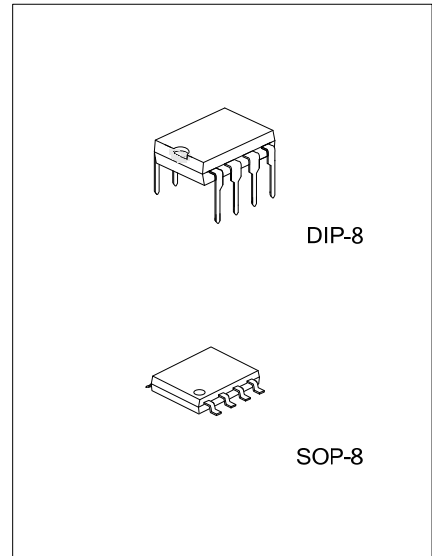




## MC33178

## LINEAR INTEGRATED CIRCUIT

### HIGH OUTPUT CURRENT LOW NOISE, LOW POWER OPERATIONAL AMPLIFIERS



#### DESCRIPTION

The UTC **MC33178** is a Bipolar dual operational amplifier with high performance concepts. Its all NPN output stage exhibits no deadband crossover distortion, large output voltage swing, and an excellent phase and gain margin. It also provides a low open loop high frequency output impedance with symmetrical source and sink AC frequency performance. This device use of high frequency PNP input transistors to produce amplifiers exhibiting low input offset voltage, noise and distortion.

#### FEATURES

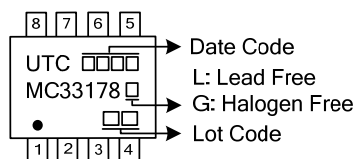
- \* Dual supply operation from  $\pm 2V$  to  $\pm 18V$
- \* High slew rate:  $2.0V/\mu s$
- \* Large output voltage swing
- \*  $600\Omega$  output drive capability
- \* Low offset voltage:  $0.15mV$  (Mean)
- \* Low total harmonic distortion:  $0.0024\%$  (@  $1.0\text{ kHz}$  w/ $600\Omega$  load)
- \* High gain bandwidth:  $5.0MHz$

#### ORDERING INFORMATION

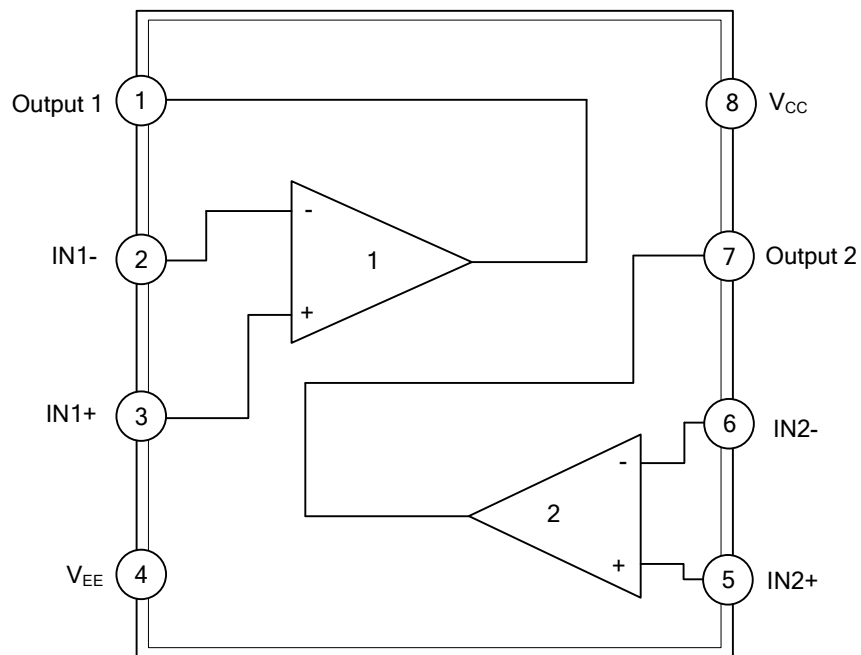
Ordering Number		Package	Packing
Lead Free	Halogen Free		
MC33178L-D08-T	MC33178G-D08-T	DIP-8	Tube
MC33178L-S08-R	MC33178G-S08-R	SOP-8	Tape Reel

