life.augmented

Automotive Standard Analog
Robustness and Performance

Content

Introduction

ST provides a wide range of analog products dedicated to the challenging and demanding automotive market.

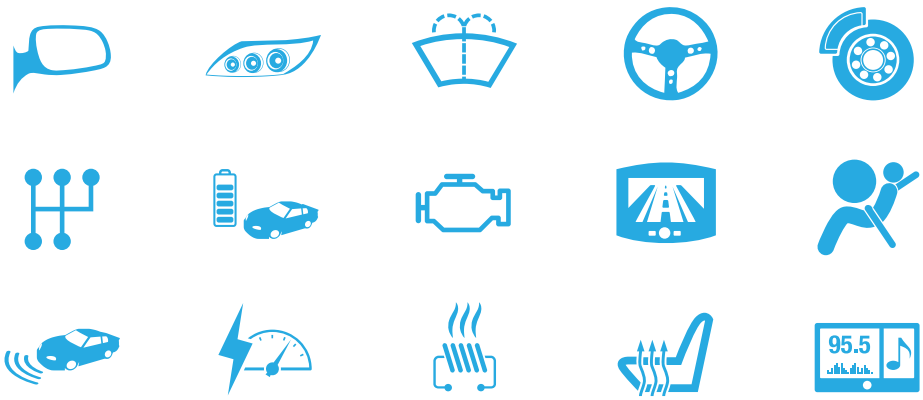
This brochure presents a large portfolio of ST's products and solutions dedicated to voltage regulation, DC-DC conversion, signal amplification, current sensing, and LED driving as well as many other small analog ICs that are needed for today's ever-growing automotive industry.

Thanks to innovative design techniques and a continuous focus on improving quality, ST offers high-performance devices that meet the specific requirements of the rigorous AEC-Q100 standard.

With a continuously growing portfolio offering the latest solutions in a wide variety of packages for powertrain, safety, and car-body systems to infotainment solutions, this brochure highlights the best products and solutions to help developers quickly get started with their designs as well as development tools for their day-to-day activities.

A large portfolio of products

For all automotive applications



Automotive grade qualification process

Our automotive products meet the specific and rigorous requirements of the automotive market. This is the result of continuous quality and reliability improvements gained through our close collaboration with leading automotive suppliers and car makers. From product conception to delivery and beyond, our constant focus on learning and upgrading our quality processes, ensure we reach the highest level of excellence in the semiconductor industry.

Customer quality

- Customer requirements
- Complaint management
- Product return process

Change management

- Product/Process Change Notifications
- Product Termination Notifications

Manufacturing & supply chain quality

- Non-conformity management
- Supplier quality management
- Traceability

Quality in product & technology development

- Test flow
- Technology development
- Product monitoring

Very high level of in-house parametric testing equipment

100% electrical testing with very extensive coverage coupled with automatic visual inspection

Part Average Testing (PAT) to detect and remove parts tested "pass" but potentially weak in reliability

Hot test & Junction Verification Test (JVT) at Final test for SOT23, Mini SO, SO, TSSOP, QFN/DFN

A specific commercial product number

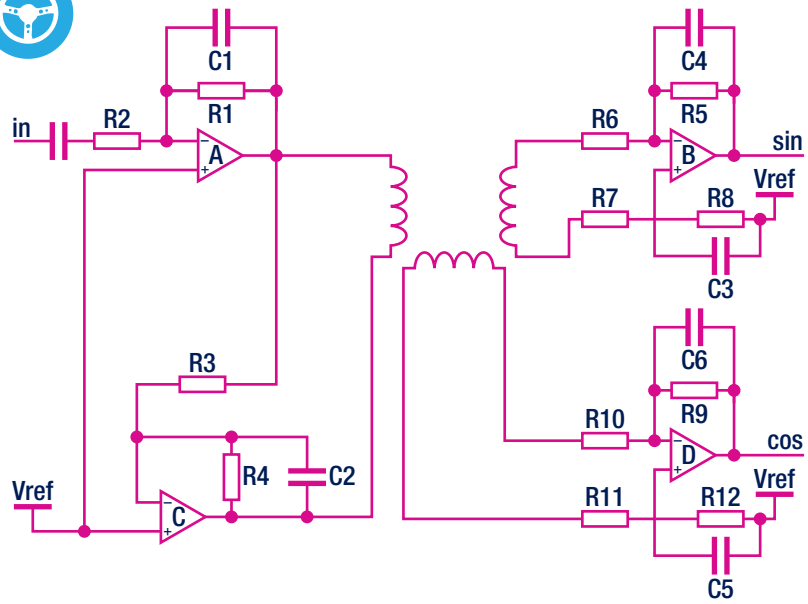
COMPLIANCE WITH

- IATF16949
- VDA 6.3
- AEC-Q100
- AEC-Q001
- AEC-Q002

PPAP provided

Application schematics

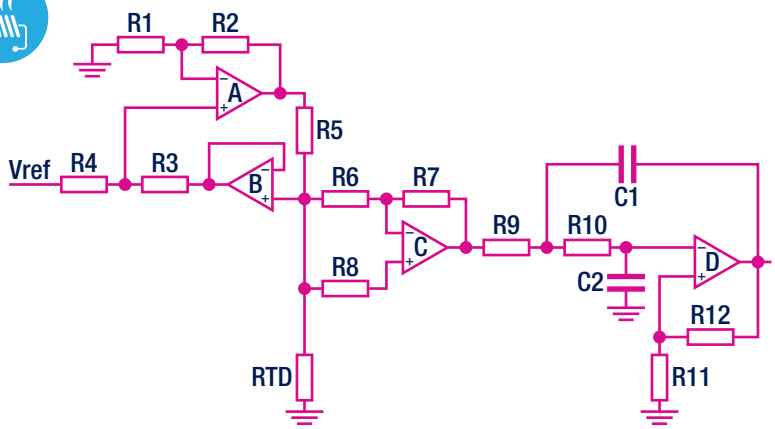
Steering angle sensor



Featured products:

- TSX564IYPT
- TSX922IYDT

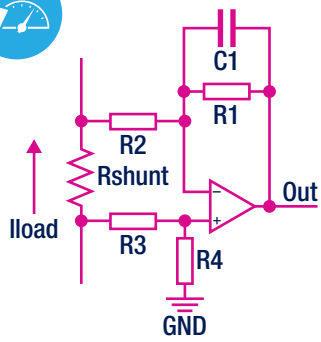
Resistance temperature detector



Featured products:

- TSZ124IYPT

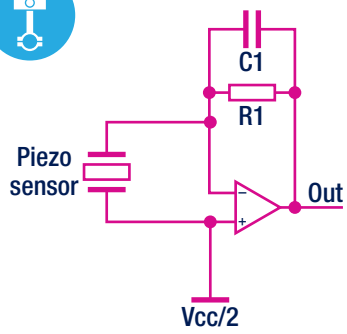
Current measurement



Featured products:

- TSX7191IYLT
- TSZ121IYLT
- TSX9291IYLT

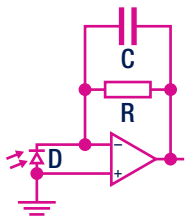
Cylinder pressure sensor



Featured products:

- TSX922IYDT
- TSV912HYDT

Photodiode current sensing



Featured products:

- TSU series
- TSX series
- TSV63 series

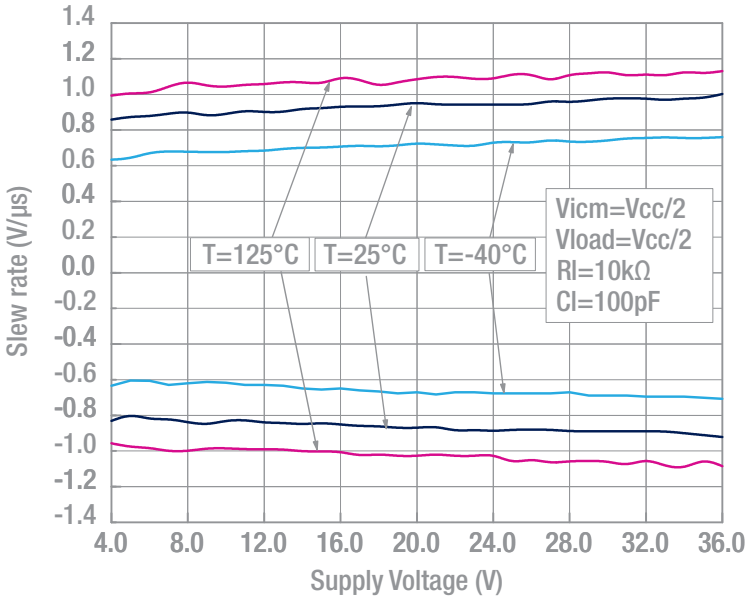
Amplifiers & Comparators

LOW-POWER OPERATIONAL AMPLIFIERS

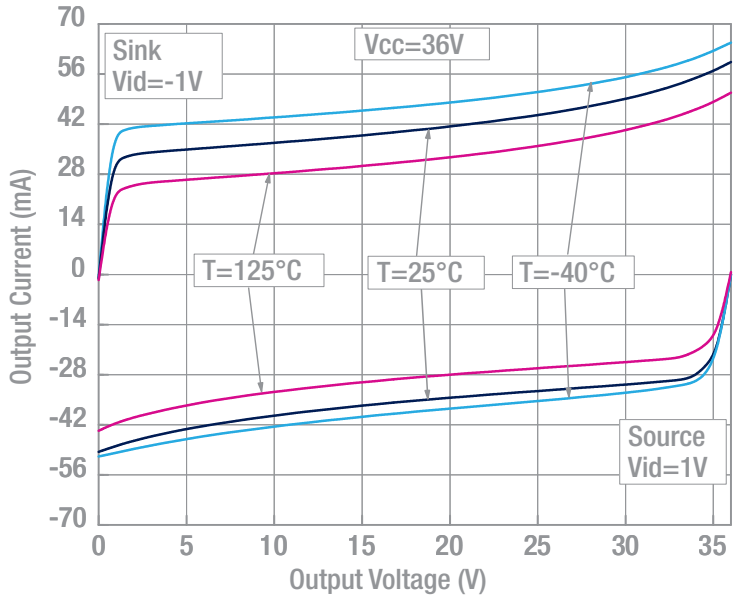
TSB572: low-power, 2.5 MHz, rail-to-rail input and output, 36 V operational amplifier

The TSB572 dual operational amplifier offers an extended voltage operating range from 4 to 36 V and rail-to-rail input/output. The TSB572 offers a very good speed/power consumption ratio with 2.5 MHz gain bandwidth product while consuming only 380 µA typically with a 36 V supply. The TSB572's stability and robustness make it an ideal solution for applications with a wide voltage range.

Slew rate vs. supply voltage and temperature



Output current vs. output voltage and temperature



FEATURES

- Low-power consumption: 380 µA (typ.)
- Wide supply voltage: 4 to 36 V
- Rail-to-rail input and output
- Gain bandwidth product: 2.5 MHz
- Low input bias current: 30 nA (max.)
- No phase reversal
- High tolerance to ESD: 4 kV (HBM)

Part number	Typ. I_{cc} per channel (µA)	Min. V_{cc} (V)	Max. V_{cc} (V)	Typ. GBP (MHz)	Typ. SR (V/µs)	Max. V_{IO} @ 25 °C (µV)	Typ. I_{OUT}(mA)	Rail to rail		Package Single	Package Dual	Package Quad
								In	Out			
TS931/2/4	20	2.7	10	0.1	0.05	10000	5	No	Yes	SOT23-5 (**)	SO8 (**)	SO14
TSZ121/2/4	31	1.8	5.5	0.4	0.19	5	17	Yes	Yes	SOT23-5	SO8, MiniSO8	TSSOP14
TSV521A/2A/4A	45	2.7	5.5	1.15	0.89	600	55	Yes	Yes		MiniSO8	
TSX631A/2A/4A (*)	45	3.3	16	0.2	0.12	500	90	Yes	Yes		MiniSO8	
TSV631/2/4	60	1.5	5.5	0.88	0.34	500	69	Yes	Yes		SO8	
TSB611 (*)	103	2.7	36	0.56	0.18	1000	60	No	Yes		NA	
TSX561A/2A/4A (*)	250	3	16	0.9	1.1	600	90	Yes	Yes		MiniSO8	TSSOP14
TSB572 (*)	380	4	36	2.5	1	1500	60	Yes	Yes	NA	MiniSO8 – QFN8	NA
TS912B/14A	400	2.7	16	1.4	1	2000	70	Yes	Yes	NA	SO8	SO14
TS1871A/2A/4A	400	1.8	6	1.8	0.6	1000	72	Yes	Yes	SOT23-5	SO8, TSSOP8	SO14, TSSOP14
TSV321A/358A/324A	500	2.5	6	1.4	0.6	1000	80	Yes	Yes		SO8, TSSOP8	SO14, TSSOP14
TS512A/14A	500	6	30	3	1.5	500	23	No	No	NA	SO8	SO14 (**)
TS321A	600	3	30	0.8	0.4	2000	40	No	No	SOT23-5	NA	NA
TSX711A/12 (*)	660	2.7	16	2.7	1.2	100	54	Yes	Yes		SO8, MiniSO8	
TSX7191A/92 (*)	660	2.7	16	8.5	2.4	100	70	Yes	Yes			
TSZ181/2 (*)	700	2.2	5.5	3	4.7	25	27	Yes	Yes			
TSV911A/2A/4A	780	2.5	5.5	8	4.5	1500	35	Yes	Yes	SOT23-5, SO8	SO8, MiniSO8	SO14, TSSOP14
TS507	850	2.7	5.5	1.9	0.6	100	115	Yes	Yes	SOT23-5	NA	
TS9222/9224	900	2.7	12	4	1.3	500	80	Yes	Yes	NA	SO8, TSSOP8	SO14, TSSOP14
TS951/2/4	950	2.7	12	3	1	6000	22	Yes	Yes	SOT23-5	SO8, MiniSO8	SO14, TSSOP14

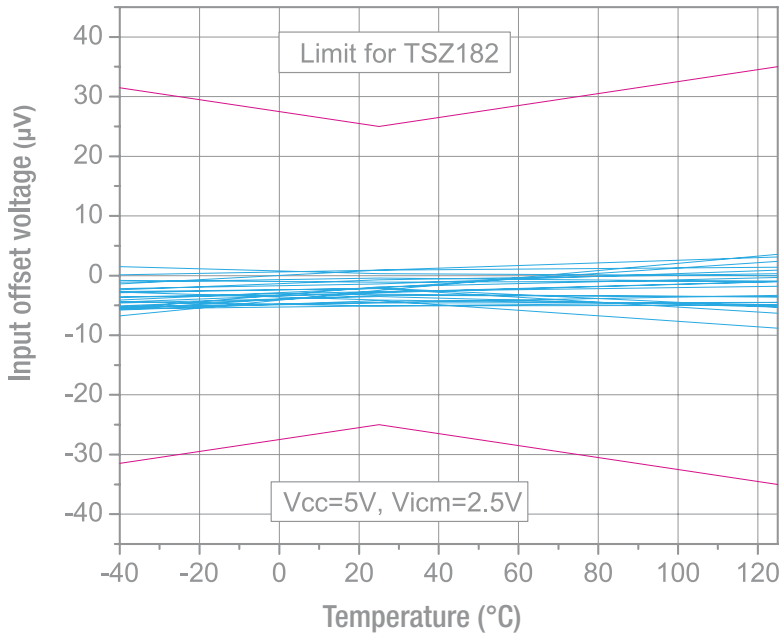
(*): New products
(**) Eligible for Automotive-grade qualification

PRECISION OPERATIONAL AMPLIFIERS

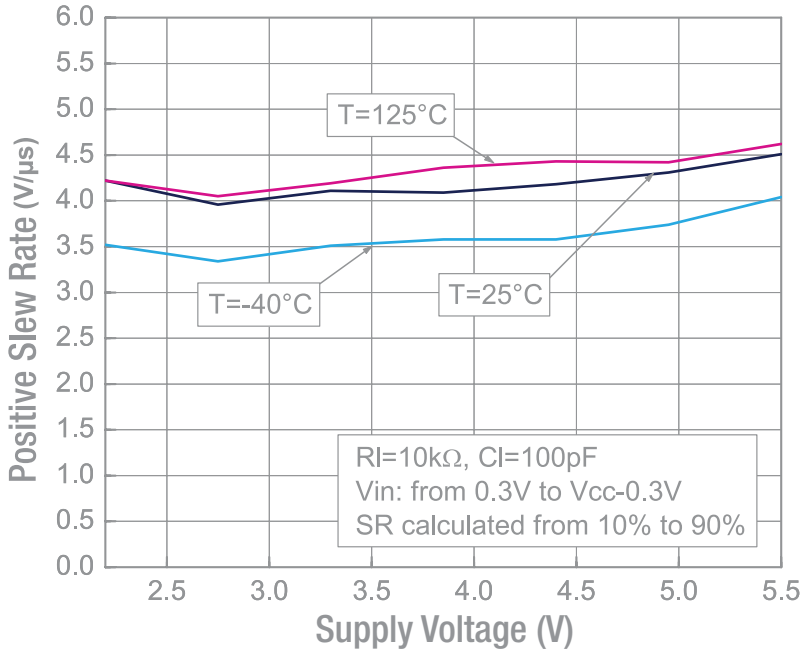
TSZ182: Very high accuracy (25 µV) zero drift 5V CMOS dual op amps with GBP = 3 MHz

The TSZ182 is a dual operational amplifier featuring very low offset voltages with virtually zero drift versus temperature changes.
The TSZ182 offers rail-to-rail input and output, excellent speed/power consumption ratio, and 3 MHz gain bandwidth product, while consuming just 1 mA at 5 V. The device also features an ultra-low input bias current. These features make the TSZ182 ideal for high-accuracy high-bandwidth sensor interfaces.

