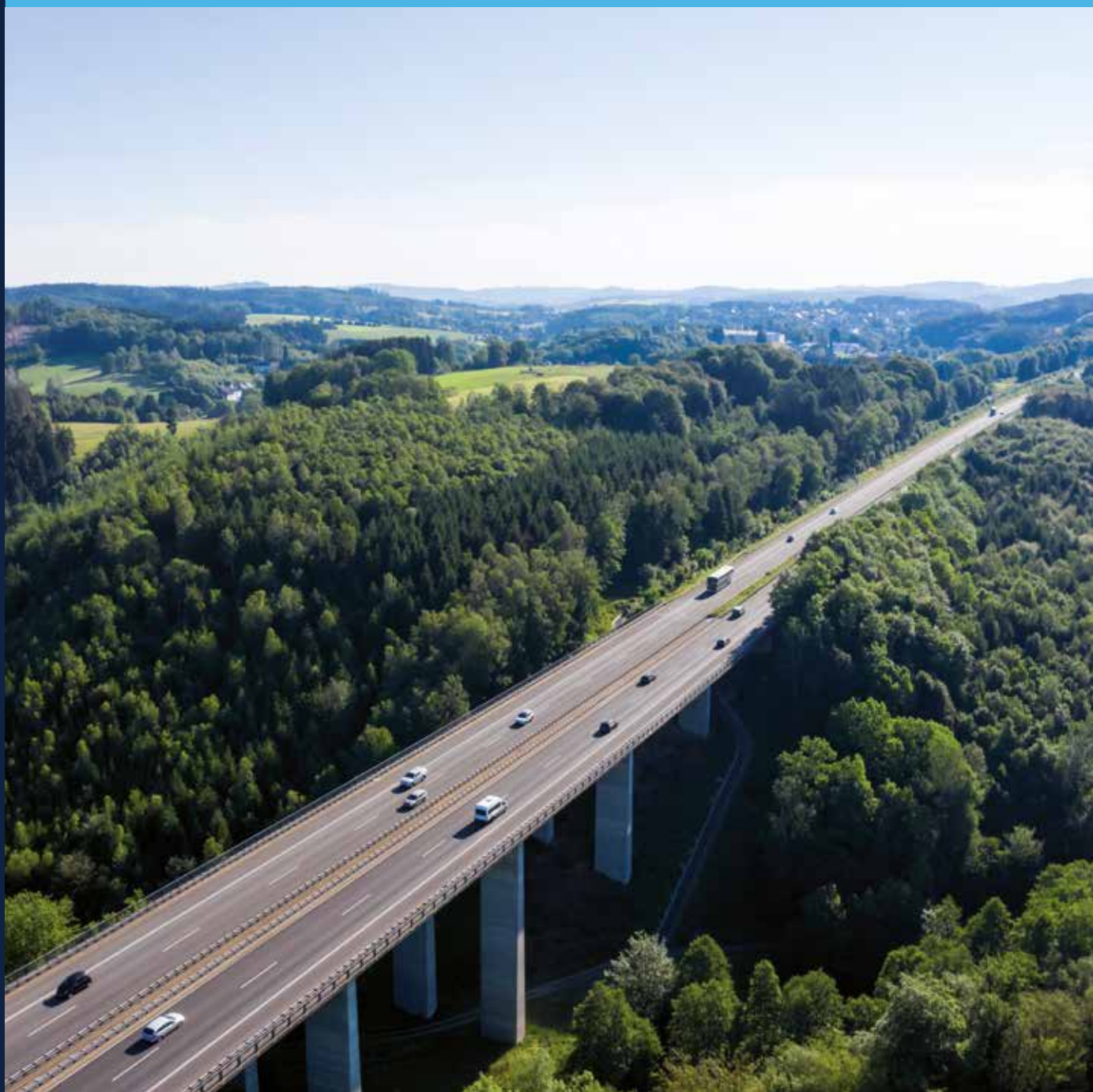
life.augmented

Automotive Standard Analog Robustness and Performance



Contents

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

Amplifiers and comparators

Current-sense amplifiers

DC-DC converters

LED drivers

Linear regulators (LDO)

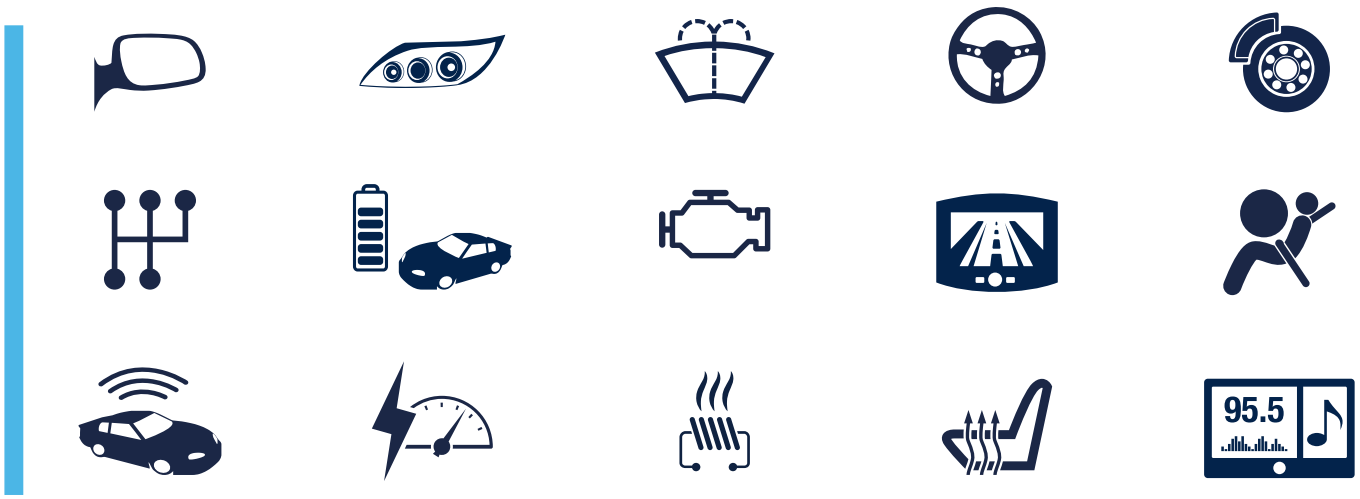
Logic ICs

USB Type-C

Voltage references

Watchdog, reset, and supervisor ICs

FOR ALL AUTOMOTIVE APPLICATIONS



Automotive grade qualification process

80%
of all innovations in the automotive industry today are enabled by electronics

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.

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 Verication 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

CUSTOMER QUALITY
- Customer requirements
- Complaint management
- Product return process

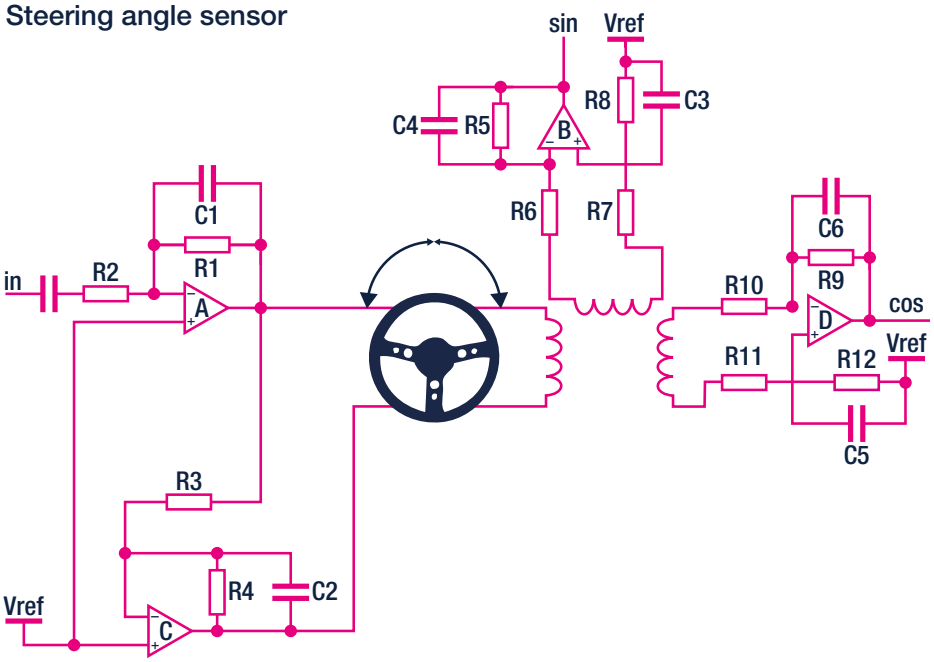
CHANGE MANAGEMENT
- Product/Process Change Notications
- Product Termination Notications

MANUFACTURING & SUPPLY CHAIN QUALITY
- Non-conformity management
- Supplier quality management
- Traceability

QUALITY IN PRODUCT & TECHNOLOGY DEVELOPMENT
- Test flow
- Technology development
- Product monitoring

Application schematics

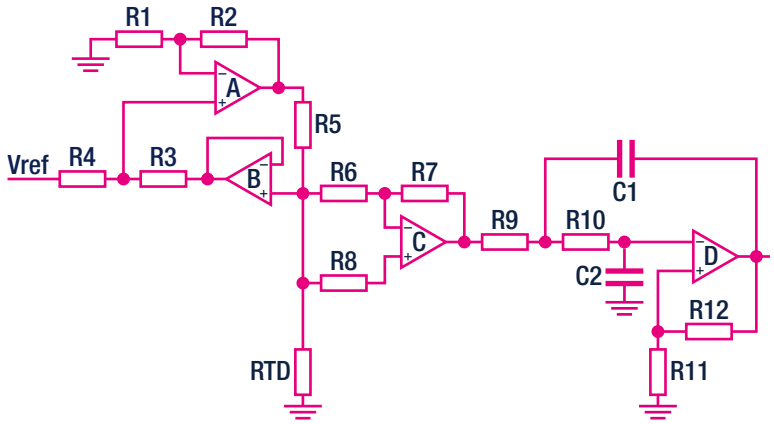
Steering angle sensor



FEATURED PRODUCTS:

- TSX564IYPT
- TSX922IYDT

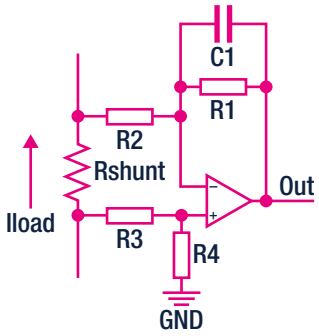
Resistance temperature detector



FEATURED PRODUCT:

- TSZ124IYPT

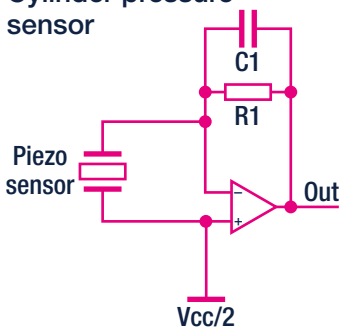
Current measurement



FEATURED PRODUCTS:

- TSX7191IYLT
- TSZ121IYLT
- TSX9291IYLT

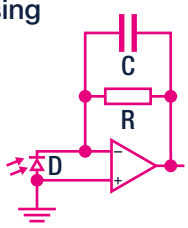
Cylinder pressure sensor



FEATURED PRODUCTS:

- TSX922IYDT
- TSV912HYDT

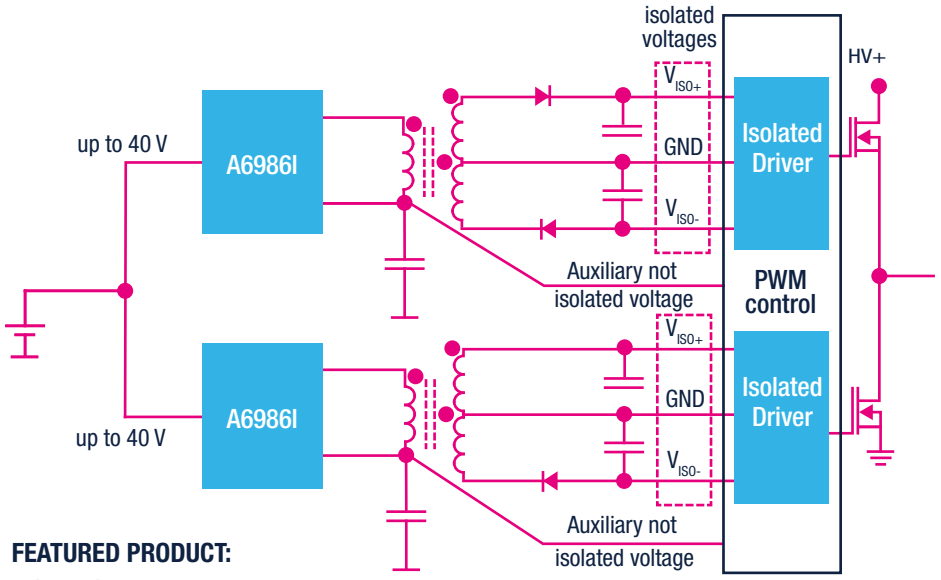
Photodiode current sensing



FEATURED PRODUCTS:

- TSU series
- TSX series
- TSV63 series

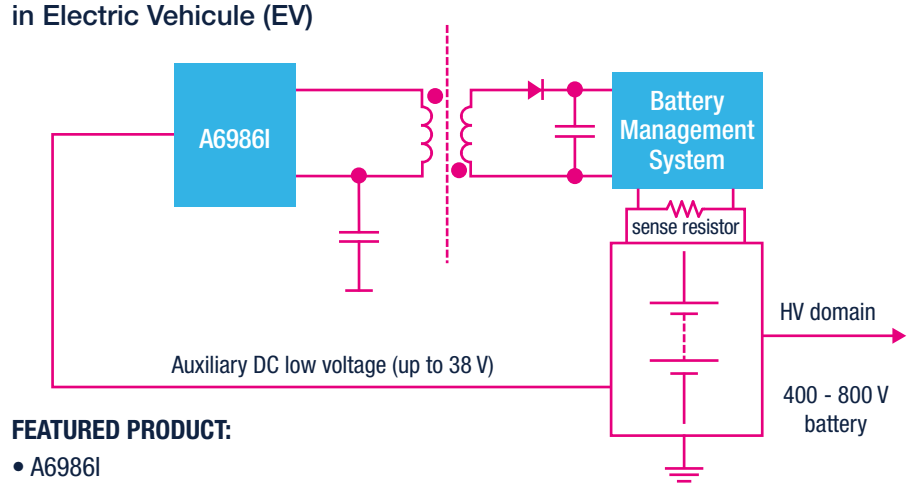
Isolated supply for gate drivers in On-Board Charging (OBC)



FEATURED PRODUCT:

