Micropower high precision series voltage reference

QFN8 1.5x1.5

Maturity status link
TS33

Features

- Fixed 1.25 V,1.8 V, 2.048 V, 2.5 V, 3.0 V, 3.3 V 4.096 V, 5.0 V output voltage
- Ultra low operating current: 3.9 µA (typ.) at 25 °C
- High initial accuracy: +/-0.15 %
- Stable when used with capacitive loads
- Extended temperature range: -40 to +125 °C
- 30 ppm/°C maximum temperature coefficient
- Available in QFN8 1.5x1.5 package

Applications

- Portable equipment
- Data acquisition systems
- Instrumentation
- Medical equipment
- Test equipment

Description

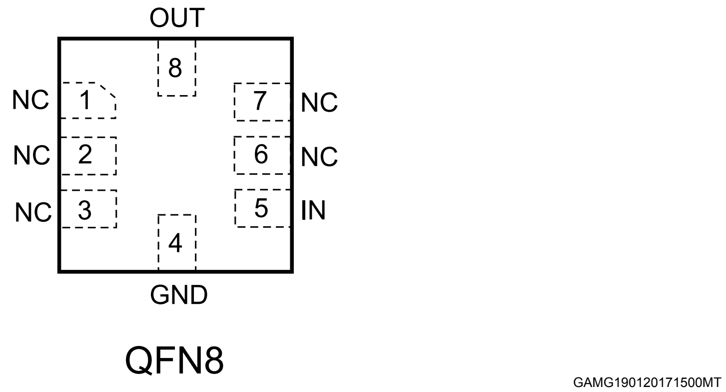
The TS33 family of low power series voltage references is capable of providing stable and precise output voltages with an initial accuracy of 0.15% over an extended temperature range (-40 to +125 °C).

The ultra low operating current is a key advantage for power-restricted designs. In addition, the TS33 is very stable over the entire operating temperature range, making it suitable for high-precision applications.

Available in QFN8 surface mount packages, the TS33 can be designed in applications where space saving is a critical issue.

1 Pin configuration

Figure 2. Pin configuration (top view)



2 Maximum ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{IN}	Maximum input voltage	-0.3 to 7	V
V_{OUT}	Maximum voltage on the output pin	-0.3 to V_{IN} +0.3	V
I_{OUT}	Output short-circuit current (sinking/sourcing)	Internally limited	mA
Pd	Power dissipation (1)	700	mW
T_{stg}	Storage temperature	-65 to +150	°C
ESD	Human body model (HBM)	4	kV
	Charged device model	1000	V
T_{lead}	Lead temperature (soldering) 10 s	260	°C
T_j	Max junction temperature	+150	°C

1. *Pd has been calculated with T_{amb} = 25 °C and T_{jmax} = 150 °C*

Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

Table 2. Thermal data

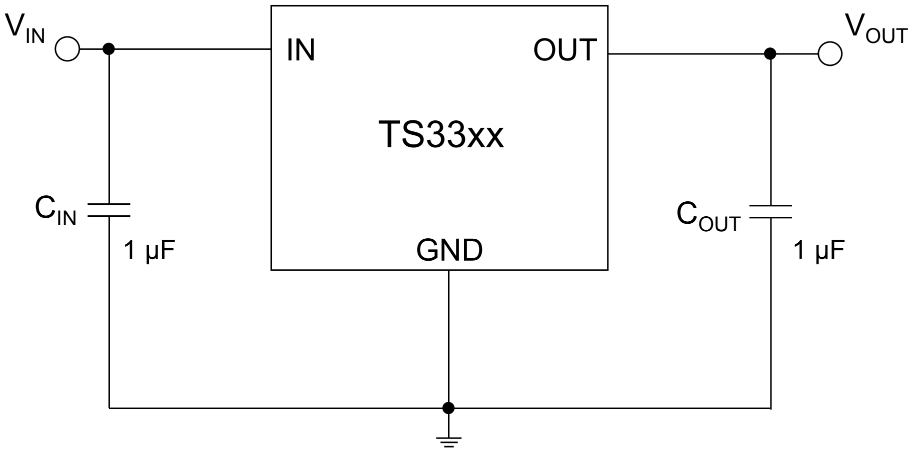
Symbol	Parameter	Value	Unit
R_{thJA}	Thermal resistance junction-ambient	159	°C/W
R_{thJC}	Thermal resistance junction-case	103	°C/W

Table 3. Recommended operating conditions

Symbol	Parameter	Value	Unit
V_{IN}	Operating input voltage range	1.8 to 5.5	V
I_{OUT}	Maximum operating current	±5	mA
T_{oper}	Operating free air temperature range	-40 to +125	°C

3 Typical application

Figure 3. Typical application circuit



4 Electrical characteristics

V_{IN} = 5 V, I_{LOAD} = 0 mA, T_{amb} = 25 °C (unless otherwise specified).