Input offset voltage vs. temperature for V_{cc} = 5 V



Positive slew rate vs. Supply voltage



FEATURES

- Very high accuracy and stability: offset voltage 25 µV (max.) at 25 °C, 35 µV over full temperature range (-40 to 125 °C)
- Rail-to-rail input and output
- Low supply voltage: 2.2 to 5.5 V
- Low power consumption: 1 mA (max.)at 5 V
- Gain bandwidth product: 3 MHz
- Slew rate of 4.7 V/µs

Part number	Max. V_{IO} @ 25 °C (µV)	Typ. V_{IO} drift (µV/°C)	Max. I_{IB} @ 25 °C (pA)	Min. V_{CC} (V)	Max. V_{CC} (V)	Typ. GBP (MHz)	Typ. SR (V/µs)	Typ. I_{CC} per channel (mA)	Typ. 1 kHz noise (nV/√Hz)	Rail to rail		Package Single	Package Dual	Package Quad
										In	Out			
TSZ121/2/4 (*)	5	0.01	200	1.8	5.5	0.4	0.19	0.031	37	Yes	Yes	SOT23-5	SO8, MiniSO8	TSSOP14
TSZ181/2 (*)	25	0.01	200	2.2	5.5	3	4.7	0.7	37	Yes	Yes			NA
TSX711A/12 (*)	100	0.8	50	2.7	16	2.7	1.2	0.66	22	Yes	Yes			
TS507	100	1	70000	2.7	5.5	1.9	0.6	0.85	12	Yes	Yes		NA	
TSX7191A/2 (*)	100	0.8	50	2.7	16	8.5	2.4	0.66	22	Yes	Yes		SO8, MiniSO8	
TSB712 (*)	300	0.5	300000	2.7	36	6	3	1.8	12	Yes	Yes	NA	SO8, MiniSO8	NA
TSB7192 (*)	300	0.5	300000	2.7	36	20	11	1.8	12	Yes	Yes		SO8, MiniSO8	
TSV631A/2A/4A	500	2	10	1.5	5.5	0.88	0.34	0.06	60	Yes	Yes	SOT23-5	SO8	TSSOP14
TSV6391A/2A/4A	500	2	10	1.5	5.5	2.4	1.1	0.06	60	Yes	Yes	SOT23-5 (**)	SO8 (**)	TSSOP14 (**)
TS9222/4	500	2	55000	2.7	12	4	1.3	0.9	9	Yes	Yes	NA	SO8, TSSOP8	SO14, TSSOP14
TS512A/4A	500	2	150000	6	30	3	1.5	0.5	8	No	No	NA	SO8	SO14 (**)
TSX561A/2A/4A (*)	600	2	100	3	16	0.9	1.1	0.25	48	Yes	Yes	SOT23-5	MiniSO8	TSSOP14
TSX631A/2A/4A (*)	700	1	100	3.3	16	0.2	0.12	0.045	60	Yes	Yes			
TS9511	800	2	70000	2.7	12	3	1	0.95	25	Yes	Yes		NA	
TSV851A/2A/4A	800	1	60000	2.3	5.5	1.3	0.7	0.13	30	No	Yes		SO8, MiniSO8	TSSOP14
LMV821A/2A/4A	800	1	120000	2.5	5.5	5.5	1.9	0.4	16	No	Yes		SO8, TSSOP8	SO14, TSSOP14
TS522/4	850	2	750000	5	30	15	7	2	4.5	No	No	NA	SO8 (**)	SO14 (**)

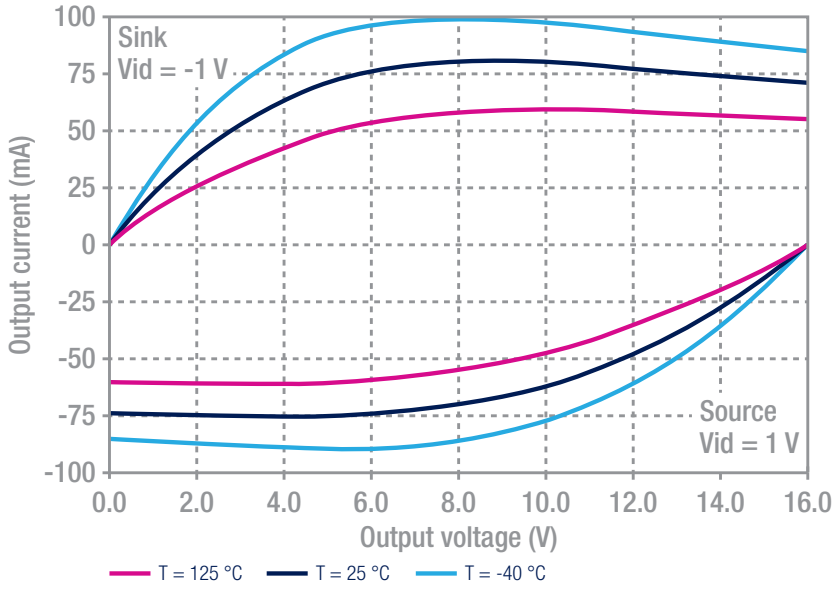
(*): New products
(**) Eligible for Automotive-grade qualification

HIGH OUTPUT CURRENT & CAPACITIVE LOAD OPERATIONAL AMPLIFIERS

TSX561/2/4: high merit factor 16 V with large output drive operational amplifiers

The TSX561/2/4 and TSX561A/2A/4A series of operational amplifiers benefit from ST's 16 V CMOS technology to offer state-of-the-art accuracy and performance in the smallest industrial packages. The TSX56 series offers an efficient speed/power consumption ratio, 900 kHz gain bandwidth product while consuming only 250 µA at 16 V. Such features make the TSX56 series ideal for sensor interfaces and industrial signal conditioning. The wide temperature range and high ESD tolerance ease use in harsh automotive applications. .

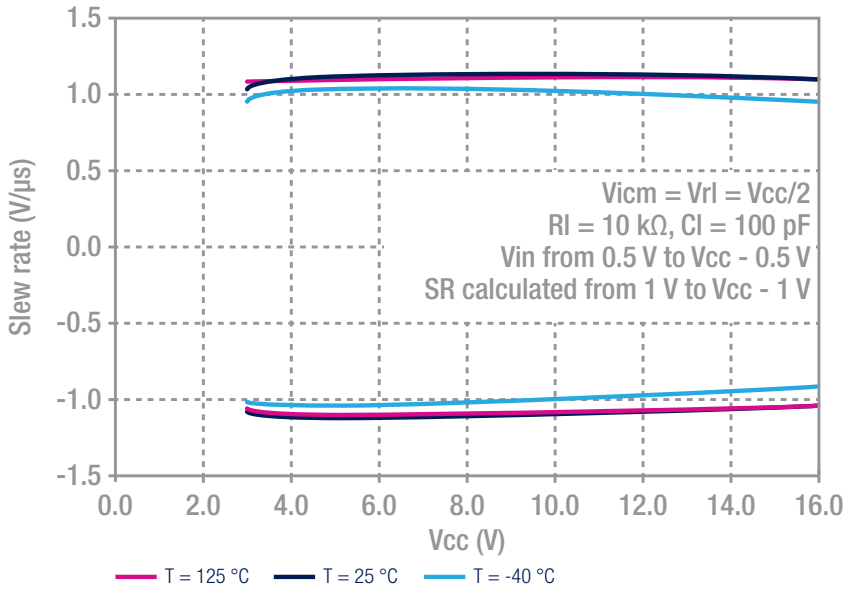
Output current vs. Output voltage and temperature



FEATURES

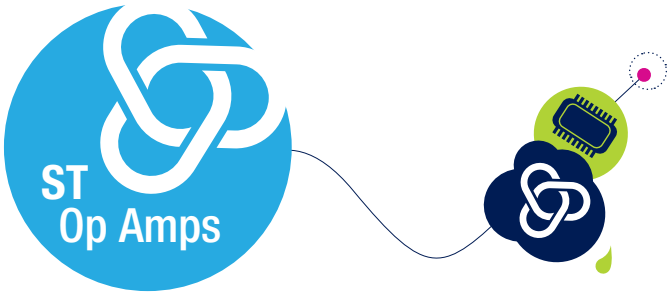
- Low power consumption: 235 µA (typ.) at 5 V
- Supply voltage: 3 to 16 V
- Gain bandwidth product: 900 kHz (typ.)
- Low input bias current: 1 pA (typ.)
- High tolerance to ESD: 4 kV
- 90 mA output current capability under 16 V
- Low offset voltage
  - "A" version: 600 µV (max.)
  - Standard version: 1 mV (max.)

Positive slew rate vs. Supply voltage



Part number	Typ. I_{OUT} (mA)	Min. V_{CC} (V)	Max. V_{CC} (V)	Typ. GBP (MHz)	Typ. SR (V/µs)	Typ. I_{CC} per channel (mA)	Rail to rail		Package Single	Package Dual	Package Quad
							In	Out			
TS921/2/4	80	2.7	12	4	1.3	1	Yes	Yes	SO8 (**)	SO8, TSSOP8	SO8, TSSOP14
TSX561A/2A/4A (*)	90	3	16	0.9	1.1	0.25	Yes	Yes	SOT23-5	MiniSO8	TSSOP14
TSX631A/2A/4A (*)	90	3.3	16	0.2	0.12	0.045	Yes	Yes			TSSOP14
TS507	115	2.7	5.5	1.9	0.6	0.85	Yes	Yes		NA	
TS982	200	2.5	5.5	2.2	0.7	5.5	Yes	Yes	NA	SO8	NA
TSV321A/358A/324A	80	2.5	6	1.4	0.6	0.5	Yes	Yes	SOT23-5	SO8, TSSOP8	SO14, TSSOP14
TS9222/4	80	2.7	12	4	1.3	0.9	Yes	Yes	NA		

(*): New products
(**) Eligible for Automotive-grade qualification

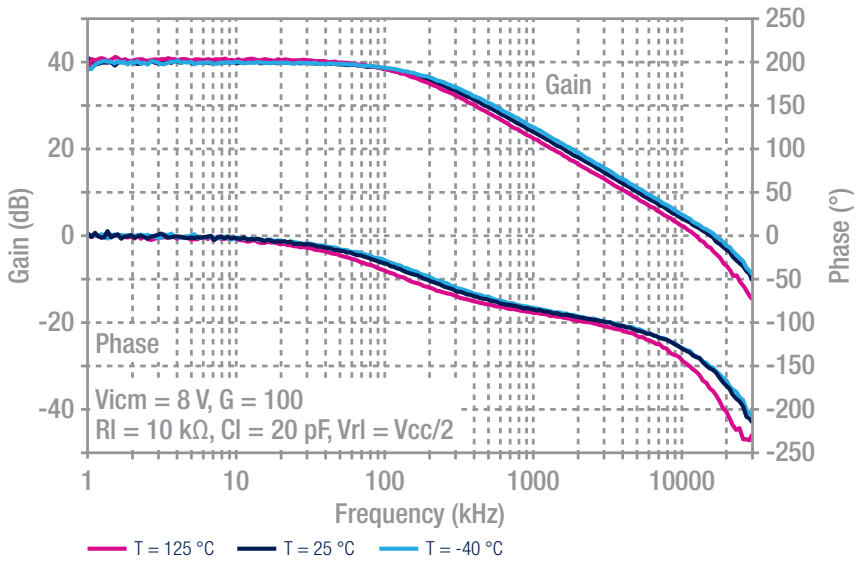


FAST OPERATIONAL AMPLIFIERS

TSX9291: high-speed 16 V rail-to-rail I/O CMOS operational amplifier

The TSX9291 and TSX9292 operational amplifiers offer excellent AC characteristics such as 16 MHz gain bandwidth, 27 V/µs slew rate, and 0.0003% THD+N. They are decompensated amplifiers which are stable when used with a gain higher than 2 or lower than -1. The rail-to-rail input and output capability of these devices operates on a wide supply voltage range of 4 to 16 V. These last two features make the TSX929 series particularly well-adapted for a wide range of applications such as communications, I/V amplifiers for ADCs, and active filtering applications.