- A6986I

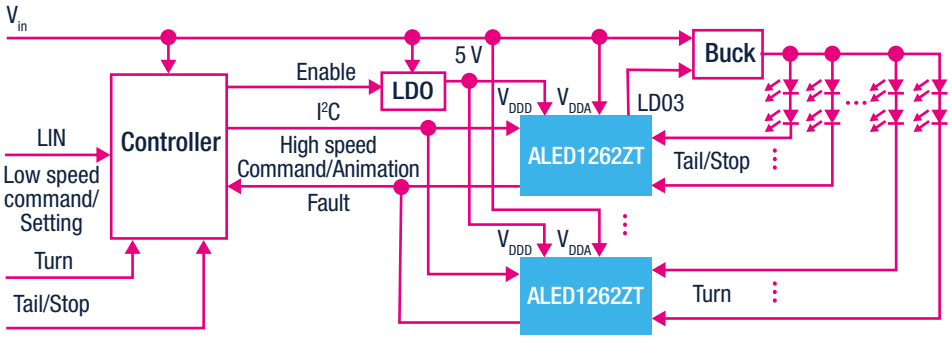
Isolated supply for Battery Management System (BMS) in Electric Vehicule (EV)



FEATURED PRODUCT:

- A6986I

Rear LED Lighting



FEATURED PRODUCTS:

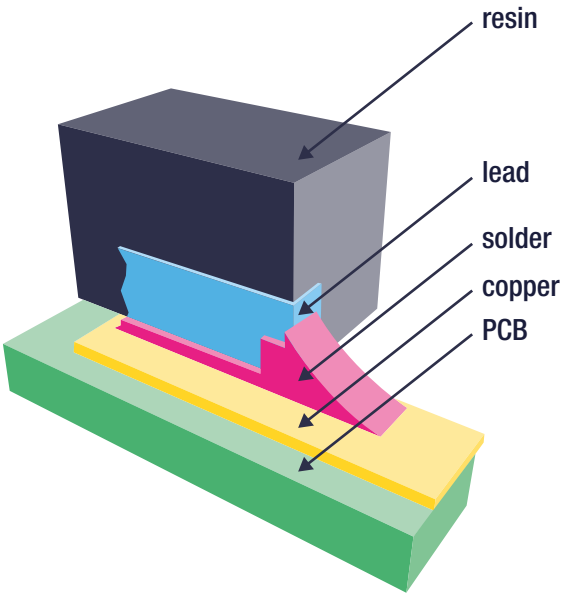
- ALED1262ZT (LED DRIVER)
- LDO40LY (LDO)
- A7986A (DC-DC BUCK CONVERTER)

Tiny and DFN/QFN Automotive Grade packages

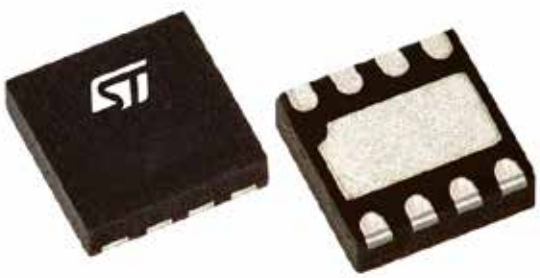
MAIN BENEFITS OF DFN/QFN PACKAGES WITH WETTABLE FLANKS

- Standard sawn DFN/QFN package has terminal flank with exposed copper which cannot form consistent solder side fillet. Automotive applications require a side fillet to perform AOI (Automated Optical Inspection) during assembly. ST has adopted the most innovative solution on the market to meet this requirement.
- Immune to soldering cracking for more than 3,000 thermal cycles at –40 to 125 °C, 1 cycle per hour, 1.0 mm high TG FR-4 PCB (Printed Circuit Board).

Wettable flanks for Automated Optical Inspection (AOI)



DFN8 3x3 mm with Wettable Flanks and Exposed PAD



Tiny and DFN/QFN Automotive Grade packages

Family	CP	Description	Package	Width (mm)	Length (mm)	Thickness (mm)
Amplifier	LM2902YQ5T (*)	Low power, bipolar operational amplifier	QFN16 3x3 WF	3	3	0,9
Amplifier	LM2904YQ6T (*)	Low power, bipolar operational amplifier	DFN8 2x2 WF	2	2	0,75
Amplifier	TS972IYQT	Output rail-to-rail very low-noise operational amplifier	DFN8 2x2	3	3	0,9
Amplifier	TSB572IYQ2T	Low-power, 2.5 MHz, RR IO, 36 V BiCMOS operational amplifier	DFN8 3x3 WF	3	3	0,75
Amplifier	TSU112IYQ3T (*)	Nanopower (900 nA) high accuracy (150 uV) 5V CMOS operational amplifier	DFN8 2x2 WF	2	2	0,75
Comparator	LM2903YQ3T	Low power dual voltage comparator	DFN8 2x2 WF	2	2	0,75
Comparator	TS3011IYQ3T	Rail-to-rail high-speed comparator	DFN8 2x2 WF	2	2	0,75
Current-sense amplifier	TSC210IYCT (*)	Low / High side bidirectional, zero-drift, current sense amplifier	SC70-6	2	2	1
Current-sense amplifier	TSC210IYQT (*)	Low / High side bidirectional, zero-drift, current sense amplifier	QFN10 1.4x1.8	1,4	1,8	0,75
Current-sense amplifier	TSC212IYCT (*)	Low / High side bidirectional, zero-drift, current sense amplifier	SC70-6	2	2	1
Current-sense amplifier	TSC212IYQT (*)	Low / High side bidirectional, zero-drift, current sense amplifier	QFN10 1.4x1.8	1,4	1,8	0,75
Current-sense amplifier	TSC213IYCT (*)	Low / High side bidirectional, zero-drift, current sense amplifier	SC70-6	2	2	1
Current-sense amplifier	TSC213IYQT (*)	Low / High side bidirectional, zero-drift, current sense amplifier	QFN10 1.4x1.8	1,4	1,8	0,75
DC-DC converter	AST1S31	Synchronous step-down switching regulator to deliver up to 3 A DC	DFN8 3x3 WF	3	3	1
DC-DC converter	AST1S31HF	Synchronous step-down switching regulator to deliver up to 3 A DC	DFN8 3x3 WF	3	3	1
DC-DC converter	A6983 (*)	Low quiscent current, Synchronous step-down switching regulator to deliver up to 3 A DC	QFN16 3x3 WF	3	3	0,8
DC-DC converter	A6984	Synchronous step-down switching regulator to deliver up to 400 mA DC	QFN10 4x4 WF	4	4	0,9
LED Driver	ALED7707	Integrated boost converter and 6-rows controlled current generator LED driver	QFN24 5x5 WF	5	5	0,9
Linear regulator (LDO)	LD39100Y	Low dropout voltage, low quiescent current, linear voltage regulator	DFN6 3x3 WF	3	3	0,9
Linear regulator (LDO)	LD59150Y	Low dropout linear voltage regulator with programmable soft-start	DFN10 3x3 WF	3	3	0,9
Linear regulator (LDO)	LDO40LY	Low quiescent current, battery connected linear voltage regulator	DFN6 3x3 WF	3	3	0,9
Linear regulator (LDO)	LDS3985Y	Low dropout volatge, low noise, linear voltage regulator	DFN6 3x3 WF	3	3	1
USB Type-C controller	STUSB1700YQTR	USB Type-C controller (with short-to-VBUS protection)	QFN24 4x4 WF	4	4	0,95
USB Type-C controller	STUSB1702YQTR	USB Type-C controller (with Tx/Rx line driver and BMC)	QFN24 4x4 WF	4	4	0,95
USB PD controller	STUSB4700YQTR	Stand-alone USB PD controller (with short-to-VBUS protection)	QFN24 4x4 WF	4	4	0,95

(*) Products under development

Amplifiers & Comparators

LOW-POWER OPERATIONAL AMPLIFIERS

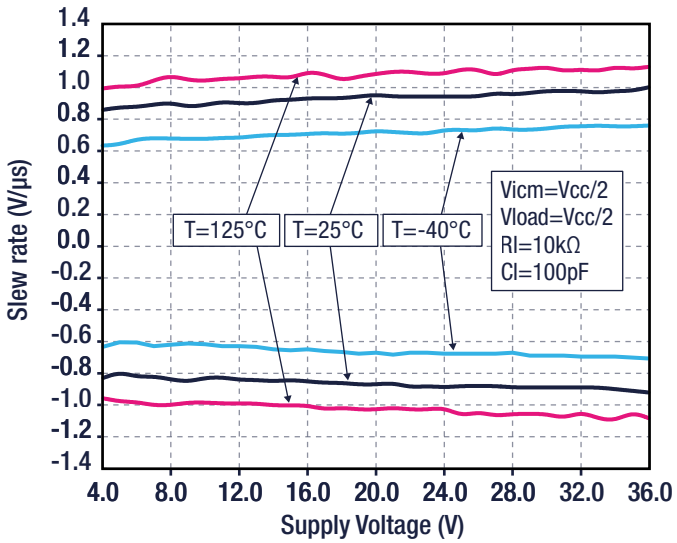
TSB571/2: low-power, 2.5 MHz, rail-to-rail input and output, 36 V operational amplifier

The TSB571 (single) and TSB572 (dual) operational amplifiers offer an extended voltage operating range from 4 to 36 V and rail-to-rail input/output.

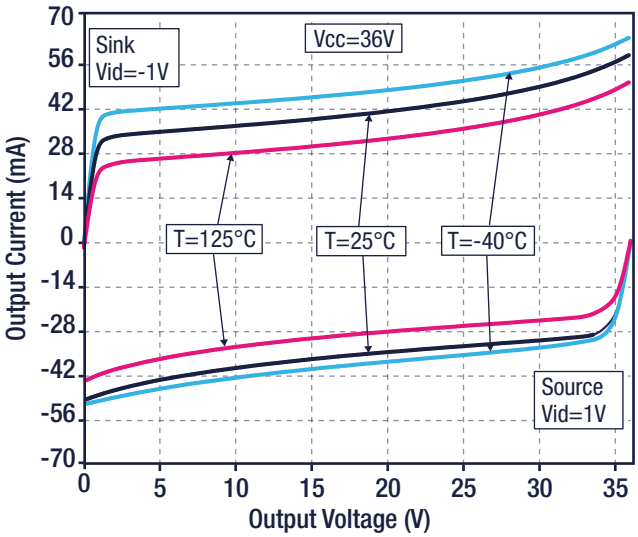
The TSB57 family offers a very good speed/power consumption ratio with 2.5 MHz gain bandwidth product while consuming only 380 µA typically with a 36 V supply.

The TSB57 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)

Low-power operational amplifiers

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			
TSU112I (*)	1	1,5	5,5	0,012	0,0017	150	41	Yes	Yes	NA	Mini-SO8, DFN8	NA
TS931/2/4	20	2,7	10	0,1	0,05	10 000	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, Mini-SO8	TSSOP14
TSV521A/2A/4A	45	2,7	5,5	1,15	0,89	600	55	Yes	Yes		Mini-SO8	
TSX631A/2A/4A	45	3,3	16	0,2	0,12	500	90	Yes	Yes		Mini-SO8	
TSV631/2/4	60	1,5	5,5	0,88	0,34	500	69	Yes	Yes		SO8	
TSB611	103	1,5	36	0,56	0,18	1 000	60	No	Yes		NA	
TSX561A/2A/4A	250	2,7	16	0,9	1,1	600	90	Yes	Yes		Mini-SO8	TSSOP14
TSB571/2	380	3	36,0	2,5	0,88	1 500	65	Yes	Yes	SOT23-5	Mini-SO8, DFN8 3X3 Wettable flanks	NA
TS912B/14A	400	4,0	16	1,4	1	2 000	70	Yes	Yes	NA	SO8	SO14
TS1871A/2A/4A	400	2,7	6	1,8	0,6	1 000	72	Yes	Yes	SOT23-5	SO8, TSSOP8	SO14, TSSOP14
TSV321A/358A/324A	500	1,8	6	1,4	0,6	1 000	80	Yes	Yes		SO8, TSSOP8	SO14, TSSOP14
TS512A/14A	500	2,5	30	3	1,5	500	23	No	No	NA	SO8	SO14 (**)
TS321A	600	6	30	0,8	0,4	2 000	40	No	No	SOT23-5	NA	NA
TSX711A/12	660	3	16	2,7	1,2	100	54	Yes	Yes		SO8, Mini-SO8	
TSX7191A/92	660	2,7	16	8,5	2,4	100	70	Yes	Yes			
TSZ181/2	700	2,7	5,5	3	4,7	25	27	Yes	Yes			
TSV911A/2A/4A	780	2,2	5,5	8	4,5	1 500	35	Yes	Yes	SOT23-5, SO8	SO8, Mini-SO8	SO14, TSSOP14
TS507	850	2,5	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	6 000	22	Yes	Yes	SOT23-5	SO8, Mini-SO8	SO14, TSSOP14

(*) New product
(**) Eligible for Automotive-grade qualification

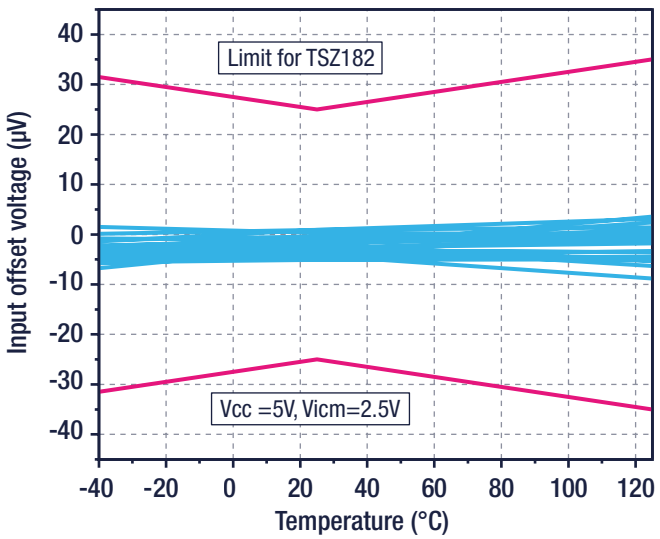
PRECISION OPERATIONAL AMPLIFIERS

TSZ181/2: Very high accuracy (25 µV) zero drift 5V CMOS dual op amps with GBP = 3 MHz

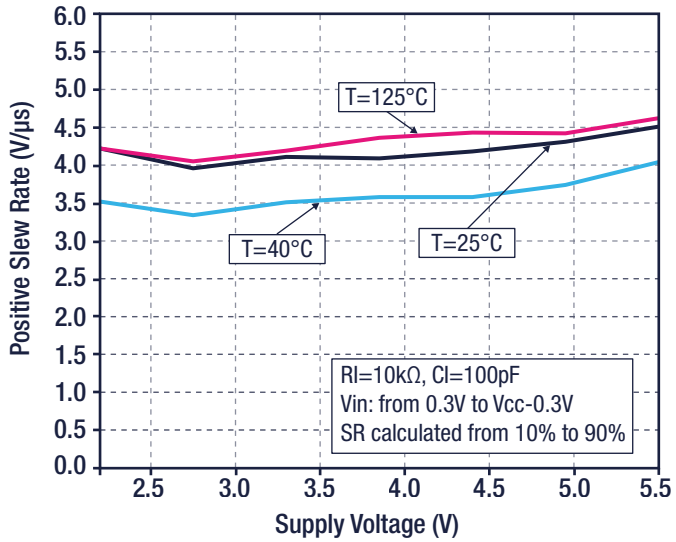
The TSZ181, TSZ182 are single-, dual- operational amplifiers featuring very low offset voltages with virtually zero drift versus temperature changes.

