

## LMV82x, LMV82xA

### Low power, high accuracy, general-purpose operational amplifier

Datasheet — production data

#### **Features**

■ Low power consumption: 400 µA max at 5 V

■ Low power shutdown mode: 50 nA max

■ Low offset voltage: 0.8 mV max at 25°C

■ Tiny packages

■ Extended temperature range: -40°C to +125°C

Low supply voltage: 2.5 V - 5.5 V
 Gain bandwidth product: 5.5 MHz

Automotive qualification

#### **Benefits**

- Longer lifetime in battery-powered applications
- Higher accuracy without calibration
- Smaller form factor than equivalent competitor devices
- Application performances guaranteed over wide temperature range

#### **Related products**

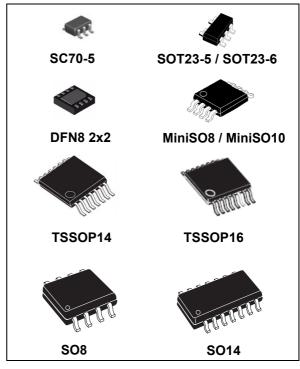
■ See TSV85x series for lower power consumption (180 µA max at 5 V)

### **Applications**

- Battery-powered applications
- Portable devices
- Automotive signal conditioning
- Active filtering
- Medical instrumentation

### Description

The LMV82x and LMV82xA series of single, dual, and quad operational amplifiers offer low voltage operation with rail-to-rail output swing. They outperform the industry standard LMV321, especially with regard to the gain bandwidth



product (5.5 MHz). The LMV821, LMV822 and LMV824 are offered with standard pinouts.

The LMV820, LMV823, and LMV825 include a power-saving shutdown feature that reduces the supply current to a maximum of 50 nA at 25 °C.

The wide temperature range, high ESD tolerance, and automotive grade qualification make them particularly suitable for use in harsh automotive applications.

Table 1. Device summary

	Without	shutdown	With sh	utSdown
	Standard Vio	Enhanced Vio	Standard Vio	Enhanced Vio
Single	LMV821	LMV821A	LMV820	LMV820A
Dual	LMV822	LMV822A	LMV823	LMV823A
Quad	LMV824	LMV824A	LMV825	LMV825A

Contents LMV82x, LMV82xA

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## 1 Package pin connections

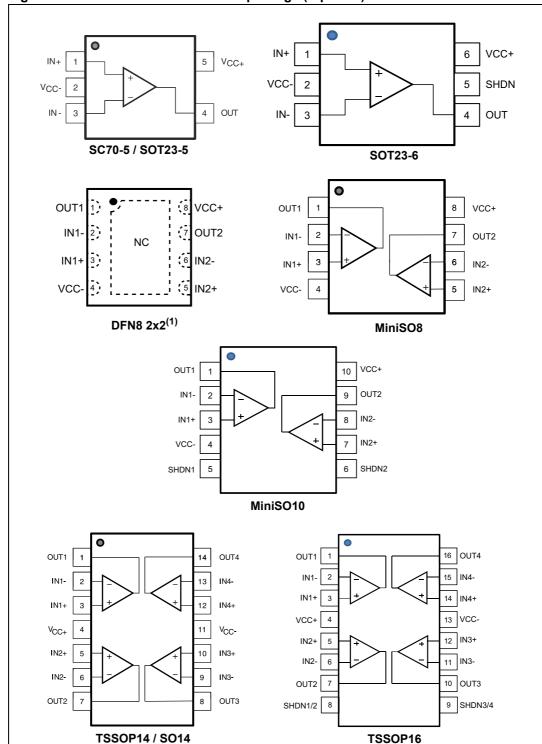


Figure 1. Pin connections for each package (top view)

1. The exposed pad of DFN8 2x2 can be connected to VCC- or left floating.

### 2 Absolute maximum ratings and operating conditions

Table 2. Absolute maximum ratings (AMR)

Symbol	Parameter	Value	Unit
V <sub>cc</sub>	Supply voltage <sup>(1)</sup>	6	
V <sub>id</sub>	Differential input voltage <sup>(2)</sup>	±V <sub>cc</sub>	V
V <sub>in</sub>	Input pins (IN+ and IN- pins) voltage <sup>(3)</sup>	$V_{cc-}$ - 0.3 to $V_{cc+}$ + 0.3	
I <sub>in</sub>	Input current <sup>(4)</sup>	10	mA
SHDN	Shutdown voltage <sup>(5)</sup>	$V_{cc-}$ - 0.2 to $V_{cc+}$ + 0.2	V
T <sub>stg</sub>	Storage temperature	-65 to +150	°C
	Thermal resistance junction to ambient <sup>(6)(7)</sup>		
	- SC70-5	205	
	- SOT23-5	250	
	– DFN8 2x2	57	
	- MiniSO8	190	
R <sub>thja</sub>	- SO8	125	°C/W
	- TSSOP14	100	
	- SO14	105	
	- SOT23-6	240	
	- MiniSO10	113	
	- TSSOP16	95	
Tj	Maximum junction temperature	150	°C
	HBM: human body model (except shutdown pin) <sup>(8)</sup>	4	14.7
	HBM: human body model (shutdown pin) <sup>(8)</sup>	3.5	- kV
ESD	MM: machine model <sup>(9)</sup>	250	V
	CDM: charged device model <sup>(10)</sup>	1.3	kV
	CDM: charged device model LMV825 <sup>(10)</sup>	1	KV
	Latch-up immunity	200	mA

- 1. All voltage values, except the differential voltage are with respect to the network ground terminal.
- 2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
- 3.  $V_{cc}$ - $V_{in}$  must not exceed 6 V,  $V_{in}$  must not exceed 6 V.
- 4. The input current must be limited by a resistor in series with the inputs.
- 5.  $V_{\text{CC}}\text{-V}_{\text{shdn}}$  must not exceed 6 V,  $V_{\text{in}}$  must not exceed 6 V.
- 6. Short-circuits can cause excessive heating and destructive dissipation.
- 7. R<sub>th</sub> are typical values.
- 8. Human body model: a 100 pF capacitor is discharged through a 1.5 k $\Omega$  resistor between two pins of the device. This is done for all couples of pin combinations while other pins are floating.
- 9. Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5  $\Omega$ ). This is done for all couples of pin combinations while other pins are floating.
- Charged device model: all pins and package are charged together to the specified voltage and then discharged directly to ground.

