

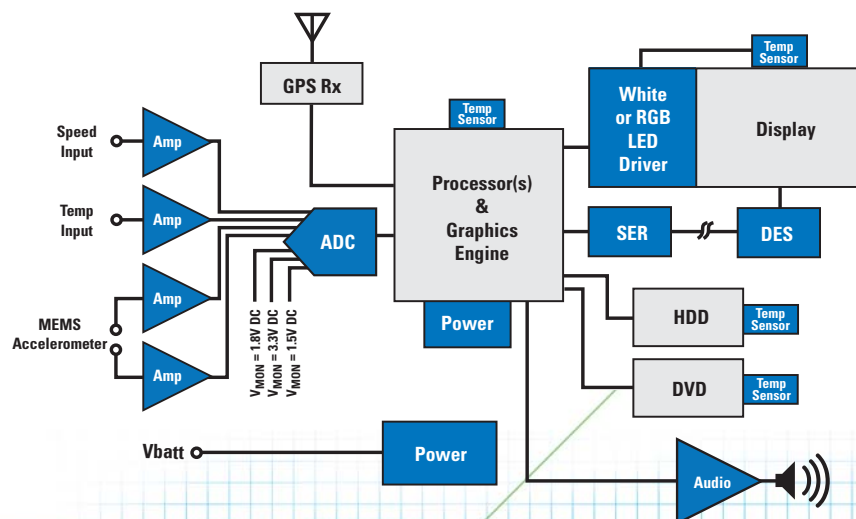
# Automotive Solutions

## Solutions Guide

[national.com/automotive](http://national.com/automotive)

2010 Vol. 2

Power Solutions  
Interface Solutions  
Data Conversion  
Temperature Solutions  
Audio Solutions  
Amplifiers  
Design Resources





**N**ew analog and mixed-signal solutions from National Semiconductor help automotive OEMs differentiate their vehicles with the latest technology advancements demanded by consumers. National's innovative automotive products reduce system costs, improve reliability, and simplify design complexity to accelerate time to market.

Advanced ICs and subsystems from National are designed for use in automotive infotainment, driver assist, safety, powertrain, energy management systems, and LED lighting.

### Challenges of the Automotive Market

Three current megatrends challenging automotive system designers are safety, environmental sustainability, and connectivity.

#### Safety

Collision avoidance or minimizing the effects of accidents is paramount. New driver assist and safety technologies combine electronic vision—or digital cameras—with sensors such as Radar, Lidar, and Ultrasound to create advanced safety systems that help drivers predict and avoid accidents. Traffic sign recognition, lane departure warning, night vision, and bird's-eye view are a few examples of vision-based technologies that help make our roads safer.

#### Environmental Sustainability

Automotive OEMs are constantly challenged to develop new vehicles that reduce or eliminate emissions.

Energy efficiency, weight reduction, and versatile power management are key elements to achieving this goal. Smart battery management solutions will enable zero emission vehicles to increase their range and extend the lifetime of cell arrays to minimize impact on the environment.

#### Connectivity

The automobile is no longer just for transportation. Today's connected vehicles integrate telematics capabilities such as navigation, wireless communication, Internet access, and vehicle tracking along with streaming TV and entertainment systems. These data-intensive applications are driving the need for higher bandwidth vehicle communication systems.

#### Quality is Key

With the exponential growth of electronics in all areas of the automobile—from infotainment to critical safety applications—demands on quality and reliability of individual components is intense. These demands can only be addressed with a zero defect approach throughout the entire process from design and qualification to manufacturing and the supply chain. National's Automotive Q-Grade program leverages this approach to deliver the highest quality solutions with enhanced robustness and reliability.

Go to [national.com/automotive](http://national.com/automotive) to see all of National's automotive products, application notes, and solutions.

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# Automotive-Grade and Die Products

## Automotive-Grade Products

To address the zero-defect expectations of automotive customers, National's automotive-grade products pass rigorous testing and provide enhanced reliability specific to automotive requirements including:

- AEC-Q100-qualified with capabilities for each temperature grade
- TS-16949 certified
- Visible and traceable throughout manufacturing, ordering, and supply chain processes
- Certification requests to meet customer-specific requirements

AECQ Temperature Grade	Min (°C)	Max (°C)
Grade 0	-40	+150
Grade 1	-40	+125
Grade 2	-40	+105
Grade 3	-40	+85
Grade 4	-0	+70

## Product Qualification and Development

In addition to the AEC-Q100 reliability specification, a complete Production Part Approval Process (PPAP) package—compliant with the AIAG manual—is generated based on customer specifications. A comprehensive, phase review development process ensures quality from product inception through completion and includes complete design process documentation and AEC-Q003-compliant device characterization.

## Manufacturing Quality

Beyond AEC-Q100 certification, National's automotive-grade manufacturing process includes additional enhancements and dedicated defect reduction programs to minimize variation:



- Special manufacturing flow with increased inspection and screening
- Enhanced defect detection through methods including PAT, delta current stress tests, statistical bin yield analysis, and reliability monitors
- Statistical process control
- Defect analysis using a closed loop, 8D-based corrective action and 5 Why root cause analysis

## Change Management

For better visibility into product changes, National provides notifications with complete AEC-Q100-compliant documentation, including:

- Six months notification for change management
- Twelve month End-Of-Life notification with three-month shipping window

## Unique Device Identification

Each qualified part is identified with a special order code Q in the device part number to enable complete product visibility and traceability. All products featured in this guide are ideal for designing automotive applications. To find products that are fully automotive-grade compliant, look for the  symbol. Products with a  symbol are completing certification requirements and will be fully qualified within the next 6 months. Contact your local National Semiconductor sales office to request that any other product enter the qualification process.

## Die Products Program

With the growing number of hybrid systems and sub-systems in production, the implementation rate of die products is rapidly increasing to meet form factor and system performance requirements. National provides products in die or wafer form to meet these needs with:

- Improved integration and reliability
- Smaller size and weight
- Improved electrical performance

Temperature extensions:

- Tj up to +175°C
- Ta -40 to +175°C

Shipping methods to suit high volume production:

- Wafer
- Diced product on Tape and Reel — surftape® 7" up to 7000/reel
- Pocket tape

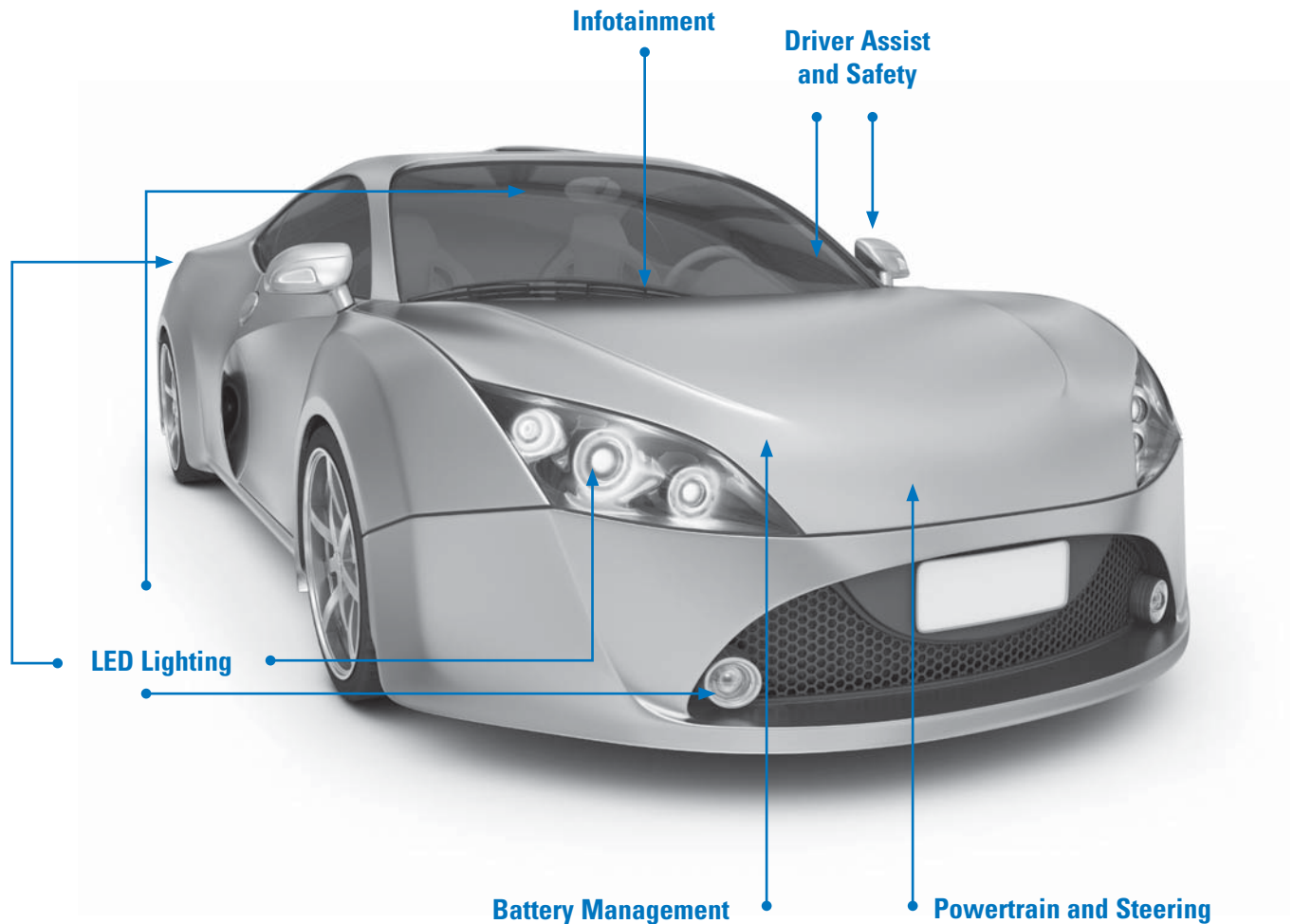
Visit [national.com/automotive](http://national.com/automotive) for updates on automotive-grade products, to view the current automotive die portfolio, or request an additional product in die or wafer form.

# Automotive Applications Overview

National's commitment to the automotive industry means providing more than just a collection of parts — it means delivering comprehensive solutions with best-in-class support and industry-leading quality, performance, and reliability.

National's system-level solutions help designers address key automotive trends in infotainment, driver assist, safety, LED lighting, and powertrain systems.

When it comes to analog in automotive, National provides highly reliable solutions through a broad and growing array of products. Look for more innovation and updates at [national.com/automotive](http://national.com/automotive).



# Automotive Applications

## Infotainment and Navigation

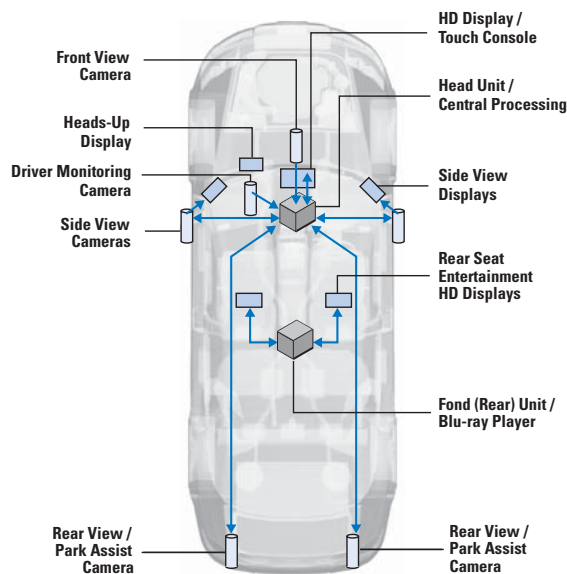
Infotainment systems help drivers navigate safely to their destination while entertaining passengers with theatre-quality audio and video. National's broad portfolio

of diverse products is specifically designed to drive high-resolution infotainment systems that are modular, compact, and feature robust EMI protection.

Product	Features	Benefits
Power	High frequency operation	EMI mitigation, high-power density, HV immunity
	External oscillator sync for spread-spectrum and/or avoiding specific radio tuner frequencies	
	Highly integrated Power Management Units (PMUs)	Small, cost-effective total footprint
FPD-Link Ser/Des	Embedded clock architecture	Simplifies interconnects, reduces number of cables and connectors
	Real-time bidirectional control channel (FPD-Link III)	Eliminates need for external CAN or LIN bus, reduces overall system cost with fewer cables and connectors
	Serial link randomization and scrambling	EMI mitigation
	Spread-spectrum clock and leading EMI-mitigation techniques	
	Up to 3 Gbps serial data rates	Uncompressed video for highest quality images
	High-bandwidth digital content protection (HDCP)	Enables playback of content-protected media such as Blu-ray video
5 to 85 MHz pixel clock	Supports high-definition resolutions, dual-view displays, and 24-bit color depth	
Temp Sensors	Best in-class rating, high accuracy and resolution, fast conversion time, low quiescent current, and integrated reliability features	Protects electronics, maintains visual aesthetics, promote energy-efficient continuous operations
Amplifiers	Extremely low noise	High-fidelity audio
	Excellent Total Harmonic Distortion (THD)	
	Analog NTSC amplifiers available	Compatible with NTSC video signal standard

### High-Speed Data Links

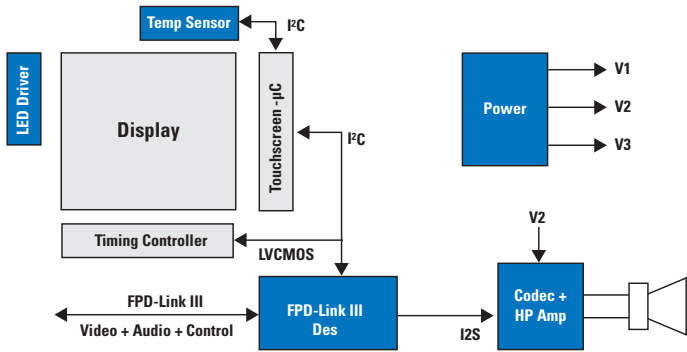
FPD-Link Ser/Des deliver high-speed data transport for Driver Assist and Infotainment systems