Table 4. Electrical characteristics for TS3312

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
V_{IN}	Minimum input voltage	I_{LOAD} = 0 mA T_{amb} = 25 °C	1.8			V
V_{OUT}	Output voltage	V_{IN} = 5 V I_{LOAD} = 0 mA T_{amb} = 25 °C		1.25		V
	Initial accuracy		-0.15		0.15	%
$\Delta V_{OUT}/\Delta T$	Average temperature coefficient	-40 °C < T_{amb} < +85 °C		9	30	ppm/°C
		-40 °C < T_{amb} < +125 °C		8	30	
$\Delta V_{OUT}/\Delta V_{IN}$	Line regulation	V_{IN} = 1.8 V to 5.5 V	-50	6	+50	ppm/V
		0 °C < T_{amb} < 70 °C		6		
		-40 °C < T_{amb} < +85 °C		8		
		-40 °C < T_{amb} < +125 °C		30		
$\Delta V_{OUT}/\Delta I_{LOAD}$	Load regulation	V_{IN} = 1.8 V	-50	6	+50	ppm/mA
		I_{LOAD} = ±5 mA 0 °C < T_{amb} < 70 °C		10		
		-40 °C < T_{amb} < +85 °C		20		
		-40 °C < T_{amb} < +125 °C		20		
I_{SC}	Short-circuit current sourcing/ sinking			35		mA
I_Q	Quiescent current			3.9	7	µA
		-40 °C < T_{amb} < +85 °C		4.4	7.5	
		-40 °C < T_{amb} < +125 °C		4.8	10	
C_{OUT}	Capacitive load		0.1		10	µF
T_{ON}	Turn-on settling time	to 0.1 %, C_{OUT} = 1 µF		2		ms
e_n	Noise floor	f = 0.1 Hz to 10 Hz		35		μV_{P-P}

Table 5. Electrical characteristics for TS3330

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output voltage	V_{IN} = 5 V		3.0		V
	Initial accuracy	I_{LOAD} = 0 mA T_{amb} = 25 °C	-0.15		0.15	%
$\Delta V_{OUT}/\Delta T$	Average temperature coefficient	-40 °C < T_{amb} < +85 °C		9	30	ppm/°C
		-40 °C < T_{amb} < +125 °C		8	30	
$\Delta V_{OUT}/\Delta V_{IN}$	Line regulation	V_{IN} = 3.2 V to 5.5 V	-50	6	+50	ppm/V
		0 °C < T_{amb} < 70 °C		6		
		-40 °C < T_{amb} < +85 °C		8		
		-40 °C < T_{amb} < +125 °C		30		
$\Delta V_{OUT}/\Delta I_{LOAD}$	Load regulation	V_{IN} = 3.2 V	-50	6	+50	ppm/mA
		I_{LOAD} = ±5 mA 0 °C < T_{amb} < 70 °C		10		
		-40 °C < T_{amb} < +85 °C		20		
		-40 °C < T_{amb} < +125 °C		20		
V_{DROP}	Minimum dropout voltage	V_{IN} = 3.2 V I_{LOAD} = ±5 mA		50	100	mV
		0 °C < T_{amb} < 70 °C		70		
		-40 °C < T_{amb} < +85 °C		75		
		-40 °C < T_{amb} < +125 °C		80		
		I_{LOAD} = ±2 mA -40 °C < T_{amb} < +85 °C			70	
I_{SC}	Short-circuit current sourcing/ sinking			35		mA
I_Q	Quiescent current			3.9	7	µA
		-40 °C < T_{amb} < +85 °C		4.4	7.5	
		-40 °C < T_{amb} < +125 °C		4.8	10	
C_{OUT}	Capacitive load		0.1		10	µF
T_{ON}	Turn-on settling time	to 0.1 %, C_{OUT} = 1 µF		2		ms
e_n	Noise floor	f = 0.1 Hz to 10 Hz		67		μV_{P-P}