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Table 3. Operating conditions

Symbol	Parameter	Value	Unit
V <sub>cc</sub>	Supply voltage	2.5 to 5.5	V
V <sub>icm</sub>	Common mode input voltage range	V <sub>cc-</sub> - 0.2 to V <sub>cc+</sub> - 1	v
T <sub>oper</sub>	Operating free air temperature range	-40 to +125	°C

### 3 Electrical characteristics

Table 4. Electrical characteristics at  $V_{cc+}$  = 2.5 V with  $V_{cc-}$  = 0 V,  $V_{icm}$  =  $V_{cc}/2$ ,  $T_{amb}$  = 25° C, and  $R_L$  connected to  $V_{cc}/2$  (unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Unit
DC perform	nance					
		LMV82xA			0.8	
V	Input offset voltage	LMV82x			3.5	
$V_{io}$	Input offset voltage	LMV82xA, -40°C < T< 125°C			2	
		LMV82x, -40°C < T< 125°C			4	
		$R_L = 600 \Omega$			220	
\/ \/	High level output voltage	R <sub>L</sub> = 600 Ω, -40°C < T< 125°C			320	m\/
V <sub>CC</sub> -V <sub>OH</sub>		$R_L = 2 k\Omega$			120	mV
		$R_L = 2 \text{ k}\Omega$ , $-40^{\circ}\text{C} < T < 125^{\circ}\text{C}$			220	
		$R_L = 600 \Omega$			220	
V	Low level output voltage	R <sub>L</sub> = 600 Ω, -40°C < T< 125°C			320	
$V_{OL}$	Low level output voltage	$R_L = 2 k\Omega$			120	
		$R_L = 2 \text{ k}\Omega$ , $-40^{\circ}\text{C} < T < 125^{\circ}\text{C}$			200	
	I <sub>sink</sub> (V <sub>out</sub> = V <sub>cc</sub> )		5			
	V <sub>id</sub> = -1 V	-40°C < T< 125°C	5			mΛ
l <sub>out</sub>	I <sub>source</sub> (V <sub>out</sub> = 0 V)		5			- mA
	V <sub>id</sub> = 1 V	-40°C < T< 125°C	5			

Table 5. Shutdown characteristics  $V_{CC} = 2.5 \text{ V}$ 

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Unit					
DC perfor	DC performance										
	Supply current in shutdown	T = 25°C		2.5	50	nA					
I <sub>CC</sub>	mode (all operators)	-40°C < T< 85°C			200	шА					
	SHDN = V <sub>CC</sub> -	-40°C < T< 125°C			1.5	μA					
t <sub>on</sub>	Amplifier turn-on time <sup>(1)</sup>	$R_L = 2 k\Omega$ $V_{out} = V_{CC-} \text{ to } V_{CC-} + 0.2 \text{ V}$		300		ns					
t <sub>off</sub>	Amplifier turn-off time <sup>(1)</sup>	$R_L = 2 k\Omega$ Vout = $V_{CC+}$ - 1 V to $V_{CC+}$ - 1.2 V		20		115					
V <sub>IH</sub>	SHDN logic high		V <sub>cc</sub> -0.5			V					
V <sub>IL</sub>	SHDN logic low				0.5	V					
I <sub>IH</sub>	SHDN current high	SHDN = V <sub>CC+</sub>		10							
I <sub>IL</sub>	SHDN current low	SHDN = V <sub>CC</sub> -		10		pА					
1.	Output leakage in shutdown	SHDN = V <sub>CC</sub> -		50							
<sup>I</sup> OLeak	mode	-40°C < T< 125°C		1		nA					

<sup>1.</sup> See Section 4.7: Shutdown function on page 17.

Table 6. Electrical characteristics at  $V_{cc+}$  = 2.7 V with  $V_{cc-}$  = 0 V,  $V_{icm}$  =  $V_{cc}/2$ ,  $T_{amb}$  = 25° C, and  $R_L$  connected to  $V_{cc}/2$  (unless otherwise specified)

