

LMV116/LMV118 Low Voltage, 45MHz, Rail-to-Rail Output Operational Amplifiers with Shutdown Option

Check for Samples: [LMV116](#), [LMV118](#)

FEATURES

- ($V_S = 2.7V$, $T_A = 25^\circ C$, $R_L = 1k\Omega$ to $V^+/2$, $A_V = +1$. Typical values unless specified).
- -3dB BW 45MHz
- Supply voltage range 2.7V to 12V
- Slew rate 40V/ μs
- Supply current 600 μA
- Power down supply current 15 μA
- Output short circuit current 32mA
- Linear output current $\pm 20mA$
- Input common mode voltage -0.3V to 1.7V

- Output voltage swing 20mV from rails
- Input voltage noise 40nV/ \sqrt{Hz}
- Input current noise 0.75pA/ \sqrt{Hz}

APPLICATIONS

- High speed clock buffer/driver
- Active filters
- High speed portable devices
- Multiplexing applications (LMV118)
- Current sense amplifier
- High speed transducer amplifier

DESCRIPTION

The LMV116 (single) rail-to-rail output voltage feedback amplifiers offer high speed (45MHz), and low voltage operation (2.7V) in addition to micro-power shutdown capability (LMV118).

Output voltage range extends to within 20mV of either supply rail, allowing wide dynamic range especially in low voltage applications. Even with low supply current of 600 μA , output current capability is kept at a respectable $\pm 20mA$ for driving heavier loads. Important device parameters such as BW, Slew Rate and output current are kept relatively independent of the operating supply voltage by a combination of process enhancements and design architecture.

For portable applications, the LMV118 provides shutdown capability while keeping the turn-off current to 15 μA . Both turn-on and turn-off characteristics are well behaved with minimal output fluctuations during transitions. This allows the part to be used in power saving mode, as well as multiplexing applications. Miniature packages (SOT23-5 & SOT23-6) are further means to ease the adoption of these low power high speed devices in applications where board area is at a premium.

Typical Application

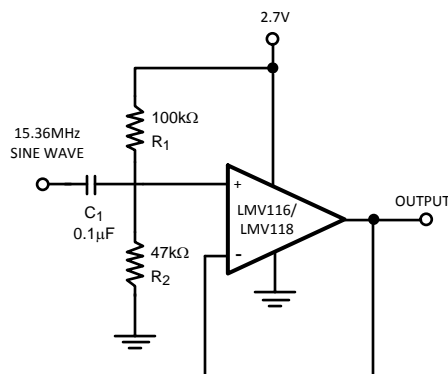


Figure 1. Non-Inverting Clock Buffer Amplifier



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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings ⁽¹⁾

ESD Tolerance	
Human Body	2KV ⁽²⁾
Machine Model	200V ⁽³⁾
V _{IN} Differential	±2.5V
Output Short Circuit Duration	⁽⁴⁾ , ⁽⁵⁾
Supply Voltage (V ⁺ - V ⁻)	12.6V
Voltage at Input/Output pins	V ⁺ +0.8V, V ⁻ -0.8V
Storage Temperature Range	-65°C to +150°C
Junction Temperature ⁽⁶⁾	+150°C
Soldering Information	
Infrared or Convection (20 sec)	235°C
Wave Soldering Lead Temp. (10 sec)	260°C

- (1) 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 performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.
- (2) Human body model, 1.5kΩ in series with 100pF.
- (3) Machine Model, 0Ω in series with 200pF.
- (4) Applies to both single-supply and split-supply operation. Continuous short circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C.
- (5) Output short circuit duration is infinite for V_S < 6V at room temperature and below. For V_S > 6V, allowable short circuit duration is 1.5ms.
- (6) The maximum power dissipation is a function of T_{J(MAX)}, θ_{JA}, and T_A. The maximum allowable power dissipation at any ambient temperature is P_D = (T_{J(MAX)} - T_A) / θ_{JA}. All numbers apply for packages soldered directly onto a PC board.

Operating Ratings ⁽¹⁾

Supply Voltage (V ⁺ - V ⁻)	2.5V to 12V
Temperature Range ⁽²⁾	-40°C to +85°C
Package Thermal Resistance ⁽²⁾ (θ _{JA})	
SOT23-5	265°C/W
SOT23-6	265°C/W

- (1) 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 performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.
- (2) The maximum power dissipation is a function of T_{J(MAX)}, θ_{JA}, and T_A. The maximum allowable power dissipation at any ambient temperature is P_D = (T_{J(MAX)} - T_A) / θ_{JA}. All numbers apply for packages soldered directly onto a PC board.