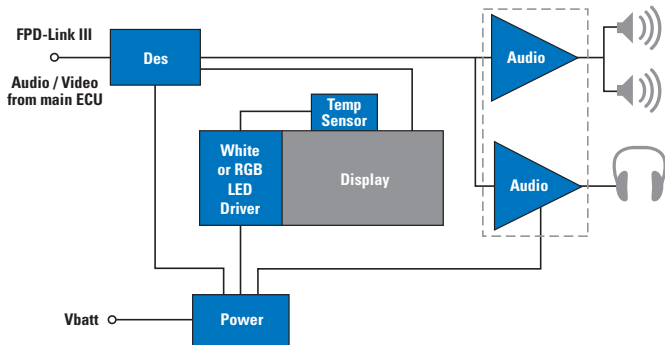
# Automotive Applications

## Infotainment and Navigation

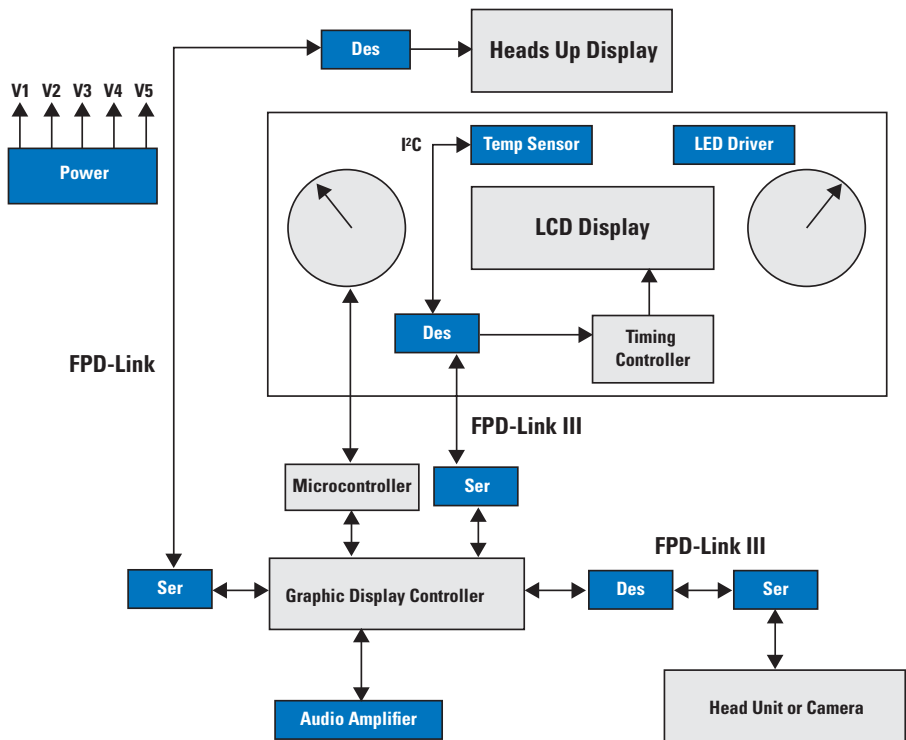
### Central Information Display



### Rear Seat Entertainment Unit



### Instrument Cluster



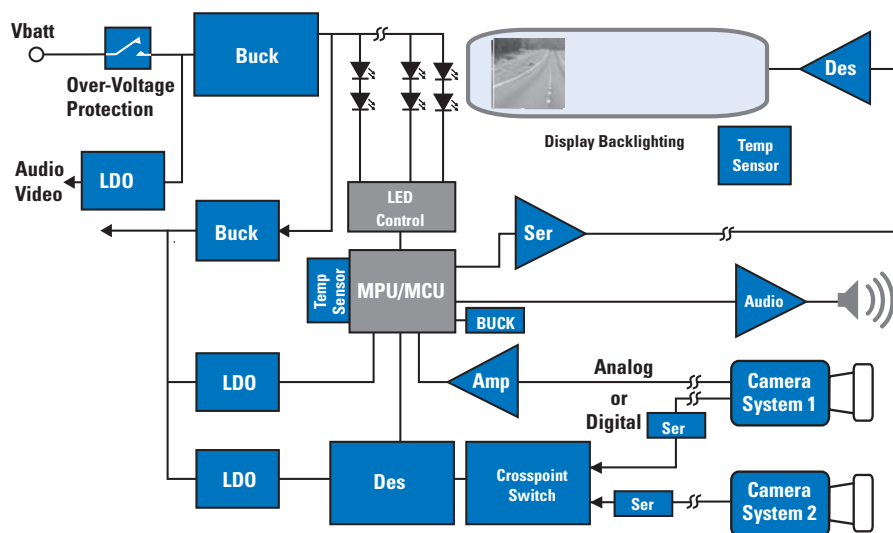
# Automotive Applications

## Driver Assist and Safety

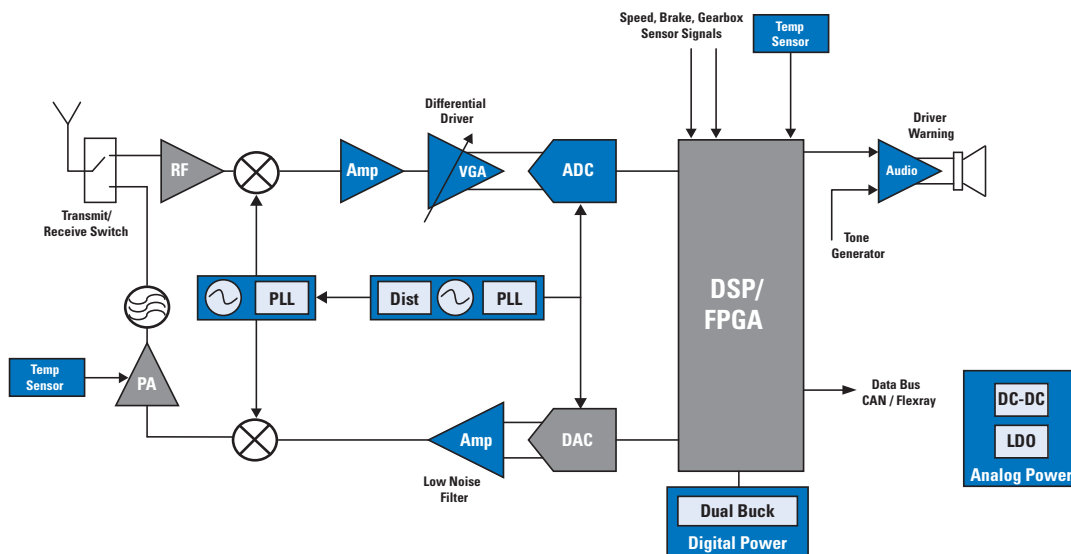
Camera systems are an increasingly important component of vehicle safety. Advanced Driver Assist and Safety (ADAS) systems require synchronization between multiple cameras and image processing cores to accurately

analyze data and make split-second decisions. National's FPD-Link serializers and deserializers deliver the industry's lowest latency integrated control channel to enable the fastest response times.

### Automotive Park Assist



### Car Radar for Active Cruise Control





# Automotive Applications

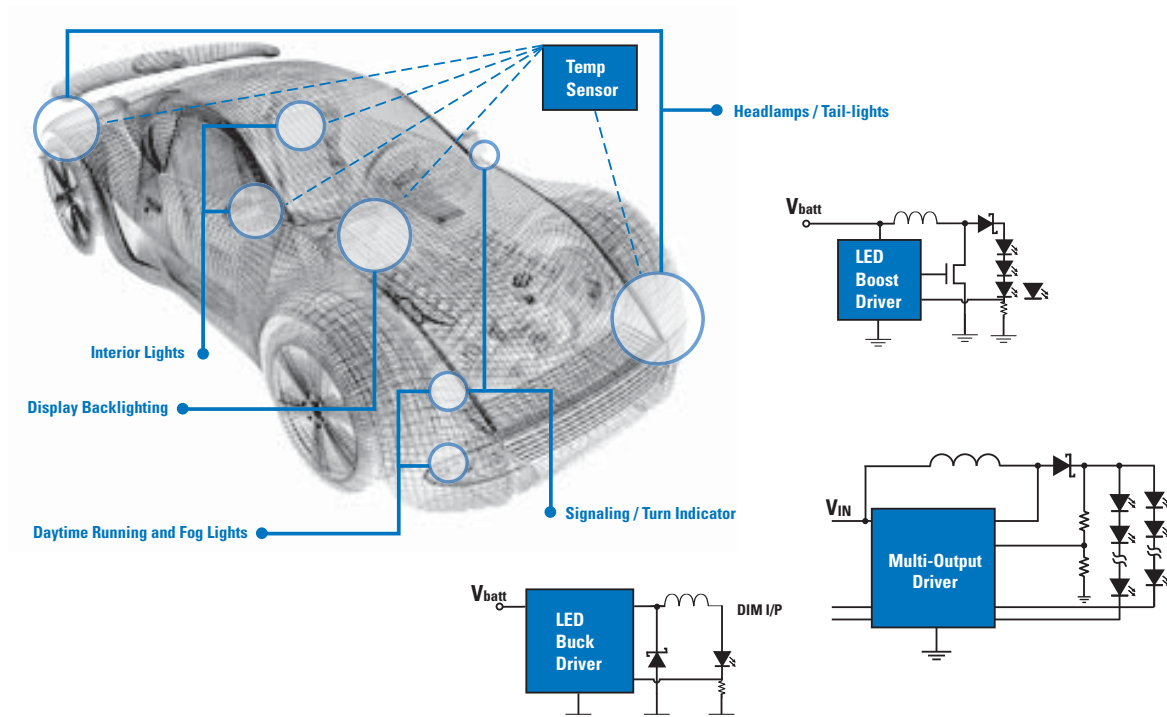
## LED Lighting

From automotive LED headlamps to backlit displays, LEDs are an integral part of the driving experience. National's portfolio of automotive LED drivers offers key features like PWM dimming, accurate under-voltage lockout (UVLO), and high-side current sensing, plus low LED ripple current and external oscillator sync capabilities

allow designers to reduce issues with EMI. National's family of PowerWise® high-brightness LED drivers power the new generation of 1W-to-5W high-brightness LEDs found in headlights, taillights, signaling, daytime running lights, interior lighting, and displays.

Features	Benefits
High efficiency	Alleviates major heat problems
High-side current sensing	LEDs grounded to chassis
Accurate current control	Protect LEDs from over current
Flexible high dimming ratio	Easily reduces current when battery is low to avoid excessive battery drain
Wide-voltage range	Stable under instant on, low and high battery, high voltage transients
Accurate UVLO	Disable when battery is low
Low LED ripple current	Minimize EMI
External oscillator sync capability	External spread spectrum for low EMI

### Automotive LED Lighting



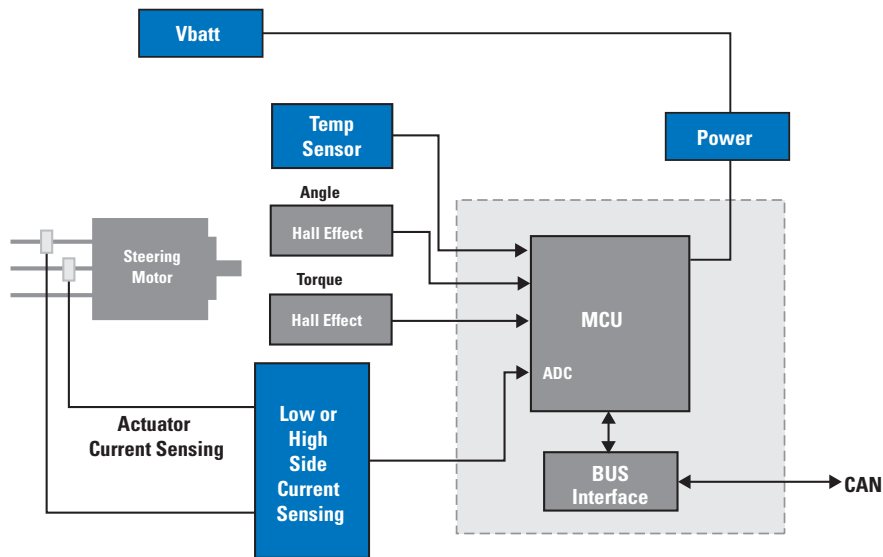
# Automotive Applications

## Powertrain

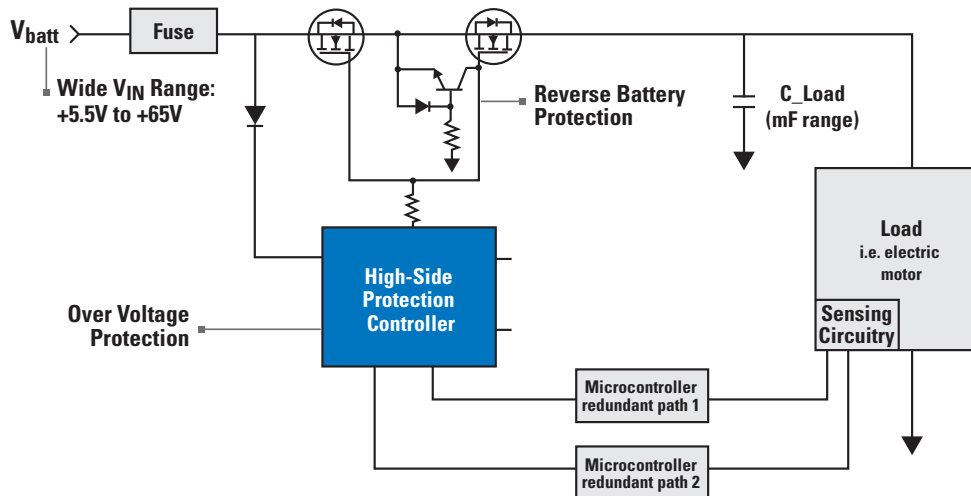
Powertrain and under-the-hood systems, like electric power steering, gearbox, and injection systems demand the highest thermal performance from electronics at temperatures up to 150° C. National offers power management, thermal management, and bare die products with a range up to 175° C for state-of-the-art steering, gearbox, injection, and hybrid drive systems.

Increasing engine efficiency, weight reduction in any system, and versatile energy management are key elements in reducing CO2 emissions. Smart battery management solutions can increase the efficiency of traditional automobiles as well as enable zero emission vehicles to increase their range and battery lifetime.