$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Symbol	Parameter	Conditions	Min.	Тур.	Max.	Unit
$V_{lo} \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	DC perfo	rmance		•	•		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			LMV82xA			0.8	
$ \frac{\Delta V_{io}/\Delta T}{\Delta V_{io}/\Delta T}  Input offset voltage drift^{(1)} \qquad -40^{\circ}C < T < 125^{\circ}C \qquad \qquad 1 \qquad \mu V/^{\circ}C $ $ Input offset current (V_{out} = V_{cc}/2) \qquad -40^{\circ}C < T < 125^{\circ}C \qquad \qquad 1 \qquad 50 \qquad \mu V/^{\circ}C $ $ Input offset current (V_{out} = V_{cc}/2) \qquad -40^{\circ}C < T < 125^{\circ}C \qquad \qquad 1 \qquad 50 \qquad \qquad 105 \qquad 30 \qquad \qquad 100 \qquad 100 \qquad \qquad 100 \qquad 100 \qquad \qquad 100 \qquad 1$		loon to effect weltone	LMV82x			3.5	\
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	v <sub>io</sub>	input onset voltage	LMV82xA, -40°C < T< 125°C			2	mv
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			LMV82x, -40°C < T< 125°C			4	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\Delta V_{io}/\Delta T$	Input offset voltage drift <sup>(1)</sup>	-40°C < T< 125°C		1		μV/°C
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		Input offset current			0.5	30	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	'io	$(V_{out} = V_{cc}/2)$	-40°C < T< 125°C		1	50	nΛ
$CMR  Common mode rejection ratio \\ 20 \log (\Delta V_{icm}/\Delta V_{io}) \\ V_{ic} = 0 \text{ V to V}_{cc}\text{-1V, V}_{out} = V_{cc}/2 \\ -40^{\circ}\text{C} < \text{T} < 125^{\circ}\text{C} \\ -40^{\circ}\text{C} < \text{T} < 125^{\circ}\text{C} \\ -68 \\ \hline \\ A_{vd}  $		Input bias current (V = V /2)			60	120	IIA
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	<b>'</b> ib	input bias current (v <sub>out</sub> – v <sub>cc</sub> /2)	-40°C < T< 125°C			180	
$V_{CC}-V_{OH} = 0 \ V \ to \ V_{CC}-1 \ V, \ V_{out} = V_{cc}/2 $	21.15			70	75		
$A_{Vd} = A_{Vd} = A_{Vot} = A_{Vot$	CMR		-40°C < T< 125°C	68			
$A_{vd} = A_{vd} = A$			R <sub>L</sub> = 600 Ω	90	100		dB
$V_{\text{CC-VOH}} = V_{\text{CC-VOH}} = V_{\text{CC-VOH}$	٨		R <sub>L</sub> = 600 Ω, -40°C < T< 125°C	85			<b></b>
$V_{CC}-V_{OH} \\ V_{CC}-V_{OH} \\ High level output voltage \\ \hline V_{CC}-V_{OH} \\ \hline V_{OL} \\ \\ \hline V_{OL} \\ \\ \hline I_{out} \\ \hline I_{out} \\ \hline I_{Out} \\ \hline \\ $	Avd		R <sub>L</sub> = 2 kΩ	95	100		
$V_{\text{CC}} - V_{\text{OH}} \\ \begin{tabular}{l} High level output voltage & $R_L = 600 \ \Omega, \ -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 300 \\ R_L = 2 \ k\Omega & 100 \\ R_L = 2 \ k\Omega & 200 \\ R_L = 600 \ \Omega & 200 \\ R_L = 600 \ \Omega & 200 \\ R_L = 600 \ \Omega, \ -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 300 \\ R_L = 2 \ k\Omega & 120 \\ R_L = 2 \ k\Omega & 15 \ 26 \\ \hline -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & I_{\text{Source}} \ (V_{\text{out}} = 0 \ V) \\ V_{\text{id}} = 1 \ V & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}\text{C} & 12 \\ \hline & -40^{\circ}\text{C} < T < 125^{\circ}$			$R_L = 2 \text{ k}\Omega$ , $-40^{\circ}\text{C} < T < 125^{\circ}\text{C}$	90			
$V_{CC}-V_{OH} \begin{tabular}{ll} High level output voltage & $R_L=2k\Omega$ & 100 \\ $R_L=2k\Omega$ -40°C < T < 125°C & 200 \\ $R_L=600\Omega$ & 200 \\ $R_L=600\Omega$ -40°C < T < 125°C & 300 \\ $R_L=2k\Omega$ & 120 \\ $R_L=2k\Omega$ & 120 \\ $R_L=2k\Omega$ & 120 \\ $R_L=2k\Omega$ -40°C < T < 125°C & 200 \\ \hline \end{tabular}$			R <sub>L</sub> = 600 Ω			200	
$V_{OL} \begin{tabular}{ l l l l l l l l l l l l l l l l l l l$	V V .	High lovel output voltage	R <sub>L</sub> = 600 Ω, -40°C < T< 125°C			300	
$V_{OL} \begin{tabular}{ l l l l l l l l l l l l l l l l l l l$	ACC-AOH	riigirievei output voitage	$R_L = 2 k\Omega$			100	
$V_{OL} \begin{tabular}{l l} $P_{L}$ & $P_{L}$			$R_L = 2 \text{ k}\Omega$ , $-40^{\circ}\text{C} < T < 125^{\circ}\text{C}$			200	m\/
$V_{OL} \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$			R <sub>L</sub> = 600 Ω			200	IIIV
$R_{L} = 2 \text{ k}\Omega$ $R_{L} = 2 \text{ k}\Omega, -40^{\circ}\text{C} < \text{T} < 125^{\circ}\text{C}$ $I_{\text{sink}} (V_{\text{out}} = V_{\text{cc}})$ $V_{\text{id}} = -1 \text{ V}$ $I_{\text{source}} (V_{\text{out}} = 0 \text{ V})$ $V_{\text{id}} = 1 \text{ V}$ $I_{\text{co}} = 1 \text{ V}$ $I_{\text{source}} (V_{\text{out}} = 0 \text{ V})$ $V_{\text{id}} = 1 \text{ V}$ $I_{\text{co}} = 1 \text{ C}$ $I_{c$	W	Low lovel output voltage	R <sub>L</sub> = 600 Ω, -40°C < T< 125°C			300	
$I_{out} = I_{sink} (V_{out} = V_{cc}) $ $I_{source} (V_{out} = 0 V) $ $V_{id} = 1 V $ $I_{source} (V_{out} = 0 V) $ $V_{id} = 1 V $ $I_{source} (V_{out} = 0 V) $ $I_{source} (V_{out} =$	VOL	Low level output voltage	$R_L = 2 k\Omega$			120	
$I_{out} = I_{out} = I_{o$			$R_L = 2 \text{ k}\Omega$ , $-40^{\circ}\text{C} < T < 125^{\circ}\text{C}$			200	
$I_{\text{out}} = 0 \text{ V}$ $V_{\text{id}} = 1 \text{ V}$ $I_{\text{source}} = 0 \text{ V}$ $V_{\text{id}} = 1 \text{ V}$ $I_{\text{source}} = 0 \text{ V}$ $I$		I <sub>sink (</sub> V <sub>out</sub> = V <sub>cc)</sub>		15	26		
I <sub>source</sub> (V <sub>out</sub> = 0 V)	I <sub>out</sub>	V <sub>id</sub> = -1 V	-40°C < T< 125°C	12			mΛ
V <sub>id</sub> = 1 V		I <sub>source</sub> (V <sub>out</sub> = 0 V)		15	21		ША
ICC Supply durient (per channel)		$V_{id} = 1 V$	-40°C < T< 125°C	12			
No load, $V_{out} = V_{cc}/2$ $-40^{\circ}C < T < 125^{\circ}C$ 500	1.	Supply current (per channel)			220	300	^
	'CC	No load, $V_{out} = V_{cc}/2$	-40°C < T< 125°C			500	μA

Table 6. Electrical characteristics at  $V_{cc+}$  = 2.7 V with  $V_{cc-}$  = 0 V,  $V_{icm}$  =  $V_{cc}/2$ ,  $T_{amb}$  = 25° C, and  $R_L$  connected to  $V_{cc}/2$  (unless otherwise specified) (continued)

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Unit				
AC perfo	AC performance									
GBP	Gain bandwidth product			5.5		MHz				
F <sub>u</sub>	Unity gain frequency	$R_{l} > 1 M\Omega$ $C_{l} = 22 pF$		4.5		IVITIZ				
$\Phi_{\!$	Phase margin	N[ > 1 Wist O[ - 22 pr		60		degrees				
G <sub>m</sub>	Gain margin			10		dB				
SR	Slew rate	$R_L > 1 M\Omega$ $C_L = 22 pF$ , $V_{out} = 0.5 V \text{ to } V_{CC} - 0.5 V$	1.2	1.7		V/µs				
e <sub>n</sub>	Equivalent input noise voltage	f = 1 kHz f = 10 kHz		18 15		$\frac{\text{nV}}{\sqrt{\text{Hz}}}$				
i <sub>n</sub>	Equivalent input noise current	f = 1 kHz		0.30		<u>pA</u> √Hz				
THD+N	Total harmonic distortion + noise	$\begin{aligned} f_{in} &= 1 \text{ kHz, A}_{CL} = 1, \text{ R}_{L} = 100 \text{ k}\Omega \\ \text{Vicm} &= \text{Vcc/2, BW} = 22 \text{ kHz,} \\ \text{Vout} &= 3 \text{ Vpp} \end{aligned}$		0.001		%				

Table 7. Shutdown characteristics  $V_{CC} = 2.7 \text{ V}$ 

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Unit					
DC perfo	DC performance										
		SHDN = V <sub>CC</sub> -		2.5	50	nA					
I <sub>CC</sub>	Supply current in shutdown mode (all operators)	-40°C < T< 85°C			200	IIA					
	(	-40°C < T< 125°C			1.5	μΑ					
t <sub>on</sub>	Amplifier turn-on time <sup>(1)</sup>	$R_L = 2 k\Omega$ $V_{out} = V_{CC-} \text{ to } V_{CC-} + 0.2 \text{ V}$		300		nc					
t <sub>off</sub>	Amplifier turn-off time <sup>(1)</sup>	$R_L = 2 k\Omega$ Vout = $V_{CC+}$ - 1 V to $V_{CC+}$ - 1.2 V		20		ns					
V <sub>IH</sub>	SHDN logic high		V <sub>cc</sub> - 0.5			V					
V <sub>IL</sub>	SHDN logic low				0.5						
I <sub>IH</sub>	SHDN current high	SHDN = V <sub>CC+</sub>		10							
I <sub>IL</sub>	SHDN current low	SHDN = V <sub>CC</sub> -		10		рА					
la	Output leakage in shutdown	SHDN = V <sub>CC</sub> -		50							
lOLeak	mode	-40°C < T< 125°C		1		nA					

<sup>1.</sup> See Section 4.7: Shutdown function on page 17.