<p>MC33178G-D08-T</p> <p>(1)Packing Type (2)Package Type (3)Green Package</p>	<p>(1) T: Tube, R: Tape Reel (2) D08: DIP-8, S08: SOP-8 (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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#### MARKING



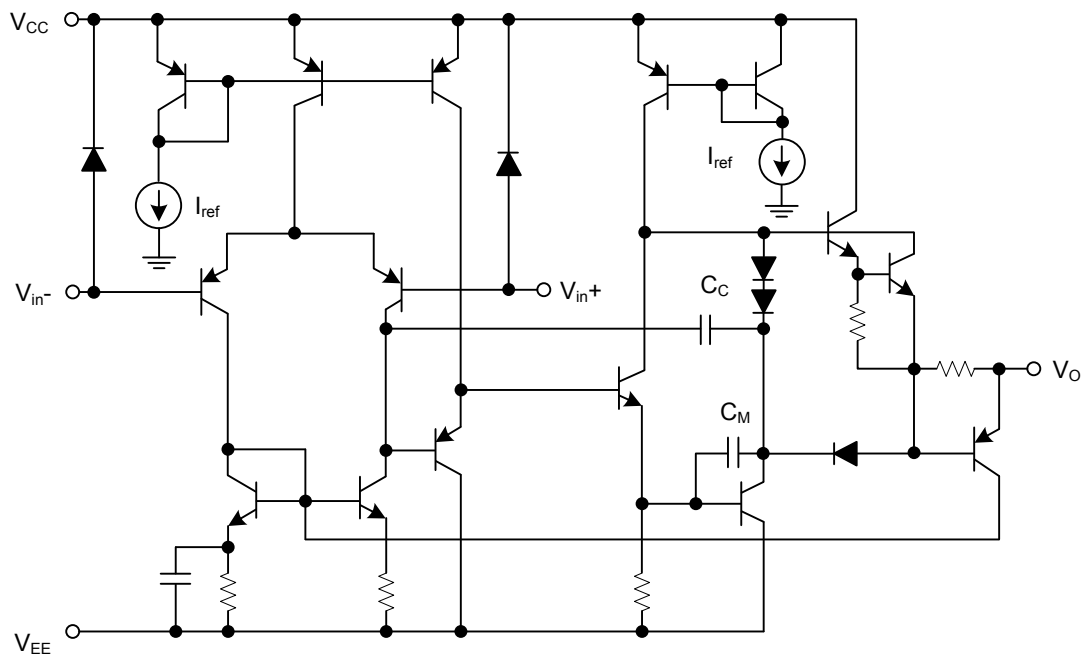
### ■ PIN CONFIGURATION



### ■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	Output 1	The output of channel 1
2, 3	IN1-, IN1+	The input of channel 1
4	$V_{EE}$	Power supply
5, 6	IN2+, IN2-	The input of channel 2
7	Output 2	The output of channel 2
8	$V_{CC}$	Power supply

## ■ BLOCK DIAGRAM



### ■ ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage ( $V_{CC}$ to $V_{EE}$ )	$V_S$	+36	V
Input Differential Voltage Range	$V_{IDR}$	(Note 2)	V
Input Voltage Range	$V_{IR}$	(Note 2)	V
Output Short Circuit Duration (Note 3)	$t_{SC}$	Indefinite	sec
Maximum Power Dissipation	$P_D$	(Note 3)	mW
Maximum Junction Temperature	$T_J$	+150	°C
Operating Temperature Range	$T_{OPR}$	-40 ~ +85	°C
Storage Temperature	$T_{STG}$	-60~+150	°C

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. Either or both input voltages must not exceed the magnitude of  $V_{CC}$  or  $V_{EE}$ .