2.7V Electrical Characteristics

Unless otherwise specified, all limits guaranteed for at $T_J = 25^\circ\text{C}$, $V^+ = 2.7\text{V}$, $V^- = 0\text{V}$, $V_{CM} = V_O = V^+/2$, and $R_F = 2\text{k}\Omega$, and $R_L = 1\text{k}\Omega$ to $V^+/2$. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Units
V_{OS}	Input Offset Voltage	$0\text{V} \leq V_{CM} \leq 1.7\text{V}$		± 1	± 5 ± 6	mV
TC V_{OS}	Input Offset Average Drift	(3)		± 5		$\mu\text{V}/^\circ\text{C}$
I_B	Input Bias Current	(4)	-2.0 -2.2	-0.40		μA
I_{OS}	Input Offset Current			1	500	nA
CMRR	Common Mode Rejection Ratio	V_{CM} Stepped from 0V to 1.55V	73	88		dB
PSRR	Power Supply Rejection Ratio	$V^+ = 2.7\text{V}$ to 3.7V or $V^- = 0\text{V}$ to -1V	72	85		dB
R_{IN}	Common Mode Input Resistance			3		M Ω
C_{IN}	Common Mode Input Capacitance			2		pF
CMVR	Input Common-Mode Voltage Range	CMRR $\geq 50\text{dB}$	-0.3 -0.1		1.7	V
A_{VOL}	Large Signal Voltage Gain	$V_O = 0.35\text{V}$ to 2.35V	73 70	87		dB
V_O	Output Swing High	$R_L = 1\text{k}\Omega$ to $V^+/2$	2.55	2.66		V
		$R_L = 10\text{k}\Omega$ to $V^+/2$		2.68		
	Output Swing Low	$R_L = 1\text{k}\Omega$ to $V^+/2$	150	40		mV
		$R_L = 10\text{k}\Omega$ to $V^+/2$		20		
I_{SC}	Output Short Circuit Current	Sourcing to V^- $V_{ID} = 200\text{mV}$ (5)	25	35		mA
		Sinking to V^+ $V_{ID} = -200\text{mV}$ (5)	25	32		
I_{OUT}	Output Current	$V_{OUT} = 0.5\text{V}$ from rails		± 20		mA
I_S	Supply Current	Normal Operation		600	900	μA
		Shut-down Mode (LMV118)		15	50	
SR	Slew Rate (6)	$A_V = +1$, $V_O = 1V_{PP}$		40		V/ μs
BW	-3dB BW	$A_V = +1$, $V_{OUT} = 200\text{mV}_{PP}$		45		MHz
e_n	Input -Referred Voltage Noise	$f = 100\text{kHz}$		40		nV/ $\sqrt{\text{Hz}}$
		$f = 1\text{kHz}$		60		
i_n	Input-Referred Current Noise	$f = 100\text{kHz}$		0.75		pA/ $\sqrt{\text{Hz}}$
		$f = 1\text{kHz}$		1.20		
t_{on}	Turn-on Time (LMV118)			250		ns
t_{off}	Turn-off Time (LMV118)			560		ns
TH_{SD}	Shut-down Threshold (LMV118)	$I_S \leq 50\mu\text{A}$		1.95	2.3	V
I_{SD}	Shutdown Pin Input Current (LMV118)	(4)		-20		μA

(1) All limits are guaranteed by testing or statistical analysis.

(2) Typical values represent the most likely parametric norm.

(3) Offset voltage average drift determined by dividing the change in V_{OS} at temperature extremes into the total temperature change.

(4) Positive current corresponds to current flowing into the device.

(5) Short circuit test is a momentary test. See Note 11.

(6) Slew rate is the average of the rising and falling slew rates.

5V Electrical Characteristics

Unless otherwise specified, all limits guaranteed for at $T_J = 25^\circ\text{C}$, $V^+ = 5\text{V}$, $V^- = 0\text{V}$, $V_{\text{CM}} = V_O = V^+/2$, and $R_F = 2\text{k}\Omega$, and $R_L = 1\text{k}\Omega$ to $V^+/2$. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Units
V_{OS}	Input Offset Voltage	$0\text{V} \leq V_{\text{CM}} \leq 1.7\text{V}$		± 1	± 5 ± 6	mV
TC V_{OS}	Input Offset Average Drift	(3)		± 5		$\mu\text{V}/^\circ\text{C}$
I_{B}	Input Bias Current	(4)	-2.0 -2.2	-0.40		μA
I_{OS}	Input Offset Current			1	500	nA
CMRR	Common Mode Rejection Ratio	V_{CM} Stepped from 0V to 3.8V	77	85		dB
PSRR	Power Supply Rejection Ratio	$V^+ = 5\text{V}$ to 6V or $V^- = 0\text{V}$ to -1V	72	95		dB
R_{IN}	Common Mode Input Resistance			3		M Ω
C_{IN}	Common Mode Input Capacitance			2		pF
CMVR	Input Common-Mode Voltage Range	CMRR $\geq 50\text{dB}$	-0.3 -0.1		4.0	V
A_{VOL}	Large Signal Voltage Gain	$V_O = 1.5\text{V}$ to 3.5V	73 70	85		dB
V_O	Output Swing High	$R_L = 1\text{k}\Omega$ to $V^+/2$	4.80	4.95		V
		$R_L = 10\text{k}\Omega$ to $V^+/2$		4.98		
	Output Swing Low	$R_L = 1\text{k}\Omega$ to $V^+/2$	200	50		mV
		$R_L = 10\text{k}\Omega$ to $V^+/2$		20		
I_{SC}	Output Short Circuit Current	Sourcing to V^- $V_{\text{ID}} = 200\text{mV}$ (5)	35	45		mA
		Sinking to V^+ $V_{\text{ID}} = -200\text{mV}$ (5)	35	43		
I_{OUT}	Output Current	$V_{\text{OUT}} = 0.5\text{V}$ from rails		± 20		mA
I_{S}	Supply Current	Normal Operation		600	900	μA
		Shut-down Mode (LMV118)		10	50	
SR	Slew Rate (6)	$A_V = +1$, $V_O = 1\text{V}_{\text{PP}}$		40		V/ μs
BW	-3dB BW	$A_V = +1$, $V_{\text{OUT}} = 200\text{mV}_{\text{PP}}$		45		MHz
e_{n}	Input -Referred Voltage Noise	$f = 100\text{kHz}$		40		nV/ $\sqrt{\text{Hz}}$
		$f = 1\text{kHz}$		60		
i_{n}	Input-Referred Current Noise	$f = 100\text{kHz}$		0.75		pA/ $\sqrt{\text{Hz}}$
		$f = 1\text{kHz}$		1.20		
t_{on}	Turn-on Time (LMV118)			210		ns
t_{off}	Turn-off Time (LMV118)			500		ns
TH_{SD}	Shut-down Threshold (LMV118)	$I_{\text{S}} \leq 50\mu\text{A}$		4.25	4.60	V
I_{SD}	Shutdown Pin Input Current (LMV118)	(4)		-20		μA

