

# UTC LMV358 LINEAR INTEGRATED CIRCUIT

## GENERAL PURPOSE, LOW VOLTAGE, RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS

### DESCRIPTION

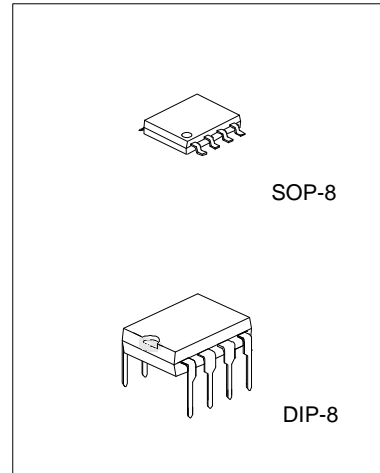
The UTC LMV358 are low voltage (2.7-5.5V) versions of the dual and quad commodity op amps, LM358, which currently operate at 5-30V. The LMV358 are the most cost effective solutions for the applications where low voltage operation, space saving and low price are needed. They offer specifications that meet or exceed the familiar LM358. The LMV358 have rail-to-rail output swing capability and the input common-mode voltage range includes ground. They all exhibit excellent speed-power ratio, achieving 1 MHz of bandwidth and 1 V/ $\mu$ s of slew rate with low supply current.

The chips are built with National's advanced submicron silicon-gate BiCMOS process. The LMV358 have bipolar input and output stages for improved noise performance and higher output current drive.

### FEATURES

(For  $V^1 = 5V$  and  $V = 0V$ . Typical Unless Otherwise Noted)

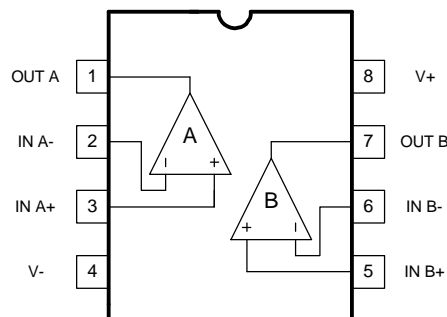
- \*Guaranteed 2.7V and 5V Performance
- \*No Crossover Distortion
- \*Space Saving Package
- \*Industrial Temp. Range
- \*Gain-Bandwidth Product
- \*Low Supply Current: 210 $\mu$ A
- \*Rail-to-Rail Output Swing  
@10k $\Omega$  Load  $V^1 - 10mV$   
 $V + 65mV$
- \* $V_{CM}$  -0.2V to  $V^1 - 0.8V$



### APPLICATIONS

- \*Active Filters
- \*General Purpose Low Voltage Applications
- \*General Purpose Portable Devices

### PIN CONFIGURATIONS



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## ABSOLUTE MAXIMUM RATINGS

PARAMETER	VALUE	UNIT
ESD Tolerance(Note 2)		
Machine Model	100	V
Human Body Model	2000	V
Differential Input Voltage	+Supply Voltage	
Supply Voltage (V <sup>1</sup> -V)	5.5	V
Output Short Circuit to V <sup>1</sup>	(Note 3)	
Output Short Circuit to V	(Note 4)	
Mounting Temp.		
Lead Temp. (Soldering 10 sec)	260	°C
Infrared (15 sec)	215	°C
Storage Temp. Range	-65 to 150	°C
Junction Temp. (T <sub>j</sub> , max) (Note 5)	150	°C

## OPERATING RATINGS (NOTE 1)

PARAMETER	VALUE	UNIT
Supply Voltage	2.7 to 5.5	V
Temperature Range	-40<=T <sub>j</sub> <=85	°C
Thermal Resistance (θ <sub>JA</sub> ) (Note 10)	235	°C/W

## 2.7V DC ELECTRICAL CHARACTERISTICS

Unless otherwise specified, all limits guaranteed for T<sub>j</sub>=25°C, V<sup>1</sup>=2.7V, V=0V, V<sub>CM</sub>=1.0V, V<sub>o</sub>=V<sup>1</sup>/2 and R<sub>L</sub>=1MΩ