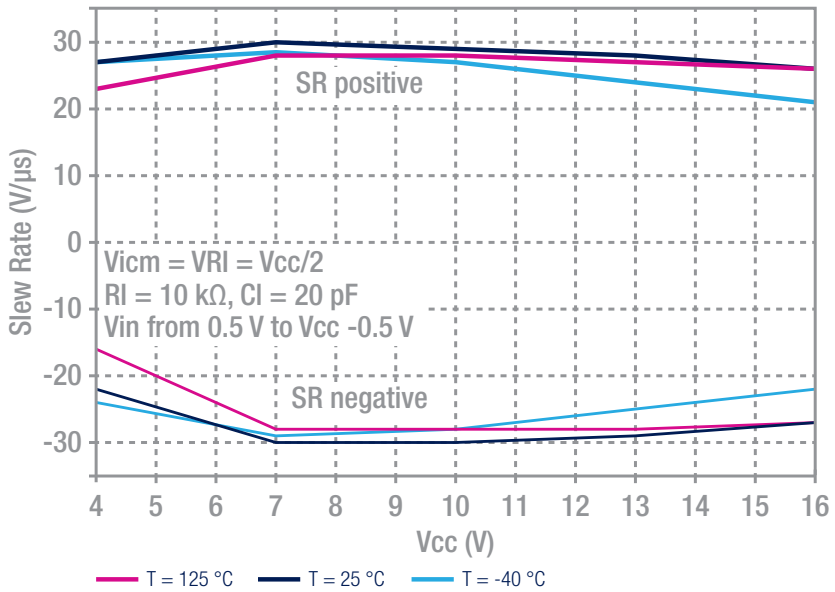
Bode diagram vs. temperature for V_{cc} = 16 V



FEATURES

- Rail-to-rail input and output
- Wide supply voltage: 4 to 16 V
- Gain bandwidth product: 16 MHz (typ.) at 16 V
- Low power consumption: 2.8 mA (typ.) at 16 V
- Slew rate: 27 V/µs
- Stable when used in gain configuration
- Low input bias current: 10 pA (typ.)
- High tolerance to ESD: 4 kV (HBM)

Slew rate vs. Supply voltage and temperature



Part number	Typ. GBP (MHz)	Typ. SR (V/µs)	Min. V_{CC} (V)	Max. V_{CC} (V)	Typ. I_{CC} per channel (mA)	Max. V_{IO} @ 25 °C (µV)	Typ. 1 kHz noise (nV/√Hz)	Typ. I_{OUT} (mA)	Rail to rail		Package Single	Package Dual	Package Quad
									In	Out			
TS921/2A/4A	4	1.3	2.7	12	1	900	9	80	Yes	Yes	SO8 (**), TSSOP8 (**)	SO8, TSSOP8	SO14, TSSOP14
TL071/2/4	4	16	6	36	1.4	3000	15	40	No	No	SO8	SO8	SO14
TSB712 (*)	6	3	2.7	36	1.8	300	12	50	Yes	Yes	NA	SO8, MiniSO8	NA
TSV911A/2A/4A	8	4.5	2.5	5.5	0.78	1500	27	35	Yes	Yes	SOT23-5, SO8	SO8, MiniSO8	SO14, TSSOP14
TSX7191/2 (*)	8.5	2.4	2.7	16	0.66	200	22	70	Yes	Yes	SOT23-5		NA
TSX921/2 (*)	10	17.2	4	16	2.8	4000	16.5	62	Yes	Yes			
TS971/2/4	12	4	2.7	10	2	5000	4	100	No	Yes		SO8, TSSOP8 DFN8 3x3	TSSOP14
MC33078/9	15	7	5	30	2	2000	4.5	30	No	No	NA	SO8	SO14
TS522/4	15	7	5	30	2	850	4.5	33	No	No		SO8 (**)	SO14 (**)
TSX9291/2 (*)	16	26	4	16	2.8	4000	16.5	62	Yes	Yes	SOT23-5	SO8 (**), MiniSO8 (**)	NA
TSV991A/2A/4A	20	10	2.5	5.5	0.82	1500	27	35	Yes	Yes	SOT23-5, SO8	SO8, MiniSO8	SO14, TSSOP14
TSB7192 (*)	20	11	2.7	36	1.8	300	12	50	Yes	Yes		SO8, MiniSO8	NA
TSH80/2	65	115	4.5	12	8.2	10000	11	55	No	Yes		SO8	

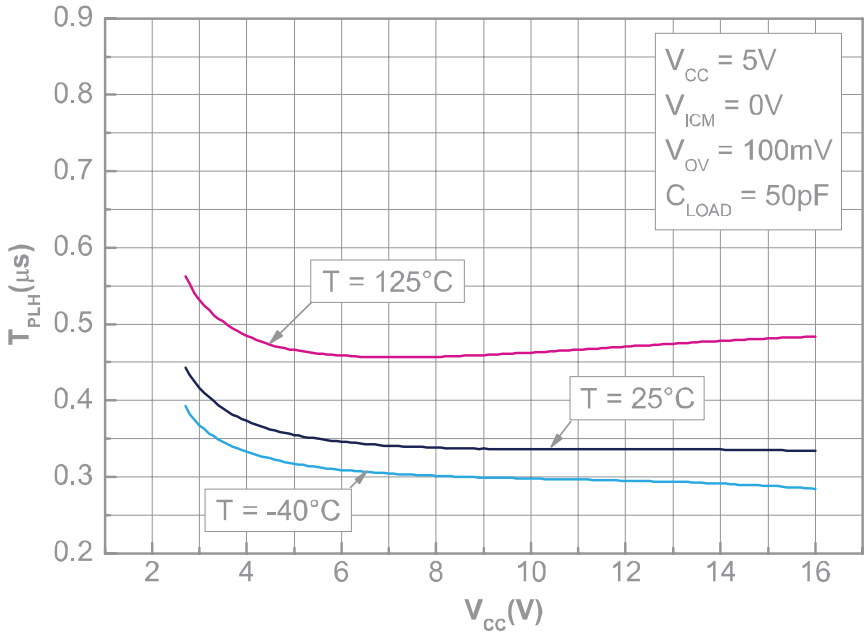
(*): New products
(**) Eligible for Automotive-grade qualification

COMPARATORS

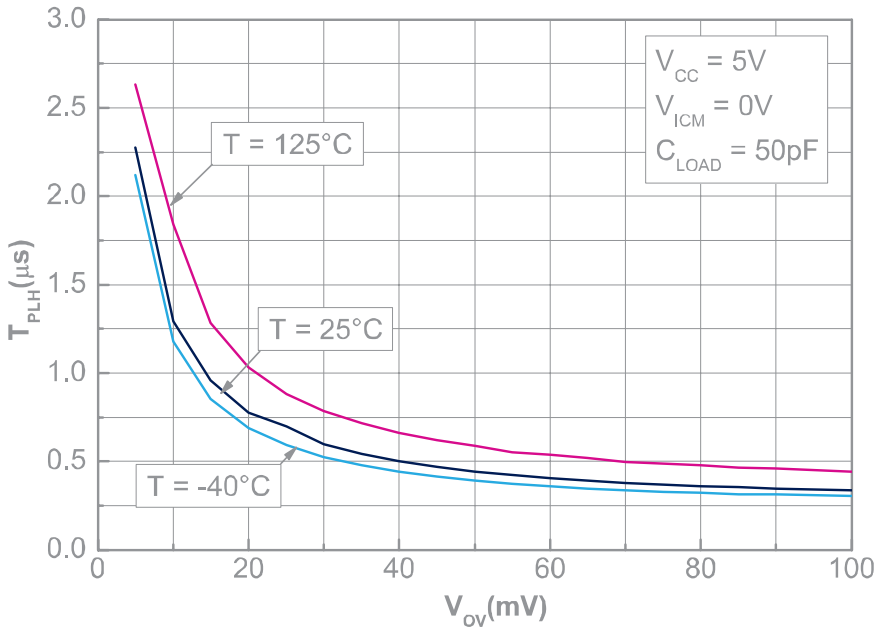
TSX3702/4: Micropower (5 µA) 16V dual/quad CMOS comparator with push-pull output

The TSX3702 and TSX3704 are micropower CMOS dual and quad voltage comparators which exhibit a very low current consumption of 5 µA (typ.) per comparator. Improving on the TS3704, these devices show a lower current consumption, a better input offset voltage, and an enhanced ESD tolerance. The TSX3702 and TSX3704 are fully specified over a wide temperature range and are available in automotive grade for the TSSOP14 and SO8 packages. They are fully compatible with the TS3702 & TS3704 CMOS comparators and are available with similar packages.

Propagation delay vs supply voltage, overdrive = 100 mV



Propagation delay vs input signal overdrive @ V_{cc} = 5V

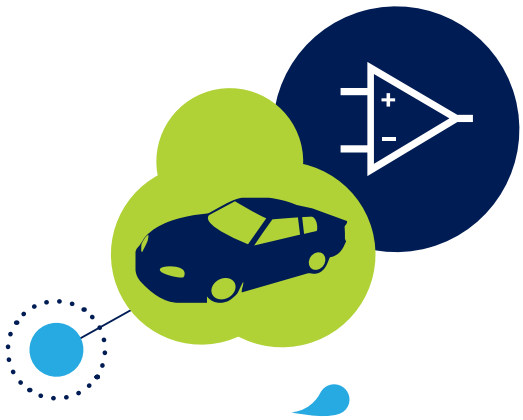


FEATURES

- Low supply current: 5 µA (typ.) per comparator
- Wide single supply range 2.7 to 16 V or dual supplies (±1.35 to ±8 V)
- Extremely low input bias current: 1 pA (typ.)
- Input common-mode voltage range includes ground
- Push-pull output
- High input impedance: 10^{12} Ω (typ.)
- Fast response time: 2.7 µs (typ.) for 5 mV overdrive
- ESD tolerance: 4 kV (HBM), 200 V (MM)

Part number	Typ. I_{cc} per channel (µA)	Min. V_{cc} (V)	Max. V_{cc} (V)	Typ. response time (ns) 100 mV overdrive	Rail to rail In	Output type	Input type	Package Single	Package Dual	Package Quad
TS331/2/4	20	1.6	5	270	Yes	Open drain	BIP	SOT23-5	SO8	SO14, TSSOP14
TSX3702/4 (*)	5	2.7	16	340	GND	Push-pull	CMOS	NA	SO8	TSSOP14
TSX393/339 (*)	5	2.7	16	550	GND	Open drain			NA	
TS3011	470	2.2	5	8	Yes	Push-pull		DFN8 (2x2 mm, wettable flanks), SOT23-5		
TS3021/2	73	1.8	5	42	Yes	Push-pull	BIP	SOT23-5	SO8, MiniSO8	NA
TS391 (*)	200	2	36	300	GND	Open collector		DFN8 (2x2 mm) (**) SOT23-5	NA	

(*): New products
(**) Eligible for Automotive-grade qualification

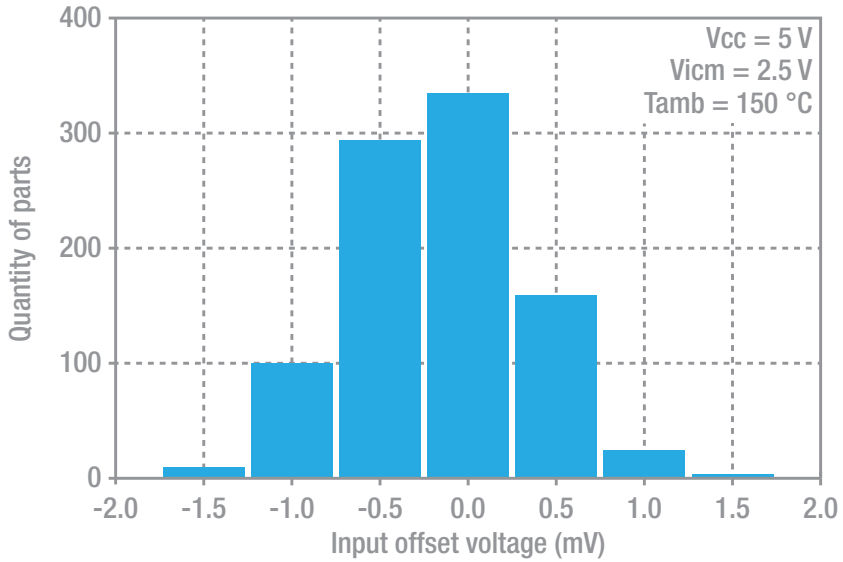


GRADE 0 (150 °C) AMPLIFIERS AND COMPARATORS

TSV912H: Wide-bandwidth (8 MHz), rail to rail input/output 5 V CMOS dual op amps

The TSV912H operational amplifier offers low-voltage operation and rail-to-rail input and output. The device features an excellent speed/power consumption ratio, offering an 8 MHz gain-bandwidth product while consuming only 1.1 mA (maximum) at 5 V. It is unity gain stable and features an ultra-low input bias current. The TSV912H is a high-temperature version of the TSV912, and can operate from -40 to +150 °C with unique characteristics. Its main target applications are automotive, but the device is also ideal for sensor interfaces, battery-supplied and portable applications, as well as active filtering.

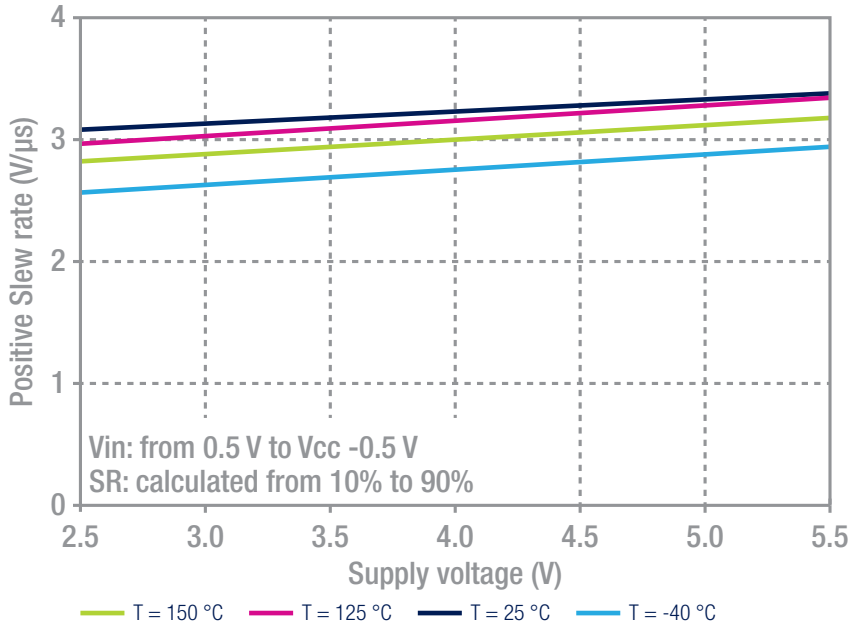
Input offset voltage distribution at T = 150 °C



FEATURES

- Rail-to-rail input and output
- Wide bandwidth
- Low power consumption: 820 µA (typ.)
- High output current: 35 mA
- Supply voltage: 2.5 to 5.5 V
- Low input bias current, 1 pA (typ.)
- Extended temperature range: -40 to + 150 °C
- ESD internal protection ≥ 5 kV (HBM)
- SO8 package

Positive slew rate



MAIN APPLICATIONS

Engine control

In-gearbox modules

Safety-critical systems

High-temperature amplifiers

Part number	Max. operating Temperature (°C)	Typ. GBP (MHz)	Typ. SR (V/µs)	Min. V_{cc} (V)	Max. V_{cc} (V)	Typ. I_{cc} per channel (mA)	Rail to rail		Package	Dual
							In	Out		
LM2904AH/WH	150	1.1	0.6	3	30	0.5	GND	No	TSSOP8, SO8, Mini-SO8	•
TSV912H	150	8	4.5	2.5	5.5	0.82	Yes	Yes	SO8	•

High-temperature comparators

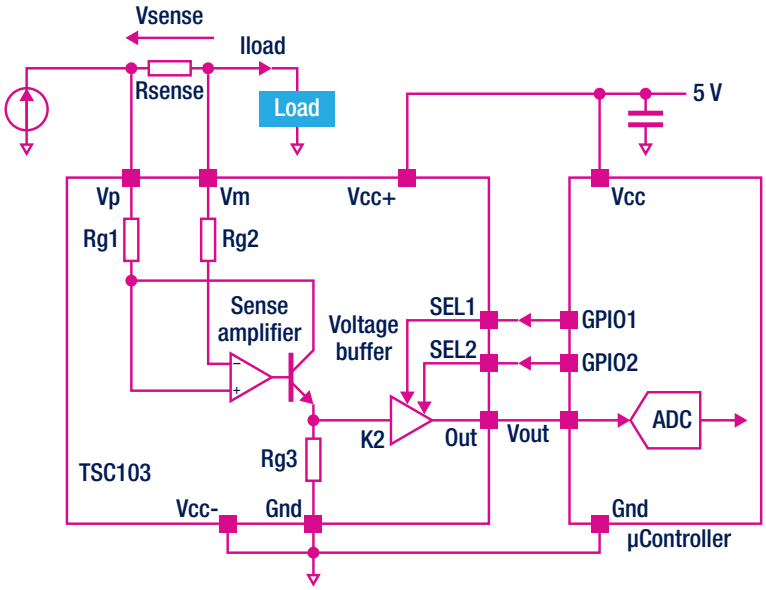
Part number	Max. operating Temperature (°C)	Typ. I_{cc} per channel (µA)	Min. V_{cc} (V)	Max. V_{cc} (V)	Typ. response time (ns) 100 mV overdrive	Rail to rail In	Output type	Package Single	Package Dual	Package Quad
TS3021H	150	73	1.8	5	42	Yes	Push-pull	SOT23-5	NA	NA
LM2903H/1H	150	200	2	36	300	GND	Open collector	NA	SO8, TSSOP8	SO14

Current-sense amplifiers

TSC103: high-voltage, high-side 70 V current-sense amplifier

The TSC103 measures a small differential voltage on a high-side shunt resistor and translates it into a ground-referenced output voltage. The gain is adjustable to four different values from 20 up to 100 V/V by two selection pins. Wide input common-mode voltage range, low quiescent current, and tiny TSSOP8 packaging enable use in a wide variety of applications. The input common-mode and power-supply voltages are independent. The common-mode voltage can range from 2.9 to 70 V in the single-supply configuration or be offset by an adjustable voltage supplied on the V_{CC-} pin in the dual-supply configuration. With a current consumption lower than 360 µA and a virtually null input leakage current in standby mode, the power consumption in applications is minimized.