Table 8. Electrical characteristics at  $V_{cc+}$  = 5 V with  $V_{cc-}$  = 0 V,  $V_{icm}$  =  $V_{cc}/2$ ,  $T_{amb}$  = 25° C, and  $R_L$  connected to  $V_{cc}/2$  (unless otherwise specified)

Symbol	Parameter Parameter	Conditions	Min.	Тур.	Max.	Unit
DC perform	nance		<u>I</u>	<u>I</u>	J.	
		LMV82xA			8.0	
.,		LMV82x			3.5	
V <sub>io</sub>	Input offset voltage	LMV82xA, -40°C < T< 125°C			2	mV
		LMV82x, -40°C < T< 125°C			4	
ΔV <sub>io</sub> /ΔΤ	Input offset voltage drift <sup>(1)</sup>	-40°C < T< 125°C		1		μV/°C
,	Innut effect current ()/ - )/ (O)			0.5	30	
l <sub>io</sub>	Input offset current (V <sub>out</sub> = V <sub>cc</sub> /2)	-40°C < T< 125°C		1	50	
,	lanut bing gurrant ()/ - )/ (2)			60	120	nA
l <sub>ib</sub>	Input bias current ( $V_{out} = V_{cc}/2$ )	-40°C < T< 125°C			180	
	Common mode rejection ratio 20		72	90		
CMR	$ \log (\Delta V_{icm}/\Delta V_{io}) $ Vic = 0 V to V <sub>cc</sub> -1V, V <sub>out</sub> = V <sub>cc</sub> /	-40°C < T< 125°C	70			
		V <sub>cc</sub> = 2.5 to 5 V				
SVR	Supply voltage rejection ratio 20 $\log (\Delta V_{cc}/\Delta V_{io})$		70	75		dB
		-40°C < T< 125°C	65			
	Large signal voltage gain	R <sub>L</sub> = 600 Ω	95	100		
A <sub>vd</sub>		R <sub>L</sub> = 600 Ω, -40°C < T< 125°C	90			
	$V_{out} = 0.5V \text{ to } (V_{cc}-0.5V)$	$R_L = 2 k\Omega$	95	100		
		R <sub>L</sub> = 2 kΩ, -40°C < T< 125°C	90			
		R <sub>L</sub> = 600 Ω			250	
V <sub>CC</sub> -V <sub>OH</sub>	High level output voltage	R <sub>L</sub> = 600 Ω -40°C < T< 125°C			400	
		$R_L = 2 k\Omega$			150	
		R <sub>L</sub> = 2 kΩ, -40°C < T< 125°C			200	mV
		R <sub>L</sub> = 600 Ω			250	IIIV
V <sub>OL</sub>	Low level output voltage	R <sub>L</sub> = 600 Ω -40°C < T< 125°C			300	
		R <sub>L</sub> = 2 kΩ			150	
		$R_L = 2 \text{ k}\Omega$ , $-40^{\circ}\text{C} < T < 125^{\circ}\text{C}$			200	
	I <sub>sink (</sub> V <sub>out</sub> = V <sub>cc)</sub> V <sub>id</sub> = -1 V		35	43		
	V <sub>id</sub> = -1 V	-40°C < T< 125°C	25			, m. A
l <sub>out</sub>	I <sub>source</sub> (V <sub>out</sub> = 0 V)		60	70		mA
	V <sub>id</sub> = 1 V	-40°C < T< 125°C	50			1

Table 8. Electrical characteristics at  $V_{cc+}$  = 5 V with  $V_{cc-}$  = 0 V,  $V_{icm}$  =  $V_{cc}/2$ ,  $T_{amb}$  = 25° C, and  $R_L$  connected to  $V_{cc}/2$  (unless otherwise specified) (continued)

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Unit
	Supply current (per channel)			300	400	
I <sub>CC</sub>	No load, $V_{out} = V_{cc}/2$	-40°C < T< 125°C			600	μΑ
AC perform	mance					
GBP	Gain bandwidth product			5.5		MHz
F <sub>u</sub>	Unity gain frequency	$R_1 > 1 M\Omega$ $C_1 = 22 pF$		4.5		IVITIZ
$\Phi_{m}$	Phase margin	K[ > 1 Wis4 O[ = 22 pr		60		degrees
G <sub>m</sub>	Gain margin			10		dB
SR	Slew rate	$R_L > 1 M\Omega C_L = 22 pF,$ $V_{out} = 0.5 V to V_{CC} - 0.5 V$	1.4	1.9		V/μs
e <sub>n</sub>	Equivalent input noise voltage	f = 1 kHz f = 10 kHz		16 13		<u>nV</u> √Hz
i <sub>n</sub>	Equivalent input noise current	f = 1 kHz		0.30		<u>pA</u> √Hz
THD+N	Total harmonic distortion + noise	$\begin{aligned} f_{\text{in}} &= 1 \text{ kHz, A}_{\text{CL}} = 1, \\ R_{\text{L}} &= 100 \text{ k}\Omega, \\ \text{Vicm} &= \text{Vcc/2, BW} = 22 \text{ kHz,} \\ \text{Vout} &= 3 \text{ Vpp} \end{aligned}$		0.001		%

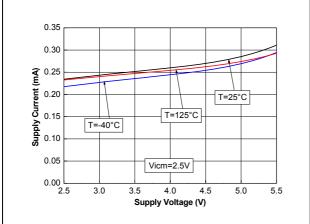
<sup>1.</sup> See Section 4.4: Input offset voltage drift over temperature.

Table 9. Shutdown characteristics  $V_{CC} = 5 V$ 

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Unit					
DC perfor	DC performance										
	Supply current in shutdown	T= 25°C		2.5	50	nA					
I <sub>CC</sub>	mode (all operators)	-40°C < T< 85°C			200	TIA .					
	SHDN = V <sub>CC</sub> -	-40°C < T< 125°C			1.5	μΑ					
t <sub>on</sub>	Amplifier turn-on time <sup>(1)</sup>	$R_L = 2 k\Omega$ $V_{out} = V_{CC} to V_{CC} + 0.2 V$		300		ns					
t <sub>off</sub>	Amplifier turn-off time <sup>(1)</sup>	$R_L = 2 k\Omega$ Vout = $V_{CC+}$ - 1 V to $V_{CC+}$ - 1.2 V		20		115					
V <sub>IH</sub>	SHDN logic high		V <sub>cc</sub> - 0.5			V					
V <sub>IL</sub>	SHDN logic low				0.5						
I <sub>IH</sub>	SHDN current high	SHDN = V <sub>CC+</sub>		10							
I <sub>IL</sub>	SHDN current low	SHDN = V <sub>CC</sub> -		10		pА					
1	Output leakage in shutdown	SHDN = V <sub>CC</sub> -		50							
l <sub>OLeak</sub>	mode	-40°C < T< 125°C		1		nA					

<sup>1.</sup> See Section 4.7: Shutdown function on page 17.