(1) All limits are guaranteed by testing or statistical analysis.

(2) Typical values represent the most likely parametric norm.

(3) Offset voltage average drift determined by dividing the change in V_{OS} at temperature extremes into the total temperature change.

(4) Positive current corresponds to current flowing into the device.

(5) Short circuit test is a momentary test. See Note 11.

(6) Slew rate is the average of the rising and falling slew rates.

±5V Electrical Characteristics

Unless otherwise specified, all limits guaranteed for at $T_J = 25^\circ\text{C}$, $V^+ = 5\text{V}$, $V^- = -5\text{V}$, $V_{CM} = V_O = 0\text{V}$, and $R_F = 2\text{k}\Omega$, and $R_L = 1\text{k}\Omega$ to $V^+/2$. **Boldface** limits apply at the temperature extremes.

Symbol	Parameter	Conditions	Min (1)	Typ (2)	Max (1)	Units
V_{OS}	Input Offset Voltage	$-5\text{V} \leq V_{CM} \leq 1.7\text{V}$		± 1	± 5 ± 6	mV
TC V_{OS}	Input Offset Average Drift	(3)		± 5		$\mu\text{V}/^\circ\text{C}$
I_B	Input Bias Current	(4)	-2.0 -2.2	-0.40		μA
I_{OS}	Input Offset Current			3	500	nA
CMRR	Common Mode Rejection Ratio	V_{CM} Stepped from -5V to 3.5V	78	104		dB
PSRR	Power Supply Rejection Ratio	$V^+ = 5\text{V}$ to 6V or $V^- = -5\text{V}$ to -6V	72	95		dB
R_{IN}	Common Mode Input Resistance			3		M Ω
C_{IN}	Common Mode Input Capacitance			2		pF
CMVR	Input Common-Mode Voltage Range	CMRR $\geq 50\text{dB}$	-5.3 -5.1		4.0	V
A_{VOL}	Large Signal Voltage Gain	$V_O = -2\text{V}$ to 2V	74 71	85		dB
V_O	Output Swing High	$R_L = 1\text{k}\Omega$	4.70	4.92		V
		$R_L = 10\text{k}\Omega$		4.97		
	Output Swing Low	$R_L = 1\text{k}\Omega$	-4.70	-4.93		mV
		$R_L = 10\text{k}\Omega$		-4.98		
I_{SC}	Output Short Circuit Current	Sourcing to 0V $V_{ID} = 200\text{mV}$ (5)	40	57		mA
		Sinking to 0V $V_{ID} = -200\text{mV}$ (5)	40	54		
I_{OUT}	Output Current	$V_{OUT} = 0.5\text{V}$ from rails		± 20		mA
I_S	Supply Current	Normal Operation		600	900	μA
		Shut-down Mode (LMV118)		15	50	
SR	Slew Rate (6)	$A_V = +1$, $V_O = 1V_{PP}$		35		V/ μs
BW	-3dB BW	$A_V = +1$, $V_{OUT} = 200\text{mV}_{PP}$		45		MHz
e_n	Input -Referred Voltage Noise	$f = 100\text{kHz}$		40		nV/ $\sqrt{\text{Hz}}$
		$f = 1\text{kHz}$		60		
i_n	Input-Referred Current Noise	$f = 100\text{kHz}$		0.75		pA/ $\sqrt{\text{Hz}}$
		$f = 1\text{kHz}$		1.20		
t_{on}	Turn-on Time (LMV118)			200		ns
t_{off}	Turn-off Time (LMV118)			700		ns
TH_{SD}	Shut-down Threshold (LMV118)	$I_S \leq 50\mu\text{A}$		4.25	4.60	V
I_{SD}	Shutdown Pin Input Current (LMV118)	(4)		-20		μA

(1) All limits are guaranteed by testing or statistical analysis.

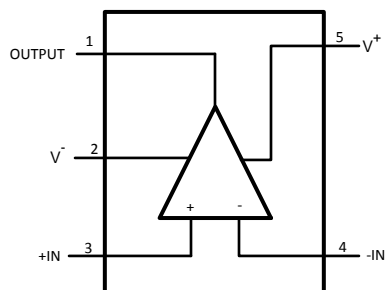
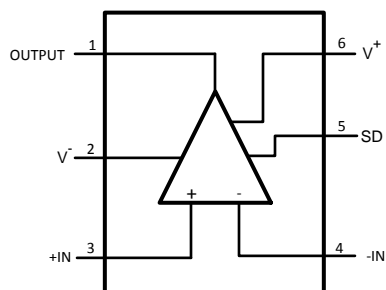
(2) Typical values represent the most likely parametric norm.