Common-mode voltage: 2.9 V to 70 V



FEATURES

- Independent supply and input common-mode voltages
- Wide common-mode operating range:
  - 2.9 to 70 V in single-supply configuration
  - -2.1 to 65 V in dual-supply configuration
- Wide common-mode surviving range: -16 to 75 V (reversed battery and load-dump conditions)
- Supply voltage range: 2.7 to 5.5 V in single-supply configuration
- Low current consumption: I_{CC} (max.) = 360 µA
- Pin selectable gain: 20, 25, 50 or 100 V/V
- Buffered output

Part number	Max. I_{CC} (µA)	Common mode operating range (V)		V_{CC} (V)		Voltage gain (V/V)	Operating temperature (°C)		Package
		Min	Max	Min	Max		Min	Max	
Hide-side current sensing									
TSC101	300	2.8	30	4	24	20, 50, 100	-40	+125	SOT23-5
TSC102	420	2.8	30	3.5	5.5	Adjustable	-40	+125	TSSOP8, SO8
TSC1021	300	2.8	30	3.5	5.5	20, 50	-40	+125	TSSOP8
TSC103	360	2.9	70	2.7	5.5	20, 25, 50, 100	-40	+125	TSSOP8, SO8
TSC1031	360	2.9	70	2.7	5.5	50, 100	-40	+125	TSSOP8, SO8

Evaluation Boards

Part number	Description	Documentation Ref.
STEVAL-ISQ007V1	High-side current-sense amplifier demonstration board based on TSC101	AN2727
STEVAL-ISQ010V1	High-side current-sense amplifier demonstration board based on TSC102	DB0982
STEVAL-ISQ013V1	Low-side current sensing based on TS507	AN3222
STEVAL-ISQ014V1	Low-side current sensing based on TSZ121	UM1737

DC-DC converters

CONVERSION FROM CAR BATTERY - SYNCHRONOUS

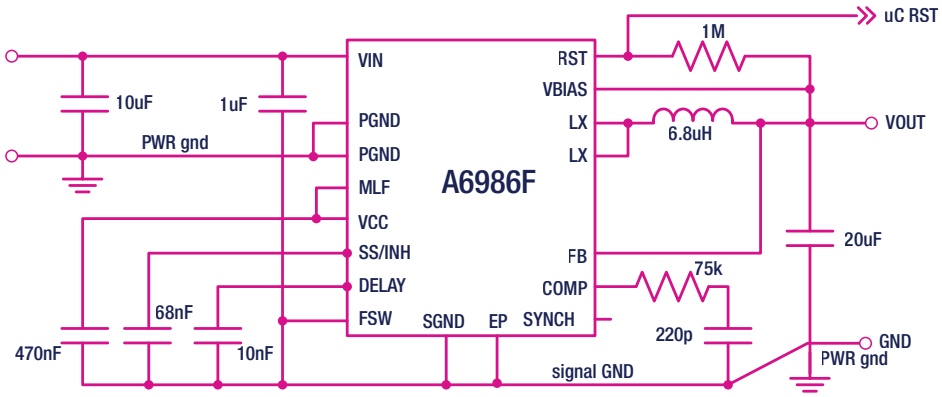
A6985F, A6986F and A6986: 38 V 0.5, 1.5 and 2A synchronous step-down switching regulators with 30 µA quiescent current

The A6985F, A6986F and A6986 are step-down monolithic converters with synchronous rectification capable of 0.5, 1.5 and 2 A output current respectively. The output voltage adjustability ranges from 0.85 V to V_{IN}. The PMOS high side allows for true 100% duty cycle capability and the wide input voltage range meet the cold crank and load dump needs for automotive systems. The "Low Consumption Mode" (LCM) is designed for applications active during car parking, so it maximizes the efficiency at light-load with controlled output voltage ripple. The "Low Noise Mode" (LNM) makes the switching frequency constant and minimizes the output voltage ripple overload current range, meeting low-noise requirements for applications such as car audio systems. The output voltage supervisor manages the reset phase for any digital load (MCU, FPGA). The RST open collector output can also implement output voltage sequencing during the power-up phase. The synchronous rectification, designed for high efficiency at medium to heavy loads, and the high switching frequency capability make the size of the application compact. Pulse-by-pulse current sensing on both power elements implements an effective constant current protection. The thermally performant HTSSOP 16 package allows for a typical junction to ambient resistance of 40 °C/W.

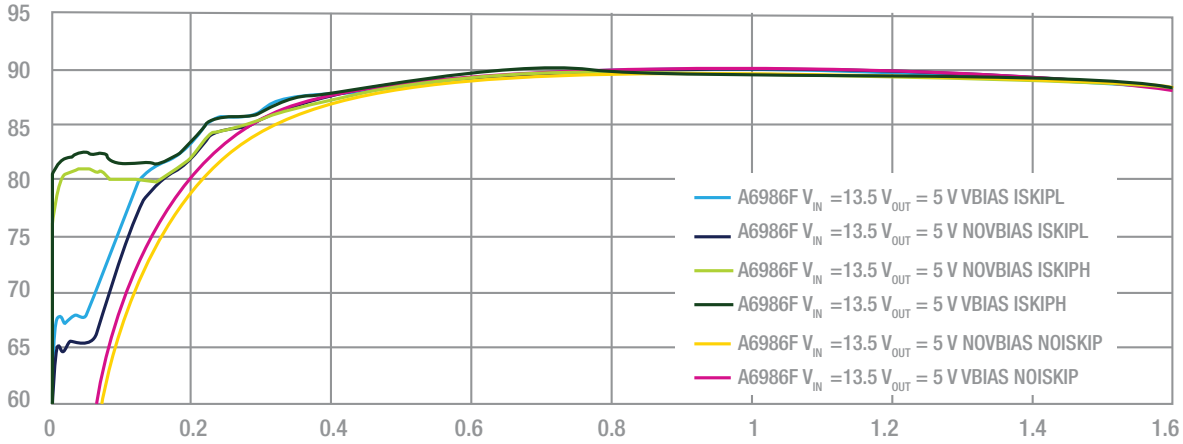
FEATURES

- Input voltage: 4 to 38 V
- Output voltage: Fixed output voltage : 3.3 and 5 V or adjustable from 0.85 V to V_{IN}
- Output current:
  - 2 A for the A6986
  - 1.5 A for the A6986F
  - 0.5 A for the A6985F
- Adjustable switching frequency (250 kHz – 2 MHz) + Sync. capability
- Synchronous rectification
- PMOS high-side for 100 % duty cycle
- Low minimum t_{ON} (80 ns for A6985F/6F/6H)
- Dynamically adjustable skip current level in LCM (A6985F/6F/6H)
- Low Consumption Mode (IQ = 30 µA) or Low Noise Mode
- Inhibit & low shut-down current (8 µA)
- Power Good with adj. delay (embedded voltage supervisor to reset MCU)
- Adjustable soft start
- VBIAS to improve efficiency at light loads
- Ceramic C_{OUT} allowed
- Over-current, over-voltage, and thermal protections
- HTSSOP16 package

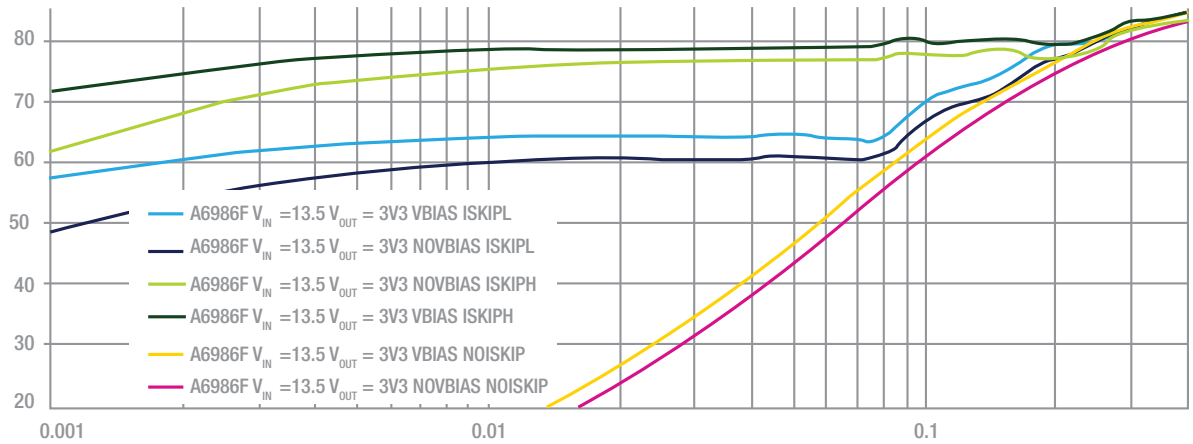
Typical A6986F application diagram



Efficiency curves for A6986F V_{IN} = 13.5 V, V_{OUT} = 5 V, f_{SW} = 500 kHz



Light-load efficiency A6986F5V at different I_{SKIP} V_{IN} = 13.5 V, V_{OUT} = 5 V, f_{SW} = 500 kHz



Part number	V_{IN} (V)	V_{OUT} (V)	I_{OUT} (A)	Frequency	I_Q (µA)	Other features	Package
A6986	4 to 38	Adj. (0.85 - V_{IN})	2	250 kHz to 2 MHz	30	Synchronization, Adj. f_{SW}, Adj. Soft-Start, Adj. reset, LNM/LCM	HTSSOP16
A6986F		Adj. (0.85 - V_{IN}) 5 3.3	1.5	250 kHz to 2 MHz	30	Synchronization, Adj. f_{SW}, Adj. Soft-Start, Adj. reset, LNM/LCM, Adj. I_{SKIP}	HTSSOP16
A6985F		Adj. (0.85 - V_{IN}) 5 3.3	0.5	250 kHz to 2 MHz	30	Synchronization, Adj. f_{SW}, Adj. Soft-Start, Adj. reset, LNM/LCM, Adj. I_{SKIP}	HTSSOP16
A6984	4.5 to 36	Adj. (0.9 - V_{IN}) 3.3	0.4	250 kHz to 600 kHz	80	Adj. fSW, Internal Soft-Start, PGOOD, LNM/LCM	QFN10 (4x4 mm with wettable flanks)

Evaluation Boards

Part number	Description	Documentation Ref.
STEVAL-ISA158V1	38 V, 2 A synchronous step-down switching regulator evaluation board based on A6986	DB2477
STEVAL-ISA185V1	38 V, 0.5 A synchronous step-down switching regulator evaluation board based on A6985F3V3	DB2814
STEVAL-ISA186V1	38 V, 0.5 A synchronous step-down switching regulator evaluation board based on A6985F5V	DB2820
STEVAL-ISA187V1	38 V, 0.5 A synchronous step-down switching regulator evaluation board based on A6985F	DB2823
STEVAL-ISA188V1	38 V, 1.5 A synchronous step-down switching regulator evaluation board based on A6986F3V3	DB2829
STEVAL-ISA189V1	38 V, 1.5 A synchronous step-down switching regulator evaluation board based on A6986F5V	DB2831
STEVAL-ISA190V1	38 V, 1.5 A synchronous step-down switching regulator evaluation board based on A6986F	DB2932
STEVAL-ISA200V1	High-efficiency synchronous step-down regulator based on A6984	DB3249

CONVERSION FROM CAR BATTERY - ASYNCHRONOUS

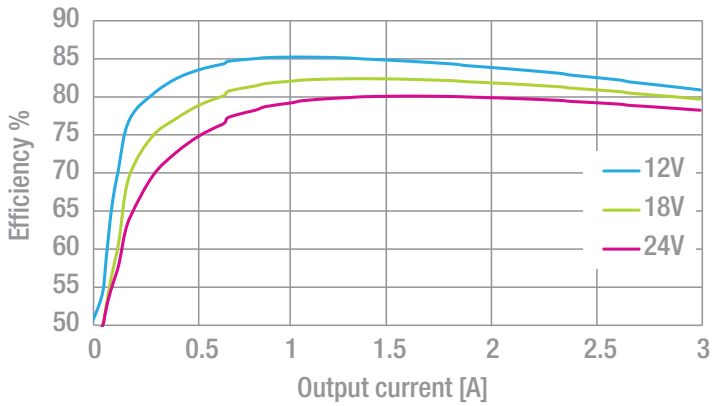
A7985A/6A: 2 A and 3 A step-down switching regulator for automotive applications

The A7986A is a step-down switching regulator with a 3.7 A (min.) current limited embedded power MOSFET, so it is able to deliver up to 3 A current to the load depending on application conditions. The input voltage can range from 4.5 to 38 V, while the output voltage can be set starting from 0.6 V to V_{IN}. Requiring a minimum set of external components, the device includes an internal 250 kHz switching frequency oscillator that can be externally adjusted up to 1 MHz. The HSOP8 package with exposed pad allows for a junction to ambient resistance of 40 °C/W.

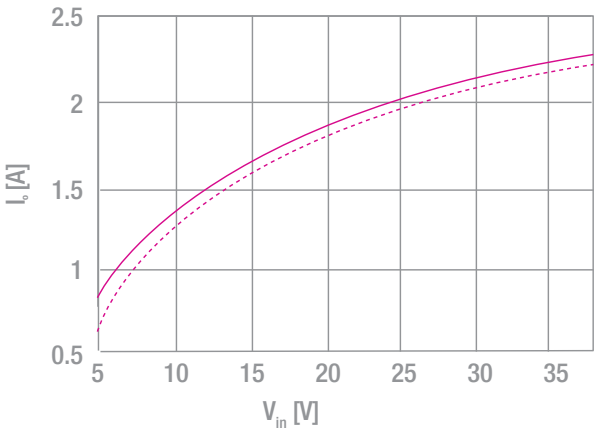
FEATURES

- Output current: 3 A DC
- Input voltage : 4.5 to 38 V
- Output voltage adjustable from 0.6 V
- 250 kHz switching frequency, programmable up to 1 MHz
- Internal soft-start and enable pin
- Low dropout operation: 100% duty cycle
- Voltage feed-forward
- Zero- load current operation
- Over-current and thermal protection
- HSOP8 package

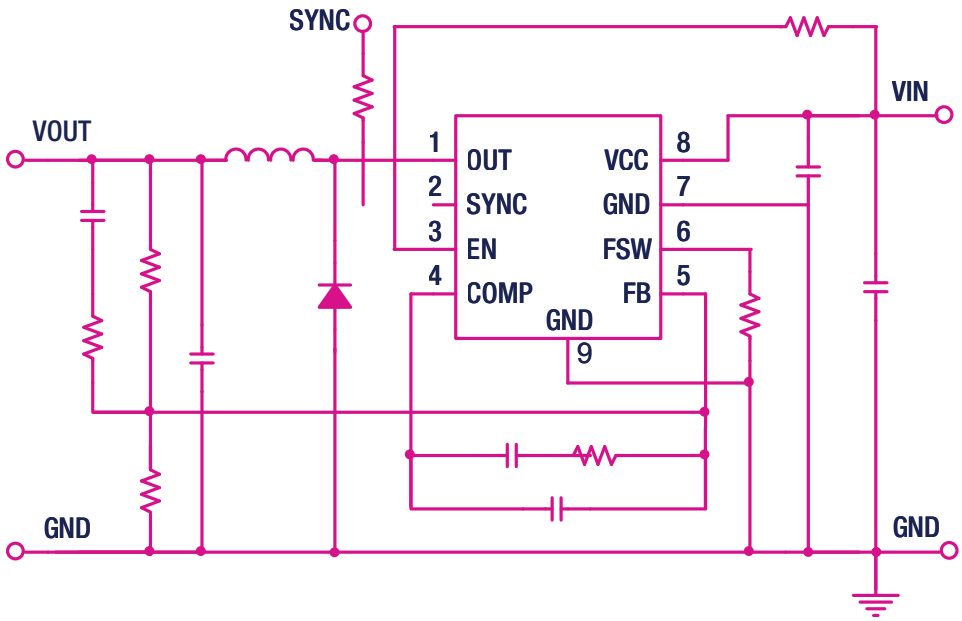
Efficiency vs output current
V_{OUT} = 5 V