Figure 2. Supply current vs. supply voltage Figure 3. Supply current vs. Vicm at at Vicm =  $V_{CC}/2$   $V_{CC} = 5 V$ 



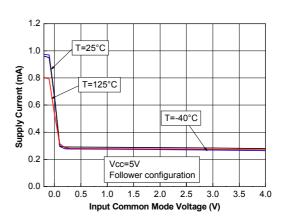
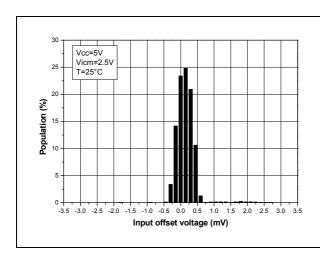


Figure 4. Vio distribution at  $V_{CC} = 5 \text{ V}$ 

Figure 5. Input offset voltage vs. input common mode voltage at V<sub>CC</sub> = 5 V



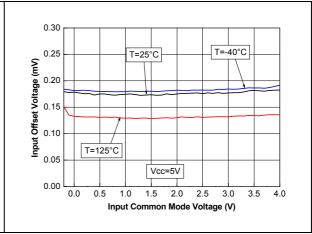
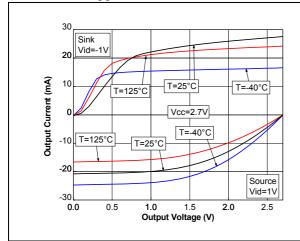
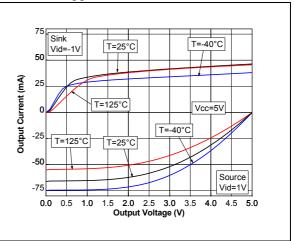


Figure 6. Output current vs. output voltage at Figure 7. Output current vs. output voltage at  $V_{CC}$  = 2.7 V  $V_{CC}$  = 5 V





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Figure 8. Output current vs. supply voltage at Figure 9. Voltage gain and phase with Vicm =  $V_{CC}/2$   $C_L = 40 \text{ pF}$ 

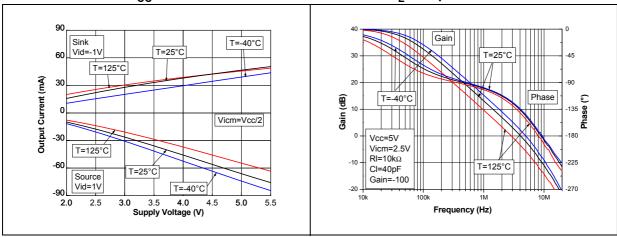


Figure 10. Voltage gain and phase with  $C_L = 100 \text{ pF}$ 

Figure 11. Voltage gain and phase with  $C_L = 200 \; pF$ 

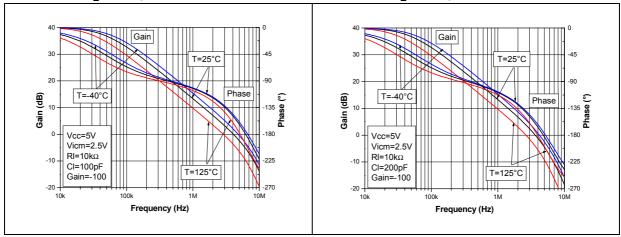


Figure 12. Phase margin vs. output current at  $V_{CC} = 5 V$  Stability in follower configuration

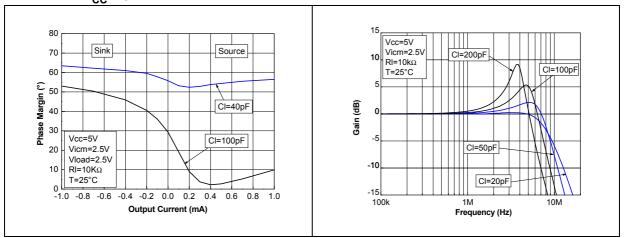


Figure 14. Positive and negative slew rate vs. Figure 15. Positive slew rate at  $V_{CC}$  = 5 V with supply voltage  $C_L$  = 100 pF

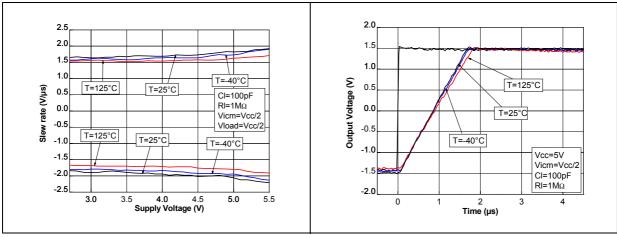


Figure 16. Negative slew rate at  $V_{CC}$  = 5 V with Figure 17. Noise vs. frequency at  $V_{CC}$  = 5 V  $C_L$  = 100 pF

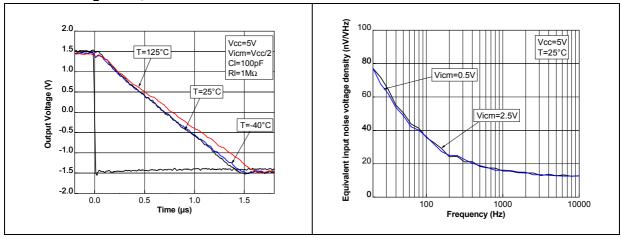
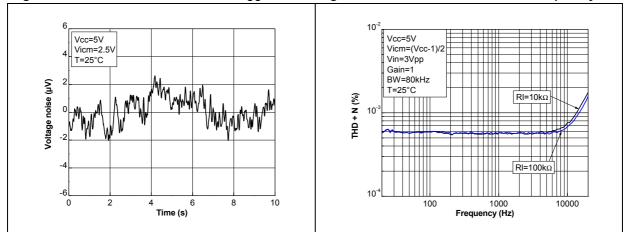


Figure 18. 0.1 Hz to 10 Hz noise at V<sub>CC</sub> = 5 V Figure 19. Distortion + noise vs. frequency



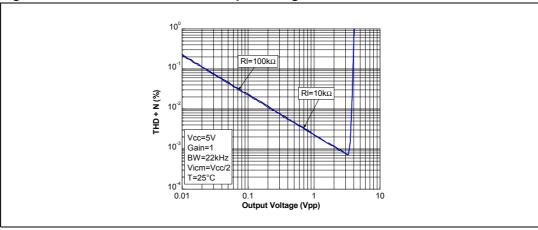


Figure 20. Distortion + noise vs. output voltage

### 4 Application information

### 4.1 Operating voltages

The LMV82x and LMV82xA can operate from 2.5 to 5.5 V. The devices' parameters are fully specified for 2.5, 2.7, and 5 V power supplies. Additionally, the main specifications are guaranteed at extended temperature ranges from -40° C to +125° C.