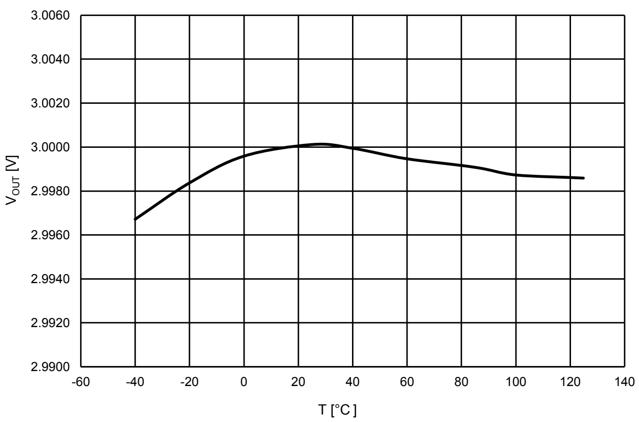
Table 6. Electrical characteristics for TS3333

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output voltage	V_{IN} = 5 V		3.3		V
	Initial accuracy	I_{LOAD} = 0 mA T_{amb} = 25 °C	-0.15		0.15	%
$\Delta V_{OUT}/\Delta T$	Average temperature coefficient	-40 °C < T_{amb} < +85 °C		9	30	ppm/°C
		-40 °C < T_{amb} < +125 °C		8	30	
$\Delta V_{OUT}/\Delta V_{IN}$	Line regulation	V_{IN} = 3.5 V to 5.5 V	-50	6	+50	ppm/V
		0 °C < T_{amb} < 70 °C		6		
		-40 °C < T_{amb} < +85 °C		8		
		-40 °C < T_{amb} < +125 °C		30		
$\Delta V_{OUT}/\Delta I_{LOAD}$	Load regulation	V_{IN} = 3.5 V	-50	6	+50	ppm/mA
		I_{LOAD} = ±5 mA 0 °C < T_{amb} < 70 °C		10		
		-40 °C < T_{amb} < +85 °C		20		
		-40 °C < T_{amb} < +125 °C		20		
V_{DROP}	Minimum dropout voltage	V_{IN} = 3.5 V I_{LOAD} = ±5 mA		50	100	mV
		0 °C < T_{amb} < 70 °C		70		
		-40 °C < T_{amb} < +85 °C		75		
		-40 °C < T_{amb} < +125 °C		80		
		I_{LOAD} = ±2 mA -40 °C < T_{amb} < +85 °C			70	
I_{SC}	Short-circuit current sourcing/ sinking			35		mA
I_Q	Quiescent current			3.9	7	µA
		-40 °C < T_{amb} < +85 °C		4.4	7.5	
		-40 °C < T_{amb} < +125 °C		4.8	10	
C_{OUT}	Capacitive load		0.1		10	µF
T_{ON}	Turn-on settling time	to 0.1 %, C_{OUT} = 1 µF		2		ms
e_n	Noise floor	f = 0.1 Hz to 10 Hz		73		μV_{P-P}

5 Typical performance characteristics

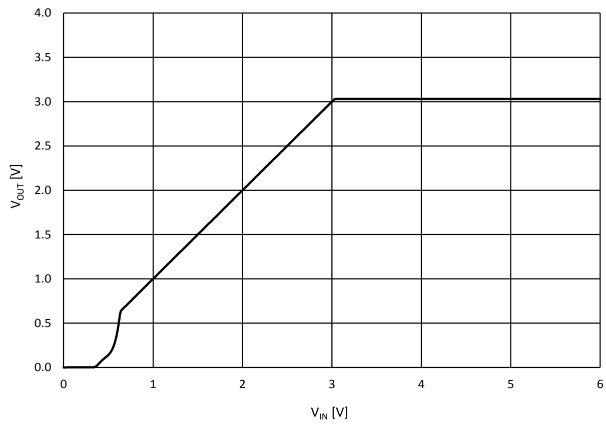
The following plots are referred to the typical application circuit and, unless otherwise noted, at T_A = 25 °C, V_{OUT} = 3.0 V.