(3) Offset voltage average drift determined by dividing the change in V_{OS} at temperature extremes into the total temperature change.

(4) Positive current corresponds to current flowing into the device.

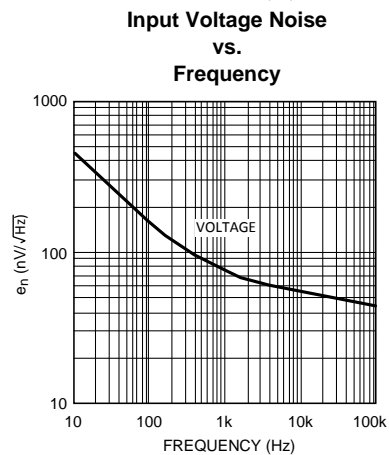
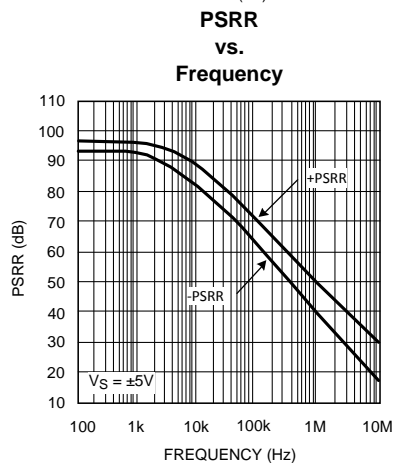
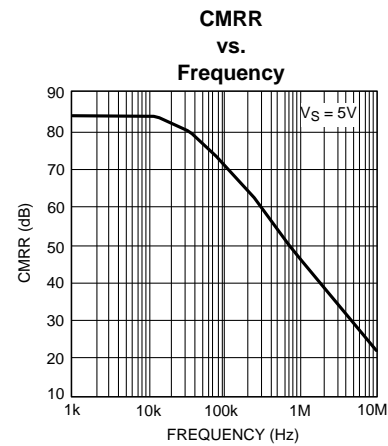
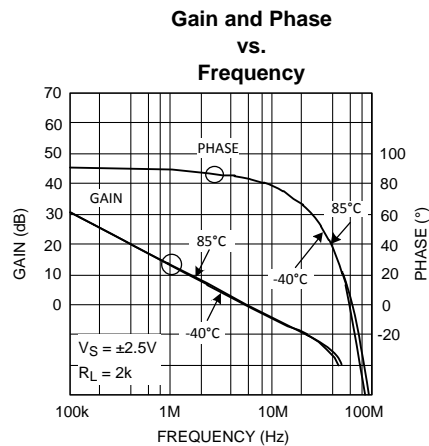
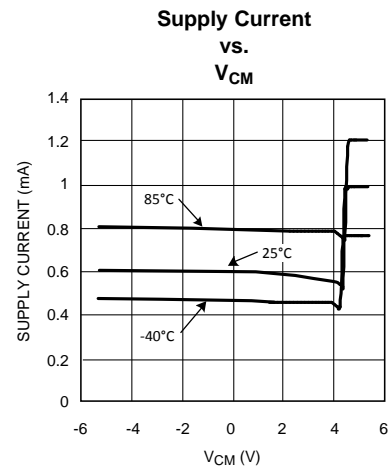
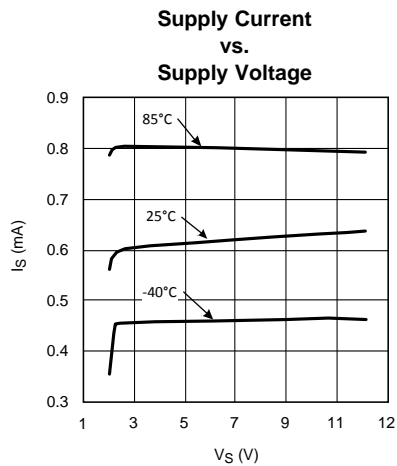
(5) Short circuit test is a momentary test. See Note 11.

(6) Slew rate is the average of the rising and falling slew rates.

Connection Diagram**SOT23-5 (LMV116)****Figure 2. Top View****SOT23-6 (LMV118)****Figure 3. Top View**

Typical Performance Characteristics

At $T_J = 25^\circ\text{C}$. Unless otherwise specified.



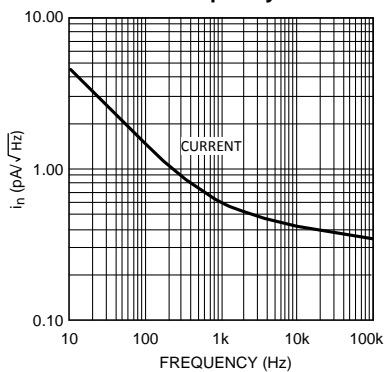
Typical Performance Characteristics (continued)

At $T_J = 25^\circ\text{C}$. Unless otherwise specified.

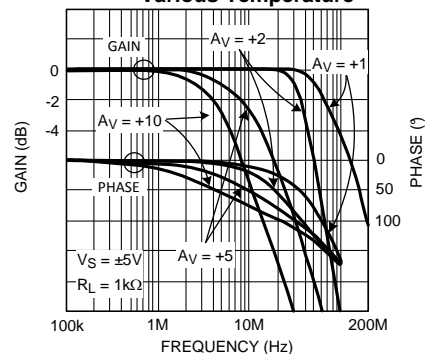
Input Current Noise

vs.