### 4.2 Input common mode range

The LMV82xA devices have an input common mode range that includes ground. The input common mode range is extended from  $V_{cc-}$  - 0.2 V to  $V_{cc+}$  - 1 V, with no output phase reversal.

### 4.3 Rail-to-rail output

The operational amplifiers' output levels can go close to the rails: 150 mV maximum above and below the rail when connected to a 2 k $\Omega$  resistive load to  $V_{cc}/2$ .

### 4.4 Input offset voltage drift over temperature

The maximum input voltage drift over temperature variation is defined in Equation 1.

#### **Equation 1**

$$\frac{\Delta Vio}{\Delta T} = max \left| \frac{Vio(T) - Vio(25^{\circ}C)}{T - 25^{\circ}C} \right|$$

for Tmin < T < Tmax.

### 4.5 PCB layouts

For correct operation, it is advised to add 10 nF decoupling capacitors as close as possible to the power supply pins.

#### 4.6 Macromodel

Accurate macromodels of the LMV82x and LMV82xA are available on STMicroelectronics' web site at <a href="https://www.st.com">www.st.com</a>. These models are a trade-off between accuracy and complexity (that is, time simulation) of the LMV82x and LMV82xA operational amplifiers. They emulate the nominal performances of a typical device within the specified operating conditions mentioned in the datasheet. They also help to validate a design approach and to select the right operational amplifier, but they do not replace on-board measurements.

### 4.7 Shutdown function

The operational amplifier is enabled when the  $\overline{SHDN}$  pin is pulled high. To disable the amplifier, the  $\overline{SHDN}$  pin must be pulled down to  $V_{CC-}$ . When in shutdown mode, the amplifier output is in a high impedance state. The  $\overline{SHDN}$  pin must never be left floating but tied to  $V_{CC-}$  or  $V_{CC-}$ .

The turn-on and turn-off times are calculated for an output variation of ±200 mV. *Figure 21* and *Figure 22* show the test configurations. *Figure 23* and *Figure 24* show the respective results with these test configurations.

Figure 21. Test configuration for turn-on time Figure 22. Test configuration for turn-off time (Vout pulled down) (Vout pulled down)

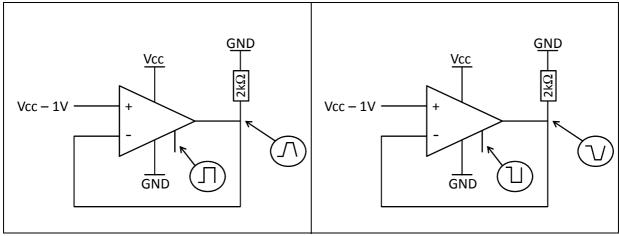


Figure 23. Turn-on time,  $V_{CC} = 5 \text{ V}$ , Vout pulled down, T = 25 °C

Shutdown pulse

Vout

Vcc = 5V T = 25°C

0.3

Time(µs)

R, connected to GND

0.4

Figure 24. Turn-off time,  $V_{CC}$  = 5 V, Vout pulled down, T = 25 °C

/oltage (V)

Package information LMV82x, LMV82xA

## 5 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: <a href="https://www.st.com">www.st.com</a>. ECOPACK<sup>®</sup> is an ST trademark.

LMV82x, LMV82xA Package information

### 5.1 SC70-5 (or SOT323-5) package information

GAUGE PLANE

DIMENSIONS IN MM

SIDE VIEW

COPLANAR LEADS

D No. (3 LEADS)

TOP VIEW

Figure 25. SC70-5 (or SOT323-5) package mechanical drawing

Table 10. SC70-5 (or SOT323-5) package mechanical data

	Dimensions						
Ref		Millimeters			Inches		
	Min	Тур	Max	Min	Тур	Max	
Α	0.80		1.10	0.032		0.043	
A1			0.10			0.004	
A2	0.80	0.90	1.00	0.032	0.035	0.039	
b	0.15		0.30	0.006		0.012	
С	0.10		0.22	0.004		0.009	
D	1.80	2.00	2.20	0.071	0.079	0.087	
E	1.80	2.10	2.40	0.071	0.083	0.094	
E1	1.15	1.25	1.35	0.045	0.049	0.053	
е		0.65			0.025		
e1		1.30			0.051		
L	0.26	0.36	0.46	0.010	0.014	0.018	
<	0°		8 °	0 °		8 °	

Package information LMV82x, LMV82xA

## 5.2 SOT23-5 package information

Figure 26. SOT23-5 package mechanical drawing

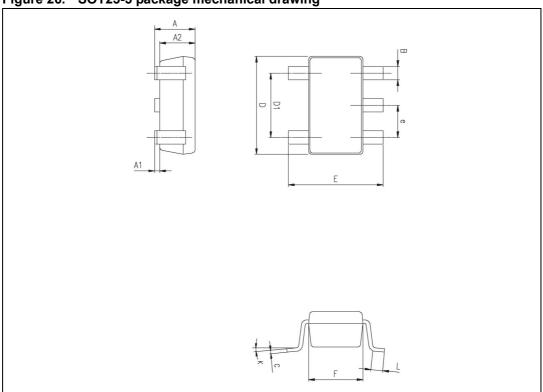


Table 11. SOT23-5 package mechanical data

	•	mago moone	Dimon	noi o no		
			Dimer	nsions		
Ref.		Millimeters			Inches	
	Min.	Тур.	Max.	Min.	Тур.	Max.
Α	0.90	1.20	1.45	0.035	0.047	0.057
A1			0.15			0.006
A2	0.90	1.05	1.30	0.035	0.041	0.051
В	0.35	0.40	0.50	0.013	0.015	0.019
С	0.09	0.15	0.20	0.003	0.006	0.008
D	2.80	2.90	3.00	0.110	0.114	0.118
D1		1.90			0.075	
е		0.95			0.037	
Е	2.60	2.80	3.00	0.102	0.110	0.118
F	1.50	1.60	1.75	0.059	0.063	0.069
L	0.10	0.35	0.60	0.004	0.013	0.023
K	0 °		10 °	0 °		10 °