3. Power dissipation must be considered to ensure maximum junction temperature ( $T_J$ ) is not exceeded.

### ■ DC ELECTRICAL CHARACTERISTICS

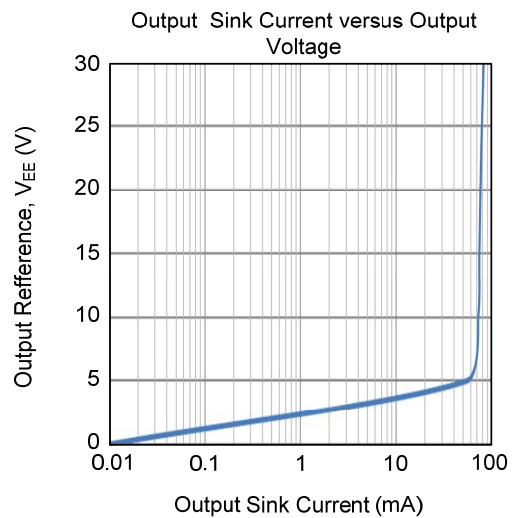
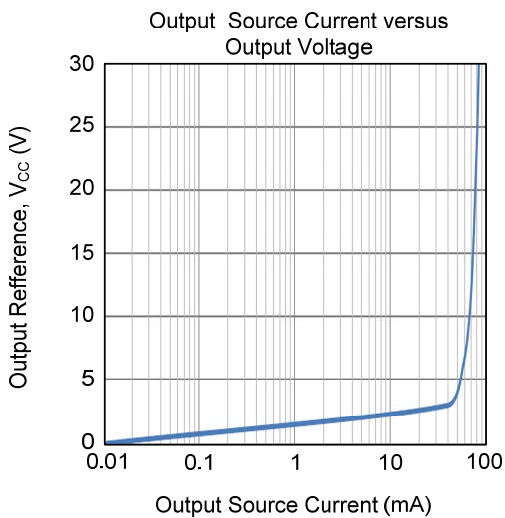
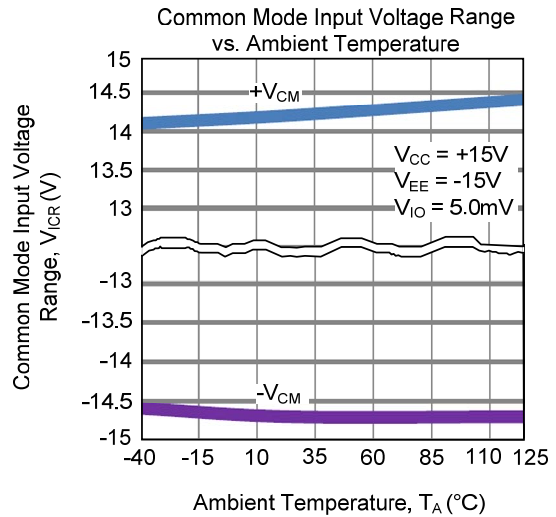
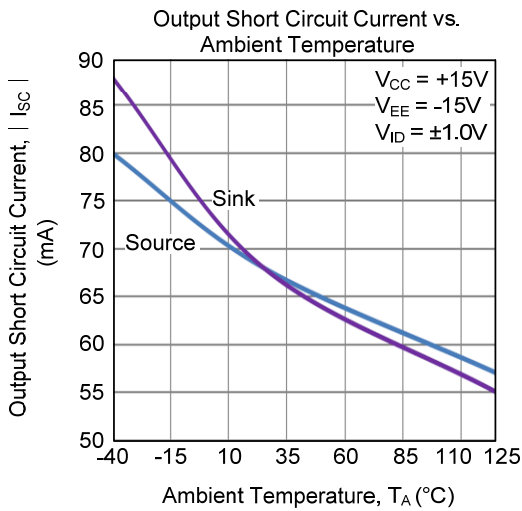
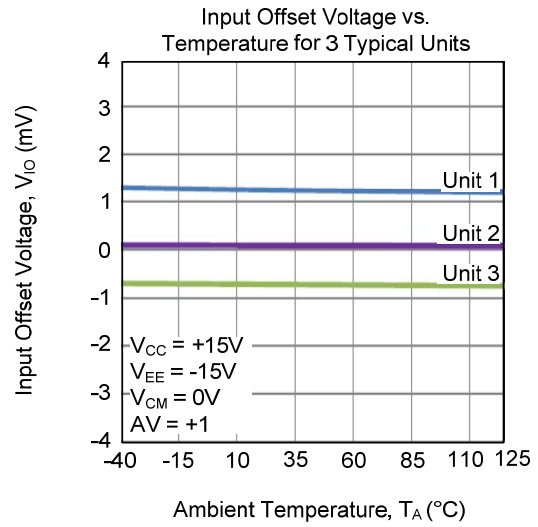
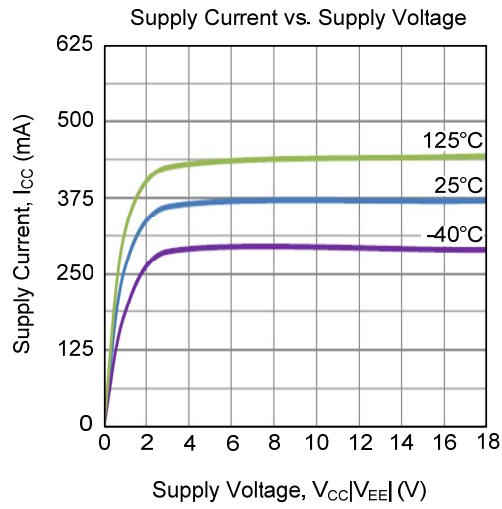
( $V_{CC}=+15$  V,  $V_{EE}=-15$  V,  $T_A=25^\circ\text{C}$ , unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT			
Input Offset Voltage	$ V_{IO} $	$R_S=50\Omega$ , $V_{CM}=0V$ , $V_O=0V$ $V_{CC}=+2.5V$ , $V_{EE}=-2.5V \sim V_{CC}=+15V$ , $V_{EE}=-15V$		0.15	3.0	mV			
Average Temperature Coefficient of Input Offset Voltage	$\Delta V_{IO}/\Delta T$	$R_S=50\Omega$ , $V_{CM}=0V$ , $V_O=0V$ , $T_A=-40^\circ\text{C} \sim +85^\circ\text{C}$		2.0		$\mu\text{V}/^\circ\text{C}$			
Input Bias Current	$I_{IB}$	$V_{CM}=0V$ , $V_O=0V$		100	500	nA			
Input Offset Current	$ I_{IO} $	$V_{CM}=0V$ , $V_O=0V$		5.0	50	nA			