PARAMETER	SYMBOL	CONDITIONS	TYP (note6)	LIMIT (note7)	UNIT
Input Offset Voltage	V <sub>os</sub>		1.7	7	mV max
Input Offset Voltage Average Drift	TCV <sub>os</sub>		5		μV/°C
Input Bias Current	I <sub>s</sub>		11	250	nA max
Input Offset Current	I <sub>os</sub>		5	50	nA max
Common Mode Rejection Ratio	CMRR	0V<=V <sub>CM</sub> <=1.7V	63	50	dB min
Power Supply Rejection Ratio	PSRR	2.7V<=V <sup>1</sup> <=5V V <sub>o</sub> =1V	60	50	dB min
Input Common-Mode Voltage Range	V <sub>CM</sub>	For CMRR>=50dB	-0.2	0	V min
			1.9	1.7	V max
Output Swing	V <sub>o</sub>	R <sub>L</sub> =10kΩ to 1.35V	V <sup>1</sup> -10	V <sup>1</sup> -100	mV min
			60	180	mV max
Supply Current	I <sub>s</sub>	Both amplifiers	140	340	μA

# UTC LMV358 LINEAR INTEGRATED CIRCUIT

PARAMETER	SYMBOL	CONDITIONS	TYP (note6)	LIMIT (note7)	UNIT
					max

## 2.7V AC ELECTRICAL CHARACTERISTICS

Unless otherwise specified, all limits guaranteed for  $T_j=25^\circ\text{C}$ ,  $V^+=2.7\text{V}$ ,  $V=0\text{V}$ ,  $V_{CM}=1.0\text{V}$ ,  $V_o=V^+/2$  and  $R_L>1\text{M}\Omega$

PARAMETER	SYMBOL	CONDITIONS	TYP (note6)	LIMIT (note7)	UNIT
Gain-Bandwidth Product	GBWP	$CL=200\text{pF}$	1		MHz
Phase Margin	$\Phi(T)$		60		Deg
Gain Margin	$G(r)$		10		dB
Input-Referred Voltage Noise	$\theta_{r1}$	$F=1\text{kHz}$	46		$\frac{\text{nV}}{\sqrt{\text{Hz}}}$
Input-referred Current Noise	$I_{r1}$	$F=1\text{kHz}$	0.17		$\frac{\text{pA}}{\sqrt{\text{Hz}}}$

## 5V DC ELECTRICAL CHARACTERISTICS

Unless otherwise specified, all limits guaranteed for  $T_j=25^\circ\text{C}$ ,  $V^+=5\text{V}$ ,  $V=0\text{V}$ ,  $V_{CM}=2.0\text{V}$ ,  $V_o=V^+/2$  and  $R_L>1\text{M}\Omega$ .

Boldface limits apply at the temperature extremes.

PARAMETER	SYMBOL	CONDITIONS	TYP	LIMIT	UNIT
Input Offset Voltage	$V_{os}$		1.7	7 9	mV max
Input Offset Voltage Average Drift	$TCV_{os}$		5		$\mu\text{V}/^\circ\text{C}$
Input Bias Current	$I_B$		15	250 500	nA max
Input Offset Current	$I_{os}$		5	50 150	nA max
Common Mode Rejection Ratio	CMRR	$0\text{V}\leq V_{CM}\leq 4\text{V}$	65	50	dB min
Power Supply Rejection Ratio	PSRR	$2.7\text{V}\leq V^+\leq 5\text{V}$ $V_o=1\text{V}$ $V_{CM}=1\text{V}$	60	50	dB min
Input Common-Mode Voltage Range	V <sub>CM</sub>	For CMRR $\geq 50\text{dB}$	-0.2	0	V min
			4.2	4	V max
Large Signal Voltage Gain(Note 8)	$A_v$	$R_L=2\text{k}\Omega$	100	15 10	V/mV min
Output Swing	$V_o$	$R_L=2\text{k}\Omega$ to 2.5V	$V^+-40$	$V^+-300$ $V^+-400$	mV min
			120	300 400	mV max
	$V_o$	$R_L=10\text{k}\Omega$ to 2.5V	$V^+-10$	$V^+-100$ $V^+-200$	mV min
			65	180 280	mV max
Output Short Circuit Current	$I_o$	Sourcing, $V_o=0\text{V}$	60	5	mA min