The TSZ18 family offers rail-to-rail input and output, excellent speed/power consumption ratio, and 8210 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 TSZ18 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

Precision operational amplifiers

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. 1kHz 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	S08, Mini-S08	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	70 000	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		S08, Mini-S08	
TSU112I (*)	150	0,5	10	1,5	5,5	0,012	0,0017	0,001	200	Yes	Yes	NA	DFN8, Mini-S08	NA
TSV792 (*)	200	1,7	300	2,2	5,5	50	30	5,5	6,5	Yes	Yes	NA	Mini-S08, S08	NA
TSB711/12A (*)	300	2,8	300 000	2,7	36,0	6,0	3,00	1,800	12	Yes	Yes	SOT23-5	S08, Mini-S08	NA
TSB7191/12A (*)	300	2,8	300 000	2,7	36,0	22	12,0	1,8	12	Yes	Yes		S08, Mini-S08	
TSV631A/2A/4A	500	2	10	1,5	5,5	0,88	0,34	0,06	60	Yes	Yes	SOT23-5	S08	TSSOP14
TSV6391A/2A/4A	500	2	10	1,5	5,5	2,4	1,1	0,06	60	Yes	Yes	SOT23-5 (**)	S08 (**)	TSSOP14 (*)
TS9222/4	500	2	55 000	2,7	12	4	1,3	0,9	9	Yes	Yes	NA	S08, TSSOP8	SO14, TSSOP14
TS512A/4A	500	2	150 000	6	30	3	1,5	0,5	8	No	No	NA	S08	SO14 (**)
TSX561A/2A/4A	600	2	100	3	16	0,9	1,1	0,25	48	Yes	Yes	SOT23-5	Mini-S08	TSSOP14
TSX631A/2A/4A	700	1	100	3,3	16	0,2	0,12	0,045	60	Yes	Yes			
TS9511	800	2	70 000	2,7	12	3	1	0,95	25	Yes	Yes		NA	
TSV851A/2A/4A	800	1	60 000	2,3	5,5	1,3	0,7	0,13	30	No	Yes		S08, Mini-S08	TSSOP14
LMV821A/2A/4A	800	1	120 000	2,5	5,5	5,5	1,9	0,4	16	No	Yes		S08, TSSOP8	SO14, TSSOP14
TS522/4	850	2	750 000	5	30	15	7	2	4,5	No	No	NA	S08 (**)	SO14 (**)

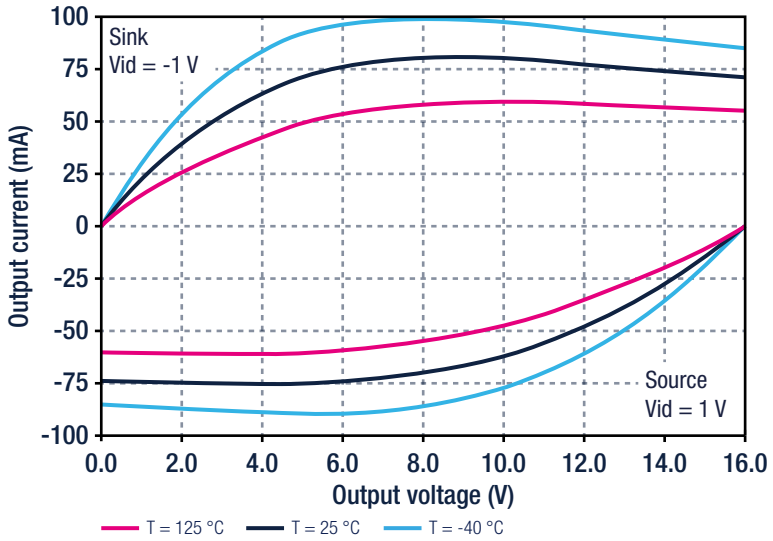
(*) New Products
(**) Eligible for Automotive-grade qualification

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.

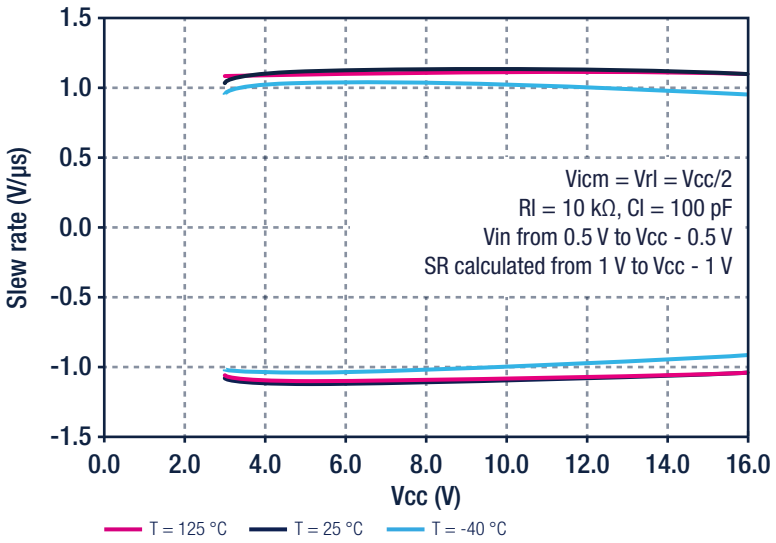
Output current vs. Output voltage and temperature



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



High output current & capacitive load operational amplifiers

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	Mini-SO8	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		

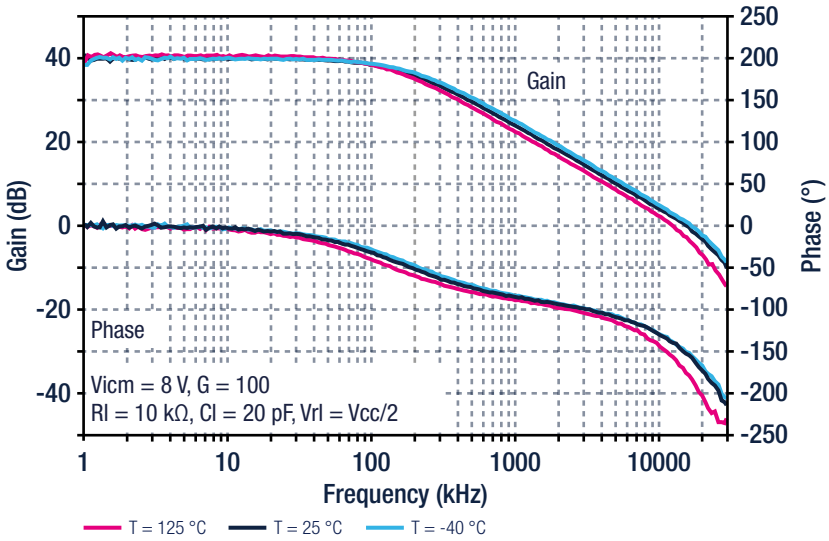
(*) Eligible for Automotive-grade qualification

FAST OPERATIONAL AMPLIFIERS

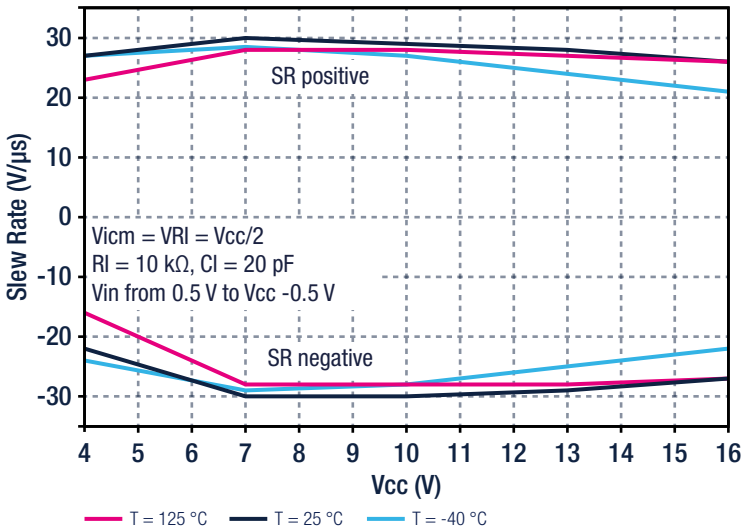
TSX9291: high-speed 16 V rail-to-rail I/O CMOS operational amplifier

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



Slew rate vs. Supply voltage and temperature



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)

Fast operational amplifiers

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	3 000	15	40	No	No	SO8	SO8	SO14
TSB711/12A (*)	6	3	2.7	36	1.8	300	12	50	Yes	Yes	NA	SO8, Mini-SO8	NA
TSV911A/2A/4A	8	4.5	2.5	5.5	0.78	1 500	27	35	Yes	Yes	SOT23-5, SO8	SO8, Mini-SO8	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	4 000	16.5	62	Yes	Yes			
TS971/2/4	12	4	2.7	10	2	5 000	4	100	No	Yes		SO8, TSSOP8, DFN8 3x3 Wettable flanks	TSSOP14
MC33078/9	15	7	5	30	2	2 000	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	4 000	16.5	62	Yes	Yes	SOT23-5	SO8, Mini-SO8	NA
TSV991A/2A/4A	20	10	2.5	5.5	0.82	1 500	27	35	Yes	Yes	SOT23-5, SO8	SO8, Mini-SO8	SO14, TSSOP14
TSB7191/92A (*)	20	11	2.7	36	1.8	300	12	50	Yes	Yes		SO8, Mini-SO8	NA
TSV792 (*)	50	30	2.2	5.5	5.5	200	6.5	60	Yes	Yes		Mini-SO8, SO8	
TSH80/2	65	115	4.5	12	8.2	10 000	11	55	No	Yes		SO8	

(*) New Products
(**) Eligible for Automotive-grade qualification

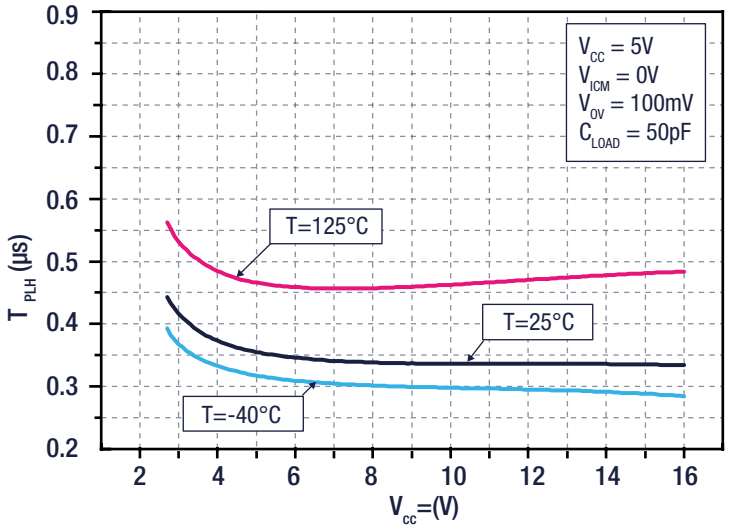
ST Op Amps

COMPARATORS

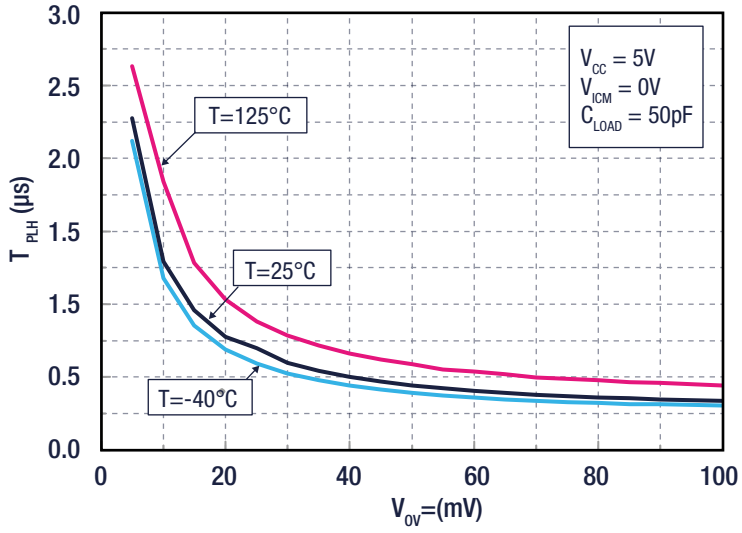
TSX3702/4: Micropower (5 µA) 16 V dual/quad CMOS comparator with push-pull output

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)

Comparators

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
TS3011	470	2,2	5	8	Yes	Push-pull	CMOS	SOT23-5, DFN8 2x2 Wettable flanks	NA	
TS3021/2	73	1,8	5	42	Yes	Push-pull	BIP	SOT23-5	SO8, Mini-SO8	NA
TS331/2/4	20	1,6	5	270	Yes	Open drain		SOT23-5	SO8	SO14, TSSOP14
TS391	200	2	36	300	GND	Open collector		SOT23-5, DFN8 2x2 Wettable flanks(*)	NA	
TSX3702/4	5	2,7	16	340	GND	Push-pull	CMOS	NA	SO8	TSSOP14
TSX393/339	5	2,7	16	550	GND	Open drain				
LM2901/3	200	2	32	1 300	GND	Open collector			Mini-SO8, DFN8 2x2 Wettable flanks	SO14, TSSOP14
TS393	9	2,7	16	1 500	GND	Open drain			SO8	NA
TS882	0	1,1	6	2 600	Yes	Push-pull			Mini-SO8	

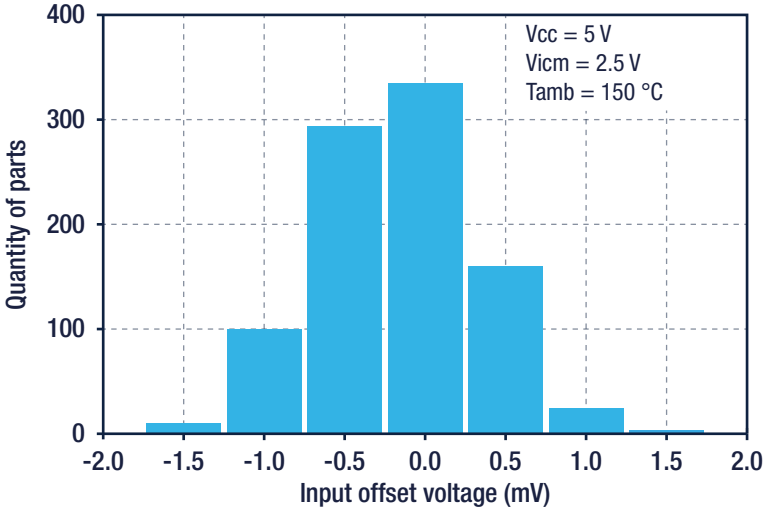
(*) Eligible for Automotive-grade qualification