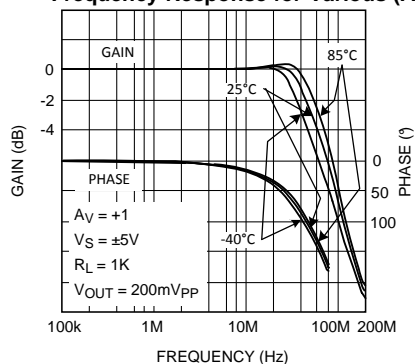
Frequency



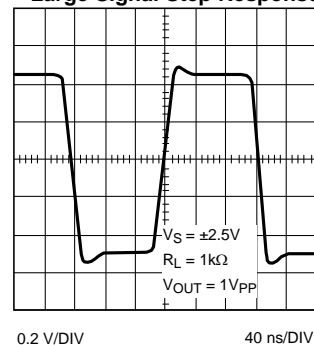
Closed Loop Frequency Response for Various Temperature



Frequency Response for Various (A_V)



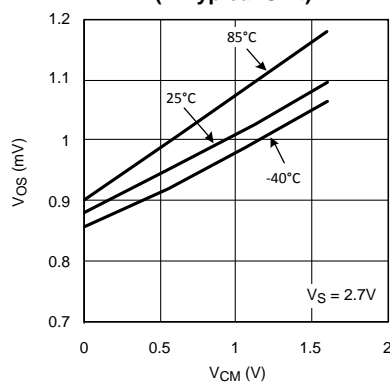
Large Signal Step Response



Offset Voltage

vs.

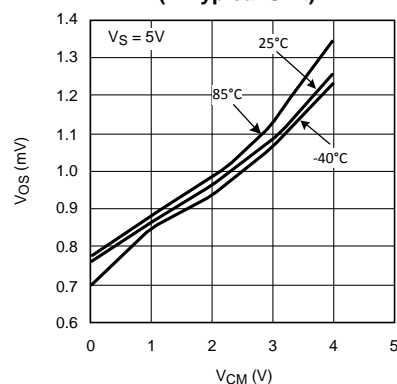
Common Mode Voltage (A Typical Unit)



Offset Voltage

vs.

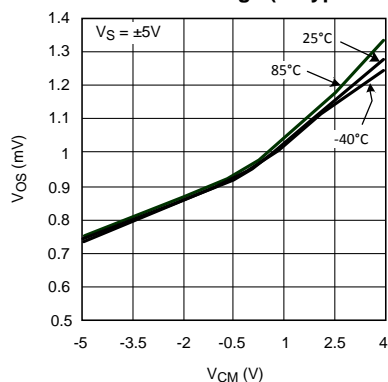
Common Mode Voltage (A Typical Unit)



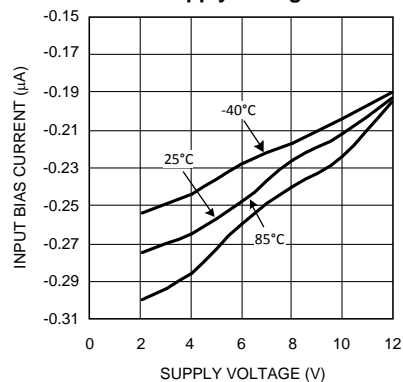
Typical Performance Characteristics (continued)

At $T_J = 25^\circ\text{C}$. Unless otherwise specified.

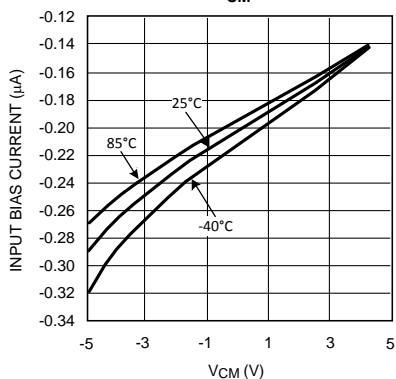
**Offset Voltage
vs.
Common Mode Range (A Typical Unit)**



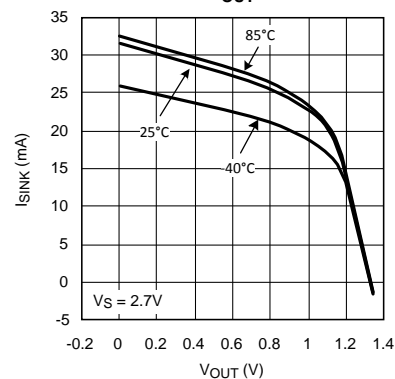
**Input Bias Current
vs.
Supply Voltage**