# UTC LMV358 LINEAR INTEGRATED CIRCUIT

PARAMETER	SYMBOL	CONDITIONS	TYP	LIMIT	UNIT
		Sinking, $V_o=5V$	160	10	mA min
Supply Current	$I_s$	Both amplifiers	210	440 615	$\mu A$ max

## 2.5V AC ELECTRICAL CHARACTERISTICS

Unless otherwise specified, all limits guaranteed for  $T_j=25^\circ C$ ,  $V^+=2.7V$ ,  $V=0V$ ,  $V_{CM}=2.0V$ ,  $V_o=V^+/2$  and  $R_L>1M\Omega$

PARAMETER	SYMBOL	CONDITIONS	TYP	LIMIT	UNIT
Slew Rate	SR	(Note 9)	1		V/ $\mu s$
Gain-Bandwidth Product	GBWP	$CL=200pF$	1		MHz
Phase Margin	$\Phi(T)$		60		Deg
Gain Margin	G(r)		10		dB
Input-Referred Voltage Noise	$\theta_{r1}$	$f=1kHz$	39		$\frac{nV}{\sqrt{Hz}}$
Input-referred Current Noise	$I_{r1}$	$f=1kHz$	0.21		$\frac{pA}{\sqrt{Hz}}$

Note1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performances is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.

Note2: Human body model 1.5k $\Omega$  in series with 100pF. Machine model, 0 $\Omega$  in series with 200pF.

Note3: Shorting output to  $V^+$  will adversely affect reliability.

Note4: Shorting output to  $V^+$  will adversely affect reliability.

Note5: The maximum power dissipation is a function of  $T_j(max)$ ,  $\theta_{JA}$  and  $T_A$ . The maximum allowable power dissipation at any ambient temperature is  $PD=(T_j(max)-T_A)/\theta_{JA}$ . All numbers apply for packages soldered directly into a PC board.

Note6: Typical values represent the most likely parametric norm.

Note7: All limits are guaranteed by testing or statistical analysis.

Note8:  $R_L$  is connected to  $V$ . The output voltages is  $0.5V \leq V_o \leq 4.5V$ .

Note9: Connected as voltage follower with 3V step input. Number specified is the lower of the positive and negative slew rates.

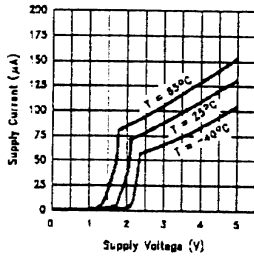
Note10: all numbers are typical, and apply for packages soldered directly note a PC board is still air.

# UTC LMV358 LINEAR INTEGRATED CIRCUIT

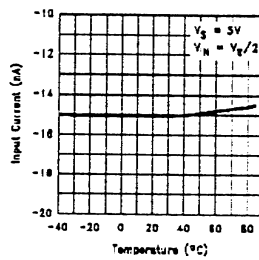
## TYPICAL PERFORMANCE CHARACTERISTICS

(Unless otherwise specified,  $V_E = +5V$ , single supply.  $T_A = 25^\circ C$ )

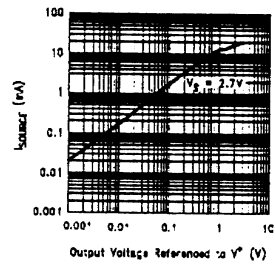
Supply Current vs Supply Voltage (LMV321)