GRADE 0 (150 °C) AMPLIFIERS AND COMPARATORS

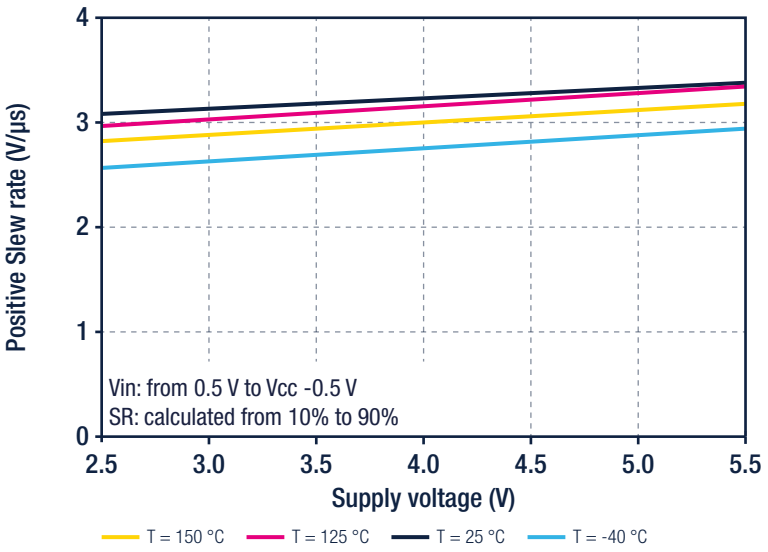
TSV912H: Wide-bandwidth (8 MHz), rail to rail input/output 5 V CMOS dual op amps

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



Positive slew rate



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

High-temperature amplifiers

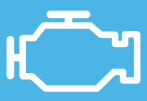
Part number	Max. operating Temperature (°C)	Typ. GBP (MHz)	Typ. SR (V/µs)	Min. V_{cc} (V)	Max. V_{cc} (V)	Typ. I_{cc} per channel (mA)	Rail to rail		Package Single	Package Dual
							In	Out		
LM2904AH/WH	150	1.1	0.6	3	30	0.5	GND	No	NA	TSSOP8, SO8, Mini-SO8
TSV912H	150	8	4.5	2.5	5.5	0.82	Yes	Yes	NA	SO8
TSZ181H/2H (*)	150	3	4.7	2.2	5.5	0.70	Yes	Yes	SOT23-5	SO8
TSZ182H1 (*)	175	3	4.7	2.2	5.5	0.70	Yes	Yes	NA	SO8

(*) New products

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

MAIN APPLICATIONS



Engine control

In-gearbox modules

Safety-critical systems

Brakes

ST Op Amps

Current-sense amplifiers

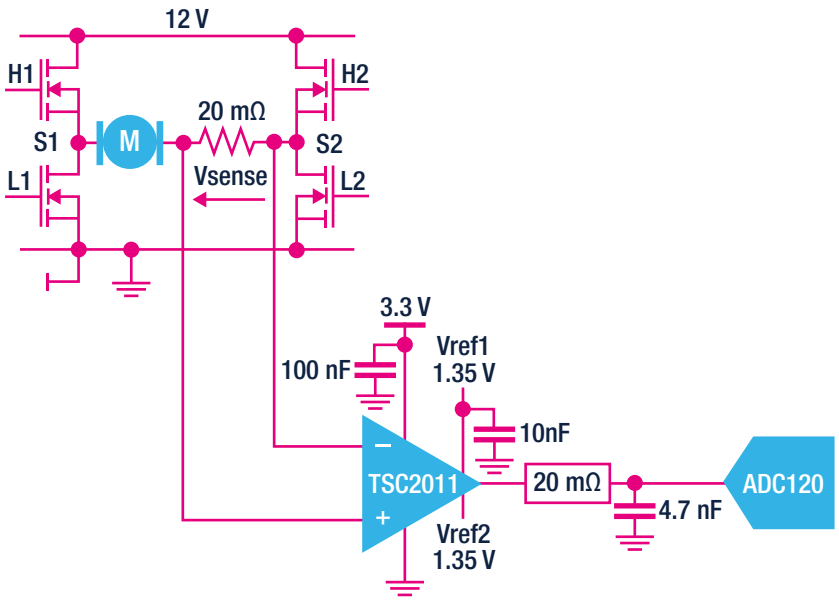
TSC2011: high-voltage, precision, bidirectional current-sense amplifier

A precision bidirectional current sense amplifier, the TSC2011 can sense the current thanks to a shunt resistor over a wide range of common mode voltages, from -20 to +70 V, regardless of the supply voltage. It is available with an amplifier gain of 60 V / V.

It is able to sense very low drop voltages as low as 10 mV full scale minimizing the measurement error.

The TSC2011 can also be used in other functions including precision current measurement, overcurrent protection, current monitoring, and feedback loops.

TSC2011 block diagram



FEATURES

- Wide common mode voltage: 20 to 70 V
- Offset voltage: ± 200 µV (maximum)
- 2.7 to 5.5 V supply voltage
- Gain: 60 V/V
- Gain error: 0.3% (maximum)
- Offset drift: 5 µV/°C (maximum)
- Gain drift: 10 ppm/°C (maximum)
- Quiescent current: 20 µA in
- Shutdown mode
- SO8 and Mini-SO8 package

Current-sense amplifiers

Part number	Type	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	Unidirectional	300	2.8	30	4	24	20, 50, 100	-40	+125	SOT23-5
TSC102	Unidirectional	420	2.8	30	3.5	5.5	Adjustable	-40	+125	TSSOP8, SO8
TSC1021	Unidirectional	300	2.8	30	3.5	5.5	20, 50	-40	+125	TSSOP8
TSC103	Unidirectional	360	2.9	70	2.7	5.5	20, 25, 50, 100	-40	+125	TSSOP8, SO8
TSC1031	Unidirectional	360	2.9	70	2.7	5.5	50, 100	-40	+125	TSSOP8, SO8
TSC2010/2011/2012 (*)	Bidirectional	1500	-20.0	70	2.7	5.5	20, 60, 100	-40	+125	Mini-SO8, SO8
TSC210/211/212/213/214/215 (*)	Bidirectional	100	-0.3	36	2.7	26	200, 500, 1000, 50, 100, 75	-40	+125	SC70-6, QFN10

(*) New products

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
STEVAL-AETKT1V2	High-side current-sense amplifier demonstration board based on TSC2010/2011/2012	DB4135

DC-DC converters

CONVERSION FROM CAR BATTERY-ASYNCHRONOUS

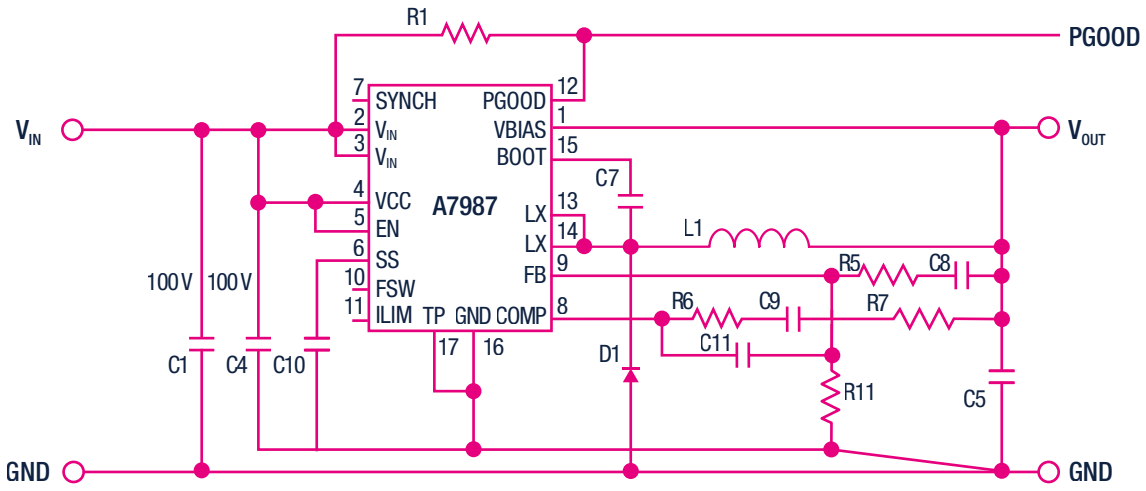
A7987: 61 V 3 A asynchronous step-down switching regulator with adjustable current limitation for automotive

The A7987 is a step-down monolithic switching regulator that can deliver up to 3 A DC. The adjustable output voltage ranges from 0.8 V to VIN. The wide input voltage range and the almost 100% duty cycle capability meet the fail-safe specifications for automotive systems. The embedded switch-over feature on the VBIAS pin maximizes efficiency at light load. The adjustable current limitation, designed to select the inductor RMS current in accordance with the nominal output current, and the high switching frequency capability make the size of the application compact. Pulse-by-pulse current sensing with digital frequency fold-back implements an effective constant current protection over the different application conditions. The peak current fold-back decreases the stress of the power components in heavy short-circuit conditions. The PGOOD open collector output can also implement the output voltage sequencing during the power-up phase. Multiple devices can be synchronized by sharing the SYNCH pin to prevent beating noise for low noise requirements such as in infotainment applications.

FEATURES

- 3 A DC output current
- 4.5 to 61 V operating input voltage
- Adjustable f_{sw} (250 kHz to 1.5 MHz)
- Output voltage adjustable from 0.8 V to V_{IN}
- Synchronization
- Adjustable soft-start time
- Adjustable current limitation
- VBIAS improves efficiency at light load
- PGOOD open collector output
- Digital frequency fold-back in short-circuit
- Auto recovery thermal shutdown
- Qualified in compliance with AEC-Q100 requirements

A7987 application schematic



DC-DC converters - conversion from car battery - asynchronous

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
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
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. Soft-Start, adj. current limit	HTSSOP16

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
STEVAL-ISA207V1	3 A step down DC/DC switching regulator (V_{IN} = 4.5 to 60 V) based on the A7987	DB3887

CONVERSION FROM CAR BATTERY - SYNCHRONOUS

A6985F, A6986F, A6986H and A6983(*): 38 V input voltage and 0.5, 1.5, 2, 3 A output current step down switching regulators.

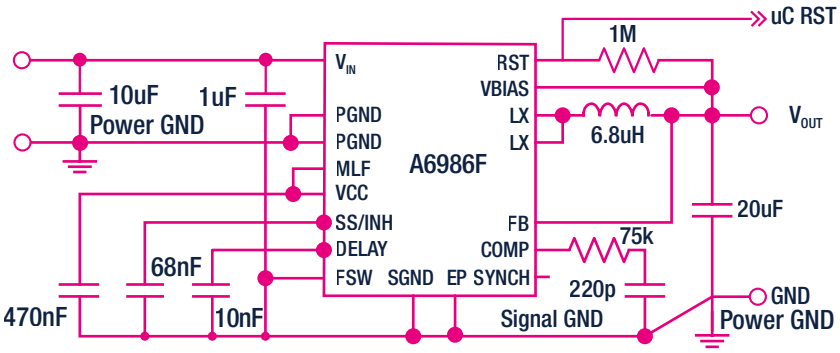
The A6985F, A6986F, A6986H and A6983(*) are step-down monolithic converters with synchronous rectification capable of 0.5, 1.5 and 2 A output current respectively. The output voltage adjustability ranges from 0.85 V to VIN. The PMOS high side allows for true 100% duty cycle capability and the wide input 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 lightload 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.

(*) Product under development

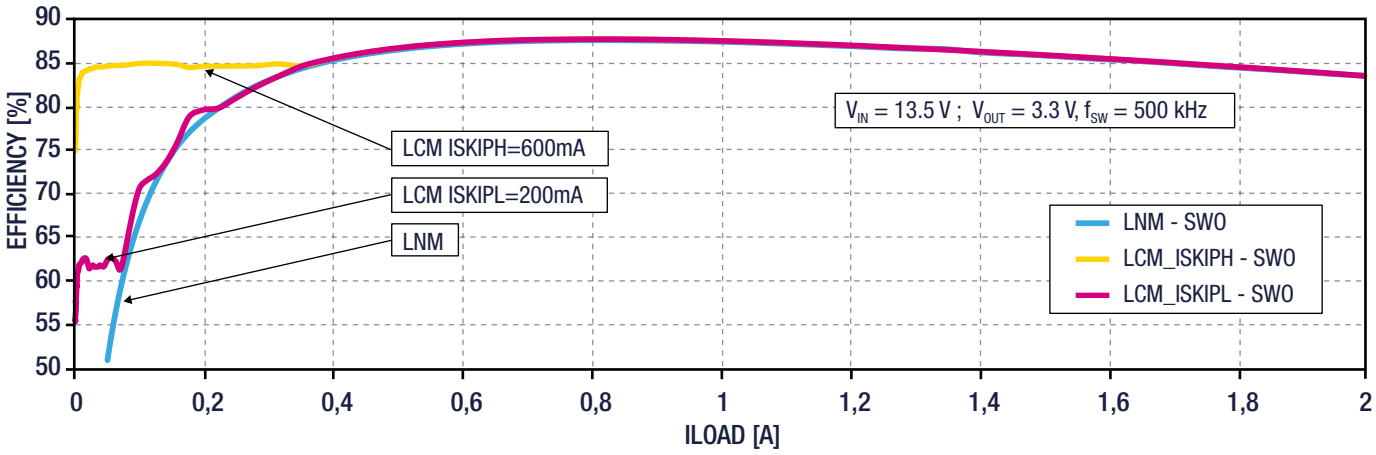
FEATURES

- 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 A6986H
  - 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 tON (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 COUT allowed
- Over-current, over-voltage, and thermal protections
- Package: HTSSOP16

Typical A6986F application diagram



Light-load Efficiency curves for A6986H



A6986I: A robust synchronous iso-buck converter for isolated applications

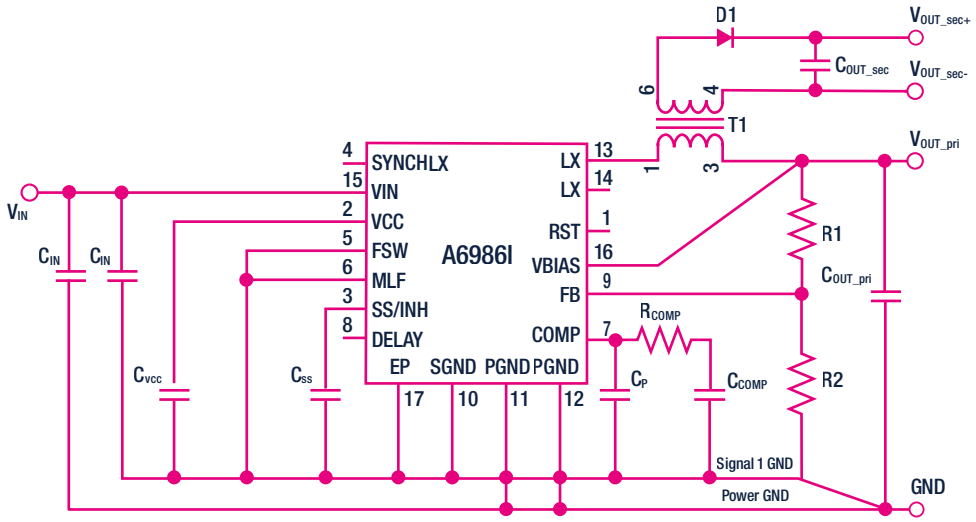
The A6986I is an automotive-grade device specifically designed for the isolated buck topology. The 100% duty cycle capability and the wide input voltage range meet the cold crank and load dump specifications for automotive systems. The primary output voltage can be accurately adjusted, whereas the isolated secondary output is derived by using a given transformer ratio. No optocoupler is required. The primary sink capability up to 1.5 A (even during soft-start) allows a proper energy transfer to the secondary side as well as enables a tracked soft-start of the secondary output.