### Automotive Electric Power Steering



### Reverse Battery Circuit Diagram



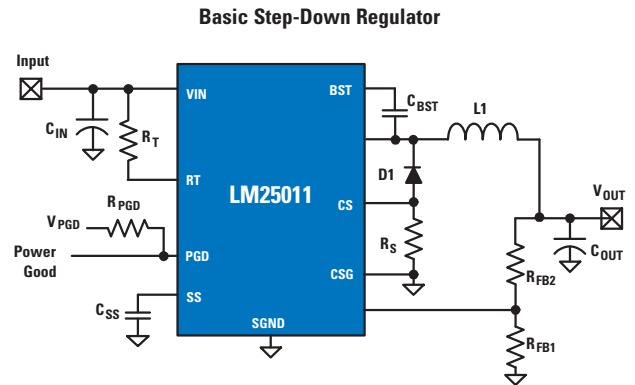
## LM25011/A – 42V Constant On-Time Switching Regulator with Adjustable Current Limit

### Features

- AEC-Q100 grade 1 qualified
- 6V to 42V input operating voltage range
- Integrated 2A N-channel Buck Switch
- Adjustable current limit allows for smaller inductor
- Adjustable output voltage from 2.51V
- Power Good output

### Applications

Ideal for use in infotainment, telematics, navigation systems, and in-dash instrumentation



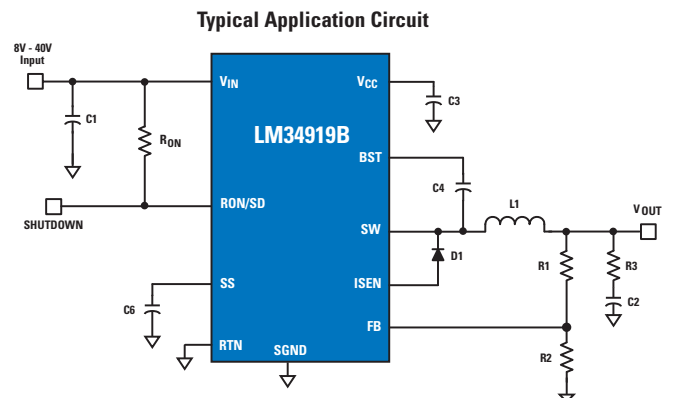
## LM34919B – Ultra-Small 40V, 600 mA Constant On-Time Buck Switching Regulator

### Features

- AEC-Q100 Grade 1 qualified
- Integrated N-channel buck switch
- Integrated start-up regulator
- 6V to 40V input voltage range
- No loop compensation required
- Ultra-fast transient response
- 2.6 MHz maximum switching frequency

### Applications

Designed for use in extremely spaced-constrained applications, such as rearview cameras



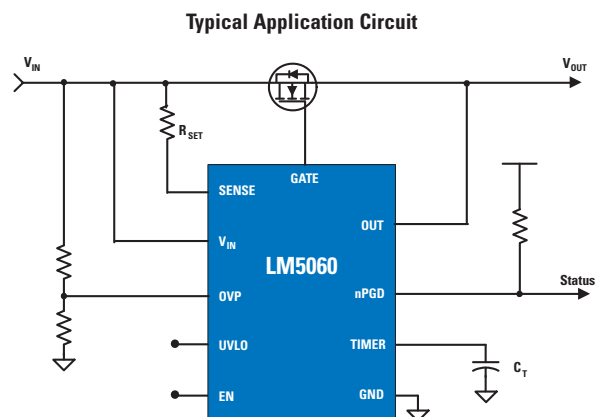
## LM5060 – High-Side Protection Controller with Low Quiescent Current

### Features

- AEC-Q100 Grade 1 qualified
- Wide operating input voltage range +5.5V to +65V
- Less than 15  $\mu$ A quiescent current in disabled mode
- Controlled output rise time for safe connection of capacitive loads
- Charge pump gate driver for external N-Channel MOSFET
- Programmable fault detection delay time

### Applications

Ideal for use in electronic power steering and braking, electric motor control, and electronic circuit breakers



# Power Management Solutions

## Buck and Boost Regulators

### SIMPLE SWITCHER® Power Modules

Product ID	Output Current (A)	V <sub>IN</sub> Min (V)	V <sub>IN</sub> Max (V)	V <sub>OUT</sub> Min (V)	V <sub>OUT</sub> Max (V)	T <sub>J</sub> Range °C	Packaging	Auto Grade
<b>NEW</b> LMZ12001/02/03 <sup>E, W</sup>	1/2/3	4.5	20	0.8	6	-40 to 125	TO-PMOD-7	*
<b>NEW</b> LMZ14201/02/03 <sup>E, W</sup>	1/2/3	6	42	0.8	6	-40 to 125	TO-PMOD-7	*
<b>NEW</b> LMZ10503/04/05 <sup>E, W</sup>	3/4/5	2.95	5.5	0.8	5	-40 to 125	TO-PMOD-7	*

### High-Voltage Switching Regulators

Product ID	Output Current (A)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Min (V)	Max Freq (kHz)	f <sub>sync</sub>	Sync. Rect.	I <sub>q</sub> /Shutdown	PWM Mode	Packaging	Auto Grade
<b>NEW</b> LM5008/09A <sup>E</sup>	0.35	6 to 95	2.5	600			110 µA	COT	MSOP, LLP-8	*
LM22671/74 <sup>E, W</sup>	0.5	4.5 to 42	1.285	1000	✓		3.4 mA/25 µA	Voltage Mode	PSOP-8	■
LM(2)5574/75/76 <sup>E, W</sup>	0.5/1.5/3	6 to 75	1.225	1000	✓		3.7 mA/48 µA	ECM	TSSOP-16, 20	(1, 0)
<b>NEW</b> LM34919B <sup>E</sup>	0.6	6 to 40	2.5	2600			0.6 mA/215 µA	COT	micro SMD-10	(1)
<b>NEW</b> LM5006 <sup>E</sup>	0.65	6 to 75	2.5	500		✓	1 mA/20 µA	COT	MSOP-10	*
LM3100/02/03 <sup>E, W</sup>	0.75/1.5/2.5	4.5 to 42	0.8	1000	✓	✓	0.7 mA/20 µA	COT-ER	eTSSOP-16, 20	*
LM(2)5010/A <sup>E, W</sup>	1	8 to 42	2.5	1000			0.6 mA/90 µA	COT	LLP-10, eTSSOP-14	(1, 0)
LM22672/75 <sup>E, W</sup>	1	4.5 to 42	1.285	1000	✓		3.4 mA/25 µA	Voltage Mode	PSOP-8	■
LM34917A <sup>E, W</sup>	1.2	8 to 33	2.5	2000			0.68 mA/95 µA	COT	micro SMD-12	*
LM34910C <sup>W</sup>	1.25	8 to 50	2.5	1000			0.6 mA/80 µA	COT	LLP-10	*
LM5575 <sup>E</sup>	1.5	6 to 75	1.225	500	✓		3.7 mA/57 µA	ECM	eTSSOP-16	(1)
<b>NEW</b> LM27341/42 <sup>E</sup>	1.5/2.0	3 to 20	1.0	2350	✓		70 nA	Current Mode	LLP-10, eMSOP-10	(1)
LM26001/03 <sup>E</sup>	1.5/3.0	3 to 38	1.25/1.24	500	✓		40 µA/10 µA	Current Mode	eTSSOP-16/20	(1)
LM22680 <sup>E, W</sup>	2	4.5 to 42	1.285	1000	✓		3.4 mA/25 µA	Voltage Mode	PSOP-8	■
<b>NEW</b> LM25011/A <sup>E, W</sup>	2	6 to 42	2.51	2000			1400 µA	COT	MSOP-10	(1)
LM(2)5005 <sup>E, W</sup>	2.5	7 to 42	1.225	500			3 mA/50 µA	ECM	eTSSOP-20	*
LM22670/73/76 <sup>E, W</sup>	3	4.5 to 42	1.285	1000	✓		3.4 mA/25 µA	Voltage Mode	THIN TO-263, PSOP-8	■
LM22677/78/79 <sup>E, W</sup>	5	4.5 to 42	1.285	1000	✓		3.4 mA/25 £gA	Voltage Mode	THIN TO-263	■

COT = Constant On-Time COT-ER = Constant On-Time Emulated Ripple Mode ECM = Emulated Current Mode

### High Power Density Buck Switching Regulators

Product ID	Output Current (A)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Min (V)	Frequency Range (kHz)	f <sub>sync</sub>	Sync. Rect.	PWM Mode	Packaging	Auto Grade
LM2734X/Y <sup>E</sup>	1000	3 to 20	0.8	500, 1600			Current Mode	SOT23-6	(1)
LM2734Z <sup>E</sup>	1000	3 to 20	0.8	3000			Current Mode	SOT23-6, LLP-6	(1)
LM2830	1000	3 to 5.5	0.6	1600			Current Mode	SOT23-5, LLP-6	(1)
LM2831/32/33	1500/2000/3000	3 to 5.5	0.6	550, 1600, 3000			Current Mode	SOT23-5, LLP-6, eMSOP-8	*
LM20242	2000	4.5 to 36	0.8	1000		✓	Current Mode	eTSSOP-16	*
LM20123/33/34	3000	2.95 to 5.5	0.8	1500, Adj	✓	✓	Current Mode	eTSSOP-16	■
LM20333	3000	4.5 to 36	0.8	250 to 1500	✓	✓	Current Mode	eTSSOP-20	*
LM20124/34/44/54	4000	2.95 to 5.5	0.8	1000, Adj	✓	✓	Current Mode	eTSSOP-16	■
LM20125/45	5000	2.95 to 5.5	0.8	500, Adj		✓	Current Mode	eTSSOP-16	■

### Boost Switching Regulators

Product ID	Switch Current (A)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Min (V)	V <sub>OUT</sub> Max (V)	Frequency Range (kHz)	f <sub>sync</sub>	Packaging	Auto Grade
LM2735X <sup>E</sup>	2.25	2.7 to 5.5	3	24	1600		SOT23-5, LLP-6	(1)
LM2735Y	2.25	2.7 to 5.5	3	24	520		SOT23-5, LLP-6	(1)
LM5000 <sup>E</sup>	2	3.1 to 40	1.259	Set by external feedback network	300 to 600		LLP-16, TSSOP-16	*
LM5001 <sup>E, W</sup>	1	3.1 to 75	1.26	Set by external feedback network	50 to 1500	✓	SO-8, LLP-8	*
LM5002 <sup>W</sup>	0.5	3.1 to 75	1.26	Set by external feedback network	50 to 1500	✓	SO-8, LLP-8	*
LM27313	1	2.7 to 14	4	28	600 to 1600		SOT23-5	*





PowerWise® product <sup>E</sup> Evaluation board <sup>W</sup> WEBENCH® enabled Automotive Grade Automotive Grade qualification in process

(0) AECQ Temperature Grade 0 (1) AECQ Temperature Grade 1 \* Contact local office to request Automotive qualification











# Power Management Solutions

## Controllers and Gate Drivers

### Advanced Topology Switching Controllers



Product ID	V <sub>IN</sub> (V)	Gate Drive Current (A)	Frequency (kHz)	PWM Mode	Topologies	Features	Packaging	Auto Grade
<b>NEW</b> LM25037 	5.5 to 75	1.2	2000	Voltage/Current	Push-pull, half-bridge, full-bridge	Alternating outputs	TSSOP-16	 (1)
LM5032	13 to 105	2.5	1000	Current	Dual independent/interleaved boost	Hiccup mode current limit	TSSOP-16	—
LM5034	13 to 105	2.5/1.5	1000	Current	Dual independent boost, forward active clamp	Reset transistor driver, output sync rectification	TSSOP-20	—
<b>NEW</b> LM5035B 	13 to 105	2	1000	Voltage/Current	Half-bridge	Sync rectification for high efficiency	LLP-24, eTSSOP-20	—
LM5037	13 to 105	1.2	2000	Voltage/Current	Push-pull, half-bridge, full-bridge	Alternating outputs	TSSOP-16	■
<b>NEW</b> LM5039 	13 to 105	2	1000	Voltage/Current	Half-bridge	Average, cycle-by-cycle, hiccup mode current limit	LLP-24, eTSSOP-20	—

### Switching Controllers

Product ID	V <sub>IN</sub> (V)	V <sub>OUT</sub> Min (V)	V <sub>OUT</sub> Max (V)	Feedback Tolerance %	Frequency Range (kHz)	f <sub>sync</sub>	On/Off Pin	PWM Mode	Topology	Channels	Packaging	Auto Grade
LM2743 <sup>E, W</sup> 	1 to 16	0.6	13.5	2.0	50 to 1000		✓	Voltage Mode	Buck	1	TSSOP-14	*
LM3478 <sup>E, W</sup>	2.97 to 40	1.26	40	2.5	100 to 1000		✓	Current Mode	Boost, SEPIC, Flyback	1	MSOP-8	 (1)
LM3488 <sup>W</sup>	2.95 to 40	1.26	40	1.5	100 to 1000	✓	✓	Current Mode	Boost, SEPIC, Flyback	1	MSOP-8	 (1)
LM3481 <sup>E</sup>	2.97 to 48	1.275	48	1.5	100 to 1000	✓	✓	Current Mode	Boost, SEPIC, Flyback	1	MSOP-10	■
LM(2)5118 <sup>E, W</sup> 	3 to 75	1.23	70	1.5	50 to 500	✓	✓	ECM	Buck-Boost	1	eTSSOP-20	 (1)
LM3485 <sup>E, W</sup>	4.5 to 35	1.242	V <sub>IN</sub>	2.0	0 to 1400			Hysteretic	Step down	1	MSOP	 (1)
LM3489 <sup>E</sup>	4.5 to 35	1.239	V <sub>IN</sub>	2.0	0 to 1400		✓	Hysteretic	Step down	1	MSOP-8	 (1)
LM(2)5085 <sup>E, W</sup> 	4.5 to 42, 75	1.25	V <sub>IN</sub>	2.0	300 to 1000		✓	COT	Buck	1	MSOP-8	 (1)
LM(2)5088 <sup>E, W</sup> 	4.5 to 42, 75	1.205	40, 70	1.5	50 to 1000		✓	ECM	Buck	1	eTSSOP-16	■
<b>NEW</b> LM(2)5119	4.5 to 42, 5.5 to 65	0.8	90% V <sub>IN</sub>	1.5	150 to 750		✓	ECM	Dual	2	LLP-32	*

ECM = Emulated Current Mode

### MOSFET Gate Drivers and High-Side Switching Controllers

Product ID	Sink/Source Current (A)	V <sub>CC</sub> Range (V)	Supplies	Inputs	Features	Packaging	Auto Grade
LM5110	5/3	3.5 to 14	Single or Split	Non-Inverting, Inverting, Mixed	Dual, low side	SOIC-8, LLP-10	*
LM5111	5/3	3.5 to 14	Single or Split	Non-Inverting, Inverting, Mixed	Dual, low side	SOIC-8, MSOP-EP	*
LM5112	7/3	3.5 to 14	Single or Split	Non-Inverting, Inverting, Mixed	Dual, low side	LLP-6, MSOP-EP	 (1)
<b>NEW</b> LM5060 <sup>E</sup>	80 μA	5.5 to 65	—	—	Single, high side	mini-SOIC-10	 (1)

 PowerWise® product <sup>E</sup> Evaluation board <sup>W</sup> WEBENCH® enabled  Automotive Grade ■ Automotive Grade qualification in process (1) AECQ Temperature Grade 1  
\* Contact local office to request Automotive qualification

