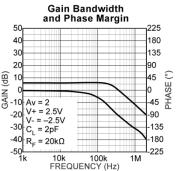


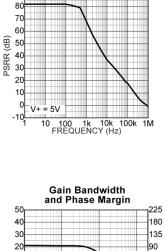






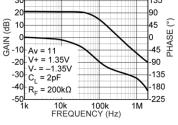


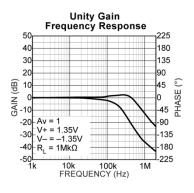




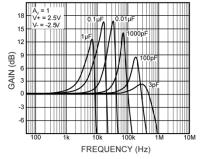
PSRR vs. Frequency

90

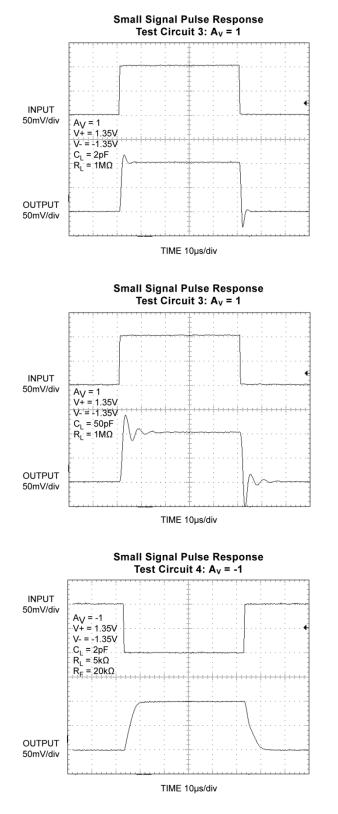


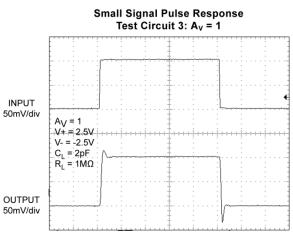


Closed-Loop Unity Gain Frequency Response



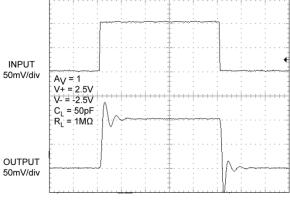
Functional Characteristics



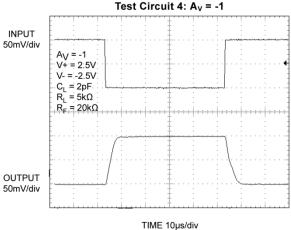


TIME 10µs/div

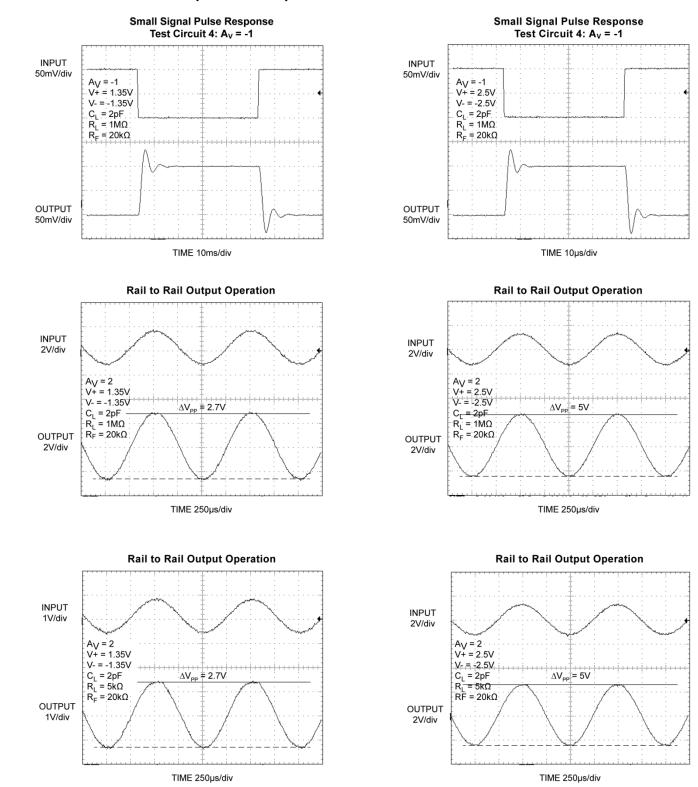
Small Signal Pulse Response Test Circuit 3: A_V = 1



TIME 250ms/div

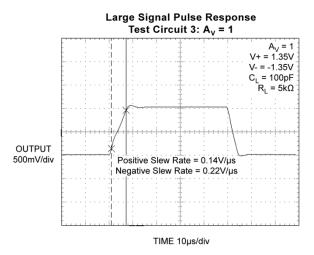


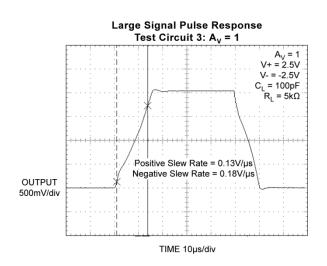
Small Signal Pulse Response



Functional Characteristics (Continued)





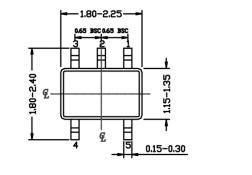


Applications Information

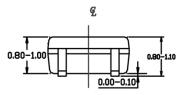
Regular supply bypassing techniques are recommended. A 10μ F capacitor in parallel with a 0.1μ F capacitor on both the positive and negative supplies is ideal. For best performance, all bypassing capacitors should be located

as close to the op amp as possible and all capacitors should be low equivalent series inductance (ESL) and equivalent series resistance (ESR). Surface-mount ceramic capacitors are ideal.

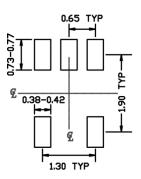
Package Information⁽⁷⁾



TOP VIEW



SIDE VIEW



END VIEW

RECOMMENDED LAND PATTERN

NOTE

1. ALL DIMENSIONS ARE IN MILLIMETERS.

2. DIMENSIONS ARE INCLUSIVE OF PLATING.

3. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH & METAL BURR.

5-Pin SC70 (C5)

Note:

7. Package information is correct as of the publication date. For updates and most current information, go to www.micrel.com.

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