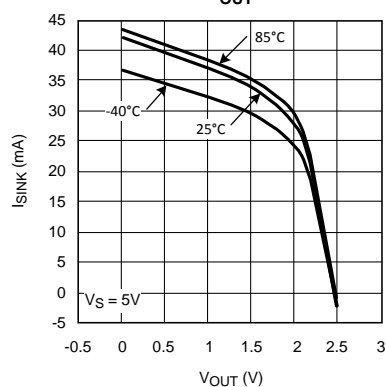
**Input Bias Current
vs.
VCM**



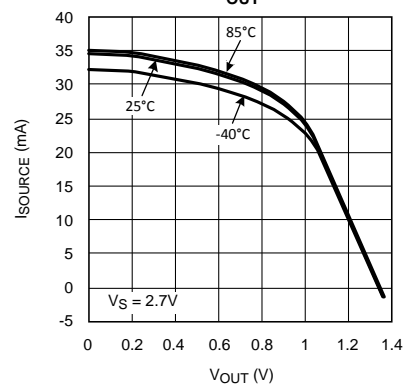
**Sink Current
vs.
VOUT**



**Sink Current
vs.
VOUT**

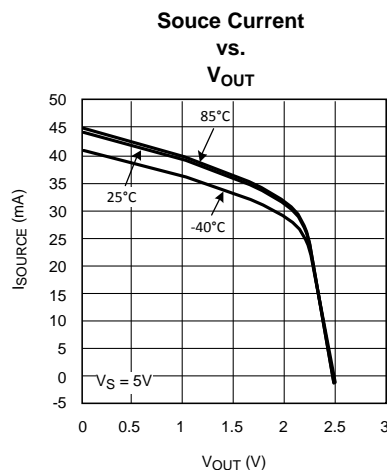


**Source Current
vs.
VOUT**



Typical Performance Characteristics (continued)

At $T_J = 25^\circ\text{C}$. Unless otherwise specified.



Application Notes

CIRCUIT DESCRIPTION

The LMV116 and LMV118 are based on National Semiconductor's proprietary VIP10 dielectrically isolated bipolar process.

The LMV116 and LMV118 architecture features the following:

- Complimentary bipolar devices with exceptionally high f_t (~8GHz) even under low supply voltage (2.7V) and low Collector bias current.
- Common Emitter push-pull output stage capable of 20mA output current (at 0.5V from the supply rails) while consuming only 600 μA of total supply current. This architecture allows output to reach within milli-volts of either supply rail at light loads.
- Consistent performance from any supply voltage (2.7V-10V) with little variation with supply voltage for the most important specifications (e.g. BW, SR, I_{OUT} , etc.)

APPLICATION HINTS

When the output swing approaches either supply rail, the output transistor will enter a Quasi-saturated state. A subtle effect of this operational region is that there is an increase in supply current in this state (up to 1 mA). The onset of Quasi-saturation region is a function of output loading (current) and varies from 100 mV at no load to about 1V when output is delivering 20 mA, as measured from supplies. Both input common mode voltage and output voltage level effect the supply current (see typical performance characteristics for plot).

MICRO-POWER SHUTDOWN

The LMV118 can be shutdown to save power and reduce its supply current to less than 50 μA guaranteed, by applying a voltage to the SD pin. The SD pin is "active high" and needs to be tied to V^- for normal operation. This input is low current (<20 μA , 4pF equivalent capacitance) and a resistor to V^- ($\leq 20\text{k}\Omega$) will result in normal operation. Shutdown is guaranteed when SD pin is 0.4V or less from V^+ at any operating supply voltage and temperature.

In the shutdown mode, essentially all internal device biasing is turned off in order to minimize supply current flow and the output goes into Hi-Z (high impedance) mode. Complete device Turn-on and Turn-off times vary considerably relative to the output loading conditions, output voltage, and input impedance, but is generally limited to less than 1 μs (see tables for actual data).

During shutdown, the input stage has an equivalent circuit as shown below in [Figure 4](#).

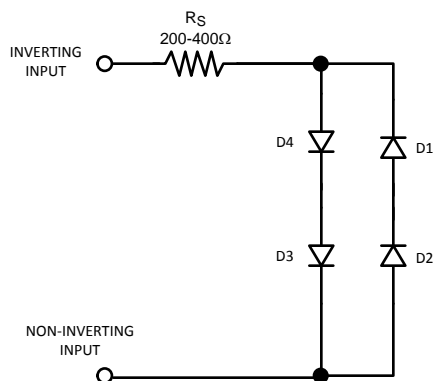


Figure 4.

As can be seen above, in shutdown, there may be current flow through the internal diodes shown, caused by input potential, if present. This current may flow through the external feedback resistor and result in an apparent output signal. In most shutdown applications the presence of this output is inconsequential. However, if the output is “forced” by another device such as in a multiplexer, the other device will need to conduct the current described in order to maintain the output potential.

To keep the output at or near ground during shutdown when there is no other device to hold the output low, a switch (transistor) could be used to shunt the output to ground. Figure 5 shows a circuit where a NPN bipolar is used to keep the output near ground (~80mV):

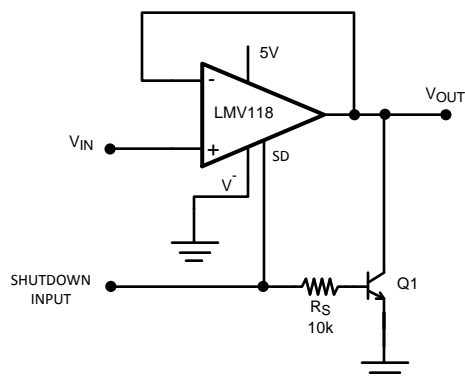


Figure 5. Active Pull-Down Schematic

Figure 6 shows the output waveform.