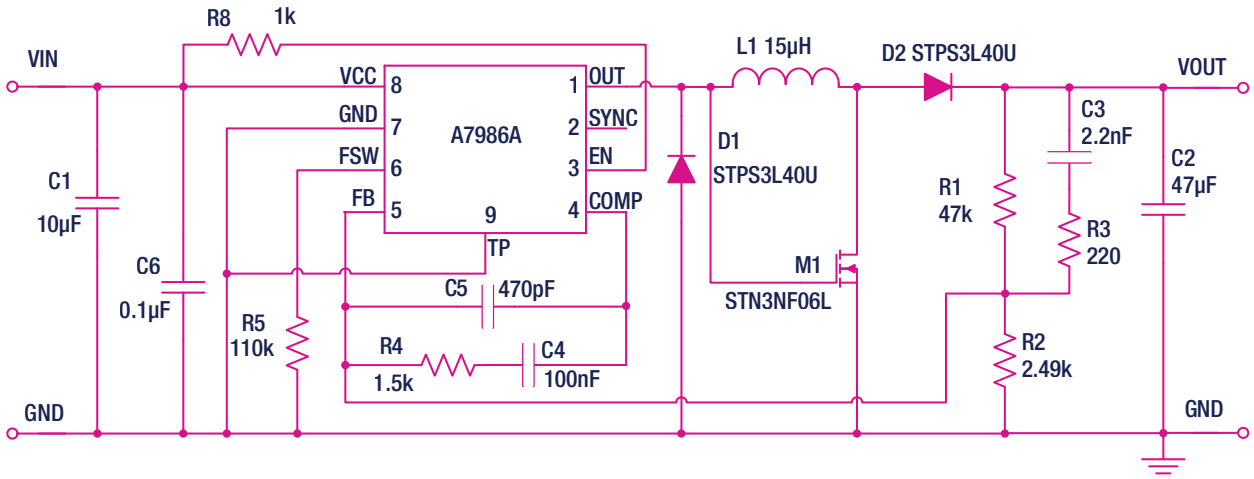
Maximum output current in Buck-Boost topology with A7986A, V_{OUT} = 12 V



A7986A buck topology application circuit



Typical A7986A positive buck-boost topology application



Part number	V_{IN} (V)	V_{OUT} (V)	I_{OUT} (A)	Frequency	Other features	Package
A5970AD	4 to 36	Adj. (1.235 to V_{IN})	1	500 kHz	Synchronization, V_{REF}	SO8
A5970D		Adj. (1.235 to V_{IN})	1	250 kHz	Synchronization, V_{REF}	SO8
A5972D		Adj. (1.235 to V_{IN})	1.5	250 kHz	Synchronization, V_{REF}	SO8
A5973AD		Adj. (1.235 to V_{IN})	1.5	500 kHz	Synchronization, V_{REF}	HSOP8
A5973D		Adj. (1.235 to 35)	2	250 kHz	Synchronization, V_{REF}	HSOP8
B5973D		Adj. (1.235 to 35)	2	250 kHz	Synchronization, V_{REF}, Burn-in	HSOP8
A5974AD		Adj. (1.235 to 35)	2	500 kHz	Synchronization, V_{REF}	HSOP8
A5974D		Adj. (1.235 to 35)	2.5	250 kHz	Synchronization, V_{REF}	HSOP8
A5975AD		Adj. (1.235 to 35)	2.5	500 kHz	Synchronization, V_{REF}	HSOP8
A5975D		Adj. (1.235 to 35)	3	250 kHz	Synchronization, V_{REF}	HSOP8
A6902D	8 to 36	Adj. (1.235 to 35)	1	250 kHz	Synchronization, V_{REF}, constant current with HS Sense	SO8
A7985A	4.5 to 38	Adj. (0.6 to 38)	2	250 kHz to 1 MHz	Synchronization, adj. f_{SW}, Internal Soft-Start	HSOP8
A7986A		Adj. (0.6 to 38)	3	250 kHz to 1 MHz	Synchronization, adj. f_{SW}, Internal Soft-Start	HSOP8
A7987L (*)	4.5 to 61	Adj. (0.8 to V_{IN})	2	250 kHz to 1.5 MHz	Synchronization, adj. f_{SW}, Power Good signal, adj. soft-start, adj. current limit	HTSSOP16
A7987 (*)	4.5 to 61	Adj. (0.8 to V_{IN})	3	250 kHz to 1.5 MHz	Synchronization, adj. f_{SW}, Power Good signal, adj. SS, adj. current limit	HTSSOP16

(*): Products in development

Evaluation Boards

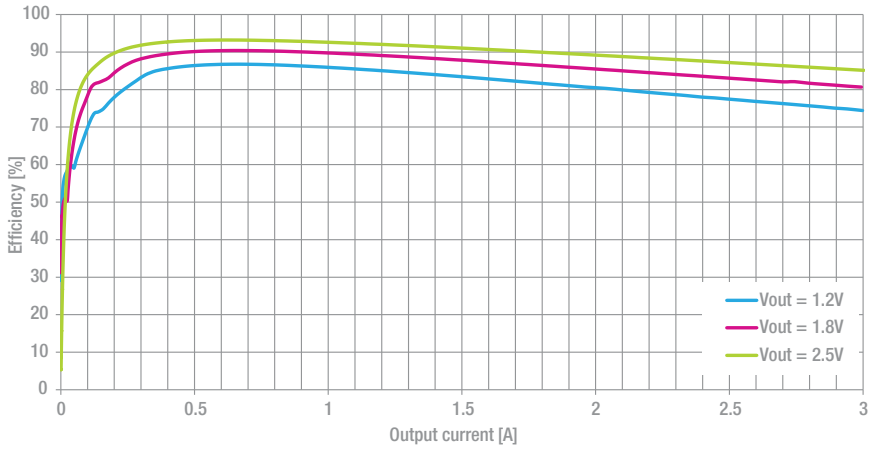
Part number	Description	Documentation Ref.
STEVAL-ISA088V1	1 A step down switching regulator (V_{IN} =4 to 36 V, V_{OUT} = 1.235 V to V_{IN}) based on A5970D	DB1265
STEVAL-ISA089V1	1.5 A step down switching regulator (V_{IN} =4 to 36 V, V_{OUT} = 1.235 V to V_{IN}) based on A5972D	DB1267
STEVAL-ISA106V1	1.5 A step-down switching regulator based on the A5973AD	DB1716
STEVAL-ISA101V1	2 A DC step-down switching regulator with 4 to 36 V input voltage range based on the A5973D	DB1663
STEVAL-ISA098V1	2 A step-down switching demonstration board based on the A7985A in HSOP8 package	DB1621
STEVAL-ISA100V1	3 A step-down switching demonstration board based on the A7986A in HSOP8 package	DB1623
STEVAL-ISA155V1	1 A constant current battery charger evaluation board based on the A6902D	DB2340
STEVAL-ISA198V1	2 A step down DC - DC switching regulator (V_{IN} = 4.5 to 60 V) based on the A7987L	DB3109
STEVAL-ISA152V1	3.3 V / 3 A high efficiency step down DC-DC converter (V_{IN}= 4.5 to 60 V) based on the A7987	DB2108

POST-REGULATION

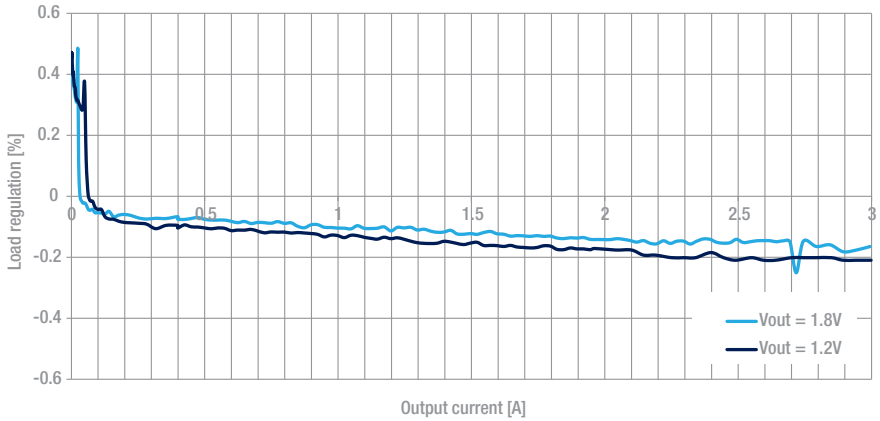
AST1S31HF: Up to 4 V, 3 A step-down 2.3 MHz switching regulator for automotive applications

The AST1S31HF is an internally compensated 2.3 MHz fixed frequency PWM synchronous stepdown regulator. The AST1S31HF operates from 2.8 to 4 V input, while it regulates an output voltage as low as 0.8 V and up to V_{IN}. The AST1S31HF device integrates a 70 mΩ high-side switch and a 55 mΩ synchronous rectifier allowing very high efficiency with very low output voltages. The peak current mode control with internal compensation deliver a very compact solution with a minimum component count. The AST1S31HF is available in a 3 x 3 mm, 8-lead VFDFPN package.

Efficiency curves V_{IN} = 3.3 V



Load regulation V_{IN} = 3.3 V



FEATURES

- Input voltage: 2.8 to 4 V
- Output voltage: 0.8 V to V_{IN}
- Output current: 3 A
- Switching frequency:
  - 1.5 MHz (AST1S31)
  - 2.3 MHz (AST1S31HF)
- Synchronous rectification
- (HS: 60 mΩ; LS: 45 mΩ)
- Internal compensation
- Power Good signal
- Enable pin
- Internal Soft Start
- Ceramic C_{OUT} allowed
- Over-current and thermal protections
- Packages: 8-lead DFN (3x3 mm)

Part number	V_{IN} (V)	V_{OUT} (V)	I_{OUT} (A)	Frequency	Iq	Package	Topology	Other Features
AST1S31	2.8 to 4	0.8 to V_{IN}	3	1.5 MHz	630 µA	DFN8 3 x 3 mm	Monolithic synchronous	Internal comp, Soft-start, Power Good
AST1S31HF	2.8 to 4	0.8 to V_{IN}	3	2.3 MHz	630 µA	DFN8 3 x 3 mm	Monolithic synchronous	Internal comp, Soft-start, Power Good
A6727	5 to 12	0.8 to V_{IN}	> 6	300 kHz	6 mA	SO8	Synchronous controller	Adj. OCB

Evaluation Boards

Part number	Description	Documentation Ref.
STEVAL-ISA069V1	3 A / 1.5 MHz step-down synchronous switching regulator based on the AST1S31 in 3x3 mm DFN package	DB1572
STEVAL-ISA160V1	3 A / 2.3 MHz step-down synchronous switching regulator based on the AST1S31HF in 3x3 mm DFN package	DB2858

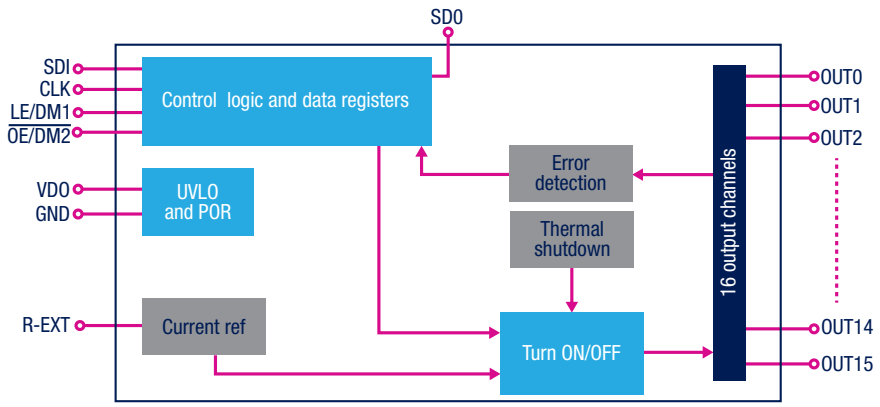
LED Drivers

LED ARRAY DRIVERS

STAP16DPS05: 16-bit constant LED driver with output error detection and auto power-saving

The STAP16DPS05 is a monolithic, low voltage, low current power 16-bit shift register designed for LED panel displays. The device contains a 16-bit serial-in, parallel-out shift register that feeds a 16-bit D-type storage register. In the output stage, sixteen regulated current sources are designed to provide 5 to 100 mA constant current to drive the LEDs.

STAP16DPS05 block schematic



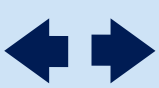
FEATURES

- Power supply voltage: 3 to 5.5 V
- 16 constant current output channels
- Adjustable output current through external resistor
- Short and open output error detection
- Serial data In/parallel data OUT
- 3.3 V micro driver-able
- Output current: 5 to 100 mA
- Auto power-saving
- Max. clock frequency: 30 MHz
- 20 V current generator rated voltage
- Thermal shutdown for over temperature protection
- ESD protection: 2.0 kV (HBM)

MAIN APPLICATIONS

Car exterior / interior lighting

Car rear light



Clusters/ Instrumentation

Dashboard and Infotainment backlighting

Part number	Nb. of channels	V_{IN} (V)	V_{OUT} (V)	LED current per channel (mA)	Special features	Auto Power saving	Package
ALED1262XT	12	5.5 to 38	0 to 19	6 – 60	12-channel LED drivers with open detection, 7-bit local dimming brightness control, configurable bus-driven and stand-alone operation mode	No	TSSOP24 Exposed pad
ALED1642GWXTTR	16	3 to 5.5	0 to 20	3 – 40	7-bit current programmability, 12/16-bit grayscale control for brightness adjustment, current setting through external resistor, programmable turn on/off, auto wake-up mode, open/shorted LED & temperature fault detection modes. Up to 30 MHz (max.) clock frequency	Yes	TSSOP14 Exposed pad
ALED8102S	8	3 to 5.5	0 to 20	5 – 100	8-channel LED drivers with constant current output channels up to 100 mA, controlled by four switch inputs for local dimming and output enable pin for global dimming.	No	TSSOP16
STAP08DP05XTTR	8	3 to 5.5	0 to 20	5 – 100	Short, open line & thermal shutdown protections. Output current adjustment through external resistor. Serial data In. Up to 30 MHz (max.) clock frequency	No	TSSOP16 Exposed PAD
STAP16DPPS05XTTR	16	3 to 5.5	0 to 20	3 - 40		Yes	TSSOP24 Exposed pad
STAP16DPS05XTTR	16	3 to 5.5	0 to 20	5 – 100		Yes	

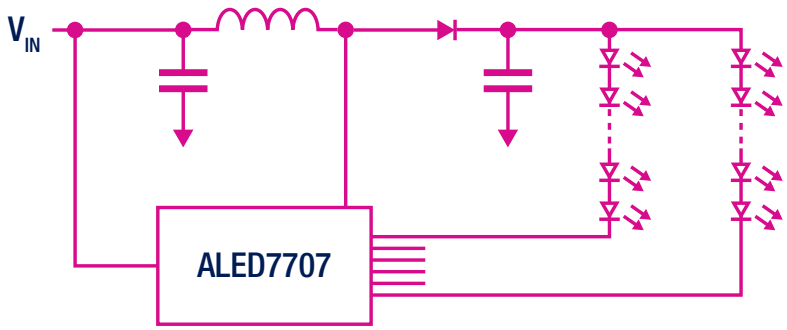
Evaluation Boards

Part number	Description	Documentation Ref.
STEVAL-LLL002V1	LED driver for automotive rear lights with animations based on ALED1262 and STM8A	DB3472
STEVAL-ILL073V1	RGB LED driver for automotive lighting based on ALED1642GW and STM8A	UM2017
STEVAL-ILL058V1	High-brightness LED array driver with diagnostics based on STAP08DP05 and STM8AF	DB2222
STEVAL-ILL060V1	High-brightness LED array driver with diagnostics based on the STAP16DPPS05 and STM8A	ULM1774
STEVAL-ILL059V1	High-brightness LED array driver with diagnostics based on the STAP16DPS05 and STM8A	DB2220

LED ROW DRIVERS

ALED7707: 6-row 85 mA LED driver with boost regulator for LCD panel backlights

The ALED7707 consists of an automotive-grade (AEC Q100 compliant) monolithic boost converter and six controlled current generators (rows) specifically designed to supply LED arrays used in the backlighting of LCD panels. The device can manage an output voltage up to 36 V (i.e.: 10 white LEDs per row). The generators can be externally programmed to sink up to 85 mA and can be dimmed via a PWM signal (1% dimming duty cycle at 1 kHz can be managed). The device can detect and manage the open and shorted LED faults and to leave unused rows floating. Basic protections (output overvoltage, internal MOSFET overcurrent and thermal shutdown) are provided.