# Power Management Solutions

## LED Lighting

### LM342x – N-Channel Controllers for Constant-Current LED Drivers

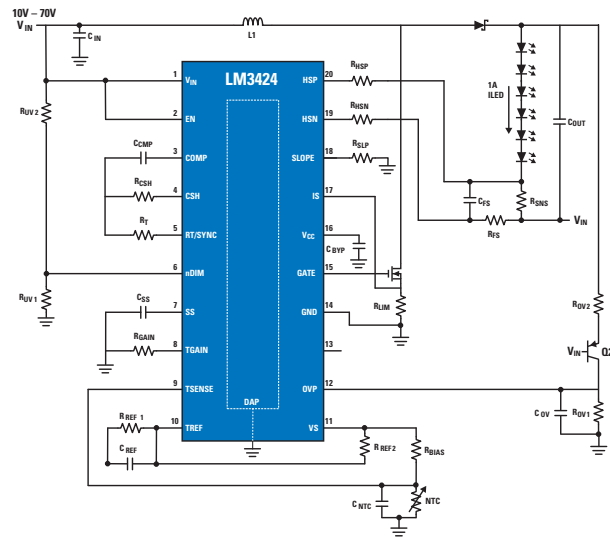
#### Features

- $V_{IN}$  range from 4.5V to 75V
- High-side adjustable current sense
- 2Ω, 1A peak MOSFET gate driver
- Input under-voltage and output over-voltage protection
- PWM and analog dimming
- Cycle-by-cycle current limit

#### Applications

Ideal for illuminating LEDs in automotive lighting systems

Typical Application Circuit



#### LED Drivers

Product ID	Max LED Current (mA)	Input Range (V)	$V_{OUT}$ Max (V)	Max # of LEDs in Series	Switching Freq (kHz)	PWM Mode	Topology	Key Features	Packaging	Auto Grade
LM3401 <sup>E,W</sup>	3000	4.5 to 30	35	9	1500	Hysteretic PFET	Buck	Adjustable hysteresis, 100% duty cycle, PWM dimming	MSOP-8	*
LM3402/04/06HV <sup>E,W</sup>	500/1000/1500	6 to 42/6 to 75	37/67	9/15	Adjustable up to 1000	0.5A constant current	Buck	Fast PWM dimming, supports ceramic capacitor and capacitor-less outputs	MSOP-8, PSOP-8	*
LM3407 <sup>E,W</sup>	350	4.5 to 30	27	7	Adjustable up to 1000	0.35A constant current	Buck	Fast PWM dimming, low external component count, constant frequency	eMSOP-8	*
LM3409/HV <sup>E,W</sup>	3000+	1.24 to $V_{IN}$	42/75	9/15	Adjustable	PFET, constant current source	Buck	Differential high-side current sense, analog current adjust, 100% duty cycle	eMSOP-10	(1)
LM3410 <sup>E,W</sup>	1000	2.7 to 5.5	24	6	525/1600	Constant current boost and SEPIC, internal compensation	Boost, SEPIC	PWM dimming, small footprint, low external component count	SOT23-5, LLP-6	(1)
LM3430/32 <sup>E</sup>	40 per string	6 to 40	80+	100	Adjustable up to 2000	6-channel constant current boost controller and current regulator	Boost	Dynamic Headroom Control for balanced current through up to 6 strings of LEDs	TSSOP-28, LLP-28	*
LM3431 <sup>E,W</sup>	200 per string	5 to 36	40+	30	Adjustable up to 1000	3-channel constant current, integrated boost controller	Boost	Balances current through 3 strings of LEDs for even brightness	LLP-12, LLP-24, eTSSOP-28	(1)
LM3421/23 <sup>E,W</sup>	>2000	4.5 to 75	75	20	Adjustable up to 2000	N-channel controllers	Buck, Boost, Flyback, SEPIC	Fast PWM dimming, LED ready, broken open check, over voltage protection	eTSSOP-16/20	(0, 1)
<sup>NEW</sup> LM3424/29 <sup>E,W</sup>	3000+	3.5 to 75	75	18/29	Adjustable	N-channel controllers	Buck, Boost, SEPIC	Programmable thermal foldback	eTSSOP-20	(1)
<sup>NEW</sup> LM3492 <sup>W</sup>	200	4.5 to 65	65	18 per channel	Up to 1000	Up to 1.0	Boost	DHC control, integrated boost converter, COMM I/O pin	LLP-48	(1)

<sup>E</sup> PowerWise® product   <sup>E</sup> Evaluation board   <sup>W</sup> WEBENCH® enabled   <sup>(1)</sup> Automotive Grade   (0) AECQ Temperature Grade 0   (1) AECQ Temperature Grade 1

\* Contact local office to request Automotive qualification

# Power Management Solutions

## Multi-Output Regulators and Sequencers

### LM26480 – Externally Programmable Dual High-Current Buck DC/DC and Dual Linear Regulators

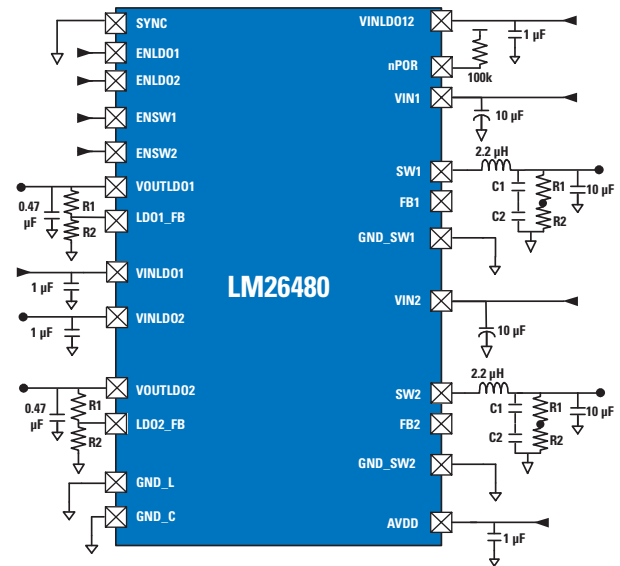
#### Features

- Compatible with advanced applications processors and FPGAs
- 2 LDOs for powering internal processor functions and I/Os
- Precision internal reference
- Thermal overload and current overload protection
- External power-on-reset function for Buck1 and Buck2
- Undervoltage lock-out detector to monitor input supply voltage

#### Applications

Ideal for use in automotive infotainment systems and camera modules

Typical Application Circuit



### Multi-Output Regulators

Product ID	Description	I <sub>OUT</sub> (A)	Input Range (V)	Output Range (V)	Peak Efficiency (%)	Features	Packaging	Auto Grade
LP3906 <sup>E</sup>	Multi-function, programmable power management unit with I <sup>2</sup> C-compatible interface	1.5	2.7 to 5.5	0.8 to 3.3	96	Dual 1.5A buck, dual 300 mA LDO, I <sup>2</sup> C	LLP-24	*
LM26480 <sup>E</sup>	Multi-function power management unit	1.5	2.7 to 5.5	0.8 to 3.3	96	Dual 1.5A buck, dual 300 mA LDO, external control	LLP-24	■
LP3907 <sup>E</sup>	Multi-function, programmable power management unit with I <sup>2</sup> C-compatible interface	1	2.7 to 5.5	0.8 to 3.3	96	Dual 1A/600 mA buck, dual 300 mA LDO, I <sup>2</sup> C	LLP-24, micro SMD-25	🚗
LM26484	Multi-function, configurable power management unit	2	3.5 to 5.5	0.8 to 3.5	90	Dual 2A buck, LDO, Power On Reset, thermal overload protection	LLP-24	*

### Cascading Sequencers






Product ID	V <sub>IN</sub> (V)	Number of Regulators Able to Sequence	Power Down	Power Up	Ability to Cascade	On/Off Pin	Packaging	Auto Grade
LM3880 <sup>E</sup>	2.7 to 5.5	3	✓	✓	✓	✓	SOT-23 - 6	🚗 (1)
LM3881 <sup>E</sup>	2.7 to 5.5	3	✓	✓	✓	✓	Mini-SOIC - 8	*

PowerWise® product  
 <sup>E</sup> Evaluation board  
 <sup>W</sup> WEBENCH® enabled  
 Automotive Grade  
 Automotive Grade qualification in process  
 (1) AECQ Temperature Grade 1  
 \* Contact local office to request Automotive qualification






# Power Management Solutions




## LDO Linear Regulators and Voltage References

### Low Dropout CMOS Linear Regulator Family

Product ID	Load (mA)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Min (V)	Maximum Dropout (mV)	Enable Pin	Packaging	Auto Grade
LP38690 	1000	2.7 to 10	ADJ (1.25 - 9) or 1.8, 2.5, 3.3, 5	1600		T0252-3, SOT223-5, LLP-6	*
LP38691/93 	500	2.7 to 10	ADJ (1.25 - 9) or 1.8, 2.5, 3.3, 5	725		T0252-3, LLP-6, SOT223-5	■
LP2960	500	-20 to 30	ADJ (1.24 - 29) or 3.3, 5	600	✓	SOIC-16	*
LM9070	250	5.3 to 26	5	800		TSOP-20, T0220-7	*
LM9071	250	5.3 to 26	5	800	✓	T0220-5, T0263-5	*
LP2950/51	75	0.3 to 30	1.24, 3.3	380	✓	SOIC-8	*
LP2952	250	-20 to 30	ADJ (1.24 - 29) or 3.3, 5	600	✓	TSOP-16, MDIP-14, D, W	*
LP2953	250	-20 to 30	ADJ (1.24 - 29) or 3.3, 5	600	✓	TSOP-16, MDIP-16, D, W	*
LP2954	250	-20 to 30	ADJ (1.24 - 29) or 5	600	✓	MSOP-8, T0220-3, T0263-3	*
LP2957	250	-20 to 30	5	600	✓	T0220-5	*
LM9076	150	3.65, 5.4 to 40	3.3, 5	450	✓	T0263-5	 (1)
LM2936	50	3.3 to 60	3, 3.3, 3.5	400	✓	MSOP-8, SOT223-4, T0252-3, SOIC-8, T092-3, D, W	 (1)
LM9036	50	3.7 to 40	3.3, 5	400		MSOP-8, T0252-3, SOIC-8	 (1)
LM2931	100	14 to 26	3, 5	300	✓	SOIC-8, T0263-3, T0220-3, T092-3	*

### Voltage References

Product ID	Type	V <sub>IN</sub> (V)	Reference (V)	Initial Accuracy (+/-) Max	Tempco, Max (ppm/C)	Output Current (mA)	Quiescent Current (mA)	Long Term Stability (ppm/1000hr)	Voltage Noise (μVp-p)	Packaging	Auto Grade
LM4120 	Series	3.3 to 14	3, 3.3, 4.096, 2.048, 5, 1.8, 2.5	0.2, 0.5	50	5	0.16	100	20	SOT23-5	*
LM4128 	Series	2.2 to 5.5	3, 3.3, 4.096, 2.048, 1.8, 2.5	0.1, 0.2, 0.5, 1	75, 100	20	0.06	50	170	SOT23-5	 (1)
LM4132 	Series	2.2 to 5.5	4.096, 2.048, 2.5	0.05, 0.1, 0.2, 0.4, 0.5	10, 20, 30	20	0.06	50	170	SOT23-5	*
LM4140 	Series	1.8 to 5.5	1.25, 4.096, 2.048, 1.024, 2.5	0.1	3	8	0.23	60	2.2	SO-8	*
LM4030	Shunt	N/A	2.5, 4.096, 5.0	0.05, 0.10, 0.15	10	30	0.12	50	100	SOT23-5	■

 PowerWise® product  Automotive Grade  Automotive Grade qualification in process (1) AECQ Temperature Grade 1

\* Contact local office to request Automotive qualification



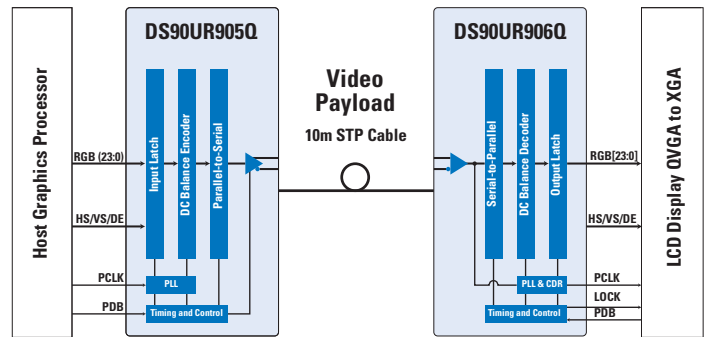
# Interface Solutions

## FPD-Link II Serializers and Deserializers

### DS90UR90x – 5 MHz to 65 MHz 24-Bit True Color FPD-Link II Ser/Des

#### Features

- Transports video data and clock over a single twisted pair cable
- RGB888 + VS, HS, DE
- 140 Mbps to 1.56 Gbps throughput
- Works with devices that support FPD-Link, LVCMOS, or LVDS
- EMI minimization on output parallel bus (Spread-Spectrum Clock Generation (SSCG), optional LVDS input/output)
- Randomizer/scrambler for DC-balanced data stream



#### Applications

Designed for navigation and entertainment displays, including dual-view displays

### FPD-Link II Ser/Des

Product ID	Description	Pixel Clock Rate (MHz)	Graphics Bits (bpp)	Function	ESD	Packaging	Auto Grade
<b>Serializers</b>							
<b>NEW</b> DS90UR905	5 to 65 MHz, 24-bit, FPD-Link II LVCMOS	65	24	Embeds the clock and balances data payload	8 kV HBM, ISO 10605	LLP-48	(2)
<b>NEW</b> DS90UR907 <sup>E</sup>	5 to 65 MHz, 24-bit color FPD-Link II converter	65	24	Converts, balances, and level shifts 4 LVDS streams	8 kV HBM, ISO 10605	LLP-36	(2)
DS99R421 <sup>E</sup>	5 to 43 MHz, 18-bit color FPD-Link II converter	43	18	AC-Coupled, DC Balance, Built-In Self Test (BIST), enhanced serial link randomization	8 kV HBM, ISO 10605	LLP-36	(2)
DS90UR241 <sup>E</sup>	5 to 43 MHz, 18-bit color FPD-Link II LVDS	43	18	AC-Coupled, DC Balance, BIST, scrambling to lower EMI	8 kV HBM, ISO 10605	TQFP-64	(2)
DS90C241 <sup>E</sup>	5 to 35 MHz, 18-bit color FPD Link II LVDS	35	18	AC-Coupled, DC Balance	8 kV HBM, ISO 10605	TQFP-48	(2)
<b>Deserializers</b>							
<b>NEW</b> DS90UR906	5 to 65 MHz, 24-bit color FPD-Link II	65	24	Recovers data and control signals, level shifts signals	8 kV HBM, ISO 10605	LLP-60	(2)
<b>NEW</b> DS90UR908 <sup>E</sup>	5 to 65 MHz, 24-bit color FPD-Link II converter	65	24	Recovers data and control signals, extracts clock	8 kV HBM, ISO 10605	LLP-48	(2)
DS99R124 <sup>E</sup>	5 to 43 MHz, 18-bit color FPD-Link II converter	43	18	AC-Coupled, DC Balance, BIST, enhanced serial link randomization	8 kV HBM, ISO 10605	LLP-36	(2)
DS90UR124 <sup>E</sup>	5 to 43 MHz, 18-bit color FPD Link II LVDS	43	18	AC-Coupled, DC Balance, BIST, frequency spread PTO, slew rate control to lower EMI	8 kV HBM, ISO 10605	TQFP-64	(2)
DS90C124 <sup>E</sup>	5 to 35 MHz, 18-bit color FPD-Link II LVDS	35	18	AC-Coupled, DC Balance, adjustable PTO to lower EMI	8 kV HBM, ISO 10605	TQFP-48	(2)