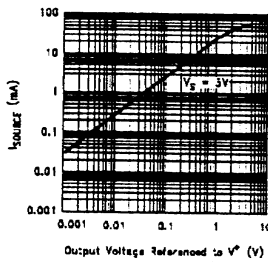
Input Current vs Temperature



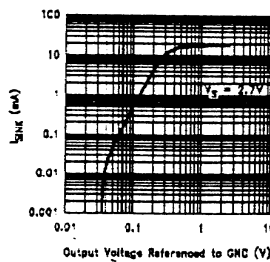
Sourcing Current vs Output Voltage



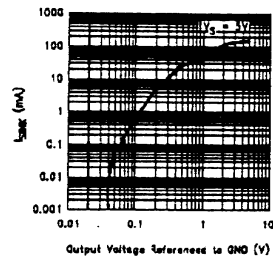
Sourcing Current vs Output Voltage



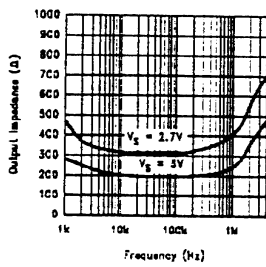
Sinking Current vs Output Voltage



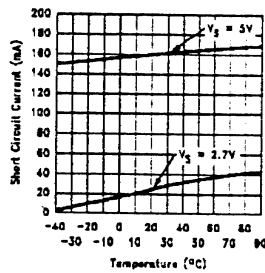
Sinking Current vs Output Voltage



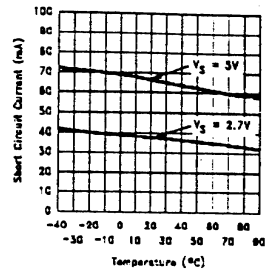
Open Loop Output Impedance vs Frequency



Short Circuit Current vs Temperature (Sinking)

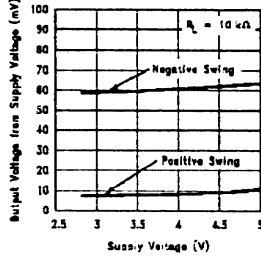


Short Circuit Current vs Temperature (Sourcing)

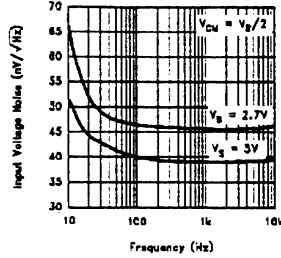


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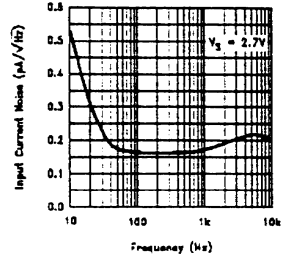
Output Voltage Swing vs Supply Voltage