FEATURES

- Rail-to-rail input and output
- Wide supply voltage: 4 to 16 V
- Gain bandwidth product: 16 MHz (typ.) at 16 V
- Low power consumption: 2.8 mA (typ.) at 16 V
- Slew rate: 27 V/µs
- Stable when used in gain configuration
- Low input bias current: 10 pA (typ.)
- High tolerance to ESD: 4 kV (HBM)

MAIN APPLICATIONS

Car exterior / interior lighting

Dashboard and Infotainment backlighting

Part number	Nb. of rows	V_{IN} (V)	Max V_{OUT} (V)	Max LED current per row	Special features	Switching frequency	Package
ALED6001	1	5.5 to 36	60	Defined by system design	PWM-dimming, integrated boost controller, buck-boost & SEPIC topologies supported, shutdown current < 10 µA, external synchronization for multi-device applications, overcurrent protection, thermal shutdown with auto restart, output short detection, LED constant current loop control, LED overcurrent protection	100 kHz to 1 MHz	TSSOP16 Exposed pad
ALED7707	6	4.55 to 36	36	85 mA	External synchronization for multi-device applications, pulse skip power-saving mode at light load, programmable soft-start, programmable OVP protection, thermal shutdown, row disable option, less than 10 µs (min.) dimming on-time, ±3% current matching between rows, LED failure (open and short-circuit) detection.	250 kHz to 1 MHz	QFN24 (5x5 mm)

Evaluation Boards

Part number	Special features	Documentation Ref.
STEVAL-ILL048V1	Single-channel LED driver for day-time running lights (DTRL) and front lights based on ALED6001 and STM32F103C6T6	DB1900 AN4549
STEVAL-ILL049V12	LED driver based on the LED6001 + 9-LED board with NTC sensor	DB2205
STEVAL-ILL072V1	Single-channel, 1 A LED driver with boost controller for interior/exterior lights based on the ALED6001	DB2608
STEVAL-ILL067V1	Six-channel ALED7707-based LED driver with embedded boost converter for automotive interior lighting and TFT backlighting	DB2607

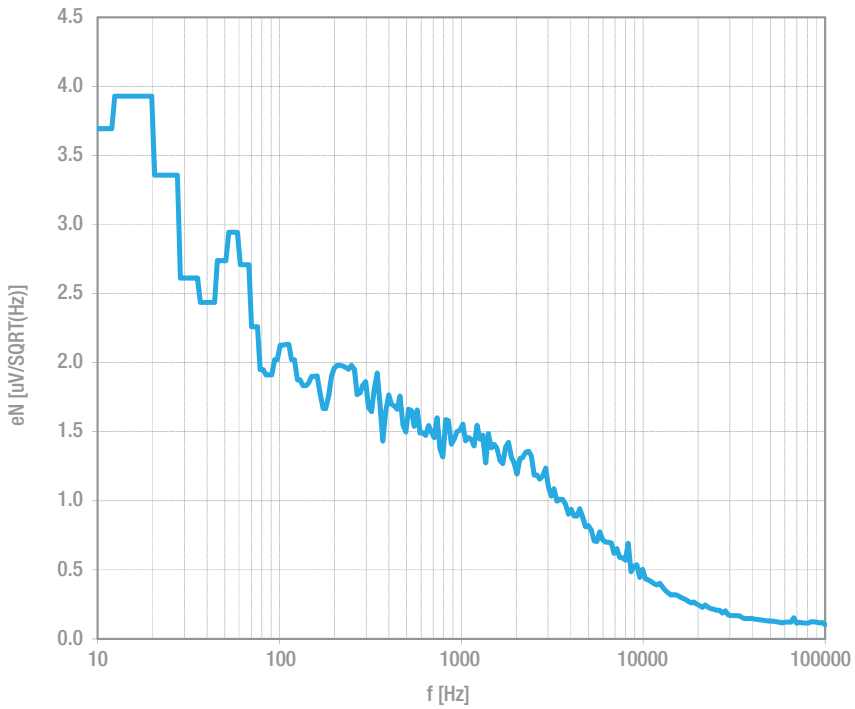
Linear Regulators (LDO)

LDO CONVERSION FROM CAR BATTERIES

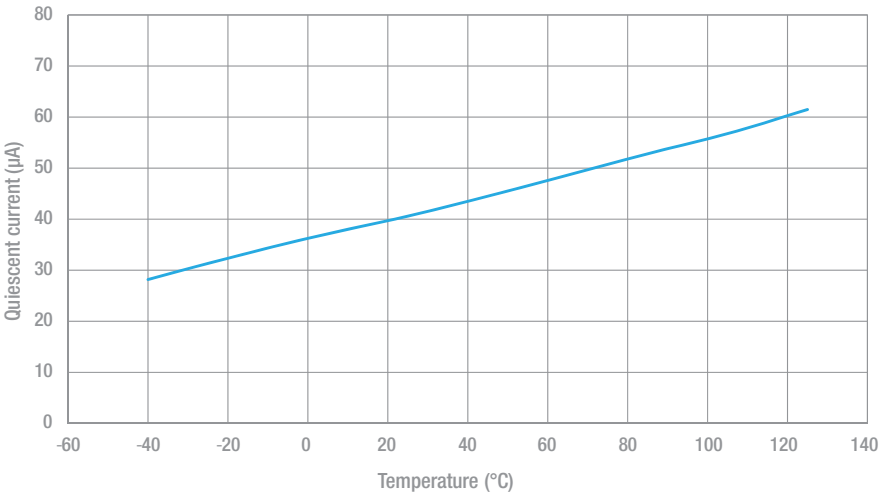
LDO40L: 38 V low-dropout regulator with 45 µA quiescent current

The LDO40L is a 400 mA LDO regulator designed for use in severe automotive environments. Its low quiescent current (45 µA) makes it suitable for applications permanently connected to the car battery. This feature is especially critical when electronic modules remain in active mode when the ignition is switched off. The LDO40L embeds protection functions, such as current limit and thermal shutdown, and is available in DFN6 (3x3 mm) with wettable flanks and PPAK packages.

Output noise voltage vs. frequency
V_{OUT} = 5 V



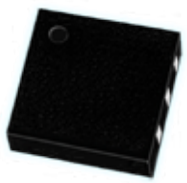
Quiescent current vs temperature
V_{IN} = 38 V, I_{OUT} = 0 mA



FEATURES

- Low quiescent current: 45 µA (typ.) at no load
- Wide input voltage operating range: 5 to 38 V
- Output current: up to 400 mA
- Output voltage options: Adj, 3.3 V, 5.0 V
- High PSRR: 73 dB @ 1 kHz
- Very low noise: 20 µVrms/VOUT
- Protection features: Current limitation (OCP) and thermal shutdown (OTP)
- Operating temperature range : -40 to +125 °C
- Packages: PPAK and DFN6 (3x3 mm with wettable flanks)

PPAK



DFN6 (wettable flank)

Part number	Op V_{IN} (V)	AMR V_{IN} (V)	V_{OUT} (V)	I_{OUT} (mA)	Drop-out voltage	I_Q	PSRR @ 1 kHz (dB)	Output noise 10 Hz to 100 kHz	Package	Other features
LM2931	3.25 to 26	-15 (-50 t<100ms) to 40 (60 t<100ms)	3.3 or 5	100	90 mV at 10 mA	2.5 mA	80	330 µV	DPAK	Load dump protection up to 60 V. Reverse battery protection up to -50 V. OCP, OTP.
LFXX	2.5 to 16	40	1.8, 2.5, 3.3, 5.0, 8.0, 8.5	500	400 mV at 500 mA	500 µA	77	50 µV	DPAK and PPAK	Inhibit pin. Only 2.2 µF for stability. Input OVP, OCP and OTP
LD040L (*)	5 to 38	40	3.3, 5, adj (2.5 to 11)	400	140 mV at 400 mA	45 µA	73	20 µV	PPAK and DFN6 (3x3 mm with wettable flanks)	Enable pin, low quiescent current, low noise. OCP and OTP.
LD040M (*)	5 to 38	40	3.3, 5, adj (2.5 to 11)	800	320 mV at 800 mA	45 µA	73	20 µV	PPAK and DFN6 (3x3 mm with wettable flanks)	Enable pin, I quiescent current, low noise. OCP and OTP.

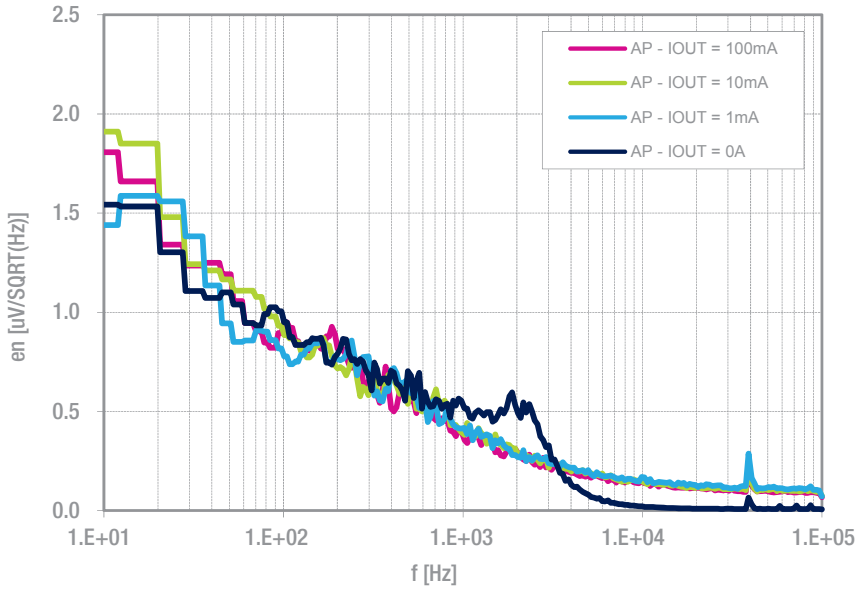
(*): Products in development

LDO POST-REGULATION

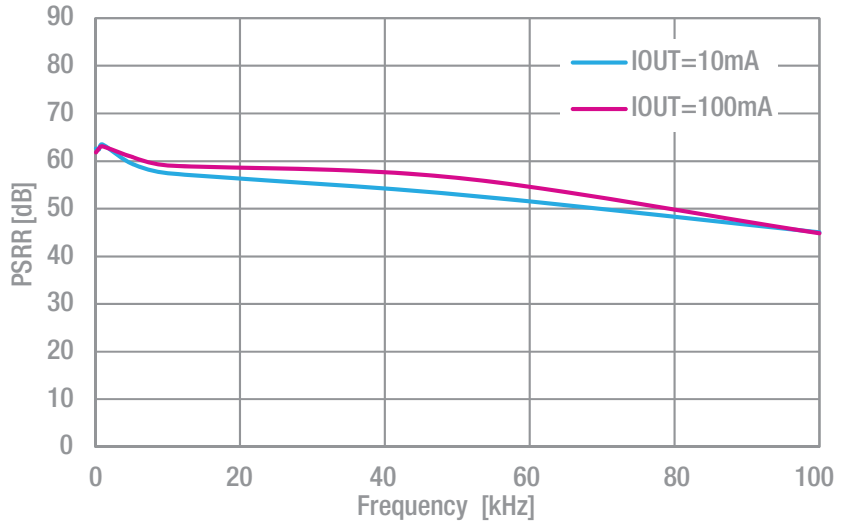
LD39100: 1 A small package and low quiescent current voltage regulator for all needs

The LD39100 provides 1 A maximum current with an input voltage range from 1.5 to 5.5 V and a typical dropout voltage of 200 mV. The device is stable with ceramic capacitors on the input and output. The ultra-low dropout voltage, low quiescent current and low-noise features make it the perfect choice for secondary regulation in automotive environments. Power supply rejection is 65 dB at low frequency and starts to roll off at 10 kHz. The enable logic control function puts the LD39100 in shutdown mode, allowing a total current consumption lower than 1 µA. The device also includes short-circuit constant current limiting and thermal protection. The LD39100 is available in a DFN6 (3x3 mm) package with wettable flanks.

Output noise voltage vs. frequency

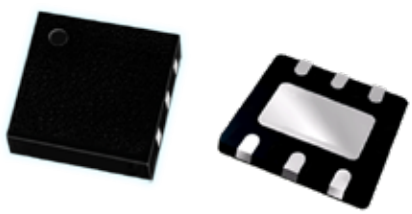


Supply voltage rejection vs freq. (V_{OUT} = 2.5 V)



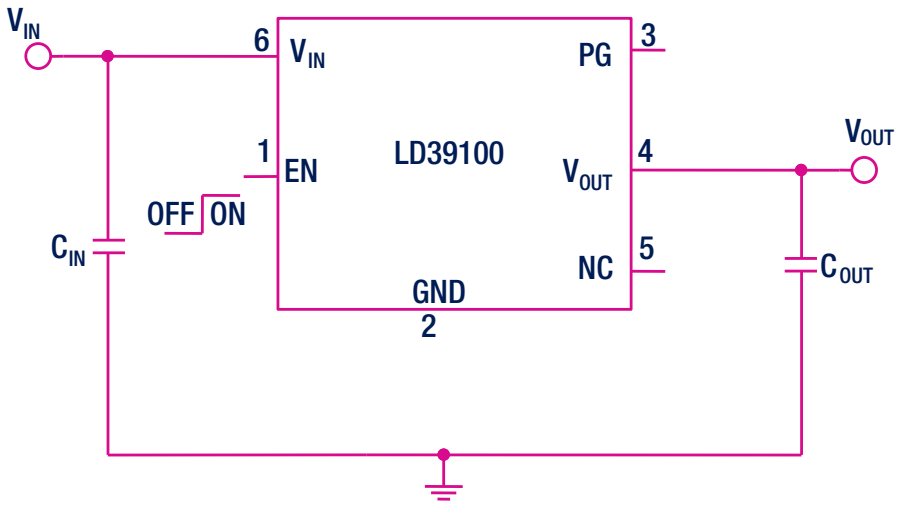
FEATURES

- Input voltage: 1.5 to 5.5 V
- Ultra-low dropout voltage (200 mV (typ.) at 1 A load)
- Very low-noise with no bypass capacitor (30 µVrms at V_{OUT} = 0.8 V)
- Very low quiescent current (20 µA (typ.) at no load, 200 µA (typ.) at 1 A load, 1 µA (max.) in off mode)
- Output voltage tolerance: ±2.0 % at 25 °C
- 1 A guaranteed output current
- Power good signal
- Stable with ceramic capacitors (C_{OUT}) = 1 µF
- Internal current (OCP) and thermal limit (OTP)
- ESD protection: 4 kV (HBM)
- DFN6 (3x3 mm) package