PowerWise® product    <sup>E</sup> Evaluation board    Automotive Grade    (2) AECQ Temperature Grade 2

# Interface Solutions

## FPD-Link III Serializers and Deserializers

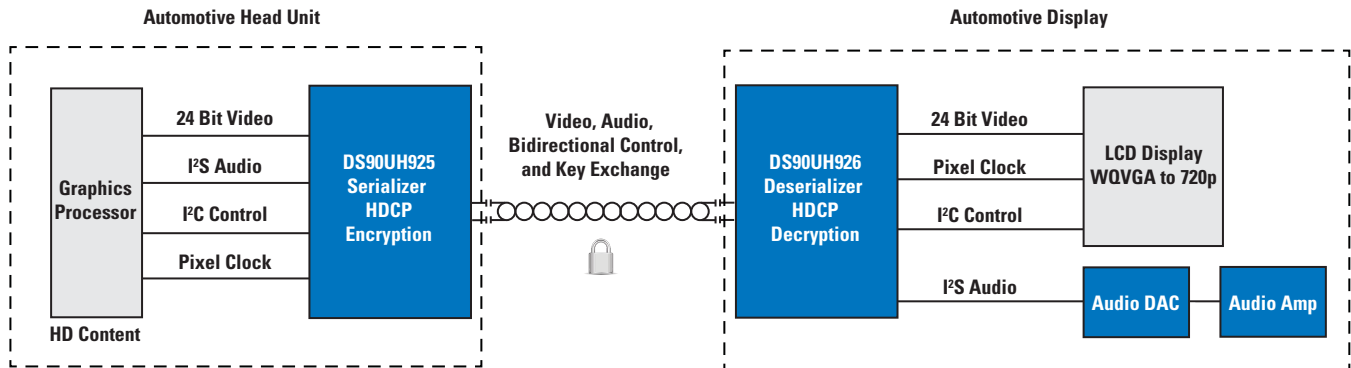
### DS90UH92X – FPD-Link III Bidirectional Control Ser/Des with HDCP

#### Features

- HDCP cipher integrated in Ser/Des
- FPD-Link III delivers content-protected video on 2 wires
  - Provides bidirectional control channel for HDCP key exchange
- Display enhancements
  - White balancing, Dithering, Test Pattern Generator
- I<sup>2</sup>S digital audio support
  - Integrated jitter cleaning for audio clock
- Single power supply w/ integrated regulator

#### Applications

Designed for high-definition navigation and entertainment displays that require content protection, including systems using Blu-ray discs



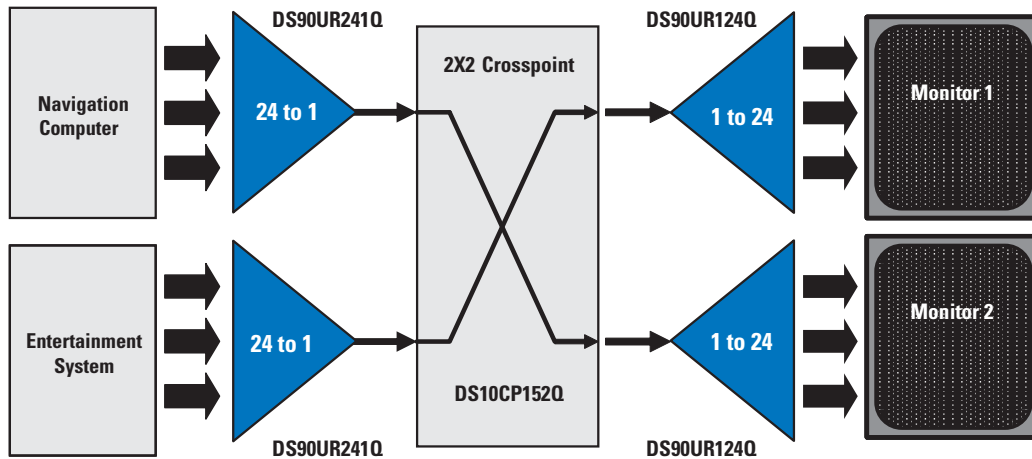
### FPD-Link III Ser/Des

Product ID	Description	Pixel Clock Rate (MHz)	Graphics Bits (bpp)	Function	ESD	Packaging	Auto Grade
<b>Serializers</b>							
<b>NEW</b> DS90UH925	5 to 85 MHz, 24 bit, FPD-Link III LVCMOS with HDCP	5 to 85	24	HDCP cipher and key exchange, real-time bidirectional control	8 kV HBM, ISO 10605	LLP-48	(2)
<b>NEW</b> DS90UB901	10 to 43 MHz, 14 bit, FPD-Link III LVCMOS	10 to 43	14	Real-time bidirectional control, CRC checking for video and control data	8 kV HBM, ISO 10605	LLP-32	(2)
<b>NEW</b> DS90UB903	10 to 43 MHz, 18 bit, FPD-Link III LVCMOS	10 to 43	18	Real-time bidirectional control	8 kV HBM, ISO 10605	LLP-40	(2)
<b>Deserializers</b>							
<b>NEW</b> DS90UH926	5 to 85 MHz, 24 bit, FPD-Link III LVCMOS with HDCP	5 to 85	24	HDCP cipher and key exchange, real-time bidirectional control	8 kV HBM, ISO 10605	LLP-60	(2)
<b>NEW</b> DS90UB902	10 to 43 MHz, 14 bit, FPD-Link III LVCMOS	10 to 43	14	Real-time bidirectional control, CRC checking for video and control data	8 kV HBM, ISO 10605	LLP-40	(2)
<b>NEW</b> DS90UB904	10 to 43 MHz, 18 bit, FPD-Link III LVCMOS	10 to 43	18	Real-time bidirectional control	8 kV HBM, ISO 10605	LLP-48	(2)

Automotive Grade (2) AECQ Temperature Grade 2

# Interface Solutions For Automotive Infotainment

## Crosspoint Switch with Ser/Des




Product ID	Description	Inputs	Outputs	Input Levels	Output Levels	Max Datarate (Mbps)	Temp Range (°C)	Packaging	Auto Grade
<b>Crosspoint Switches</b>									
DS25CP102	3.125 Gbps LVDS 2X2 crosspoint with pre-emphasis and equalization	2	2	LVDS	LVDS	3125	-40 to 85	LLP-16	(3)
DS10CP152Q	1.5 Gbps LVDS 2X2 crosspoint	2	2	LVDS	LVDS	1500	-40 to 85	SOIC-16	(3)
DS25CP152Q	3.125 Gbps LVDS 2X2 crosspoint	2	2	LVDS	LVDS	3125	-40 to 85	LLP-16	(3)
<b>Drivers/Receivers</b>									
DS90LV011AQ	LVDS driver	1	1	LVTTTL	LVDS	400	-40 to 85	SOT-23-5	(1)
DS90LV027AQ	Dual LVDS driver	2	2	LVTTTL	LVDS	400	-40 to 85	SOIC-8	(1)
DS90LT012AQ	LVDS receiver	1	1	LVDS	LVTTTL	400	-40 to 85	SOT-23-5	(1)
DS90LV028AQ	Dual LVDS receiver	2	2	LVDS	LVTTTL	400	-40 to 85	SOIC-8	(1)
DS90LV049Q	Dual, full duplex LVDS transceiver	4	4	LVTTTL/LVDS	LVDS/LVTTTL	400	-40 to 85	SOIC-16	(1)
<b>M-LVDS</b>									
DS91D176	M-LVDS transceiver	1	1	LVTTTL/LVDS	LVDS/LVTTTL	200	-40 to 85	SOIC-8	*
DS91C176	M-LVDS transceiver	1	1	LVTTTL/LVDS	LVDS/LVTTTL	200	-40 to 85	SOIC-8	*
DS91D180	M-LVDS full duplex	2	2	LVTTTL/LVDS	LVDS/LVTTTL	200	-40 to 85	SOIC-8	*
DS91C180	M-LVDS full duplex	2	2	LVTTTL/LVDS	LVDS/LVTTTL	200	-40 to 85	SOIC-8	*
DS91M040	Quad, full duplex M-LVDS transceiver	4	4	LVDS/LVTTTL	LVDS/LVTTTL	250	-40 to 85	LLP-32	*
DS91M047	Quad M-LVDS driver	4	4	LVTTTL	LVDS	250	-40 to 85	SOIC-16	*
DS91M124	1 to 4 M-LVDS driver	1	4	LVTTTL	LVDS	250	-40 to 85	SOIC-16	*
DS91M125	1 to 4 M-LVDS driver	1	4	LVDS	LVDS	250	-40 to 85	SOIC-16	*

PowerWise® product Automotive Grade (1) AECQ Temperature Grade 1 (3) AECQ Temperature Grade 3 \* Contact local office to request Automotive qualification


# Data Conversion Solutions

## A/D Converters

### Ultra-High-Speed A/D Converters

Product ID	Sampling Rate (MSPS)	Power (W)	NPR (dB)	IMD (dBFS)	Noise Floor (dBm/Hz)	ENOB (bits)	SNR (dB)	SFDR (dBc)	Packaging	Auto Grade
<b>NEW</b> ADC12D1800 <sup>E</sup>	1800/3600	4.4	48.5	-61	-149.5	9.4	58.5	73	TEPBGA-292	*
<b>NEW</b> ADC12D1600 <sup>E</sup>	1600/3200	3.88	48.5	-63	-149.6	9.4	58.5	70.3	TEPBGA-292	*
<b>NEW</b> ADC12D1000 <sup>E</sup>	1000/2000	3.38	49.5	-66	-148.6	9.6	60.2	71	TEPBGA-292	*
ADC10D1500 <sup>E</sup>	1500/3000	3.59	48	-67.6	-144.7	8.9	57	66	TEPBGA-292	*
ADC10D1000 <sup>E</sup>	1000/2000	2.77	48	-67.6	-144.7	9.1	57	66	TEPBGA-292	*
ADC08B3000 <sup>E</sup>	3000	1.6	—	—	—	7.2	45.3	55.4	eLQFP-128	*
ADC08D1520 <sup>E</sup>	1500/3000	2	—	—	—	7.4	46.8	58	eLQFP-128	*
ADC081500	1500	1.2	—	—	—	7.4	47	56	eLQFP-128	*
ADC08D1020 <sup>E</sup>	1000/2000	1.6	—	—	—	7.4	46.8	58	eLQFP-128	*
ADC08D500 <sup>E</sup>	500	1.4	—	—	—	7.5	47	55	eLQFP-128	*
ADC08B200 <sup>E</sup>	200	0.306	—	—	—	7.2	46.3	56	TQFP-48	 (2)

### High-Speed A/D Converters

Product ID	Channels	Speed (MSPS)	Power (mW)	SNR (dB)	SFDR (dB)	Outputs	Packaging	Auto Grade
<b>16-Bit</b>								
<b>NEW</b> ADC16DV160 <sup>E</sup>	2	160	1300	78.5	95	LVDS	LLP-68	*
<b>NEW</b> ADC16V130 <sup>E</sup>	1	130	755	78.5	95.5	LVDS	LLP-64	*
<b>14-Bit</b>								
ADC14155/V155 <sup>E</sup>	1	155	967/951	71.3/71.7	87/86.9	CMOS/LVDS	LLP-48	*
ADC14DS080/105 <sup>E</sup>	2	80/105	800/1000	74.2/73	90	Serial LVDS	LLP-60	*
ADC14DC080/105 <sup>E</sup>	2	80/105	600/800	73/74	90	CMOS	LLP-60	*
ADC14C080/105 <sup>E</sup>	1	80/105	300/400	74.2/74	90	CMOS	LLP-32	*
ADC14L020/40 <sup>E</sup>	1	20/40	150/235	74/73	93/90	CMOS	LQFP-32	*
<b>12-Bit</b>								
ADC12C170/V170 <sup>E</sup>	1	170	715/781	67.2	85.4/85.8	CMOS/LVDS	LLP-48	*
ADC12C080/105 <sup>E</sup>	1	80/105	300/400	71.2/71	90	CMOS	LLP-32	*
ADC12DS080/105 <sup>E</sup>	2	80/105	800/1000	71	88	Serial LVDS	LLP-60	*
ADC12DC080/105 <sup>E</sup>	2	80/105	600/800	71.5/71	90	CMOS	LLP-60	*
ADC12L066/80 <sup>E</sup>	1	66/80	357/425	66	80	CMOS	LQFP-32	*
<b>11-Bit</b>								
ADC11DV200 <sup>E</sup>	2	200	450	62.5	82	CMOS or LVDS	LLP-60	*
ADC11C125/70 <sup>E</sup>	1	125/170	608/715	65.5/65.1	88.2/85.4	CMOS	LLP-48	*
ADC11DL066	2	66	686	64	80	CMOS	TQFP-64	*
ADC11L066	1	66	357	65	78	CMOS	LQFP-32	*
<b>10-Bit</b>								
ADC10DV200 <sup>E</sup>	2	200	450	59.9	82	CMOS or LVDS	LLP-60	*
ADC10080 <sup>E</sup>	1	80	78.6	59.5	79	CMOS	TSSOP-28	*
ADC10040	1	40	55.5	59.6	80	CMOS	TSSOP-28	 (3)
ADC10D020/40	2	20/40	150/257	59/60	75/72	CMOS	TQFP-48	*

 PowerWise® product <sup>E</sup> Evaluation board  Automotive Grade (2) AECQ Temperature Grade 2 (3) AECQ Temperature Grade 3