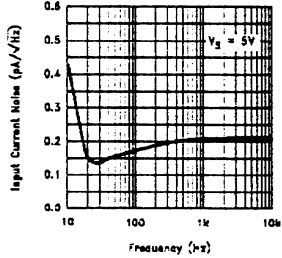
Input Voltage Noise vs Frequency



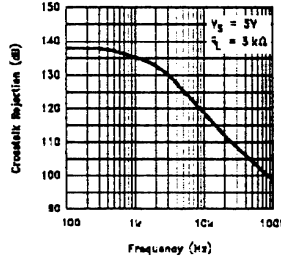
Input Current Noise vs Frequency



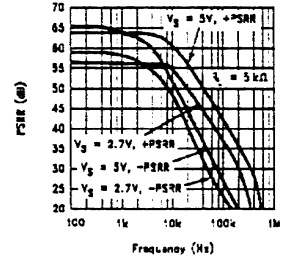
Input Current Noise vs Frequency



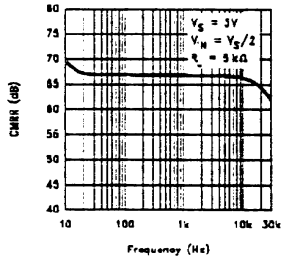
Crosstalk Rejection vs Frequency



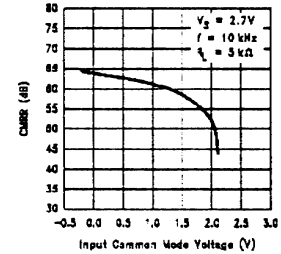
PSRR vs Frequency



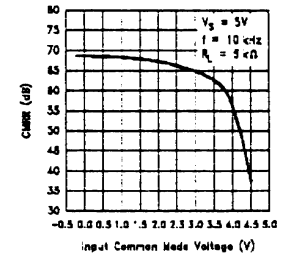
CMRR vs Frequency



CMRR vs Input Common Mode Voltage

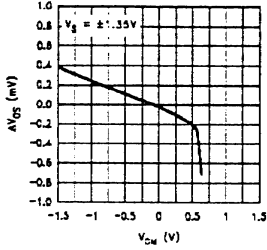


CMRR vs Input Common Mode Voltage

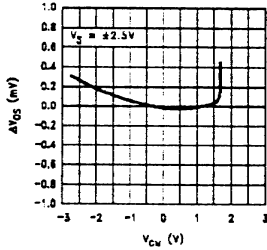


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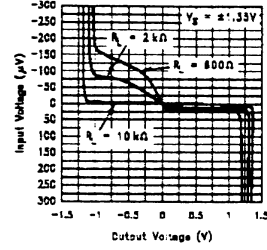
$\Delta V_{OS}$  vs CMR



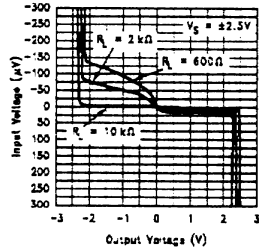
$\Delta V_{OS}$  vs CMR



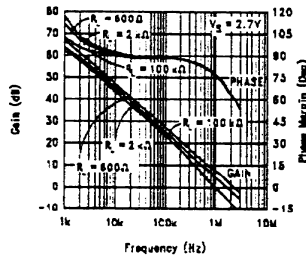
Input Voltage vs Output Voltage



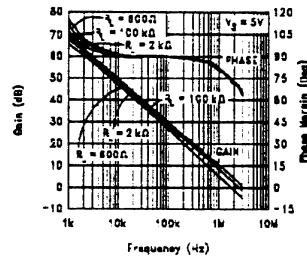
Input Voltage vs Output Voltage



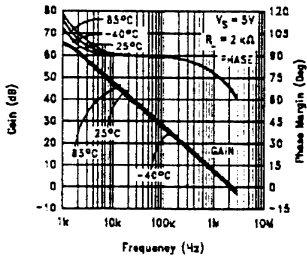
Open Loop Frequency Response



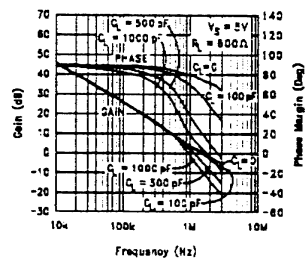
Open Loop Frequency Response



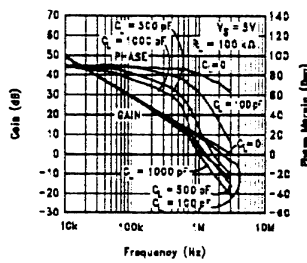
Open Loop Frequency Response vs Temperature



Gain and Phase vs Capacitive Load

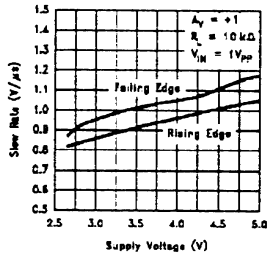


Gain and Phase vs Capacitive Load

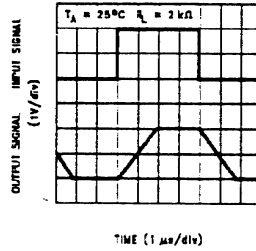


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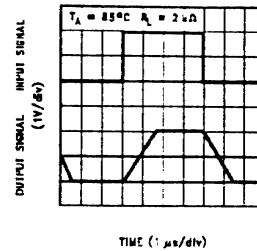
**Slew Rate vs Supply Voltage**



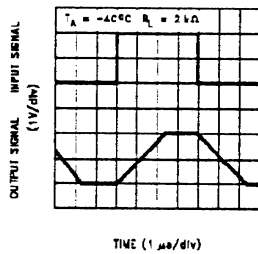
**Non-Inverting Large Signal Pulse Response**