The A6986I is ideal for various applications present in Electric or Hybrid Vehicles, such as a gate drivers' supply either for IGBT- or SiC MOSFET-based electric traction systems, on-board charging (OBC) systems, battery management systems, and wherever an isolated single or double output supply is required.

FEATURES

- Designed for iso-buck topology
- 4 to 38 V operating input voltage
- Primary output voltage regulation / no optocoupler required
- 2.5 A source / 1.5 A sink peak primary current capability
- Peak current mode architecture in forced PWM operation
- 300 ns blanking time
- 8 µA IQ-SHTDWN
- Adjustable switching frequency and synchronization
- Embedded primary output voltage supervisor
- Adjustable soft-start time
- Internal primary current limiting
- Overvoltage protection
- Thermal shutdown

A6986I application schematic



DC-DC converters - conversion from car battery - synchronous

Part number	V_{IN} (V)	V_{OUT} (V)	I_{OUT} (A)	Frequency	I_Q (µA)	Other features	Package
A6986H	4 to 38	Adj. (0.85 - V_{IN}) 5 & 3.3	2	250 kHz to 2 MHz	30	T_{ON}min=80ns, Synchronization, Adj. f_{SW}, Selectable SKIP/ PWM Thsr., Adj. Soft-Start & PGOOD, Adj. Reset, Low Noise or Low Cosumption Mode, OV &OC protection	HTSSOP16
A6986F		Adj. (0.85 - V_{IN}) 5 & 3.3	1,5				
A6985F		Adj. (0.85 - V_{IN}) 5 & 3.3	0,5			T_{ON}min=100ns, Synchronization, Adj. f_{SW}, Adj. Soft-Start & PGOOD, Adj. Reset, Low Noise or Low Cosumption Mode, OV & OC protection	
A6984	4.5 to 36	Adj. (0.9 - V_{IN})	0,4	250 kHz to 600 kHz	80	Adj. f_{SW}, Internal Soft-Start, PGOOD, Low Noise or Low Cosumption Mode	QFN10 (4x4 mm WF)
A6986I (*)	4.5 to 38	Adj. (0.85 - V_{IN})	2	250 kHz to 2 MHz	30	Isolated Buck, T_{ON}min=300ns, Synchronization, Adj. f_{SW}, Adj. Soft-Start & PGOOD, Adj. Reset, OV &OC protection	HTSSOP16
A6983 (**)	3.5 to 38	Adj. (0.85 - V_{IN})	3	250 kHz to 2.2 MHz	17	T_{ON}min=75ns, Adj. f_{SW}, Spread Spectrum, Synchronization, Internal Compensation, PGOOD, Low Noise or Low Cosumption Mode	QFN16 (3x3 mm WF)

(*) New Product
(**) Product under development

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
STEVAL-ISA205V1	38 V, 2 A synchronous step-down switching regulator evaluation board based on A6986H	DB3889
STEVAL-A6986IV1	38 V, 2 A synchronous step-down isolated buck regulator evaluation board based on A6986I	-
STEVAL- A6986IV2	38 V, 5W synchronous iso-buck converter evaluation board with single isolated output based on the A6986I	-

POST-REGULATION

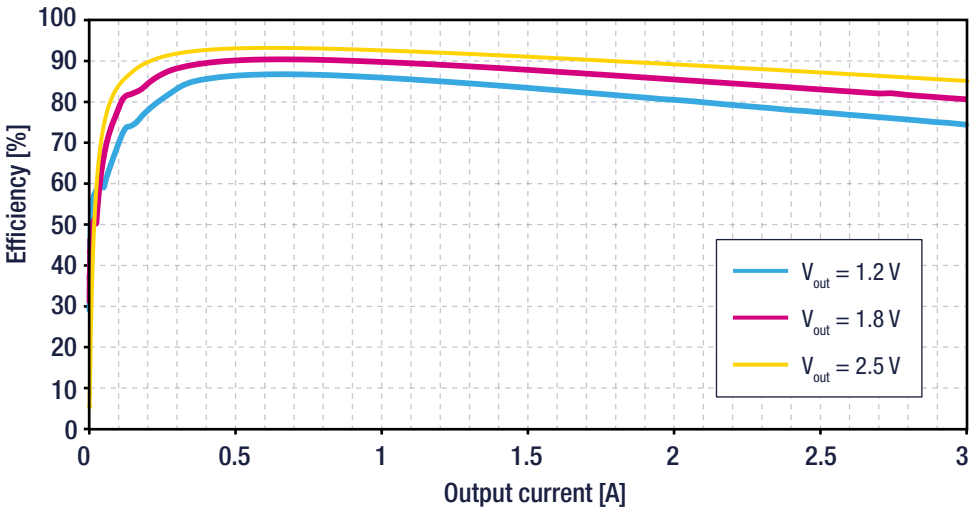
AST1S31HF: Up to 4 V, 3 A step-down 2.3 MHz switching regulator for automotive applications

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 VIN.
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.

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 COUT allowed
- Over-current and thermal protections
- Package: 8-lead DFN (3x3 mm)

Efficiency curves V_{IN} = 3.3 V



DC-DC converters - post regulation

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

ALED1262ZT: 12-channel LED driver with open detection, 7-bit local dimming brightness control, configurable bus-driven and stand-alone mode

The ALED1262ZT 12-channel LED driver for automotive rear combination lamps and interior lighting offers features which support the creation of complex and innovative visual effects.

Independent 7-bit PWM dimming on all channels allows for the flexible control of tail, brake and turn lights which produce dynamic effects. Each channel supplies a constant output current at 19 V to drive strings of LEDs in series. An adjustment of the output current between 6 and 60 mA provides a wide dimming range, and high maximum brightness.

The LED lighting driver responds to I2C commands from a host microcontroller. It provides two pre-programmed configurations which enable stand-alone operation for extra flexibility.

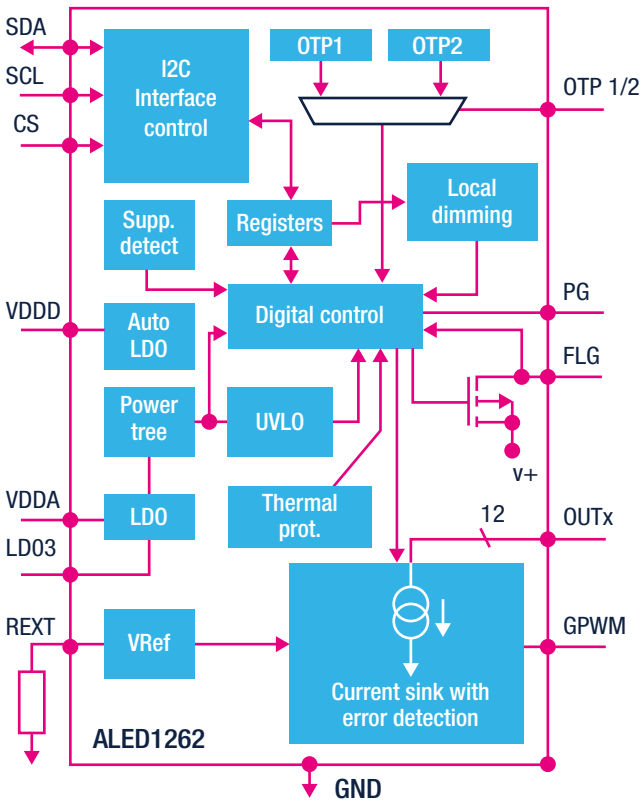
The ALED1262ZT gives reliable and stable operation and a long lifetime in automotive applications, offering diagnostic and protection features including open-LED detection and an over-temperature warning to trigger thermal shut-down.

INNOVATIVE FEATURES

- Fast I²C with selectable Hamming encoding
- Programmable standalone mode by OTP and Bus-driven mode via I²C
- 12-bit local dimming with non-linear steps
- Channels' gradual output delay and dithered clock for EMI reduction
- Error detection and wired OR programmable error flag

HIGH FLEXIBILITY

- I²C control interface and/or OTP programming
- Factory custom configuration by OTP



MAIN APPLICATIONS

Automotive rear combination lights

Front Light DRL (Daytime Running Light)

Automotive interior and exterior lights

Dashboard and Infotainment backlighting

LED array drivers

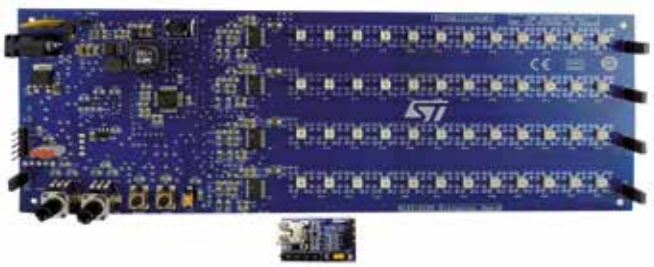
Part number	Nb. of channels	V_{IN} (V)	V_{LED} (V)	LED current per channel (mA)	Special features	Auto Power saving	Package
ALED1262ZT	12	5.5 to 38	0 to 19	6 - 60	LEDs OPENs & SHORTs detection, 7-bits local dimming brightness control, I²C interface bus-driven or stand-alone operation mode, ustom configuration by OTP with Redundancy and ECC	No	HTSSOP24 exposed PAD
ALED1642GW	16	3 to 5.5	0 to 19	3 - 40	7-bits global current gain programmability, 12/16-bits local PWM grayscale brightness control, current setting through external resistor, programmable turn on/off, auto wake-up mode, Error detection mode (both open and shorted-LEDs)	Yes	HTSSOP24 exposed PAD
STAP08DP05	8	3 to 5.5	0 to 20	5 - 100	Short and open output error detection, thermal shutdown protection, adjustable output current through external resistor, Serial data IN/parallel data OUT	No	HTSSOP16 exposed PAD
STAP16DPPS05	16	3 to 5.5	0 to 20	3 - 40		Yes	HTSSOP24 exposed PAD
STAP16DPS05	16	3 to 5.5	0 to 20	5 - 100		Yes	
ALED8102S (*)	8	3 to 5.5	0 to 19	5 - 100	8 constant current output channels driven by four input control pins for local dimming, Output enable input for global dimming, adjustable output current through external resistor	No	HTSSOP16 exposed PAD

(*) Product under development

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 STM8A	DB2222
STEVAL-ILL059V1	High-brightness LED array driver with diagnostics based on the STAP16DPS05 and STM8A	DB2220
STEVAL-ILL060V1	High-brightness LED array driver with diagnostics based on the STAP16DPPS05 and STM8A	ULM1774
STEVAL-ILL090V1	Evaluation kit Based on ALED8102S (8 channel LED driver with direct switch control)	-

STEVAL-LLL002V1: Evaluation kit for automotive rear lights with pattern animations based on ALED1262ZT and STM8AF6266

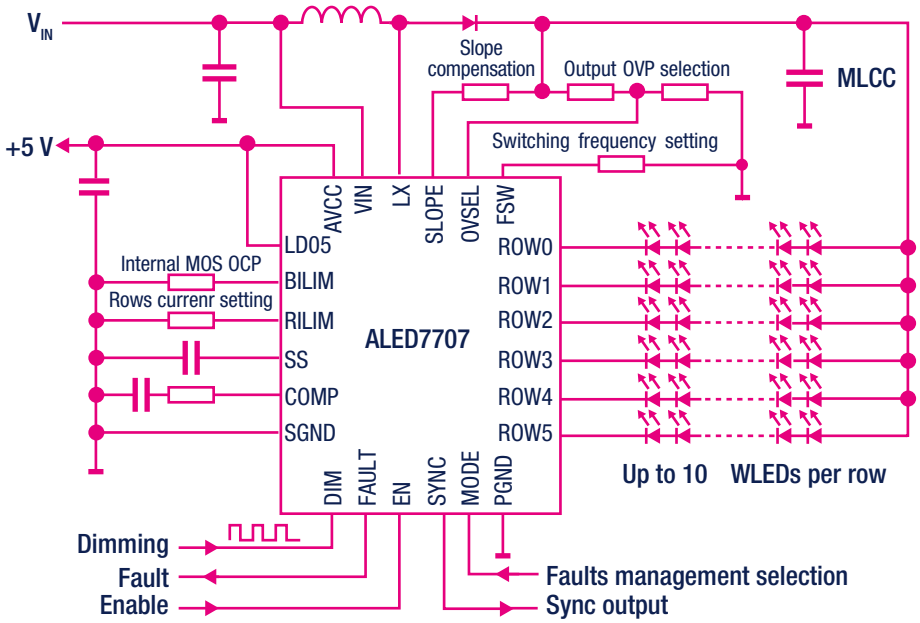


LED ROW DRIVERS

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.

ALED7707 application diagram



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

- Automotive interior and exterior lights
- Dashboard and Infotainment backlighting
- Front Light DRL (Daytime Running Light)
- HUD (Head Up Display)

STEVAL-ILL067V1: Six-channel ALED7707-based LED driver with embedded boost converter for automotive interior lighting and TFT backlighting

LED row drivers

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	0 to 60	Defined by system design	PWM-dimming, integrated boost controller, buck-boost and SEPIC topologies supported, very low shutdown current: ISHDN < 10µA , external synchronization for multi-device applications, overcurrent protection, thermal shutdown with auto restart, output short detection, LED constant current control loop	100 kHz to 1 MHz	HTSSOP16 exposed pad
ALED6000 (*)	1	4.5 to 60	0 to 60	3A	Adjustable fSW (250 kHz – 1.5 MHz), OC and thermal protection with auto-recovery, adjustable soft-start time, Dimming function with dedicated pin, adjustable current limitation, external synchronization for multi-device applications, very low shutdown current (10µA typ.), 3% output current accuracy overtemperature	250 kHz to 1.5 MHz	HTSSOP16 exposed pad
ALED7707	6	4.5 to 36	0 to 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 WF) exposed pad
ALED7709 (**)	1	4 to 42	0 to 60	200 mA	Adjustable fSW (250kHz – 2.2MHz) with optional Spread Spectrum Mixed PWM and Analog dimming, Selectable channels phase-shifting and adjustable Rise/Fall time for reducing EMI Synch. Boost and SEPIC controller topologies support Cycle-by-cycle power switch OCP, Input OVP and output SCP, Thermal shutdown LED failure (open and short-circuit) detection	250 kHz to 2.2 MHz	QFN24 (5x5 mm WF) exposed pad

(*) New product
(**) Product under development

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
STEVAL-ILL089V01	1 A buck LED driver board based on the ALED6000	-

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.