LMV82x, LMV82xA Package information

## 5.3 SOT23-6 package information

Figure 27. SOT23-6 package mechanical drawing

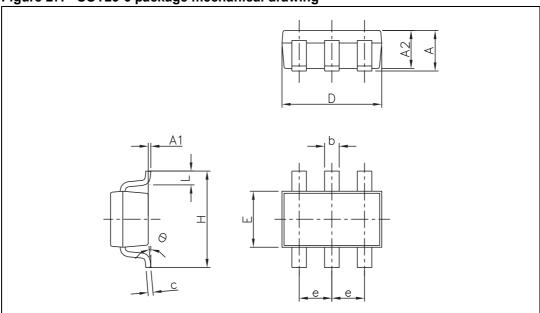


Table 12. SOT23-6 package mechanical data

			Dimer	nsions		
Ref.	Millimeters			Inches		
	Min.	Тур.	Max.	Min.	Тур.	Max.
Α	0.90		1.45	0.035		0.057
A1			0.10			0.004
A2	0.90		1.30	0.035		0.051
b	0.35		0.50	0.013		0.019
С	0.09		0.20	0.003		0.008
D	2.80		3.05	0.110		0.120
E	1.50		1.75	0.060		0.069
е		0.95			0.037	
Н	2.60		3.00	0.102		0.118
L	0.10		0.60	0.004		0.024
θ	0 °		10 °	0 °		10 °

**Package information** LMV82x, LMV82xA

#### 5.4 DFN8 2 x 2 mm package information

SEATING PLANE ppp С A3 ۲ PIN#1 ID D2

Figure 28. DFN8 2 x 2 mm package mechanical drawing (pitch 0.5 mm)

Table 13. DFN8 2 x 2 mm package mechanical data (pitch 0.5 mm)

			Dimer	nsions					
Ref.		Millimeters			Inches				
	Min.	Тур.	Max.	Min.	Тур.	Max.			
А	0.51	0.55	0.60	0.020	0.022	0.024			
A1			0.05			0.002			
A3		0.15			0.006				
b	0.18	0.25	0.30	0.007	0.010	0.012			
D	1.85	2.00	2.15	0.073	0.079	0.085			
D2	1.45	1.60	1.70	0.057	0.063	0.067			
Е	1.85	2.00	2.15	0.073	0.079	0.085			
E2	0.75	0.90	1.00	0.030	0.035	0.040			
е		0.50			0.020				
L			0.50			0.020			
ddd			0.08			0.003			

BOTTOM VIEW

LMV82x, LMV82xA Package information

# 5.5 MiniSO-8 package information

Figure 29. MiniSO-8 package mechanical drawing

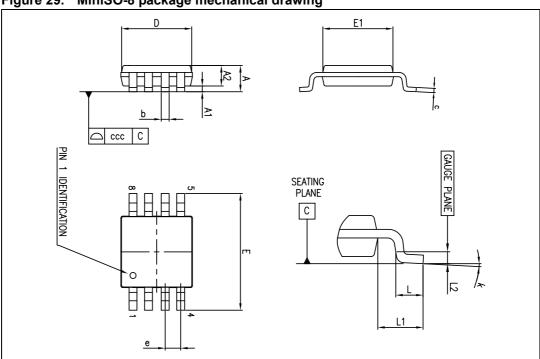


Table 14. MiniSO-8 package mechanical data

			Dime	nsions			
Ref.		Millimeters			Inches		
	Min.	Тур.	Max.	Min.	Тур.	Max.	
Α			1.1			0.043	
A1	0		0.15	0		0.006	
A2	0.75	0.85	0.95	0.030	0.033	0.037	
b	0.22		0.40	0.009		0.016	
С	0.08		0.23	0.003		0.009	
D	2.80	3.00	3.20	0.11	0.118	0.126	
E	4.65	4.90	5.15	0.183	0.193	0.203	
E1	2.80	3.00	3.10	0.11	0.118	0.122	
е		0.65			0.026		
L	0.40	0.60	0.80	0.016	0.024	0.031	
L1		0.95			0.037		
L2		0.25			0.010		
k	0 °		8 °	0 °		8 °	
ccc			0.10			0.004	

Package information LMV82x, LMV82xA

### 5.6 MiniSO-10 package information

Figure 30. MiniSO-10 package mechanical drawing

E1

Output

Discrepancy

SEATING PLANE

CAGE PLANE

CAGE PLANE

CLAUSE

CAGE PLANE

CLAUSE

C

Table 15. MiniSO-10 package mechanical data

			Dime	nsions						
Ref.		Millimeters			Inches					
	Min.	Тур.	Max.	Min.	Тур.	Max.				
Α			1.10			0.043				
A1	0.05	0.10	0.15	0.002	0.004	0.006				
A2	0.78	0.86	0.94	0.031	0.034	0.037				
b	0.25	0.33	0.40	0.010	0.013	0.016				
С	0.15	0.23	0.30	0.006	0.009	0.012				
D	2.90	3.00	3.10	0.114	0.118	0.122				
E	4.75	4.90	5.05	0.187	0.193	0.199				
E1	2.90	3.00	3.10	0.114	0.118	0.122				
е		0.50			0.020					
L	0.40	0.55	0.70	0.016	0.022	0.028				
L1		0.95			0.037					
k	0 °	3 °	6 °	0 °	3 °	6 °				
aaa			0.10			0.004				

## 5.7 TSSOP14 package information

Figure 31. TSSOP14 package mechanical drawing

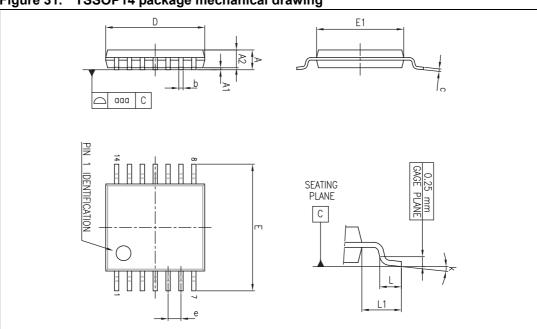


Table 16. TSSOP14 package mechanical data

			Dime	nsions					
Ref.		Millimeters			Inches				
	Min.	Тур.	Max.	Min.	Тур.	Max.			
Α			1.20			0.047			
A1	0.05		0.15	0.002	0.004	0.006			
A2	0.80	1.00	1.05	0.031	0.039	0.041			
b	0.19		0.30	0.007		0.012			
С	0.09		0.20	0.004		0.0089			
D	4.90	5.00	5.10	0.193	0.197	0.201			
E	6.20	6.40	6.60	0.244	0.252	0.260			
E1	4.30	4.40	4.50	0.169	0.173	0.176			
е		0.65			0.0256				
L	0.45	0.60	0.75	0.018	0.024	0.030			
L1		1.00			0.039				
k	0 °		8 °	0 °		8 °			
aaa			0.10			0.004			