\* Contact local office to request Automotive qualification

# Data Conversion Solutions

## A/D and D/A Converters

### Low-Power Analog-to-Digital Converters

Product ID	Res (bits)	Inputs	Pin and Function Compatible	Speed Range (kSPS)	Supply Voltage Range (V)	Typ Power (mW)		Static Performance (Typ)		ENOB (bits) typ	Temp Range (°C)	Packaging	Auto Grade
						3V	5V	INL (LSB)	DNL (LSB)				
<b>Single-Ended Input I<sup>2</sup>C A/D Converters</b>													
ADC121C021 E, W	12	1		5.56 to 189	2.7 to 5.5	0.26	0.78	+12, -0.9	±0.5	11.5	-40 to 125	TSOT-6, MSOP-8	(1)
<b>Single-Ended Input SPI A/D Converters</b>													
ADC121S021 E, W	12	1	↕	50 to 200	2.7 to 5.25	1.5	7.9	+0.45, -0.4	+0.45, -0.25	11.7	-40 to 85	SOT-23, LLP-6	*
ADC121S051 E, W	12	1		200 to 500	2.7 to 5.25	1.7	8.7	+0.45, -0.4	+0.5, -0.25	11.6	-40 to 85	SOT-23, LLP-6	*
ADC121S101 E, W	12	1		500 to 1000	2.7 to 5.25	2	10	±0.4	+0.5, -0.3	11.7	-40 to 125	SOT-23, LLP-6	*
ADC122S021 E, W	12	2	↕	50 to 200	2.7 to 5.25	2.2	7.9	±0.35	+0.4, -0.2	11.7	-40 to 85	MSOP-8	*
ADC122S051 E, W	12	2		200 to 500	2.7 to 5.25	3	10	±0.5	+0.7, -0.4	11.7	-40 to 85	MSOP-8	*
ADC122S101 E, W	12	2		500 to 1000	2.7 to 5.25	4.3	13.1	±0.64	+0.9, -0.6	11.7	-40 to 85	MSOP-8	*
ADC124S021 E, W	12	4	↕	50 to 200	2.7 to 5.25	2.2	7.9	±0.35	+0.4, -0.2	11.7	-40 to 85	MSOP-10	*
ADC124S051 E, W	12	4		200 to 500	2.7 to 5.25	3	10	±0.5	+0.7, -0.4	11.7	-40 to 85	MSOP-10	*
ADC124S101 E, W	12	4		500 to 1000	2.7 to 5.25	4.3	13.1	±0.64	+0.9, -0.6	11.7	-40 to 85	MSOP-10	*
ADC128S022 E, W	12	8	↕	50 to 200	2.7 to 5.25	1.2	7.5	±0.4	-0.3, +0.5	11.8	-40 to 105	TSSOP-16	*
ADC128S052 E, W	12	8		200 to 500	2.7 to 5.25	1.6	8.7	±0.4	-0.4, +0.6	11.8	-40 to 105	TSSOP-16	■
ADC128S102 E, W	12	8		500 to 1000	2.7 to 5.25	2.3	10.7	±0.5	-0.4, +0.7	11.8	-40 to 105	TSSOP-16	(2)
<b>Differential-Input SPI A/D Converters</b>													
ADC121S625 E, W	12	1	↕	50 to 200	4.5 to 5.5	—	2.25	+0.5/ -0.3	±0.4	11.8	-40 to 85	MSOP-8	*
ADC121S655 E, W	12	1		200 to 500	4.5 to 5.5	—	9	±0.6	±0.4	11.7	-40 to 105	MSOP-8	*
ADC121S705 E, W	12	1		500 to 1000	4.5 to 5.5	—	11.5	±0.6	±0.4	11.7	-40 to 105	MSOP-8	*
ADC141S626 E, W	14	1	↕	50 to 250	2.7 to 5.5	2	4.8	±0.5	±0.5	13.7	-40 to 85	MSOP-10	■
ADC122S625 E, W	12	2		50 to 200	4.5 to 5.5	—	8.6	±1.0	±0.95	11.25	-40 to 105	MSOP-10	*
ADC122S655 E, W	12	2		200 to 500	4.5 to 5.5	—	11	±1.0	±0.95	11.25	-40 to 105	MSOP-10	*
ADC122S706 E, W	12	2	↕	500 to 1050	2.7 to 5.5	20	25	±1.0	±0.95	11.25	-40 to 105	TSSOP-14	*

### Low-Power Digital-to-Analog SPI Output Converters

Product ID	Res (bits)	# Mux Inputs	Pin and Function Comp. Family	Typ Settling Time (µsec)	Supply Voltage (V)	Typ Current Consumption (µA)		Static Performance (Typ)		Reference	Packaging	Auto Grade
						3V	5V	INL (LSB)	DNL (LSB)			
DAC081S101 E	8	1	↕	3	2.7 to 5.5	175	260	±0.2	±0.04	Supply	TSOP-6, MSOP-8	*
DAC101S101 E	10	1		8	2.7 to 5.5	175	260	±0.6	±0.15	Supply	TSOP-6, MSOP-8	(1)
DAC121S101 E	12	1		8	2.7 to 5.5	175	260	±2.6	+0.2, -0.1	Supply	TSOP-6, MSOP-8	(1)
DAC082S085 E	8	2	↕	3	2.7 to 5.5	210	320	±0.14	+0.04, -0.02	External	MSOP-10, LLP-10	*
DAC102S085 E	10	2		4.5	2.7 to 5.5	210	320	±0.7	+0.08, -0.03	External	MSOP-10, LLP-10	*
DAC122S085 E	12	2		6	2.7 to 5.5	210	320	±2.4	+0.2, -0.1	External	MSOP-10, LLP-10	*
DAC084S085 E	8	4	↕	3	2.7 to 5.5	350	500	±0.14	+0.04, -0.02	External	MSOP-10, LLP-10	*
DAC104S085 E	10	4		4.5	2.7 to 5.5	350	500	±0.7	+0.08, -0.03	External	MSOP-10, LLP-10	*
DAC124S085 E	12	4		6	2.7 to 5.5	360	480	±2.4	+0.2, -0.1	External	MSOP-10, LLP-10	*
DAC088S085 E	8	8	↕	3	2.7 to 5.5	650	970	±0.125	±0.03	Dual External	TSSOP-16, LLP-16	*
DAC108S085 E	10	8		4.5	2.7 to 5.5	650	970	±0.5	+0.08, -0.04	Dual External	TSSOP-16, LLP-16	*
DAC128S085 E	12	8		6	2.7 to 5.5	650	970	±2.0	+0.15, -0.09	Dual External	TSSOP-16, LLP-16	*

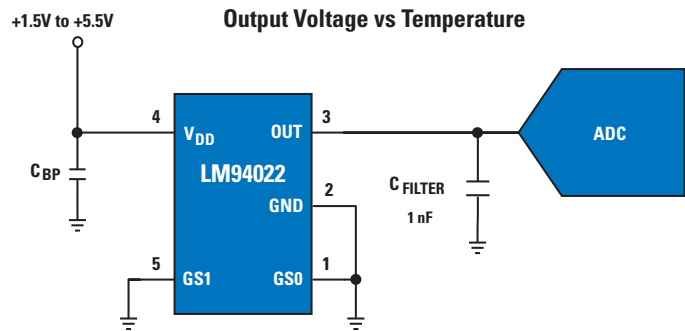
PowerWise® product   Evaluation board   WEBENCH® enabled   Automotive Grade   (1) AECQ Temperature Grade 1   (2) AECQ Temperature Grade 2  
 ■ Automotive Grade qualification in process   \* Contact local office to request Automotive qualification

# Temperature Sensor Solutions

## LM94022 – 1.5V, SC70, Multi Gain Analog Temperature Sensor with Class-AB Output

### Features

- 1.5V to 5.5V supply
- 5.4  $\mu$ A typ quiescent current
- $\pm 1.5^\circ\text{C}$  accuracy
- $-50^\circ\text{C}$  to  $150^\circ\text{C}$  operating temperature
- Four selectable gains to optimize maximum gain for a given supply voltage
- Optimized to drive ADC inputs
  - $\pm 50 \mu\text{A}$  output drive
  - Drives up to 1100 pF load capacitance without external resistor



### Applications

Ideal for use in cabin/control electronics and driver assist systems

## Analog Temperature Sensors

Product ID	Key Features	Temperature Range ( $^\circ\text{C}$ )	Accuracy ( $^\circ\text{C}$ )	Scale Factor / Resolution mV/ $^\circ\text{C}$	Power Supply (V)	Supply Current ( $\mu\text{A}$ )	Packaging	Auto Grade
<b>NEW</b> LM94021 <sup>E</sup>	4 selectable gains, Class A output	-50 to 150	$\pm 1.5$	-5.5 to -13.6	1.5 to 5.5	9.0	SC-70	(0)
LM94022 <sup>E</sup>	4 selectable gains, Class-AB output	-50 to 150	$\pm 1.5$	-5.5 to -13.6	1.5 to 5.5	5.4	SC-70	(0)
LM94023	Very low supply current, CMOS, tiny packages	-50 to 150	$\pm 1.5$	-5.5 or -8.2	1.5 to 5.5	8.1	micro SMD	*
LM19	Very low supply current, CMOS	-55 to 130	$\pm 2.5$	-11.7	2.4 to 5.5	4.5	TO-92	*
LM35	Bipolar, high accuracy	-55 to 150	$\pm 0.5$	10.0	4 to 30	56	SOIC-8, TO-92, TO-220, TO-46	*

## Analog Temperature Sensors with Temperature Switch

Product ID	Key Features	Accuracy ( $^\circ\text{C}$ )	Set Point Range ( $^\circ\text{C}$ )	Power Supply (V)	Supply Current $\mu\text{A}$	Packaging	Auto Grade
LM26	Small, low-power	$\pm 3$	-55 to 120, $1^\circ\text{C}$ increments	2.7 to 5.5	16	SOT-23	*
LM26LV <sup>E</sup>	Small, low-voltage, low-power, extended temperature	$\pm 2.2$	0 to 150, $1^\circ\text{C}$ increments	1.6 to 5.5	8	LLP-6	*
LM27	Small, low-power, high-temp	$\pm 3$	120 to 150, $1^\circ\text{C}$ increments	2.7 to 5.5	15	Die, SOT-23	*
LM56	User-programmable, dual setpoint/output	$\pm 2.0$	-40 to 125, ext resistor set	2.7 to 10	110	SOIC-8, MSOP-8	*
LM57 <sup>E</sup>	User-programmable, setpoint/output	$\pm 1.5$	-40 to 150, ext resistor set	2.4 to 5.5	24	LLP-8	*

PowerWise® product <sup>E</sup> Evaluation board Automotive Grade (0) AECQ Temperature Grade 0 \* Contact local office to request Automotive qualification

# Temperature Sensor Solutions

## Digital Temperature Sensors

Product ID	Key Features	Accuracy (°C)	Power Supply (V)	Supply Current (mA)	Temperature Range (°C)	Interface Type	Resolution (bits)	Packaging	Auto Grade
LM73 <sup>E</sup>	Incremental $\Sigma\Delta$ ADC, SMBus, I <sup>2</sup> C-compatible	± 1	2.7 to 5.5	0.320	-40 to 150	2-wire	11-14	SOT23-6	*
LM75A <sup>E</sup>	Integrated $\Sigma\Delta$ ADC, I <sup>2</sup> C-compatible	± 2.0	2.7 to 5.5	0.280	-55 to 125	2-wire	9	MSOP-8, SOIC-8	*
LM92	Highly accurate, thermal window comparator	± 0.33 and ± 0.5	2.7 to 5.5	0.350	-55 to 150	2-wire	13	SOIC-8	*
LM71	High accuracy and resolution, SPI/Microwire™ interface	± 1.5	2.65 to 5.5	0.300	-40 to 150	3-wire	14	SOT23-5, LLP-6	(0)
LM71A	High accuracy and resolution, SPI/Microwire interface	± 1.5	2.65 to 5.5	0.300	-40 to 150	3-wire	14	Die	*
LM74	12 bit, SPI/Microwire interface	±1.25	3.0 to 5.5	0.265	-55 to 150	3-wire	12	Die, SOIC-8	*
LM95071 <sup>E</sup>	High accuracy and resolution, SPI interface	± 1.0	2.4 to 5.5	0.28	-40 to 150	3-wire	14	SOT23-5	*
LM95172 <sup>E</sup>	200°C, high temperature, accuracy, and resolution, SPI interface	±1.0	3 to 5.5	0.28	-40 to 200	3-wire	16	Cerpack-10	*
LM95172AQ	175°C, high temperature, accuracy, and resolution, SPI interface	±1.0	3 to 5.5	0.400	-40 to 175	3-wire	16	Die	(0)

## Remote Diode Temperature Sensors

Product ID	Key Features	Temperature Range (°C)	Accuracy (°C)	Scale Factor/Resolution	Power Supply (V)	Supply Current $\mu$ A	Packaging	Auto Grade
LM95235 <sup>E</sup>	11-bit remote, SMBus interface, and TruTherm® technology	-40 to 85, 140 remote range	±0.75	0.03125°C/LSB	3.0 to 3.6	350	MSOP-8	(3)
LM95213 <sup>E</sup>	11-bit dual remote, SMBus interface, 3 Tcrit	-40 to 140, 140 remote range	±1.1	0.03125°C/LSB	3.0 to 3.6	570	LLP-14	*
LM95214 <sup>E</sup>	11-bit quad remote, SMBus interface, 3 Tcrit	-40 to 140, 140 remote range	±1.1	0.03125°C/LSB	3.0 to 3.6	570	LLP-14	*

## Hardware Monitors with Temperature Sensors

Product ID	Key Features	Temperature Range (°C)	Accuracy (°C)	Scale Factor/Resolution	Vmon Accuracy	Power Supply (V)	Supply Current	Packaging	Auto Grade
LM87 <sup>E</sup>	Dual remote diodes, DAC output, TACH Inputs	-40 to 125	±3.0	1°C/LSB	2%	2.8 to 3.8	0.7 mA	TSSOP-24	*
LM63 <sup>E</sup>	Remote diode, digital, PWM output, LUT fan control	0 to 85 (local) 25 to 125° (remote)	±1.0	0.125°C/LSB	—	3.0 to 3.6	1.3 mA	SOIC-8	*
LM96194	4 TruTherm remote diodes, 4 fan monitors, 2 PWM fan controls, 8 voltage monitors, PI LUT closed loop fan control	-40 to 85 (local) -40 to 100 (remote)	±3.0	0.5°C/LSB	2%	3.0 to 3.6	1.6 mA	LLP-48	*
LM96163 <sup>E</sup>	TruTherm support, LUT fan control	-40 to 125	±0.75	0.03125°C/LSB	—	3.0 to 3.6	456 $\mu$ A	LLP-10	*
LM96080 <sup>E</sup>	Voltage monitoring, DAC output, TACH inputs	-40 to 125	±3.0	0.0625°C/LSB	—	3.0 to 5.5	0.3 mA	TSSOP-24	*