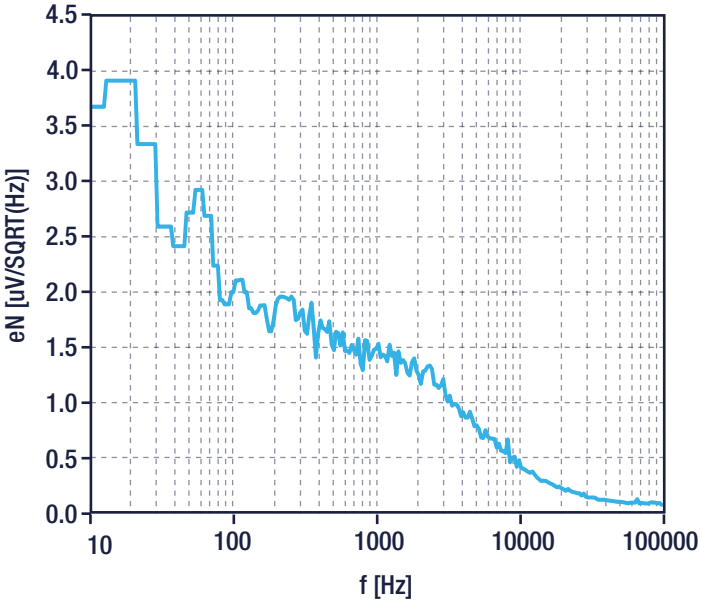
The LDO40L embeds protection functions, such as current limit and thermal shutdown, and is available in DFN6 (3x3 mm) with wettable flanks package.

LDO

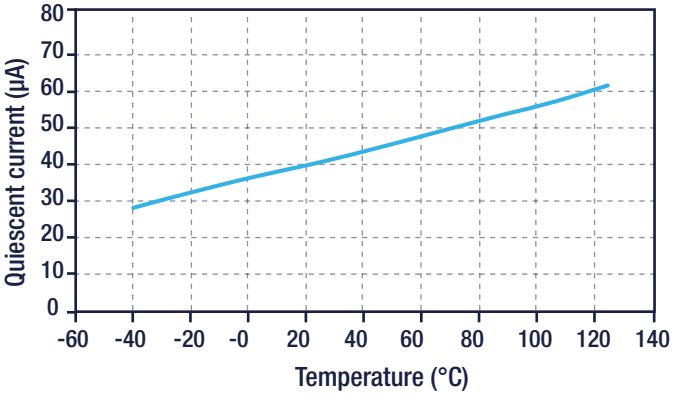
FEATURES

- 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
- Package: DFN6 (3x3 mm with wettable flanks)

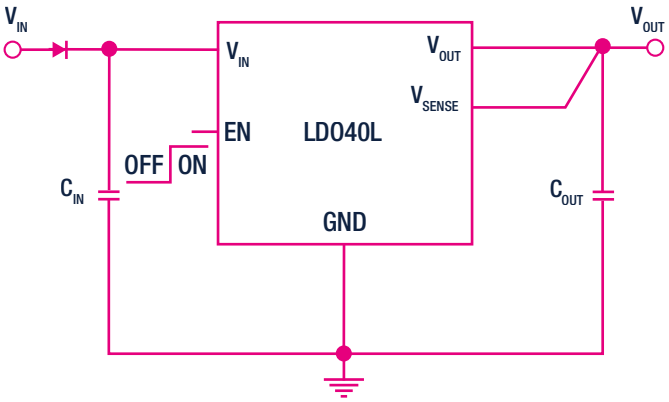
Output noise voltage vs. frequency V_{OUT} = 5 V



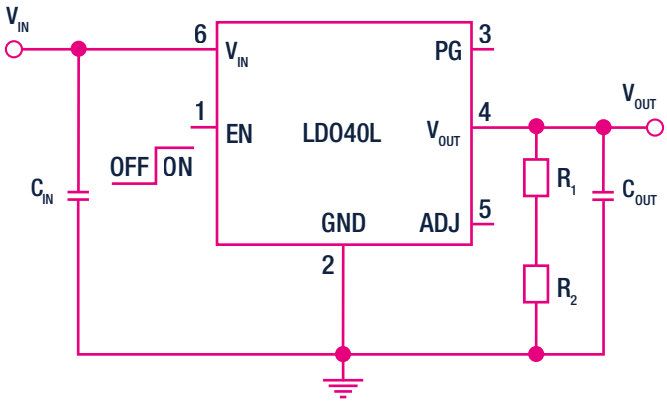
Quiescent current vs temperature
V_{IN} = 38 V, I_{OUT} = 0 mA



LDO40LY application diagram (fixed)



LDO40LY application diagram (adjustable)



LDO conversion from car batteries

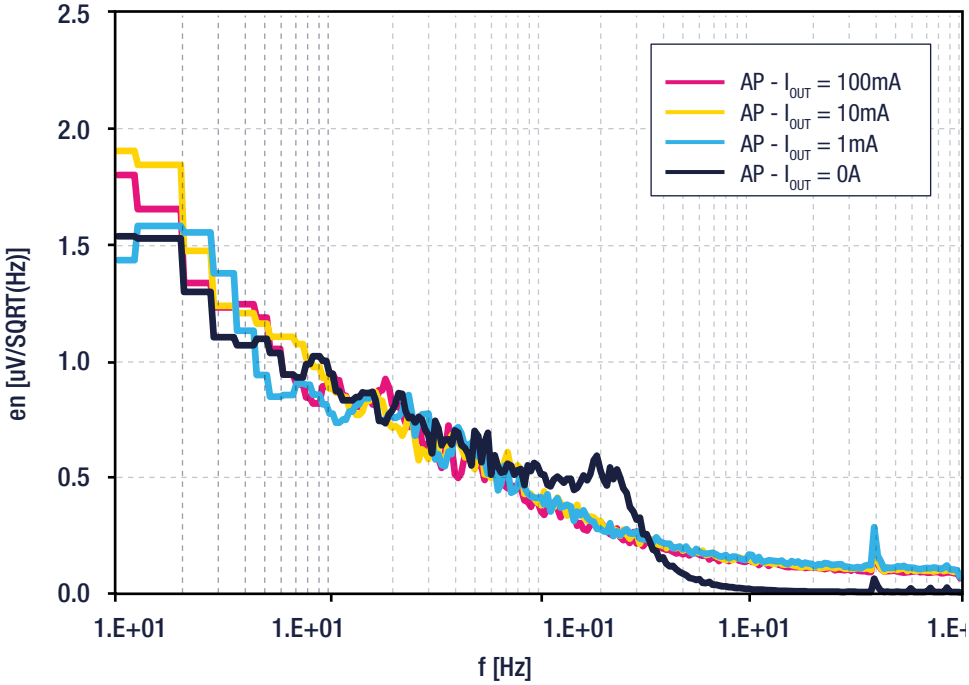
Part number	Operating V_{IN} (V)	AMR V_{IN} (V)	V_{OUT} (V)	I_{OUT} (mA)	Drop-out voltage	I_Q	PSRR @ 1 kHz (dB)	Output noise 10 Hz to 100 kHz	Other features	Package
LDO40LY	5 to 38	40	Adj (2.5 to 11) 3.3 & 5	400	140 mV@400 mA	45 µA	73	20 µV	Enable pin, low noise. OC and thermal protection	DFN6 (3x3 mm WF) exposed pad
LFXX	2.5 to 16	40	2.5, 3.3, 5.0, 8.0, 8.5	500	400 mV at 500 mA	500 µA	77	50 µV	Inhibit pin, Input OV protection, OC and thermal protection	DPAK
LD1086Y	2.85 to 30	30	Adj (1.25 to 24)	1500	1.3 V at 1500 mA	5 mA	68	150 µV at 5V	1% output tolerance @ 25°C 2% tolerance full temp range OC and thermal protection	DPAK

LDO POST-REGULATION

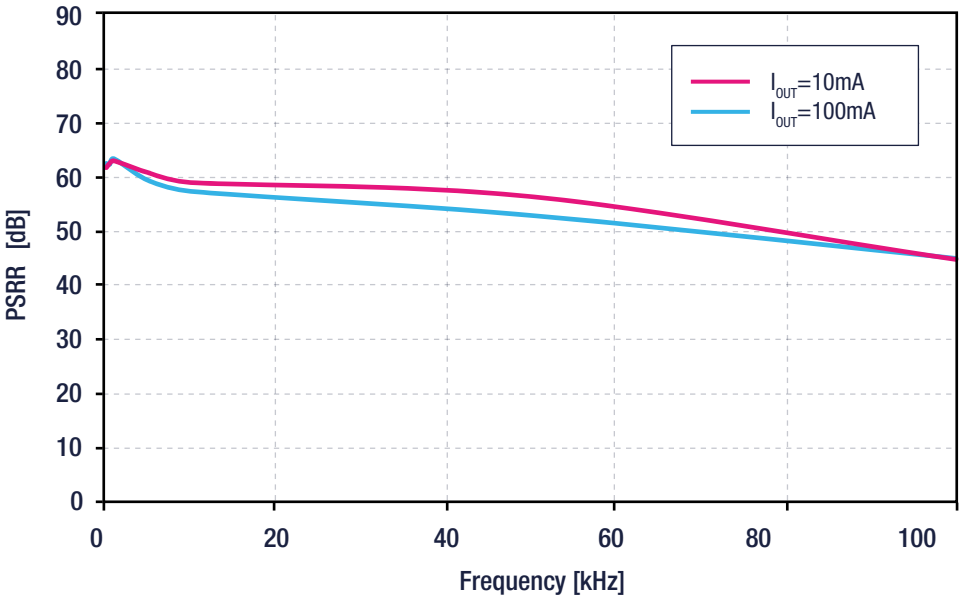
LD49100: 1 A small package and low quiescent current voltage regulator for all needs

The LD49100 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 LD49100 in shutdown mode, allowing a total current consumption lower than 1 µA. The device features a tight and precise Power Good indicator, useful for monitoring and sequencing functions. Internal 1 ms soft-start circuit allows the reduction of inrush current. The device also includes short-circuit constant current limiting and thermal protection. The LD49100 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)



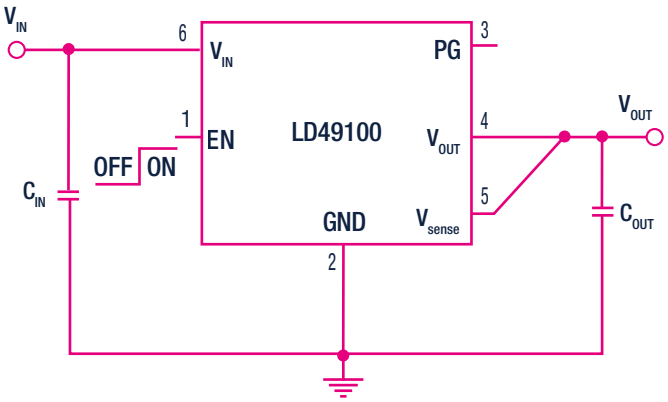
MAIN FEATURES

- Input voltage: 1.5 to 5.5 V
- 1 A guaranteed output current
- Ultra-low dropout voltage: 200 mV (typ.) at 1 A load
- Very low quiescent current: 20 µA (typ.) at no load
- Enable, Power Good signal
- Soft Start (1ms)
- Output voltage tolerance:
- ±2.0 % at 25 °C

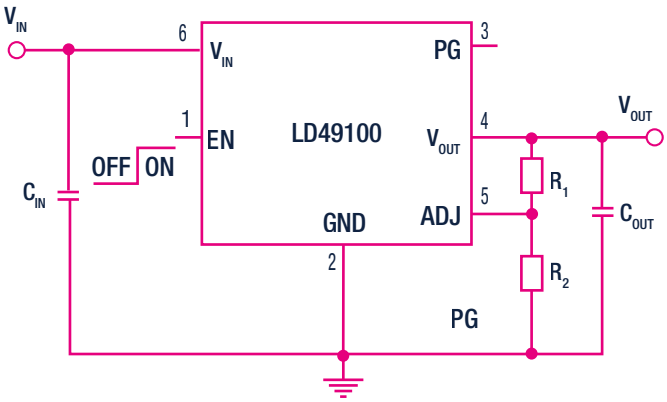
MAIN APPLICATIONS

- In-cabin ECU
- Infotainment/Dashboard: Cluster, Radio-Navigator, HUD, secondary displays
- ADAS: Rear and Front cameras, Radars, Sensors
- Telematics central unit

LD49100 application diagram (fixed)



LD49100 application diagram (adjustable)

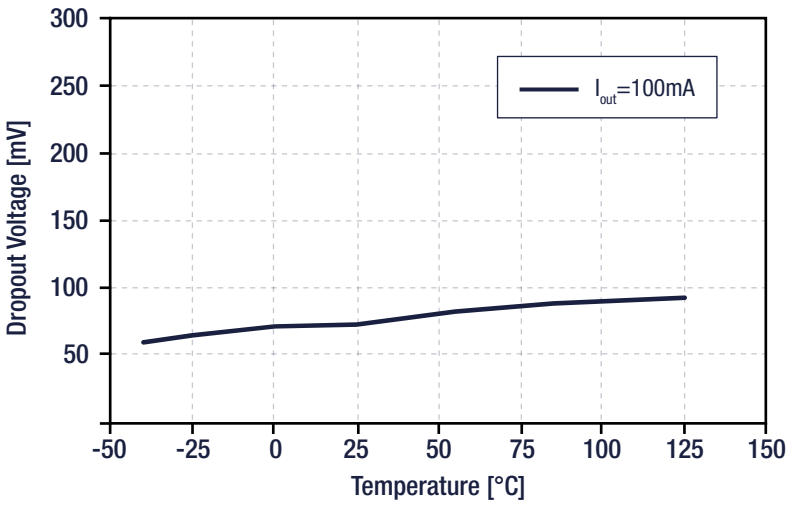


LDK130: 300 mA SOT-23 cost effective, low noise voltage regulator

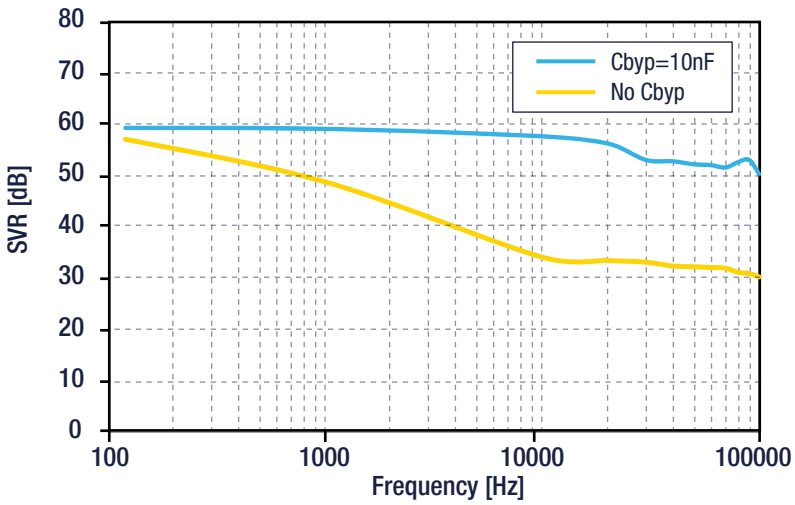
The LDK130 low-dropout voltage regulator provides 300 mA of maximum current from an input supply voltage in the range of 1.9 to 5.5 V, with a typical dropout voltage of 100 mV. It is stabilized with a ceramic capacitor on the output.