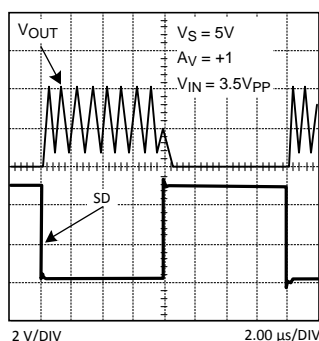


Figure 6. Output Held Low by Active Pull-Down Circuit

If bipolar transistor power dissipation is not tolerable, the switch could be by a N-channel enhancement mode MOSFET.

2.7V SINGLE SUPPLY 2:1 MUX

The schematic show in [Figure 7](#) will function as a 2:1 MUX operating on a single 2.7V power supply, by utilizing the shutdown feature of the LMV118.

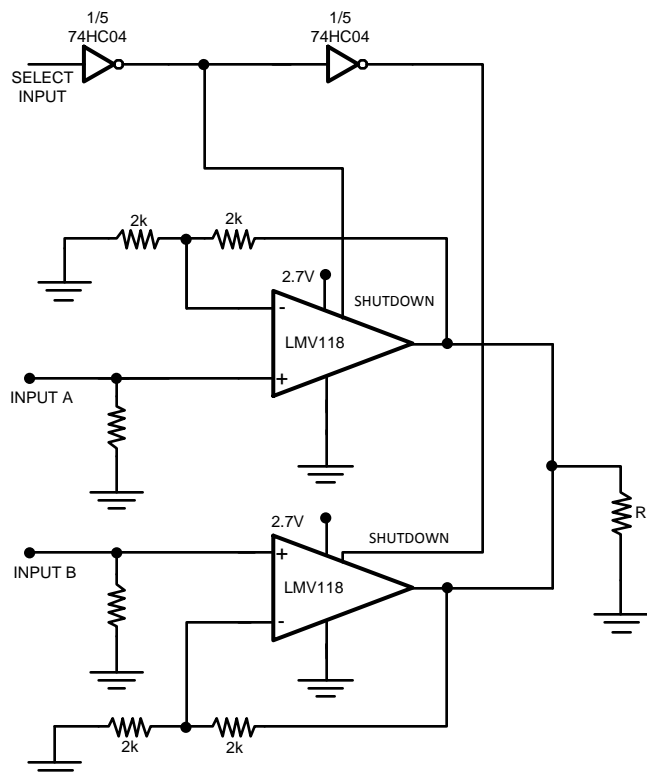


Figure 7. 2:1 MUX Operating off a 2.7V Single Supply

[Figure 8](#) shows the MUX output when selecting between a 1MHz sine and a 250kHz triangular waveform.

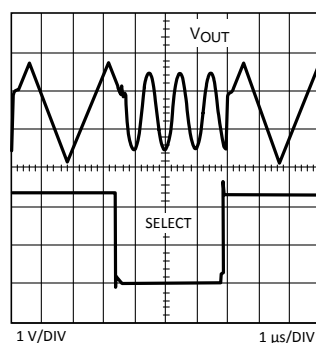


Figure 8. 2:1 MUX Output

As can be seen in [Figure 8](#), the output is well behaved and there are no spikes or glitches due to the switching. Switching times are approximately around 500ns based on the time when the output is considered “valid”.

PRINTED CIRCUIT BOARD LAYOUT, COMPONENT VALUES SELECTION, AND EVALUATION BOARDS

Generally, a good high-frequency layout will keep power supply and ground traces away from the inverting input and output pins. Parasitic capacitances on these nodes to ground will cause frequency response peaking and possible circuit oscillations (see Application Note OA-15 for more information).

Another important parameter, is the component values selection. Choosing large valued external resistors, will effect the closed loop behavior of the stage because of the interaction of these resistors with parasitic capacitances. These capacitors could be inherent to the device or a by-product of the board layout and component placement. Either way, keeping the resistor values lower, will diminish this interaction. On the other hand, choosing very low value resistors could load down nodes and will contribute to higher overall power dissipation.

National Semiconductor suggests the following evaluation boards as a guide for high frequency layout and as an aid in device testing and characterization:

Device	Package	Evaluation Board PN
LMV116	SOT23-5	CLC730068
LMV118	SOT23-6	CLC730116

These free evaluation boards are shipped when a device sample request is placed with National Semiconductor.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LMV116MF	ACTIVE	SOT-23	DBV	5	1000	TBD	CU SNPB	Level-1-260C-UNLIM	-40 to 85	AC1A	Samples
LMV116MF/NOPB	ACTIVE	SOT-23	DBV	5	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	AC1A	Samples
LMV116MFX	ACTIVE	SOT-23	DBV	5	3000	TBD	CU SNPB	Level-1-260C-UNLIM	-40 to 85	AC1A	Samples
LMV116MFX/NOPB	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	AC1A	Samples
LMV118MF	ACTIVE	SOT-23	DBV	6	1000	TBD	CU SNPB	Level-1-260C-UNLIM	-40 to 85	AD1A	Samples
LMV118MF/NOPB	ACTIVE	SOT-23	DBV	6	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	AD1A	Samples
LMV118MFX	ACTIVE	SOT-23	DBV	6	3000	TBD	CU SNPB	Level-1-260C-UNLIM	-40 to 85	AD1A	Samples
LMV118MFX/NOPB	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	AD1A	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) Only one of markings shown within the brackets will appear on the physical device.