PowerWise® product <sup>E</sup> Evaluation board Automotive Grade (0) AECQ Temperature Grade 0 (3) AECQ Temperature Grade 3

\* Contact local office to request Automotive qualification




# Audio Solutions

## Amplifiers and Subsystems


### Class AB Mono

Product ID	Key Features	THD (%)	Output Power at 1% THD+N $V_{DD} = 5V$		Packaging	Auto Grade
			4Ω (W)	8Ω (W)		
LM48100Q 	Mono, 1.25W, output fault detection, volume control	0.02	—	1.25	Exposed Pad TSSOP-14	 (2)
LM4941 E 	1.25W Boomer®, RF suppression, high PSRR and CMRR	0.04	—	1.25	micro SMD-9, LLP-8	*
LM4990	2W (into 4Ω) Boomer, selectable shutdown	0.02	2.03	1.25	LLP-10, micro SMD-9, MSOP-8, TSSOP-10	*
LM4995 E 	1.3W Boomer	0.08	—	1.3	micro SMD-9, LLP-8	*



### Class D Mono

Product ID	Key Features	THD (%)	Output Power THD ≤ 1% $V_{DD} = 5V$		Packaging	Auto Grade
			4Ω (W)	8Ω (W)		
LM4673 E 	Mono, filterless	0.02	2.15	1.24	micro SMD-9, LLP-8	*
LM4675 E 	Mono, ultra-low EMI	0.02	2.2	1.3	micro SMD-9, LLP-8	*
LM48310 E 	Mono filterless, Enhanced Emission Suppression (E <sup>2</sup> S)	0.03	2.1	1.3	LLP-10	*



### Class AB Stereo

Product ID	Key Features	THD (%)	Output Power at THD ≤ 1%		Packaging	Auto Grade
			4Ω (W)	8Ω (W)		
LM48510 E 	1.2W, Boosted Class D Boomer	0.07	1.7 at 3.3V	1.2 at 3.3V	LLP-16	*
LM48511 E	3W, Boosted Class D Boomer, ultra-low EMI, spread spectrum	0.03	5.4 at 5V	3 at 5V	LLP-24	*
LM4928 E	RF suppression	0.04	1.8	1.2	LLP-14, micro SMD-16	*

### Class D Stereo

Product ID	Key Features	THD (%)	Output Power THD ≤ 1% $V_{DD} = 5V$		Packaging	Auto Grade
			4Ω (W)	8Ω (W)		
LM4674A E 	Stereo, class D, filterless	0.07	1.02	0.63	micro SMD-16	*
LM48411 E 	Enhanced Emission Suppression (E <sup>2</sup> S)	0.05	2	1.25	micro SMD-16	*

### Audio Subsystems

Product ID	Key Features	Mono Input Ch.	Stereo Input Ch.	Class D Speaker Driver	Packaging	Auto Grade
LM49450 E	2.5W, low-EMI stereo class D, 24-bit DAC, ground referenced headphones, volume control, 3D enhancement	—	I <sup>2</sup> S	✓	LLP-32	*
LM4934	3D, stereo speaker, OCL/SE stereo headphone, earpiece, monoline level outputs	1	2, I <sup>2</sup> S	—	micro SMD-42	*
LM4935 E	Dual-mode, stereo headphone, mono high-efficiency loudspeaker amplifiers, multi-purpose ADC	1 analog, I <sup>2</sup> S	1 analog, I <sup>2</sup> S	✓	micro SMD-49	*
LM49250 	Enhanced Emissions Suppression (E <sup>2</sup> S), stereo class D, ground referenced headphone amplifier	Differential	2	✓	micro SMD-36	*
LM49370 E 	Boomer, dedicated interface for Bluetooth® transceivers	PCM	I <sup>2</sup> S	✓	micro SMD-49	*





 PowerWise® product     Evaluation board     Automotive Grade    (2) AECQ Temperature Grade 2    \* Contact local office to request Automotive qualification



# Audio Solutions

## Amplifiers and Drivers

### High-Performance Audio Operational Amplifiers

Product ID	Description	Input Voltage Noise Density (nV/√Hz)	THD (%)	Slew Rate (V/μs)	GBWP (MHz)	PSRR (dB)	Supply Voltage (V)	Packaging	Auto Grade
LME49710 <sup>E</sup> 	High-fidelity	2.7	0.00003	20	56	125	±2.5 to ±17	DIP-8, MSOP-8, TO99-8	*
LME49870	44V High-fidelity	2.7	0.00003	20	55	125	±2.5 to ±22	SOIC-8	*
LM4562 <sup>E</sup> 	Dual, high-fidelity	2.7	0.00003	20	56	110	±2.5 to ±17	DIP-8, MSOP-8, TO99-8	*
LME49720 <sup>E</sup> 	Dual, high-fidelity	2.7	0.00003	20	56	110	±2.5 to ±17	DIP-8, MSOP-8, TO99-8	*
LME49860	44V dual, high-fidelity	2.7	0.00003	20	55	120	±2.5 to ±22	SOIC-8	*
LME49740 <sup>E</sup> 	Quad high-performance, high-fidelity	2.7	0.00003	20	56	125	±2.5 to ±17	DIP-8, MSOP-8	*
LME49713 <sup>E</sup>	High-fidelity, current feedback	1.9	0.00008	1900	30	102	±5 to ±18	SOIC-8	*
LME49721 <sup>E</sup>	High-performance, high-fidelity, rail-to-rail input/output	4	0.0002	8.5	20	103	2.2 to 5.5	MSOP-8	*
LME49723 <sup>E</sup>	Dual, high-fidelity	3.6	0.0002	8	17	100	±2.5 to ±17	MSOP-8	*
LME49743	Quad, high-fidelity	3.5	0.0001	12	30	98	±4 to ±17	TSSOP-14	*


### Headphone Buffer

Product ID	Description	THD (%)	Output Current (mA)	Slew Rate (V/μs)	GBWP (MHz)	Supply Voltage (V)	Packaging	Auto Grade
LME49600 <sup>E</sup>	High-performance, high-fidelity, high-current audio buffer	0.00015	250	2000	20/180	±2.25 to ±18	TO263-5	*

### High-Performance Audio Power Amplifier Drivers

Product ID	Description	Supply Voltage Max (V)	Typical THD Ratings (%)	THD Measurement Conditions	PSRR (dB)	Supply Voltage Range (V)	Mute/Shutdown	Packaging	Auto Grade
LM4702B	Stereo high-fidelity	±100	0.003	A <sub>v</sub> = 30 dB, V <sub>OUT</sub> = 20 V <sub>RMS</sub> at 1 kHz	110	±20 to ±100	Mute	TO220-15	*
LM4702C	Stereo high-fidelity	±75	0.005	A <sub>v</sub> = 30 dB, V <sub>OUT</sub> = 14 V <sub>RMS</sub> at 1 kHz	110	±20 to ±75	Mute	TO220-15	*
LME49810	Mono high-fidelity, Baker Clamp	±100	0.0007	No load, BW = 30 kHz, V <sub>OUT</sub> = 20 V <sub>RMS</sub> at 1 kHz	110	±20 to ±100	Mute	TO247-15	*
LME49811	Mono high-fidelity	±100	0.005	No load, AV = 30 dB, V <sub>OUT</sub> = 10 V <sub>RMS</sub> at 1 kHz	110	±20 to ±100	Mute	TO247-15	*

### Stereo Headphone Amplifiers





Product ID	Description	THD (%)	PSRR (dB)	Output Power THD ≤ 1%, V <sub>CC</sub> = 3V		Auto Grade
				16Ω (mW)	32Ω (mW)	
LM4980 	42 mW high-fidelity, click/pop suppression	0.02	90	42	28	*
LM4985 <sup>E</sup>	135 mW Boomer, OCL or cap-coupled output, 32-step I <sup>2</sup> C volume control	0.08	77	45	23	*

 PowerWise® product <sup>E</sup> Evaluation board \* Contact local office to request Automotive qualification


# Amplifier Solutions

## High-Speed Amplifiers

### High-Speed Amplifiers

Product ID	Channels	-3 dB BW (MHz)	Slew Rate (V/ $\mu$ s)	Supply Voltage (V)	Supply Current/Channel (mA)	Input Offset Voltage Max at 25°C (mV)	Packaging	Auto Grade
<b>Video</b>								
LM6171 <sup>E</sup>	1	160 at +1	3600	5.5 to 34	2.5	3	MDIP-8,SOIC-8	*
LM6172 <sup>E</sup>	2	160 at +1	3000	5.5 to 36	2.2	3	MDIP-8, CDIP8, CSOIC-16, SOIC-8	*
LM7171 <sup>E,W</sup>	1	220 at +2,-1	4100	5.5 to 36	6.5	1	MDIP-8, SOIC-8, CDIP-8, CPACK-10	*
LM7372 <sup>E,W</sup>	2	220 at +2,-1	3000	9 to 36	6.5	8	SOIC, PSOP, LLP-8	*
LMH6722 <sup>E</sup>	4	420 at+1	1800	10 to 12	5.6	5	SOIC-14, TSSOP-14, LLP-14	 (1)
LMH6715 <sup>E,W</sup>	2	480 at +1	1300	10 to 12	5.8	6	SOIC-8, CDIP-8	*
LMH6723/24 <sup>E</sup>	1, 2, 4	370 at +1	600	4.5 to 12	1	3	SOT23-5, SOIC-8, SOIC-14, TSSOP-14	*
LMH6733 <sup>E,W</sup>	3	1000 at +1	3750	3 to 12	6.5	2.2	SSOP-16	*
<b>Single Supply Optimized for Video</b>								
LMH6601 <sup>E</sup>	1	125 at +1	250	2.4 to 5.5	9.6	2.4	SC70-6,	 (3)
LMH6611/12 <sup>E</sup>	1,2	345 at+1	460	2.7 to 11	3.25	0.75	SOT23-6	*
LMH6618/19 <sup>E,W</sup>	1, 2	140 at+1	57	2.7 to 11	1.35	0.6	TSOT-6	*
LMH6639 <sup>E,W</sup>	1	228 at +1	172	3 to 12	4.18	5	SOT23-6, SOIC-8	*
LMH6642/43/44 <sup>E,W</sup>	1, 2, 4	130 at +1	135	2.7 to 12.8	2.7	5	SOT23-5, SOIC-8, SOIC-14, TSSOP-14	*
LMH6645/46/47 <sup>E,W</sup>	1, 2,1	55 at +1	22	2.5 to 12	0.725	3	SOT23-5, SOT23-6, SOIC-8, MSOP-8	*
<b>Low Noise</b>								
 LMH6629 <sup>E</sup>	1	900 at 10	1600	2.7 to 5.5	15.5	0.78	LLP-8, SOT-23	*
LMH6609 <sup>E</sup>	1	900 at +1	1400	6 to 12	7	2.5	SOT23, SOIC-8	*
LMH6624/26 <sup>E</sup>	1, 2	190/170 at 10	400/360	5 to 12	12	0.5	SOT23-5, SOIC-8, CDIP-8, CPACK-10	*
LMH6628	2	300 at +1	550	5 to 12	9	2	SOIC-8	*
LMH6702 <sup>E,W</sup>	1	1700 at +1	3100	10 to 12	12.5	4.5	SOT23-5, SOIC-8, CDIP-8, CPACK-10	*
LMH6703 <sup>E</sup>	1	1800 at +1	4200	8 to 12	11	7	SOT23-6,SOIC-8	*
<b>Differential</b>								
LMH6550 <sup>E</sup>	1	400 at +1	3000	5 to 12	20	5	SOIC-8, MSOP-8	*
LMH6551 <sup>E</sup>	1	370 at +1	2400	3 to 12	12.5	4	SOIC-8, MSOP-8	*
LMH6552 <sup>E</sup>	1	1500 at +1	3800	4.5 to 12	19	16.5	SOIC-8, LLP-8	*
 LMH6554 <sup>E</sup>	1	2500 at +1	6200	4.7 to 5.3	52	3	LLP-14	*
LMH6555 <sup>E</sup>	1	1200 at +1	1300	3 to 3.6	120	50	LLP-16	*

### Variable Gain Amplifiers

Product ID	Input	-3db Bandwidth Unity Gain (MHz)	Gain Adjust Range (dB)	I <sub>cc</sub> (mA)	Slew rate (V/ $\mu$ s)	Linear in	Packaging	Auto Grade
LMH6502	Differential	130	70	27	1800	dB	SOIC-14, TSSOP-14	*
LMH6503	Differential	135	70	37	1800	V/V	SOIC-14, TSSOP-14	*
LMH6505 <sup>E</sup>	Single-Ended	150	80	11	1500	dB	SOIC-8, MSOP-8	*
LMH6514 <sup>E</sup>	Differential	600	42	107	—	dB	LLP-16	*
LMH6515 <sup>E</sup>	Differential	600	31	107	—	dB	LLP-16	*
 LMH6517 <sup>E</sup>	Differential	1200	31.5	80	—	dB	LLP-32	*

 PowerWise® product <sup>E</sup> Evaluation board <sup>W</sup> WEBENCH® enabled  Automotive Grade (1) AECQ Temperature Grade 1 (3) Temperature Grade 3  
\* Contact local office to request Automotive qualification

# Amplifier Solutions

## Clock Buffers and RF Detectors

### LMH6629 – 8 GHz Gain Bandwidth Ultra-Low-Noise Amplifier

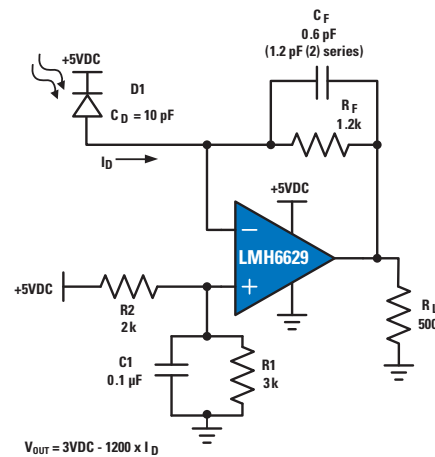
#### Features

- -3 dB bandwidth 900 MHz at 10V/V
- 0.69 nV/√Hz input noise voltage
- 780 μV input offset voltage max at 25°C
- 1600 V/μs slew rate
- -90/-94 dBc HD2/HD3 at 0.5 MHz
- 2.7 to 5V supply voltage range
- ≥4/≥10 selectable min gain