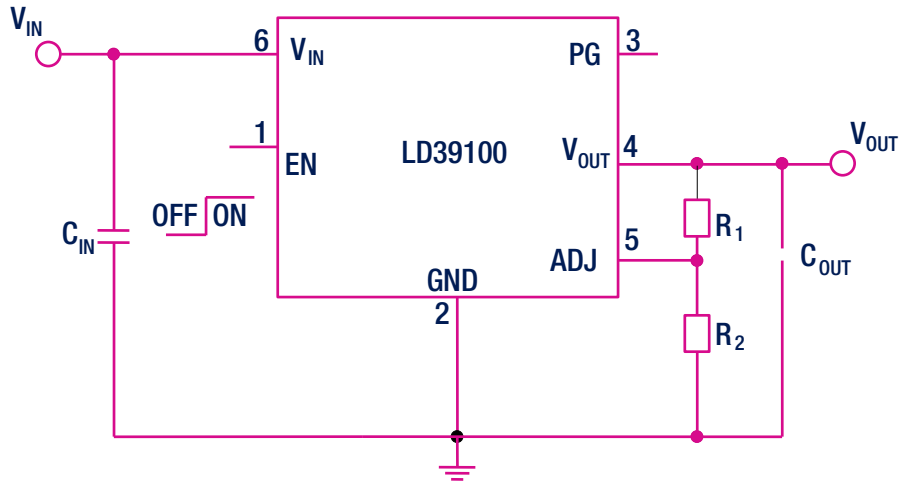


DFN6 (3x3 mm)

LD39100 application diagram (fixed version)



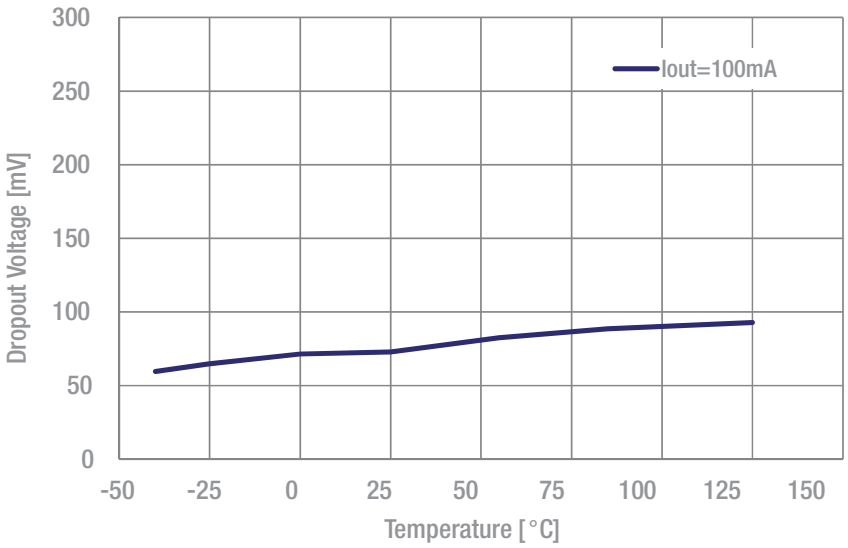
LD39100 application diagram (adjustable version)



LDK130: 300 mA SOT-23 cost effective, low noise voltage regulator

The LDK130 low-dropout voltage regulator provides 300 mA of maximum current from an input supply voltage in the range of 1.9 to 5.5 V, with a typical dropout voltage of 100 mV. It is stabilized with a ceramic capacitor on the output.
The very low-dropout voltage, low quiescent current and low noise features make it suitable for automotive post-regulation. An enable logic control function puts the LDK130 in shutdown mode allowing a total current consumption lower than 1 µA. The device also includes short-circuit constant current limiting and thermal protection. The SOT23 package is the perfect choice for a cost-sensitive applications.

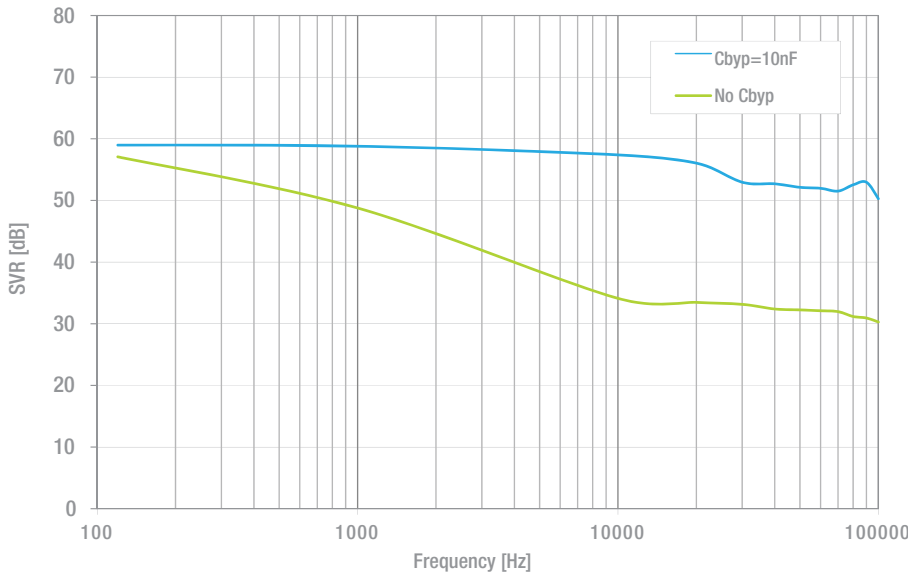
Dropout voltage vs. temperature



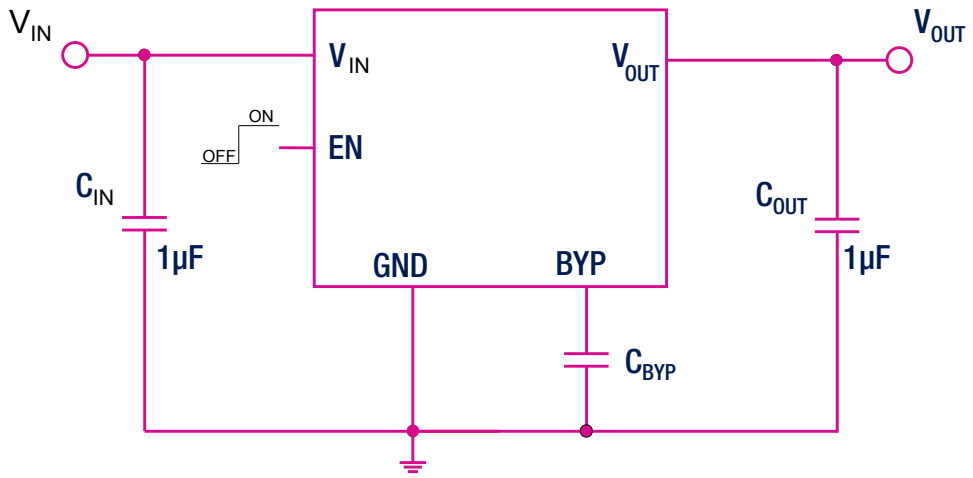
FEATURES

- Input voltage: 1.9 to 5.5 V
- Very-low dropout voltage: 100 mV (typ.) at 100 mA load
- Low quiescent current: 30 µA (typ.) at no load, 1 µA (max.) in off mode
- Low-noise
- Output voltage tolerance: ±2.0 % at 25 °C
- 300 mA guaranteed output current
- Stable with ceramic capacitors (C_{OUT}) = 1 µF
- Internal current (OCP) and thermal limit (OTP)
- SOT23-5L package

Supply voltage rejection vs freq. V_{OUT} = 2.5 V



LDK130 typical application diagram



Part number	Operating V_{IN} (V)	AMR V_{IN} (V)	V_{OUT} (V)	I_{OUT}	Drop-out voltage	Iq	PSRR @1kHz [dB]	Output noise 10Hz – 100kHz	Package	Other features
L4931	2 to 20	20	2.7 or 3.3	250 mA	400 mV at 250 mA	600 µA	71	50 µV	SO8	Inhibit pin, 2.2µF small output capacitor. OCP and OTP.
LD1086	2.85 to 30	30	Adj. from 1.25	1.5 A	1.3 V at 1.5 A	5 mA	68	0.003% of V_{OUT}	TO-220 and DPAK	±1% output tolerance @ 25°C. ±2% tolerance full temp range. OCP and OTP.
LDS3985	2.5 to 6	6	Fixed: 3.3, 1.8	300 mA	150 mV at 300 mA	85 µA	55	30 µV	DFN6 (3x3 mm)	Enable pin. OCP and OTP.
LD39100	1.5 to 5.5	7	Adj. from 0.8 Fixed: 1.2, 1.8, 3.3(*)	1 A	200 mV at 1 A	25 µA	70	30 µV	DFN6 (3x3 mm) Wettable flanks	Enable pin, Power Good output. OCP and OTP.
LDK130	1.9 to 5.5	7	Fixed: 1.5, 1.8, 2.8, 3.3. (*)	300 mA	100 mV at 100 mA	35 µA	60	Fixed: 50 µV Adj: 130 µV	SOT23-5L	Enable pin. OCP and OTP.
LD39130S (**)	1.4 to 5.5	7	Adj. from 0.8 Fixed: 2.5, 3.3 (*)	300 mA	300 mV at 300 mA	1 µA	70	38 µV	DFN6 (2x2 mm) Wettable flanks	Enable pin, Green mode for ultra-low consumption. 2% output precision at 3T. OCP and OTP.
LD59150 (**)	0.8 to 5.5 & 2.7 to 5.5	6	Adj. from 0.8 to 3.6	1.5 A	65 mV at 1.5 A	1 mA	60	25 µV	DFN10 (3x3 mm) Wettable flanks	Dual supply pin, enable pin, programmable soft-start, power good output. OCP and OTP.
LDLN050 (**)	2.7 to 6.5	7	Fixed: 3.3(*)	500 mA	280 at 500 mA	45 µA	68	11 µV	DFN8 (3x3 mm) Wettable flanks	Enable pin, Ultra low noise. OCP and OTP.

(*): Other fixed versions may be available upon request.
(**): Products in development

Logic ICs

The Automotive-grade logic ICs offer a range of products including counters/encoders/decoders, gates, flip-flop/registers and buffer drivers, that fulfill all test and quality requirements for AEC-Q100 qualification in both highly reliable standard SO and TSSOP packages.

Commercial Product	Function	Packages
74LCX125YMTR **74LCX125YTTR**	Quad Bus Buffer (3-State)	SO14, TSSOP14
74VHC14YMTR **74VHC14YTTR**	Hex Schmitt Inverter	SO14, TSSOP14
74LCX07YMTR **74LCX07YTTR**	Hex Buffer	SO14, TSSOP14
74LCX00YMTR **74LCX00YTTR**	Quad 2-Input NAND Gate	SO14, TSSOP14
HCF40106YM013TR	Hex Schmitt Trigger	SO14
HCF4010YM013TR	Hex Buffer/Converters non Inverting	SO16
HCF4013YM013TR	Dual D Flip-Flop	SO14
HCF4021YM013TR	8-Stage Static Shift Register	SO16
HCF4051YM013TR	Single 8-channel Analog Mux/Demux	SO16
HCF4060YM013TR	14-stage counter/Driver AND Oscillator	SO16
HCF4069YUM013TR	Hex Inverter	SO14
HCF4070YM013TR	Quad Exclusive OR Gate	SO14
HCF4093YM013TR	Quad 2-Input NAND Schmitt Trigger	SO14
HCF4094YM013TR	8-Stage Shift-AND-Store Bus Register	SO16
M74HC4851YRM13TR **M74HC4851YTTR**	Single 8-channel Analog Mux/Demux	SO16, TSSOP16
M74HC4852YRM13TR	Dual 4-channel Analog Mux/Demux	SO16
M74HC04YRM13TR **M74HC04YTTR**	Hex Inverter	SO14, TSSOP14
M74HC08YRM13TR **M74HC08YTTR**	Quad 2-Input AND Gate	SO14, TSSOP14
M74HC126YRM13TR **M74HC126YTTR**	Quad Bus Buffer (3-State)	SO14, TSSOP14
M74HC132YRM13TR **M74HC132YTTR**	Quad 2-Input Schmitt NAND Gate	SO14, TSSOP14
M74HC14YRM13TR **M74HC14YTTR**	Hex Schmitt Inverter	SO14, TSSOP14
M74HC151YRM13TR **M74HC151YTTR**	8-channel Multiplexer	SO16, TSSOP16
M74HC259YRM13TR **M74HC259YTTR**	8-bit Addressable Latch	SO16, TSSOP16
M74HC280YRM13TR	9-bit Parity Generator	SO14
M74HC4060YRM13TR **M74HC4060YTTR**	14-stage Binary Counter/Oscillator	SO16, TSSOP16
M74HC4094YRM13TR **M74HC4094YTTR**	8-bit SIPO Shift Register Latch (3-State)	SO16, TSSOP16
M74HC595YRM13TR **M74HC595YTTR**	8-bit Shift Register Output Latch (3-State)	SO16, TSSOP16
M74HC365YRM13TR **M74HC365YTTR**	Hex Bus Buffer (3-State)	SO16, TSSOP16

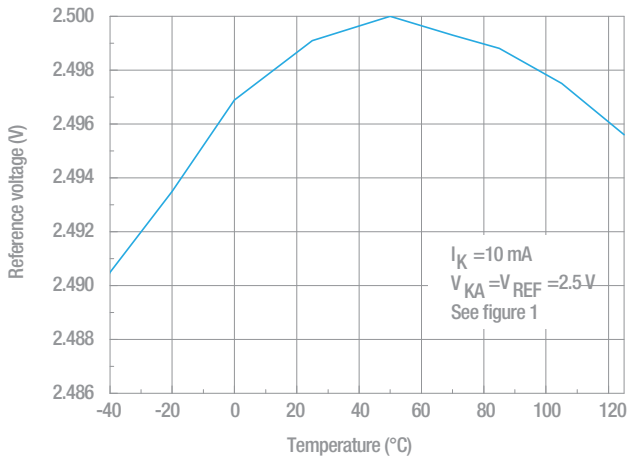
Voltage references

SHUNT VOLTAGE REFERENCES

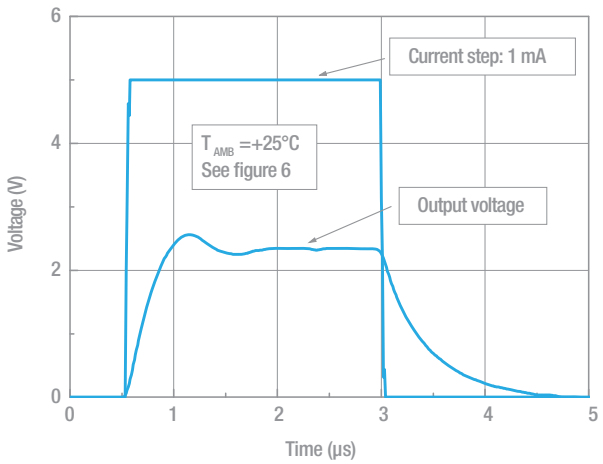
TL1431: adjustable precision voltage reference

The TL1431 is a programmable shunt voltage reference with guaranteed temperature stability over the entire operating temperature range. The output voltage may be set to any value between 2.5 and 36 V with two external resistors. The TL1431 operates with a wide current range from 1 to 100 mA with a typical dynamic impedance of 0.2 Ω.