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 SOT23-5L package is the perfect choice for a cost-sensitive applications.

Dropout voltage vs. temperature



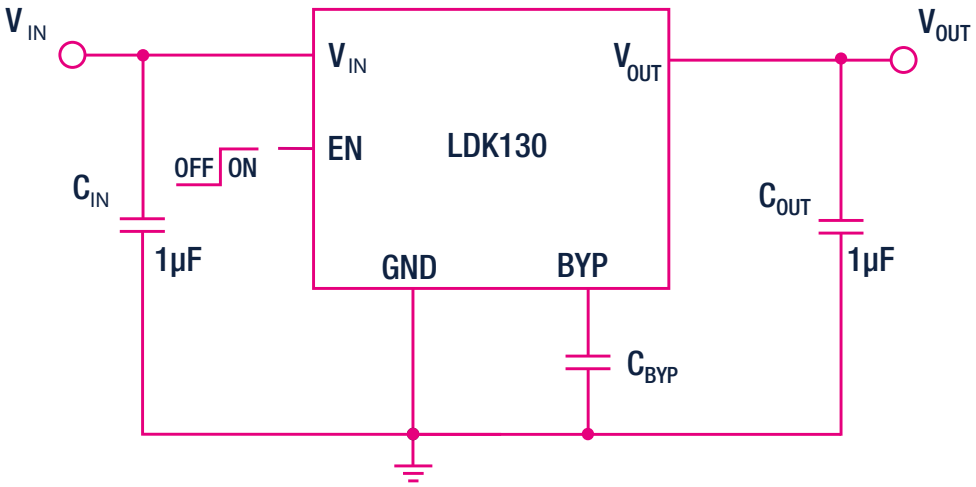
Supply voltage rejection vs freq. V_{OUT} = 2.5 V



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
- Over Current (OC) and Thermal protection
- Package: SOT23-5L

LDK130 typical application diagram



LDO

LDO post-regulation

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	Other features	Package
LD1086Y	2.85 to 30	30	Adj. (1.25 to 24)	1.5 A	1.3 V at 1.5 A	5 mA	68	0.003% of V_{out}	1% output tolerance @ 25°C 2% tolerance full temp range OC and thermal protection	DPAK
LDS3985Y	2.5 to 6	6	1.8 & 3.3	300 mA	150 mV at 300 mA	85 µA	55	30 µV	ENABLE, BYPASS for NR OC and thermal protection	DFN6 (3x3 mm WF) exposed pad
LD39100Y	1.5 to 5.5	7	Adj. (0.8 to 5) 1.2, 1.8, 2.5, 3.3	1 A	200 mV at 1 A	25 µA	70	30 µV	1% output tolerance @ 25°C 2% tolerance full temp range OC and thermal protection	DFN6 (3x3 mm WF) exposed pad
LD49100Y	1.5 to 5.5	7	Adj. (0.8 to 5) 1.0, 1.2, 1.8 2.5, 3.3	1 A	200 mV at 1 A	25 µA	70	30 µV	ENABLE, PGOOD, SOFT-START, remote sensing OC and thermal protection	DFN6 (3x3 mm WF) exposed pad
LDK130Y	1.9 to 5.5	7	1.1, 1.5, 1.8 2.2, 2.8, 3.3	300 mA	100 mV at 100 mA	30 µA	60	50 µV	ENABLE, BYPASS for NR, OC and thermal protection	SOT23-5L
LD59150Y	0.8 to 5.5 2.7 to 5.5	6	Adj. (0.8 to 3.6)	1.5 A	65 mV at 1.5 A	1 mA	70	25 µV	BIAS pin, ENABLE, program. SOFT-START, PGOOD OC and thermal protection	DFN10 (3x3 mm WF) exposed pad

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.

Logic ICs

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

USB-C and PD controllers

STUSB1700Y AND STUSB4700Y: USB-C AND PD CONTROLLERS FOR AUTOMOTIVE APPLICATIONS

Designed to address 15W charging (STUSB1700Y) or 60W charging (STUSB4700Y) in automotive applications, STUSB1700Y and STUSB4700Y are respectively USB-C and Power delivery standalone controller ICs. Paired with an appropriate power management IC, they are effective solutions for quick design of single or dual port satellites offering a maximum charging speed for Smartphone, Tablets, Notebook, portable gaming accessories or portable displays, drones etc…

Being hardwired controllers packaged in QFN with wettable flancks, STUSB1700Y and STUSB4700Y are robust, safe and interoperable controllers which received AEC-Q100 qualification at +105°C.

MAIN FEATURES

- Automotive Grade
- Internal VBUS Discharge
- Shorts-to-VBUS protection
- Vdd = [4.1V; 22V]
- Operating temperature range: -40 to +105 °C
- Package: QFN-24 wettable flancks

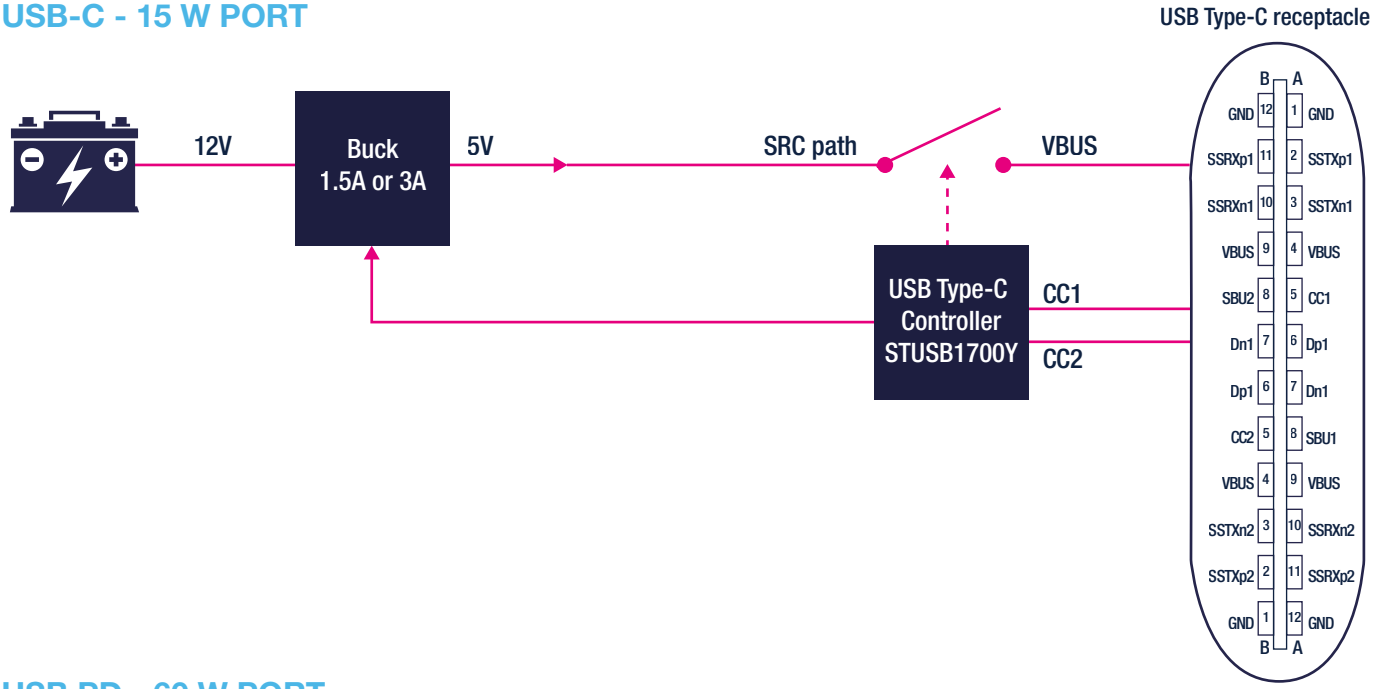
MAIN APPLICATIONS

- USB car chargers
- Front seats and Rear seats charging
- 12 V car chargers accessories
- Infotainment systems
- E-bikes

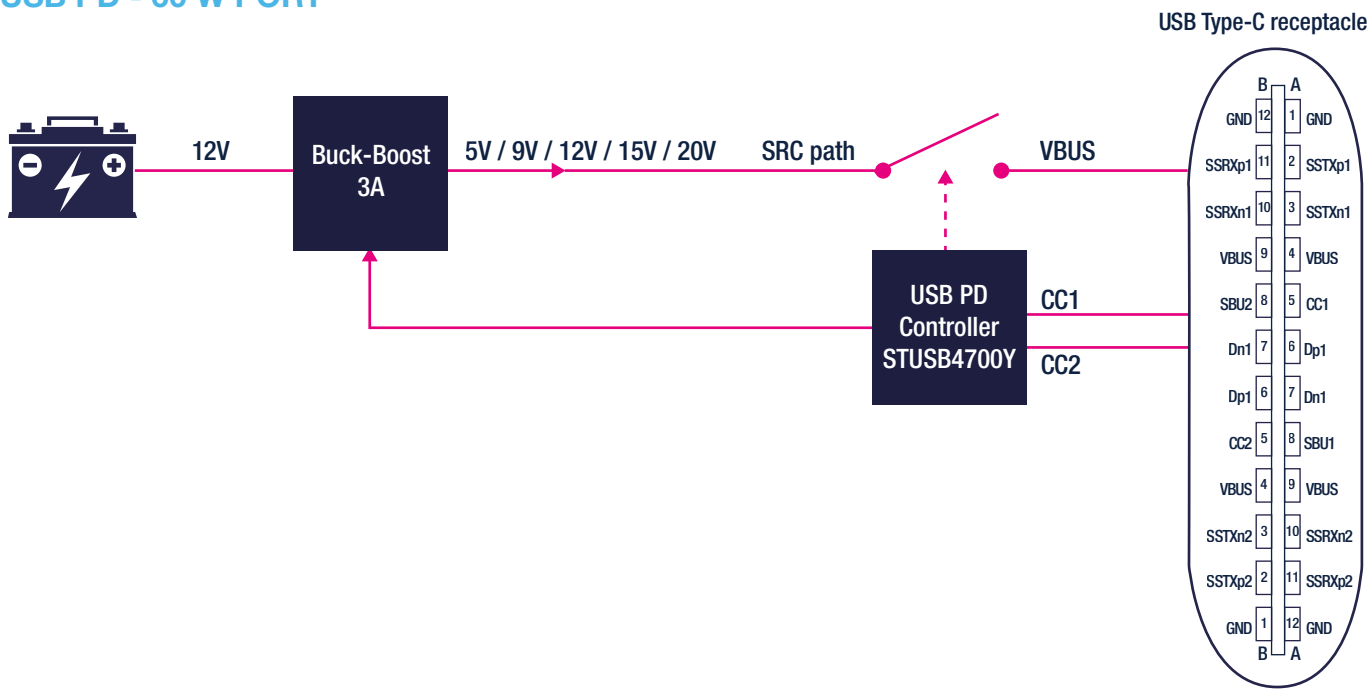
USB-C

Part number	Description	Role	Typical Power	Operating temperature (°C)		Package
				Min	Max	
USB-C and PD controller						
STUSB1700Y	USB-C controller	Source	Up to 5 V; 3 A	-40	+105	QFN24 4x4 Wettable flanks
STUSB4700Y	USB PD controller	Source	Up to 20 V; 3 A	-40	+105	QFN24 4x4 Wettable flanks

USB-C - 15 W PORT



USB PD - 60 W PORT



Voltage references

SHUNT VOLTAGE REFERENCES

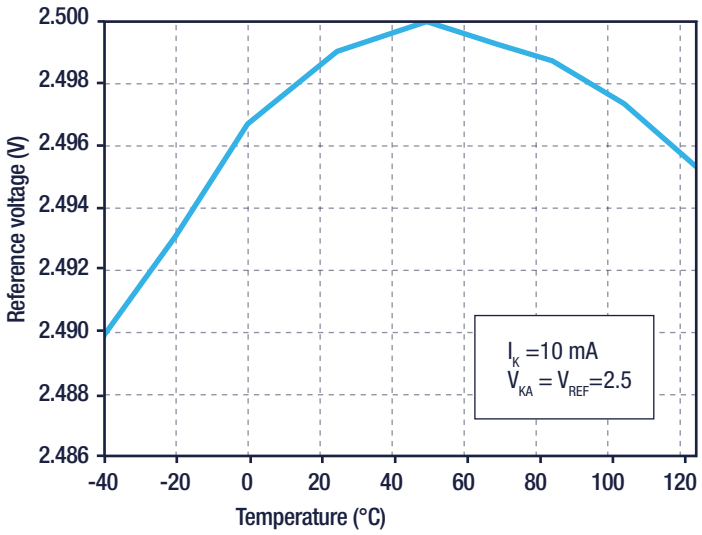
TL1431: adjustable precision voltage reference

The TL1431 is a programmable shunt voltage reference with guaranteed 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 throughout a wide current range from 1 to 100 mA with a typical dynamic impedance of 0.2 Ω.