#### Applications

Ideal for use in automotive LIDAR systems

Typical Application Circuit



### Clock Buffers with Independent Shutdown

Product ID	Features	Channels	Frequency (MHz)	Phase Noise (dBc/Hz)	Slew Rate (V/μs)	Supply Voltage Range (V)	Supply Current (mA)	Packaging	Auto Grade
LMH2180 <sup>E</sup>	75 MHz, dual	2	78	-123	106	2.4 to 5	2.3	LLP-8	*
LMV112 <sup>E</sup>	49 MHz, dual	2	40	—	110	2.4 to 5	1.6	LLP-8	*

### RF Detectors with Shutdown

Product ID	Features	RF frequency (MHz)	Dynamic Range (dB)	Power Range (dBm)	Accuracy (dB)	Supply Voltage (V)	Supply Current (mA)	Packaging	Auto Grade
<b>NEW</b> LMH2110 <sup>E</sup>	Multi-mode, multi-band RF power control	50 to 6000	45	-40 to 5	0.5	2.7 to 5	4.8	micro SMD-6	*
LMH2100 <sup>E</sup>	Log power, CDMA, WCDMA	50 to 4000	40	-45 to -5	0.5	2.7 to 3.3	7.1	SMD-6	*
LMV221 <sup>E</sup>	Log power, CDMA, WCDMA	50 to 3500	40	-45 to -5	0.5	2.7 to 3.3	7.2	LLP-6	*
LMV225 <sup>E</sup>	CDMA, WCDMA	450 to 2000	30	-30 to 0	1	2.7 to 5.5	4.8	SMD-4, LLP-6	*
LMV228 <sup>E</sup>	CDMA, WCDMA	450 to 2000	30	-15 to 15	1	2.7 to 5.5	4.9	SMD-4, LLP-6	*

### Special Video Functions

Product ID	Description	Vcc (V)	Supported Standards	Outputs	Packaging	Auto Grade
LMH1980	Auto detecting SD/HD/PC video sync separator	3.3 to 5	NTSC, PAL, 480i/p, 576i/P, 720p, 1080i/p, PC RGB	H/V/C sync, burst/back porch, odd/even, HD detect	MSOP-10	*
LMH1981 <sup>E</sup>	Auto-format video SD/HD sync separator, low H jitter	3.3 to 5	NTSC, PAL, SECAM, 480i/p, 576i/p, 720p, 1080i/p	H/V/C sync, odd/even, burst/back porch, video	TSSOP-14	*
LMH1982 <sup>E</sup>	Multi-rate video clock generator with Genlock	2.5	NTSC, 48-kHz audio clock input, 720p, 576i/p, 480i/p, 1080i/p, PAL	2	LLP-32	*
LMH1251	YPBPR to RGBHV converter, 2:1 video switch	4.75 to 5.25	1: YPBPR 480i/p, 576i/p, 720p, 1080i/p 2: PC RGBHV up to UXGA	RGBHV up to UXGA	TSSOP-24	*

PowerWise® product <sup>E</sup> Evaluation board \* Contact local office to request Automotive qualification

# Amplifier Solutions

## Precision Amplifiers

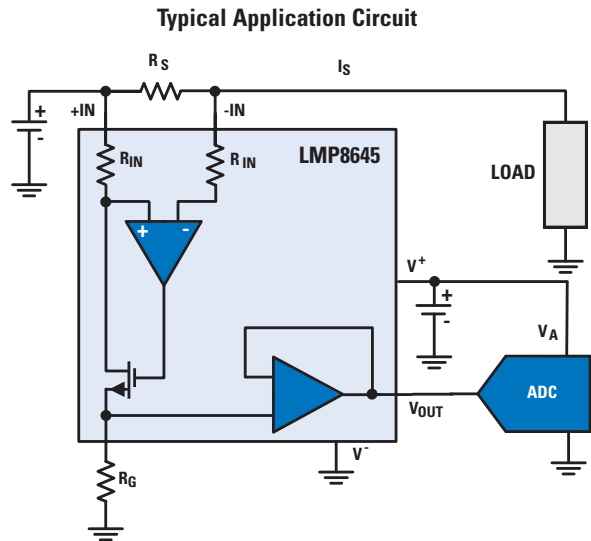
### LMP8645/HV – Precision High-Voltage Variable Gain Current Sense Amplifier

#### Features

- -2 to 42V CMVR (standard grade)
- -2 to 76V CMVR (HV grade)
- 1 mV max input offset voltage
- Buffered output
- Variable gain (1 to 100V/V) set by external resistor
- 2% max gain accuracy
- -40°C to 125°C operating temperature range

#### Applications

Ideal for use in high side current sense, vehicle current measurement, motor controls, battery monitoring, remote sensing, and power management



### Current Sense Amplifiers

Product ID	Description	V <sub>CM</sub> Range (V)	V <sub>OS</sub> (mV) (Max)	T <sub>C</sub> V <sub>OS</sub> (μV/°C) Max	Gain (V/V)	Supply Voltage Range (V)	Supply Current (mA)	PSRR (dB)	Packaging	Auto Grade
LMP8601	Precision, Wide Common Mode Range	-22 to 60	1	10	20	3.0 to 5.5	1.1	90	SOIC-8	(1)
LMP8602	Precision, Wide Common Mode Range	-22 to 60	1	10	50	3.0 to 5.5	1.1	90	SOIC-8, MSOP-8	(1)
LMP8603	Precision, Wide Common Mode Range	-22 to 60	1	10	100	3.0 to 5.5	1.1	90	SOIC-8, MSOP-8	(1)
LMP8645	Variable gain, high voltage	-2 to 42	1	7	ExtR (1 to 100)	2.7 to 12	0.61	90	TSOT-6	*
LMP8645HV	Variable gain, high voltage	-2 to 76	1	7	ExtR (1 to 100)	2.7 to 12	0.61	90	TSOT-6	*
LMP8640/HV	Fixed gain, high voltage	-2 to 42/76	0.9	2.6	20, 50, 100	2.7 to 12	0.722	90	TSOT-6	*

### High-Voltage Operational Amplifiers

Product ID	Channels	Supply Voltage Range (V)	Supply Current/Channel (mA)	Gain Bandwidth (MHz)	Slew Rate (V/μs)	Offset Voltage Max at 25°C (mV)	Voltage Noise (nV/√Hz)	Output Current (mA)	Temp Range (°C)	CMOS Inputs	Rail-to-Rail Inputs	Packaging	Auto Grade
LM6211	1	5 to 24	0.96	17	5.5	2.5	6	16	-40 to 125	✓		SOT23-5	*
LM8261/62	1/2	2.5 to 30	1.05	21	12	7	15	60	-40 to 85	Bipolar	✓	MSOP-8, SOT23-5	*
LM7341	1	2.5 to 32	0.6	4.5	1.2	4	36	8	-40 to 125	Bipolar	✓	SOT23-5	*
LM7321/22	1/2	2.5 to 32	0.48	16	8.5	5	11.9	48	-40 to 125	—	✓	SOT23-5, SOIC-8, MSOP-8	*
LM7332	2	2.5 to 32	1.5	19.3	12	4	14.8	55	-40 to 125	—	✓	SOIC-8, MSOP-8	*

Automotive Grade (1) AECQ Temperature Grade 1 \* Contact local office to request Automotive qualification

# Amplifier Solutions

## Low-Power Operational Amplifiers

### LMC7101 – Tiny, Low-Power Operational Amplifier with Rail-to-Rail Input and Output

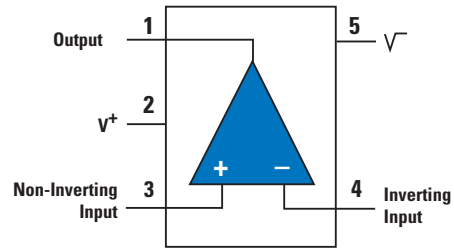
#### Features

- AEC-Q100 Grade 1 qualified
- Tiny space-saving package
- Guaranteed specs at 2.7V, 3V, 5V, 15V supplies
- Typical supply current 0.5 mA at 5V
- Typical total harmonic distortion of 0.01% at 5V
- 1.0 MHz gain bandwidth

#### Applications

Designed for space constrained and weight critical automotive designs

Typical Application Circuit



### Low-Power Operational Amplifiers

Product ID	Channels	Supply Current/Channel (mA)	Gain Bandwidth (MHz)	Offset Voltage Max at 25°C (mV)	Max Input Bias Current (nA)	Voltage Noise (nV/√Hz)	Supply Voltage Range (V)	CMOS Inputs	Rail-to-Rail Inputs	Packaging	Auto Grade
LMV641	1	0.158	10	0.5	105	14	2.7 to 12	Bipolar		SOIC-8, SC70-5	*
LM6132/34	2/4	0.36	10	6	350	27	2.7 to 24	Bipolar	✓	SOIC-8, MDIP-8, SOIC-14	*
LMV851/52/54 <sup>E</sup>	1/2/4	0.41	8	1	0.5	11	2.7 to 5	✓		SC70-5, MSOP, TSSOP-14	*
LMV951	1	0.57	2.8	2.8	85	25	0.9 to 3	Bipolar	✓	TSOT-6	*
LMP7701/02/04	1/2/4	0.725	2.5	0.22	0.4	9	2.7 to 12	✓	✓	SOIC-8, SOT23-5, MSOP, TSSOP-14	(1)
LMV841/42/44	1/2/4	1	4.5	5	0.3	20	2.7 to 12	✓	✓	SC70-5, SOIC, MSOP, TSSOP-14	(1)
<b>NEW</b> LMC7101 <sup>W</sup>	1	0.5	1.1	3 to 7	0.064	37	2.7 to 15.5	✓	✓	SOT-23-5	(1)
LMV772 <sup>W</sup>	2	0.95	3.5	0.85	0.1	6.5	2.7 to 5.5	Bipolar		SOIC-8, MSOP-8	(1)
<b>NEW</b> LMC796 <sup>W</sup>	1	1.15	17	1.35	0.1	5.8	1.8 to 5.5	✓		SOT-23-5, MSOP-8	■







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# Amplifier Solutions

## Precision Amplifiers and Comparators








### Precision Operational Amplifiers

Product ID	Offset Voltage Max at 25°C (mV)	Supply Voltage Max (V)	T <sub>c</sub> V <sub>OS</sub> (μV/°C)	CMRR (dB)	PSRR (dB)	Avol (dB)	Voltage Noise (nV/√Hz)	Channel	Supply Current/Channel (mA)	Supply Voltage Range (V)	CMOS Inputs	Rail-to-Rail Inputs	Packaging	Auto Grade
LMP2015/16	0.005	5	0.015	130	120	130	35	1/2	0.93	2.7 to 5	✓		SOT23-5, SOIC-8, MSOP-8	*
LMP2014MT	0.025	5	0.01	130	120	130	35	2	0.93	2.7 to 5	✓		TSSOP-14	*
LMP7731/32 	0.04	5.5	1	120	129	130	2.9	1/2	2.2	1.8 to 5.5	Bipolar	✓	SOT-23, SOIC-8	*
LMP2021/22	0.005	5.5	0.02	139	130	160	11	1/2	1.1	2.2 to 5.5	✓		SOT-23, SOIC-8, MSOP-8	*
LMP2232/34 	0.15	5	1	97	120	120	60	1/2/4	0.009	1.8 to 5	✓		MSOP-8, SOIC-8, TSSOP-14	*
LMP7711/12 	0.15	5.5	1	100	100	110	5.8	1/2	1.15	1.8 to 5.5	✓		TSOT-6, MSOP-10	*
LMP7716 	0.15	5	1	100	98	110	5.8	1/2	1.15	1.8 to 5	✓		SOT23-5	 (1)
LMP7717/18 	0.15	5	1	100	98	110	5.8	1/2	1.15	1.8 to 5	✓		SOIC-8, SOT23-5, MSOP-8	*

### High-Speed Comparators

Product ID	Features	V <sub>CC</sub> (V)	I <sub>CC</sub> (mA/ ch)	t <sub>pd</sub> (ns)	Toggle Rate (Mbps)	Packaging	Auto Grade
LMH7322 <sup>E</sup> 	Dual, LVDS/ RSPECL outputs	2.7 to 12	22.6	0.7	4000	LLP-24	*
LMH7324 <sup>E</sup> 	Quad, LVDS/ RSPECL outputs	5 to 12	22.6	0.7	4000	LLP-32	*
LMH7220 <sup>E</sup> 	LVDS outputs	2.7 to 12	6.8	2.9	1080	TSOT-23	*
LMV7219 <sup>E</sup> 	TTL outputs	2.7 to 5	1.1	7	—	SC70-5, SOT-23	*

### Low-Power Comparators

Product ID	Channels	Response Time (μs)	Offset Voltage Max at 25°C (mV)	Supply Voltage Max (V)	Supply Voltage Range (V)	Supply Current/Channel (mA)	Output	Temperature Range (°C)	Packaging	Auto Grade
LMV7219 	1	0.009	6	5	2.7 to 5	1.1	Push Pull	-40 to 85	SC70, SOT23-5	*
LMV761/62	1/2	0.12	0.3/1	5	2.7 to 5	0.275/0.7	Push Pull	-40 to 125	SOIC-8, SOT23-6, MSOP-8	■
LM6511	1	0.18	5	36	2.7 to 36	2.7	Open Drain	-40 to 85	SOIC-8	*
LMV331/39	1/2/4	0.2	7	5.5	2.7 to 5.5	0.06	Open Drain	-40 to 85	SC70-5, SOT23-5, MSOP, TSSOP	*
LMV7271 	1	0.88	4	5	1.8 to 5	0.009	Push Pull	-40 to 85	SC70-5, SOT23-5	*
LMV7291 	1	0.88	4	5	1.8 to 5	0.009	Push Pull	-40 to 85	SC70-5	*
LMC6762	2	4	15	15	2.7 to 15	0.006	Push Pull	-40 to 85	SOIC-8	*
LMC6772 	2	4	5	15	2.7 to 15	0.006	Open Drain	-40 to 85	SOIC-8	 (3)
LMC7211	1	4	5	15	2.7 to 15	0.007	Push Pull	-40 to 85	SOIC-8, SOT23-5	*
LMP7300	1	4	0.3	12	2.7 to 12	0.012	Open Drain	-40 to 125	SOIC-8	*
LPV7215 	1	4.5	3	5	1.8 to 5	0.001	Push Pull	-40 to 85	SC70-5, SOT23-5	*
LMC7215 	1	24	6	8	2 to 8	0.001	Push Pull	-40 to 85	SOIC-8, SOT23-5	*

 PowerWise® product <sup>E</sup> Evaluation board  Automotive Grade ■ Automotive Grade qualification in process (1) AECQ Temperature Grade 1

(3) AECQ Temperature Grade 3 \* Contact local office to request Automotive qualification

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# Worldwide Design Centers and Manufacturing Facilities



- Design Centers
- Manufacturing Facilities

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