Reference voltage vs. temperature



Pulse response for Ik = 1 mA



FEATURES

- Adjustable output voltage: V_{REF} to 36 V
- Sink current capability: 1 to 100 mA
- Typical output impedance: 0.22 Ω
- 0.4 % and 0.25 % voltage precision
- Operating temperature range: -40 to +125 °C

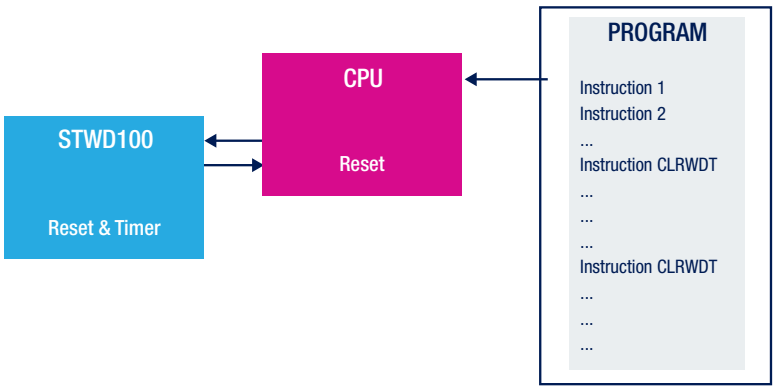
Part number	Adjustable	V_{REF} (V)	Reference Input voltage (V)	Initial accuracy (±)	Temperature coefficient max ppm / °C	Sink current range	Operating temperature range	Package
TL431AIYDT	Yes	2.5 to 36	2.5	1 %	± 70	1 mA to 100 mA	-40 to +125 °C	SO8
TL431IYDT				2 %				
TL1431AIYDT				0.25 %	± 90			
TL1431IYDT				0.4 %				
TS431IYLT		1.24 to 6	1.24	2 %	± 100	60 µA to 30 mA		SOT23-5L
TS431AIYLT				1 %				
TS431BIYLT				0.5 %				

Watchdog, reset and supervisor ICs

STWD100: watchdog timer circuit for automotive applications

The STWD100 watchdog timer circuits are self-contained devices which prevent system failures caused by certain types of hardware errors (including non-responding peripherals and bus contention) or software errors (such as a bad code jump or code stuck in loop). A watchdog input (WDI) signal periodically resets the internal watchdog timer within a specified timeout period. If the system fails, the watchdog timer is not reset, a system alert is generated and the watchdog output is asserted. The small SOT23-5 package ensures a small board impact area and has a low current consumption of only a few µA.

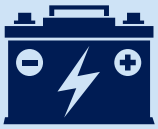
STWD100 system integration



FEATURES

- Current consumption 13 µA (typ.)
- Supply voltage: 2.7 to 5.5 V
- Available watchdog timeout periods are 3.4 ms, 6.3 ms, 102 ms, and 1.6 s
- Chip enable input
- Open-drain or push-pull WDO output
- Operating temperature range: - 40 to +125 °C
- Package: SOT23-5
- ESD performance : 2 kV (HBM) and 1 kV (CDM)

MAIN APPLICATIONS



Uninterruptible power supply

Alarm systems

Part number	Watchdog	Supervisor	Manual reset input	V_{DD} (V)	I_{CC} (µA)	Watchdog Timeout Period	Output type	Reset Pulse width	Package
STWD100YNWWY3F	Yes	No	No	2.7 to 5.5	13	6.3 ms	Open-drain (**)	NA	SOT23-5
STWD100YNYWY3F						1.6 s			
STWD100YNPWY3F						3.4 ms			
STWD100YNXWY3F						102 ms			
STM6321Yx (*)			No	1.2 to 5.5	3	1.6 s	Open-drain Or push-pull	1.4 up to 240 ms	
STM6322Yx (*)		Yes From 1.95 up to 4.746 V	Yes						

(*): Eligible for Automotive-grade qualification
(**) Push-pull version eligible for Automotive-grade qualification

Current sensing for 48 V batteries

APPLICATION NOTE AN4909 SUMMARY

Introduction

Standard automotive protections are designed to immediately cut off current to the load when overcurrent, short-circuit, or overtemperature events are detected. Due to the growing demand for increased energy efficiency and less pollutant emissions, certain automotive platforms are adding a second 48 V battery which requires an electronic adaptation to the higher supply voltage range.

This application note describes a simple way to protect against ground loss or offset, voltage peaks, reverse or disconnected battery, and load dumps for 48 V battery applications.

Designed with AEC-Q100 compliant components already in mass-production, this intelligent power switch precisely measures the current load and quickly disconnects the power when a system fault occurs.

This application note covers basic system considerations including precision, speed and design architecture.

General Overview

This function is realized using a TSC1031IYDT/PT high-side current-sense amplifier (Figure 1) which ensures a precise current measurement.

Figure 1 : General system overview

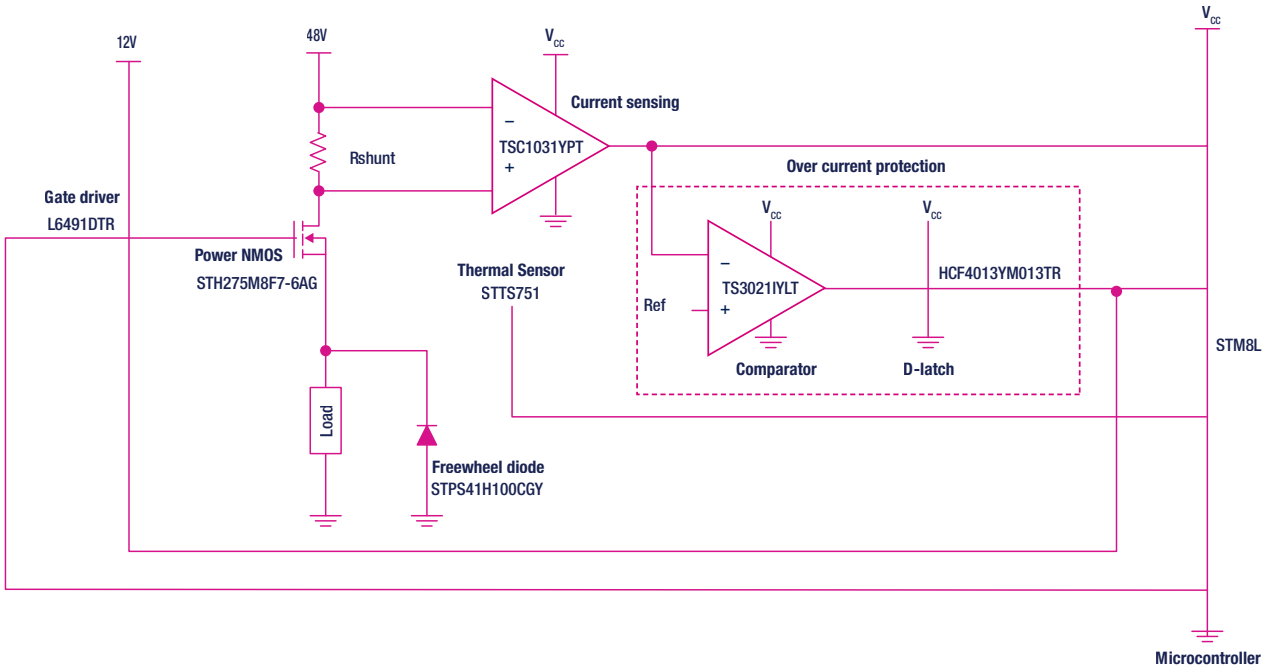
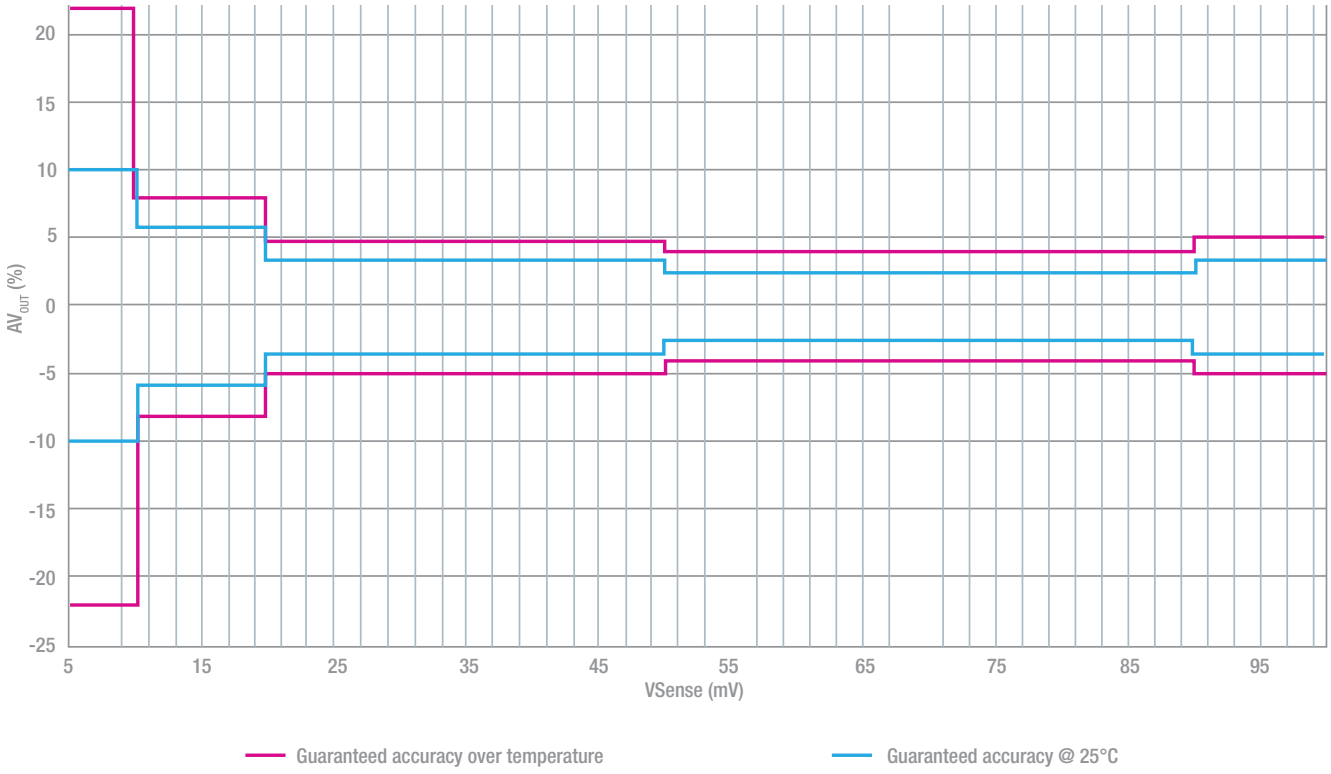


Figure 2 describes the maximum guaranteed error, which can happen on the output of the TSC1031 at 25°C and for over-temperature conditions

The current measurement is extremely important, firstly to control the current flowing into the load and also to be able to take a decision in case of a default like a short circuit or over current event. This function is realized thanks to the high side current sensing TSC1031IYDT/PT which allow a precise measurement. The figure describes the maximum guaranteed error, which can happen on the output of the TSC1031 at 25°C and over temperature

Figure 2 : Maximum output voltage error of the TSC1031



The N-channel Power MOSFET is a key component as it helps control the load current and also protect the application when a fault is detected. In addition being able to sustain the high 48V voltage range as well as load dumps, its RDS(ON) must be as low as possible in order to limit power dissipation. The STH275N8F7-6AG is an 80V STripFET F7 Power MOSFET with a maximum RDS(ON) of 2.1 mΩ at 25 °C.

When a short-circuit or over-current event is detected, the application must be switched off as quickly as possible. Moreover after such an event, the application must not restart by itself and must remain switched off until a manual reset is applied.

When using a TS3021Y high-speed comparator with an HCF4013 dual-D flip-flop to realize a latch function, it takes less than 9 µs to switch off the Power NMOS when an over-current event is detected in the load.

In the particular case of this application, an STTS751 thermal sensor is used to control the MOS temperature in order to protect the PCB when it exceeds 125 °C.

Moreover, an STM8L microcontroller is used to generate a configurable PWM in order to drive the gate of the power NMOS by analyzing the data coming from the current sensor. In case of overheating, it is also able to stop the system by opening the NMOS and can generate an alarm when an over-current event occurs.

eDesignSuite

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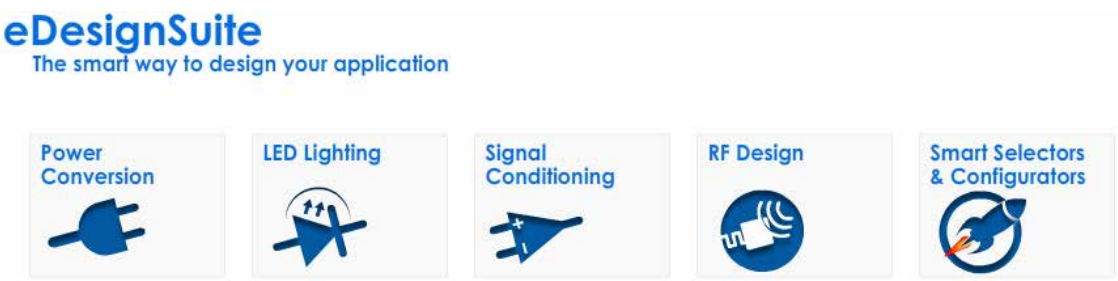


STEP 1

Select
- Power Conversion module
- Signal Conditioning module

STEP 2

- Select the type of product family
- Power Supply and Battery Charger for a Power Conversion module
- Active analog, comparators or low side current sensing for a Signal Conditioning module

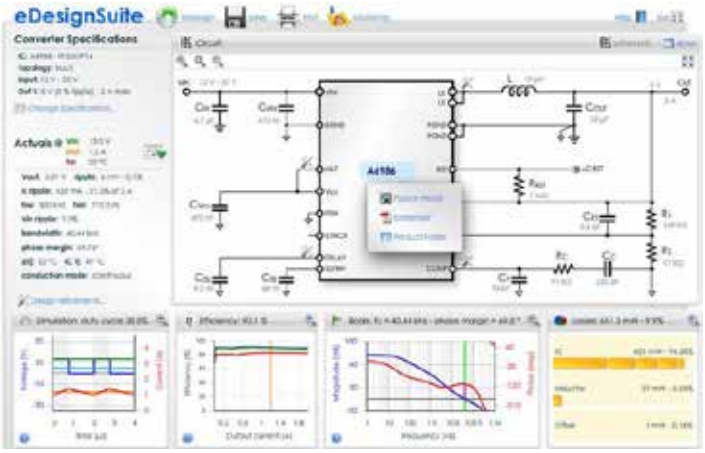
STEP 3

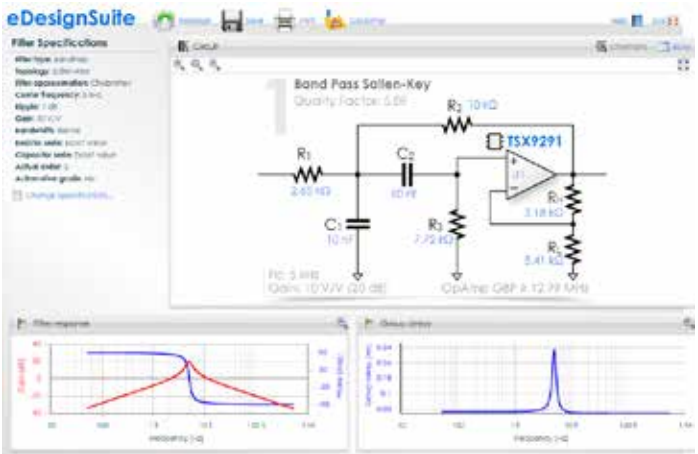
Adjust your choice with different parameters (stability, efficiency, center frequency, bandwidth …)

…you can then

- Get the suggested schematics
- Get the Bill Of Material (BOM)
- Get the different charts depending on the selected product (waveforms, efficiency, gain, phase …) in order to analyze your filter easily

- Access the Datasheet
- Access the Product folder
- Save and export a PSPICE model





Mobile apps

ST VOLTAGE REGULATORS APP

The ST Vreg app (ST-VREG-FINDER) is a free all-in-one smart selector for smartphones and tablets.
You can select the products that fit your application needs from among our Linear and switching voltage regulators and Voltage reference portfolios.
The app includes a parametric search engine and a browser by product family, for easy sorting and filtering. Once you have made your selection, share the relevant documentation by mail or social media, check the availability of samples and order them in few clicks!

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The ST Op Amps app (ST-OPAMPS-APP) is a free all-in-one design toolkit and smart selector for smartphones and tablets.
You can select the best product from among our operational amplifier, comparator, current-sensing, power and high-speed amplifier portfolios for your application.
Sort, compare and filter electrical parameters or use the smart component value calculator with interactive schematics.
Search using the competitor cross-reference tool and access 3D.

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