Common Mode Input Voltage Range	$V_{ICR}$	$\Delta V_{IO}=5.0\text{mV}$ , $V_O=0V$	+13	+14 -14	-13	V			
Large Signal Voltage Gain	$A_{VOL}$	$V_O=-10V \sim +10V$ , $R_L=600\Omega$	92	115		dB			
Output Voltage Swing	$V_{O+}$	$V_{ID}=\pm 1.0V$	$V_{CC}=+15V$ , $V_{EE}=-15V$	$R_L=300\Omega$		+12	V		
	$V_{O-}$			$R_L=300\Omega$		-12	V		
	$V_{O+}$			$R_L=600\Omega$	+12	+13.6		V	
	$V_{O-}$			$R_L=600\Omega$		-13	-12	V	
	$V_{O+}$			$R_L=2.0\text{k}\Omega$	+13	+14		V	
	$V_{O-}$			$R_L=2.0\text{k}\Omega$		-13.8	-13	V	
	$V_{OL}$			$V_{CC}=+2.5V$ , $V_{EE}=-2.5V$	$R_L=600\Omega$	1.1	1.6		V
	$V_{OH}$			$R_L=600\Omega$		-1.6	-1.1	V	
Common Mode Rejection	CMR	$V_{in}=\pm 13V$	80	110		dB			
Power Supply Rejection	PSR	$V_{CC}/V_{EE}=+15V/-15V$ , $+5.0V/-15V$ , $+15V/-5.0V$	80	110		dB			
Output Short Circuit Current	$I_{SC}$	$V_{ID}=1.0V$ , Output to Ground	Source ( $V_{CC}=2.5V \sim 15V$ )	+50	+68		mA		
			Sink ( $V_{EE}=-2.5V \sim -15V$ )		-68	-50	mA		
Power Supply Current (Dual)	$I_D$	$V_O=0V$			1.4	mA			