Package information LMV82x, LMV82xA

### 5.8 TSSOP16 package information

Figure 32. TSSOP16 package mechanical drawing

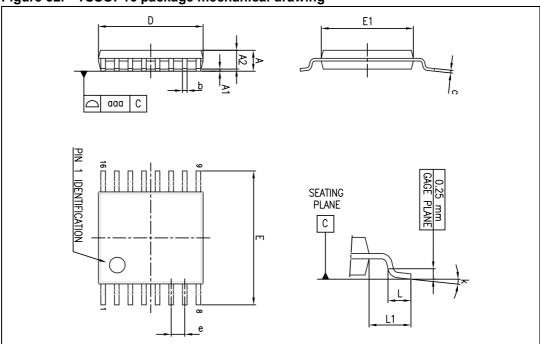


Table 17. TSSOP16 package mechanical data

			Dimer	nsions		
Ref.		Millimeters			Inches	
	Min.	Тур.	Max.	Min.	Тур.	Max.
Α			1.20			0.047
A1	0.05		0.15	0.002		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
С	0.09		0.20	0.004		0.008
D	4.90	5.00	5.10	0.193	0.197	0.201
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	4.30	4.40	4.50	0.169	0.173	0.177
е		0.65			0.0256	
k	0 °		8 °	0 °		8 °
L	0.45	0.60	0.75	0.018	0.024	0.030
L1		1.00			0.039	
aaa			0.10			0.004

## 5.9 SO-8 package information

Figure 33. SO-8 package mechanical drawing

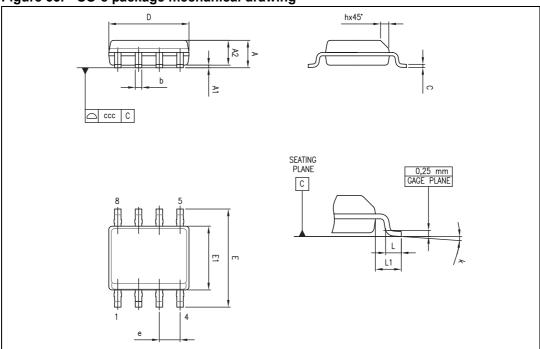


Table 18. SO-8 package mechanical data

			Dime	nsions			
Ref.		Millimeters			Inches		
	Min.	Тур.	Max.	Min.	Тур.	Max.	
Α			1.75			0.069	
A1	0.10		0.25	0.004		0.010	
A2	1.25			0.049			
b	0.28		0.48	0.011		0.019	
С	0.17		0.23	0.007		0.010	
D	4.80	4.90	5.00	0.189	0.193	0.197	
Е	5.80	6.00	6.20	0.228	0.236	0.244	
E1	3.80	3.90	4.00	0.150	0.154	0.157	
е		1.27			0.050		
h	0.25		0.50	0.010		0.020	
L	0.40		1.27	0.016		0.050	
L1		1.04			0.040		
k	1 °		8 °	1 °		8 °	
ccc			0.10			0.004	

Package information LMV82x, LMV82xA

## 5.10 SO-14 package information

Figure 34. SO-14 package mechanical drawing

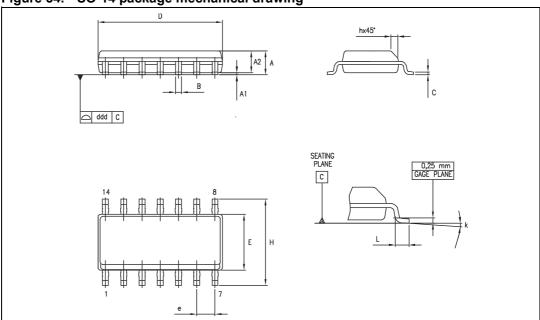


Table 19. SO-14 package mechanical data

	Dimensions						
D-f		Millimeters II			Inches	nches	
Ref.	Min.	Тур.	Max.	Min.	Тур.	Max.	
Α	1.35		1.75	0.05		0.068	
A1	0.10		0.25	0.004		0.009	
A2	1.10		1.65	0.04		0.06	
В	0.33		0.51	0.01		0.02	
С	0.19		0.25	0.007		0.009	
D	8.55		8.75	0.33		0.34	
E	3.80		4.0	0.15		0.15	
е		1.27			0.05		
Н	5.80		6.20	0.22		0.24	
h	0.25		0.50	0.009		0.02	
L	0.40		1.27	0.015		0.05	
k	8 ° (max.)						
ddd			0.10			0.004	

# 6 Ordering information

Table 20. Order codes

Order code	Temperature range	Package	Packing	Marking
LMV821ICT		SC70-5		K1S
LMV821ILT		SOT23-5	Tape & reel	K155
LMV822IQ2T		DFN8 2x2		K1S
LMV822IST	-40 ° C to +125 ° C	MiniSO8		K155
LMV822IDT		SO8		LMV822I
LMV824IPT		TSSOP14		LMV824I
LMV824IDT		SO14		LMV824I
LMV821AICT		SC70-5		K1T
LMV821AILT		SOT23-5		K156
LMV822AIST	-40 ° C to +125 ° C	MiniSO8	Tano 8 rool	K156
LMV822AIDT	-40 C t0 +125 C	SO8	Tape & reel	LMV822AI
LMV824AIPT		TSSOP14		LMV824AI
LMV824AIDT		SO14		LMV824AI

Table 21. Order codes (with shutdown pin)

Order code	Temperature range	Package	Packing	Marking
LMV820ILT		SOT23-6		K155
LMV823IST	-40 ° C to +125 ° C	MiniSO10	Tape & reel	K155
LMV825IPT		TSSOP16		LMV825I
LMV820AILT		SOT23-6		K156
LMV823AIST	-40 ° C to +125 ° C	MiniSO10	Tape & reel	K156
LMV825AIPT		TSSOP16		LMV825AI

Ordering information LMV82x, LMV82xA

Table 22. Order codes (automotive grade parts)

Order code	Temperature range	Package	Packing	Marking
LMV821IYLT	-40 ° C to +125 ° C Automotive grade <sup>(1)</sup>	SOT23-5	Tape & reel	K167
LMV822IYST		MiniSO8		K167
LMV822IYDT		SO8		LMV822IY
LMV824IYDT		SO14		LMV824IY
LMV824IYPT		TSSOP14		
LMV821AIYLT	-40 ° C to +125 ° C Automotive grade <sup>(1)</sup>	SOT23-5	Tape & reel	K168
LMV822AIYST		MiniSO8		K168
LMV822AIYDT		SO8		LMV822AY
LMV824AIYDT		SO14		LMV824AIY
LMV824AIYPT		TSSOP14		

Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q 002 or equivalent.

LMV82x, LMV82xA Revision history

# 7 Revision history

Table 23. Document revision history

Date	Revision	Changes	
10-Nov-2011	1	Initial release.	
06-Jul-2012	2	Addition of automotive grade parts.	
29-Jan-2013	3	Description and Section 4.6: Macromodel: small text changes. Updated Figure 1. Updated titles of Figure 3, Figure 13, and Figure 27. Updated Table 10, Table 11, Table 12, and Table 22: Order codes (automotive grade parts). Section 4.7: Shutdown function: added explanation of Figure 23 and Figure 24.	

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