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TAPE AND REEL INFORMATION


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LMV116MF	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LMV116MF/NOPB	SOT-23	DBV	5	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LMV116MFX	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LMV116MFX/NOPB	SOT-23	DBV	5	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LMV118MF	SOT-23	DBV	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LMV118MF/NOPB	SOT-23	DBV	6	1000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LMV118MFX	SOT-23	DBV	6	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
LMV118MFX/NOPB	SOT-23	DBV	6	3000	178.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LMV116MF	SOT-23	DBV	5	1000	203.0	190.0	41.0
LMV116MF/NOPB	SOT-23	DBV	5	1000	203.0	190.0	41.0
LMV116MFX	SOT-23	DBV	5	3000	206.0	191.0	90.0
LMV116MFX/NOPB	SOT-23	DBV	5	3000	206.0	191.0	90.0
LMV118MF	SOT-23	DBV	6	1000	203.0	190.0	41.0
LMV118MF/NOPB	SOT-23	DBV	6	1000	203.0	190.0	41.0
LMV118MFX	SOT-23	DBV	6	3000	206.0	191.0	90.0
LMV118MFX/NOPB	SOT-23	DBV	6	3000	206.0	191.0	90.0

DBV (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - Falls within JEDEC MO-178 Variation AA.

DBV (R-PDSO-G5)

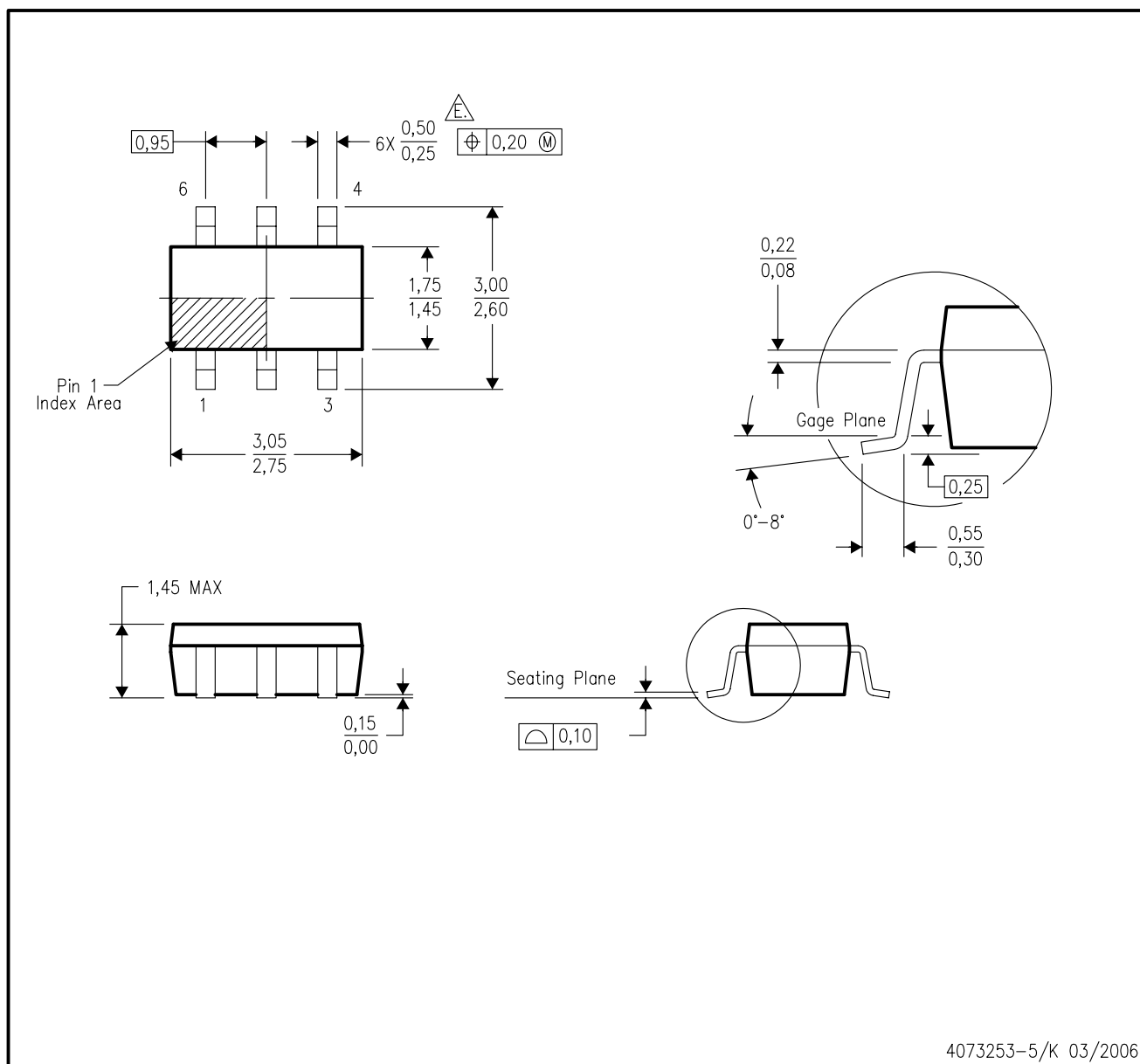
PLASTIC SMALL OUTLINE




- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - D. Publication IPC-7351 is recommended for alternate designs.
 - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

DBV (R-PDSO-G6)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
-  Falls within JEDEC MO-178 Variation AB, except minimum lead width.

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