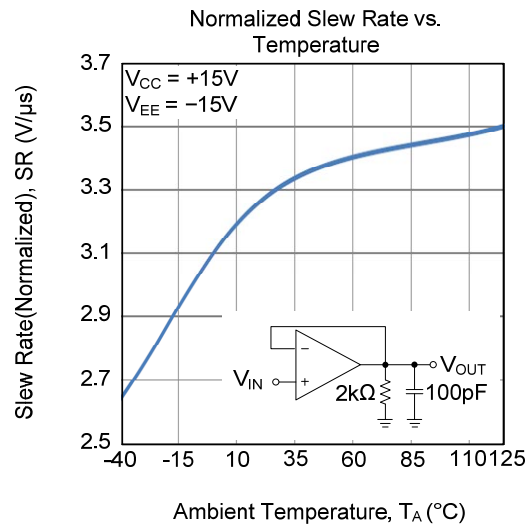
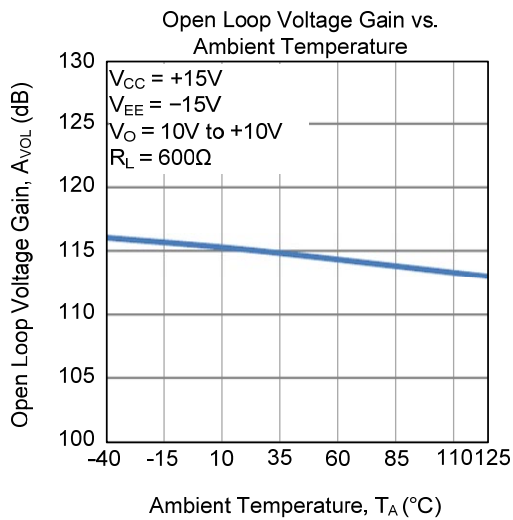
■ AC ELECTRICAL CHARACTERISTICS ( $V_{CC}=+15\text{ V}$ ,  $V_{EE}=-15\text{ V}$ ,  $T_A=25^\circ\text{C}$ , unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Slew Rate	SR	$V_{in}=-10\text{V}\sim+10\text{ V}$ , $R_L=2.0\text{k}\Omega$ , $C_L=100\text{Pf}$ $A_V=+1.0\text{V}$	1.2	3.5		V/ $\mu\text{s}$
Gain Bandwidth Product	GBW	$f=100\text{kHz}$	2.5	5		MHz
AC Voltage Gain	$A_{VO}$	$R_L=600\Omega$ , $V_O=0\text{V}$ , $f=20\text{kHz}$		50		dB
Unity Gain Frequency	$f_U$	Open-Loop, $R_L=600\Omega$ , $C_L=0\text{pF}$		3		MHz
Gain Margin	$A_m$	$R_L=600\Omega$ , $C_L=0\text{pF}$		15		dB
Phase Margin	$\phi_m$	$R_L=600\Omega$ , $C_L=0\text{pF}$		60		Degrees
Channel Separation	CS	$f=100\text{Hz}\sim 20\text{kHz}$		-120		dB
Power Bandwidth	$BW_p$	$V_O=20\text{Vpp}$ , $R_L=600\Omega$ , $\text{THD}\leq 1.0\%$		32		kHz
Total Harmonic Distortion	THD	$R_L=600\Omega$ , $V_O=2.0\text{Vpp}$ , $A_V=+1.0\text{V}$	$f=1.0\text{kHz}$	0.0024		%
			$f=10\text{kHz}$	0.014		%
			$f=20\text{kHz}$	0.024		%
Open Loop Output Impedance	$ Z_O $	$V_O=0\text{V}$ , $f=3.0\text{MHz}$ , $A_V=10\text{V}$		150		$\Omega$
Differential Input Resistance	$R_{IN}$	$V_{CM}=0\text{V}$		200		$\text{k}\Omega$
Differential Input Capacitance	$C_{IN}$	$V_{CM}=0\text{V}$		10		pF
Equivalent Input Noise Voltage	$e_n$	$R_S=100\Omega$	$f=10\text{Hz}$	8		$\text{nV}/\sqrt{\text{Hz}}$
			$f=1.0\text{kHz}$	7.5		$\text{nV}/\sqrt{\text{Hz}}$
Equivalent Input Noise Current	$i_n$	$f=10\text{Hz}$		0.33		$\text{pA}/\sqrt{\text{Hz}}$
		$f=1.0\text{kHz}$		0.15		$\text{pA}/\sqrt{\text{Hz}}$

## TYPICAL CHARACTERISTICS



## ■ TYPICAL CHARACTERISTICS



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