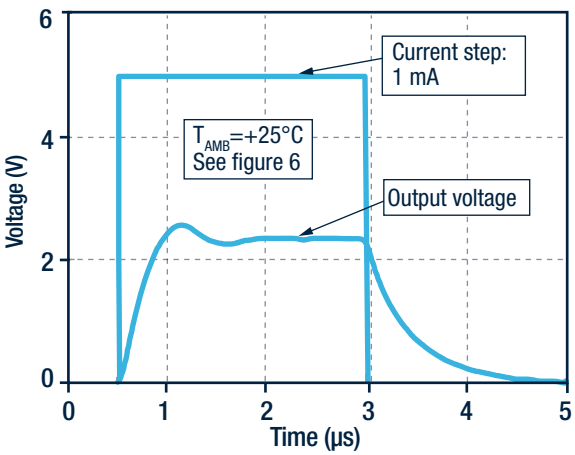
FEATURES

- Adjustable output voltage: VREF 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
- Package: SO8

Reference voltage vs. temperature



Pulse response for I_k = 1 mA



Shunt voltage references

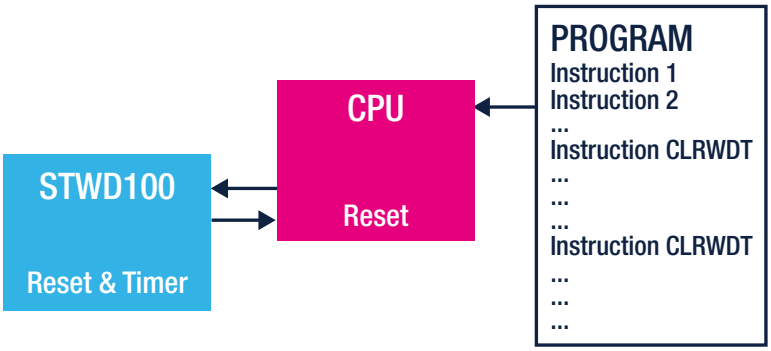
Part number	Adjustable	V_{REF} (V)	Reference Input voltage (V)	Initial accuracy (±)	Temperature coefficient max ppm / °C	Sink current range	Operating temperature range	Package
TL431AIYDT	Yes	2.5 to 36	2.5	1 %	± 30	1 mA to 100 mA	-40 to +125 °C	SO8
TL431IYDT				2 %				
TL1431AIYDT		2.5 to 36	2.5	0.25 %	± 30	1 mA to 100 mA	-40 to +125 °C	
TL1431IYDT				0.4 %				
TS431IYLT		1.24 to 6	1.24	2 %	± 21	60 µA to 30 mA	-40 to +125 °C	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 in BLDC motor applications

APPLICATION NOTE AN5423 SUMMARY

Introduction

The brushless DC motor is becoming more and more popular in domains such as industrial automation, automotive, medical and health care appliance thanks to their high reliability and durability.

Different techniques can be used to sense the current, but one of the most effective uses the in-line phase current. This method requires the use of dedicated current sensing ICs able to work with common mode largely higher than the power supply, and with an especially good and fast response time to fast common mode step variations.

Inline phase current

The configuration shown in Figure 1 is the best method to know precisely the current flowing into the motor. And this current measurement offers the best information that can be used in feedback motor control, in order to optimize the motor performance.

As the shunt resistor is placed directly in line with the PWM driver, it requires the use of dedicated current sensing able to reject fast common mode variations.

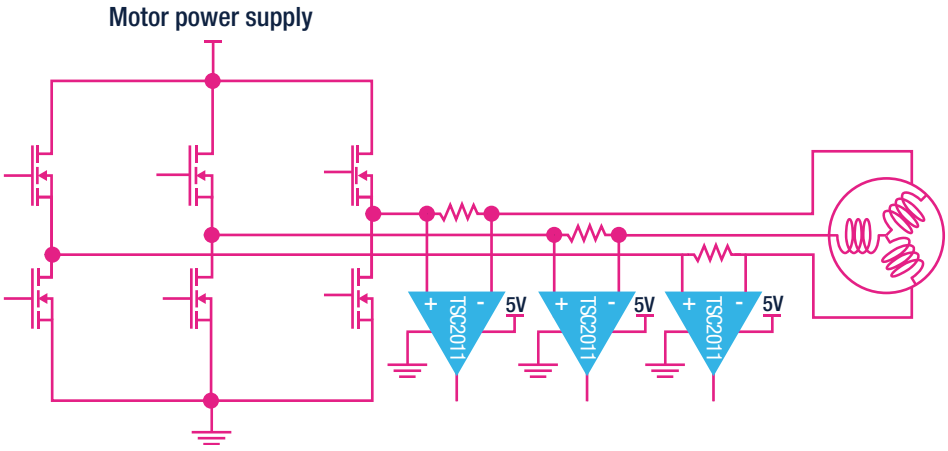


Figure 1: Inline phase current sensing

The TSC2011 is a bidirectional high side current sensing amplifier designed for use in such a configuration.

The main advantage of this topology is that the current can be read without a strong linkage to the PWM status and without timing limitations in the event a very small PWM signal is applied to the phase (low side current sensing can only be executed while the low side transistor of that leg is on).

It also can detect phase short-circuits.

Theoretical maximum error calculation

The principal sources of error that can be seen on the TSC2011 output are mainly due to input offset voltage, gain error and common mode rejection ration. In addition, the accuracy of the shunt resistor should be taken into account. The maximum total error expected on the output of the device can be described as the sum of these different sources as described by equation (1).

$$Vout = G\left(1 + \varepsilon G + \left|\frac{dG}{dT}\right| * |\Delta T|\right) \cdot \left(Rshunt\,(1 + eshunt) \cdot (Isense) + \left(Vio + \left|\frac{dVio}{dT}\right| * |\Delta T|\right) + \left(\frac{(Vicm - 12V)}{CMRR}\right)\right) + \left(\frac{Vref1 + Vref2}{2}\right)(1 + erref) + Noise \quad (1)$$

It is important to note that this has been calculated using all the maximum values and all errors have been added to each other, meaning that the chance to get this worst case condition is extremely low, and the error in the most parts of the application will be largely smaller.

The noise can be then expressed as two times the first one related to the 1/f noise and the second due to the white noise. As the noise is bandwidth-dependent, the higher the application's bandwidth, the greater the noise.

So the RMS value of the output noise given in VRMS is the integration of the spectral noise over a dedicated bandwidth BW can be expressed by equation (2):

$$enRMS = \left(\sqrt{\int_{0.1}^{10000}\left(\frac{196.10^{-9}}{\sqrt{f}\sqrt{1+\frac{10}{f}}}\right)^2 df + \int_{0.1}^{BW(Hz)\frac{\pi}{2}}(29.10^{-9})^2\,df}\right) * Gain$$

Figure 2 represents the total error in % on the output at ambient and 125°C, for Vicm=12V, by using a shunt of 20mΩ at 1% and a current flowing into one motor phase in the range of [0.2 to 2A].

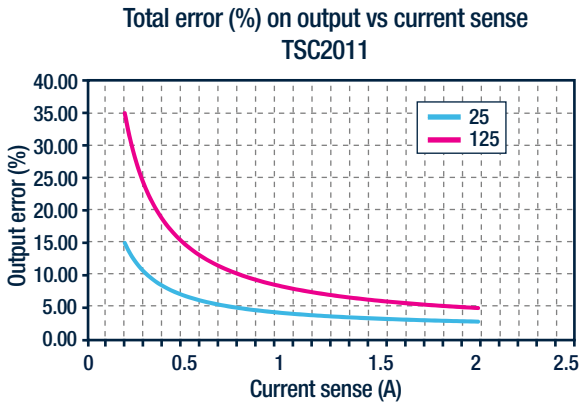


Figure 2: Total error vs current @Vicm=12V

TSC2011 in motor application

Figure 3 shows the response of the TSC2011 in the application described by Figure 1.

Only one phase current motor out of three has been measured.

The PWM frequency of the motor is 20 kHz, represented by the blue curve in Figure 3.

The current flowing in one phase of the motor is in the range of 2.5A, for a 7000 rpm motor speed.

The pink curve is issued from a current probe placed on the same phase than the shunt resistance. The green curve represents the output of the TSC2011, after a RC filter (154 kHz), and shows the good signal integrity of the TSC2011.

On the fast transition of the current, a response time of less than 5µs can be observed, due to the TSC2011 response time to a fast-common mode transition and the RC filter constant time.

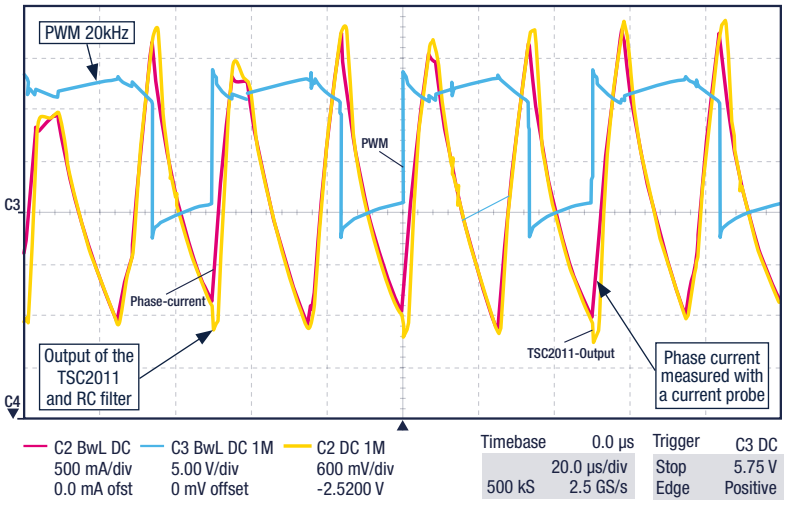


Figure 3: behavior of the output of the TSC2011 in a motor application.

Conclusion

In motor control applications, the ability to measure current is essential in order to provide feedback about the motor. When an accurate measurement of the phase current is critical, for example in electric power steering or e-turbo applications or when functional safety is a must, inline current sensing is very good solution.

Thanks to their good response time to a fast step variation on input common mode voltages, ST's TSC20xx series of precision bidirectional current sense amplifiers is a good choice for these kinds of applications. Our high-voltage bidirectional current sense amplifier evaluation kit based on the TSC2010, TSC2011 and TSC2012 (STEVAL-AETKT1V2) is a good way to get started.

Inside the STEVAL-AETKT1V2 evaluation kit, there are one main board and three daughter boards for the TSC2010, TSC2011 and TSC2012.

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

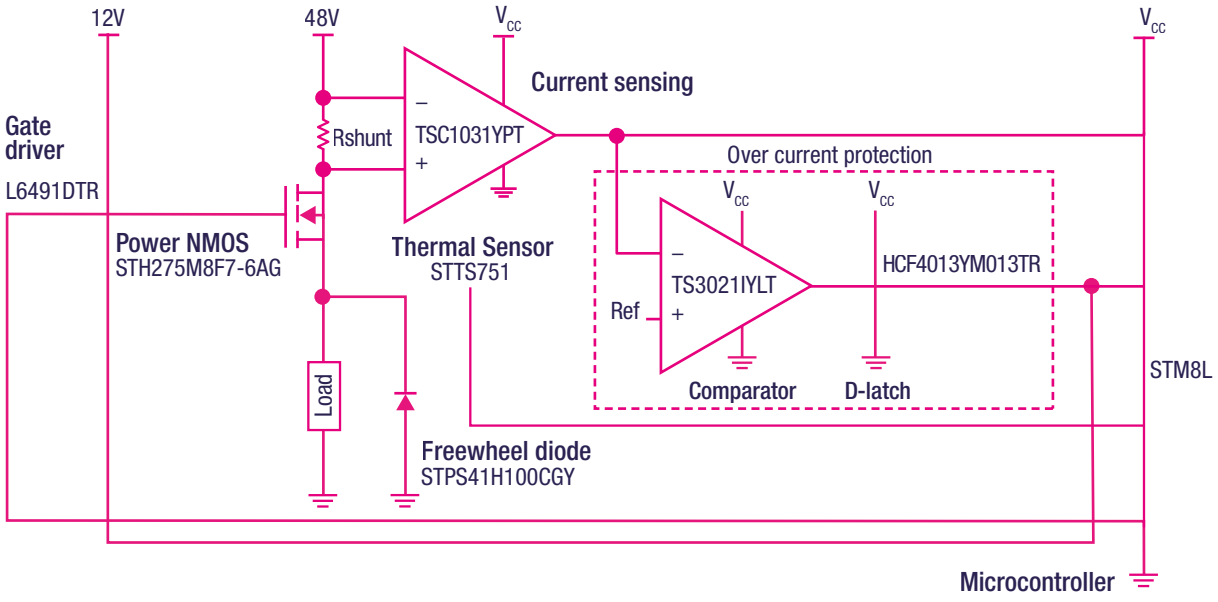
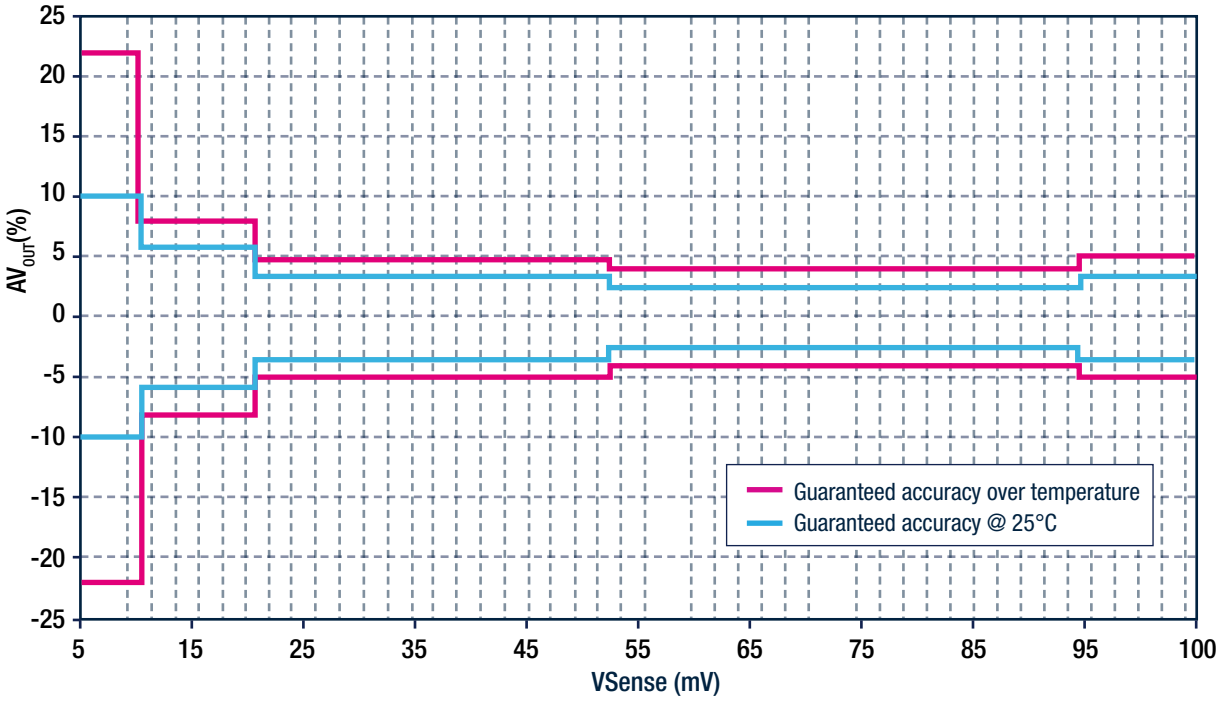


Figure 2 describes the maximum guaranteed error, which can happen on the output of the TSC1031 at 25°C and for over-temperature conditions

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.

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STEP 2

- Select the type of product family

STEP 3

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

…you can then

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- 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

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