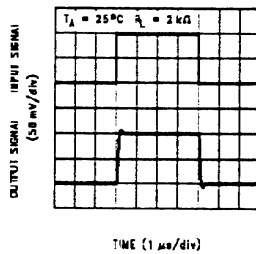
**Non-Inverting Large Signal Pulse Response**



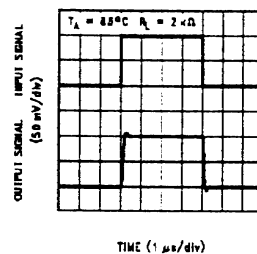
**Non-Inverting Large Signal Pulse Response**



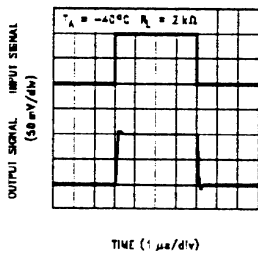
**Non-Inverting Small Signal Pulse Response**



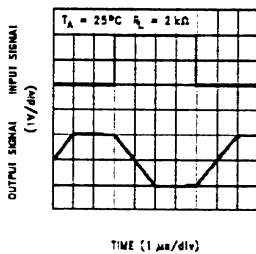
**Non-Inverting Small Signal Pulse Response**



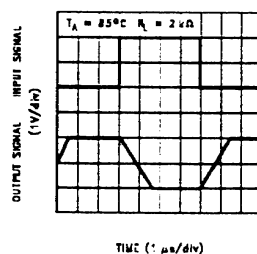
**Non-Inverting Small Signal Pulse Response**



**Inverting Large Signal Pulse Response**



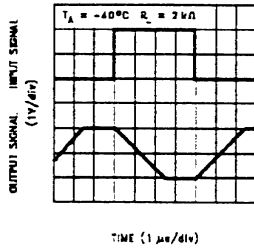
**Inverting Large Signal Pulse Response**



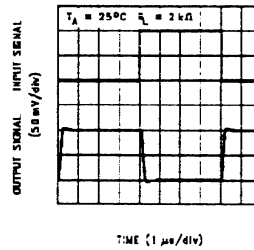


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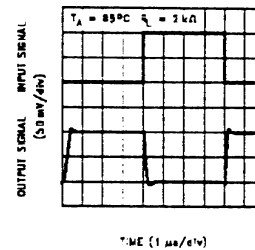
**Inverting Large Signal Pulse Response**



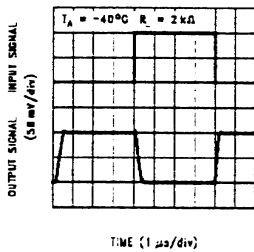
**Inverting Small Signal Pulse Response**



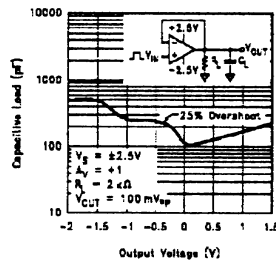
**Inverting Small Signal Pulse Response**



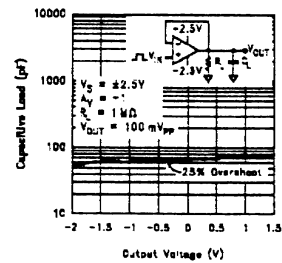
**Inverting Small Signal Pulse Response**



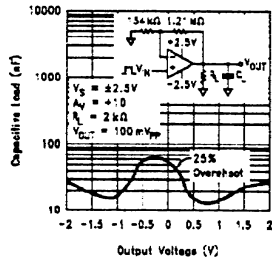
**Stability vs Capacitive Load**



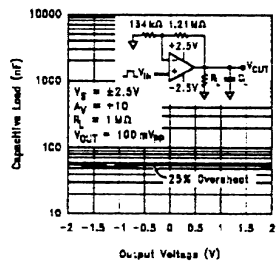
**Stability vs Capacitive Load**



**Stability vs Capacitive Load**



**Stability vs Capacitive Load**



**THD vs Frequency**