Figure 4. Output voltage vs. temperature



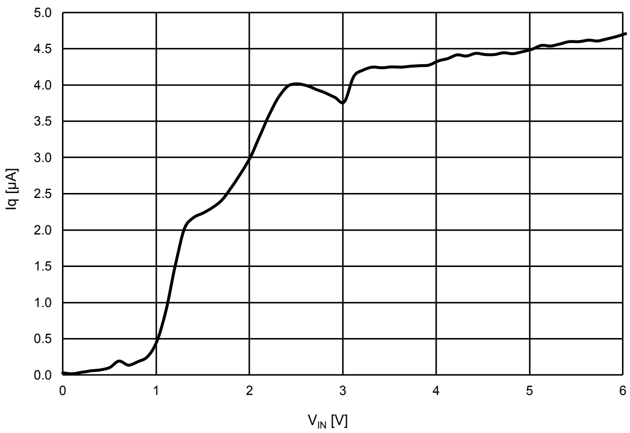
GAMG251120160930MT

Figure 5. Output voltage vs. input voltage



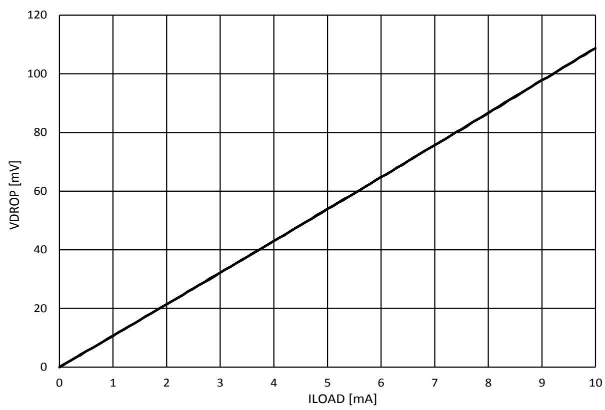
GAMG251120160931MT

Figure 6. Quiescent current vs. input voltage



GAMG251120160932MT

Figure 7. Dropout voltage vs. load current



GAMG251120160933MT

Figure 8. SVR vs. frequency

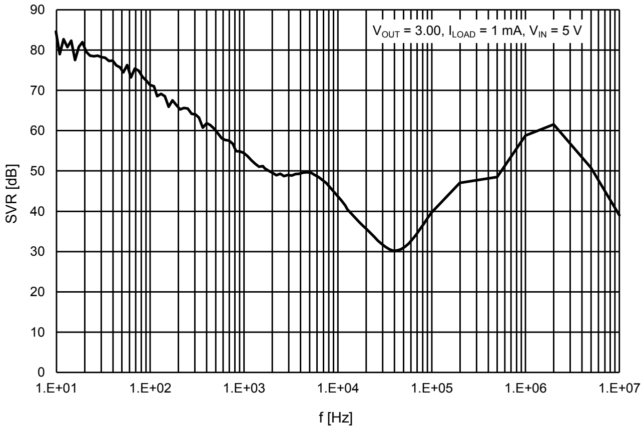
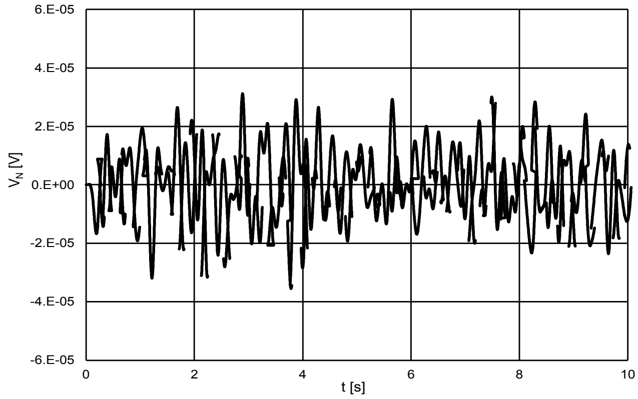


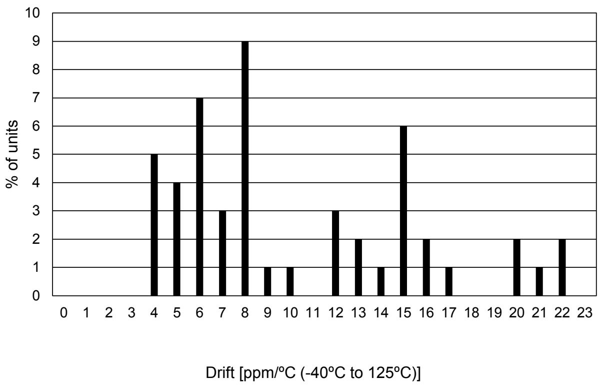
Figure 9. Low frequency noise



V_N = f(t), V_{OUT} = 3.00 V, f = 0.1 - 10 Hz

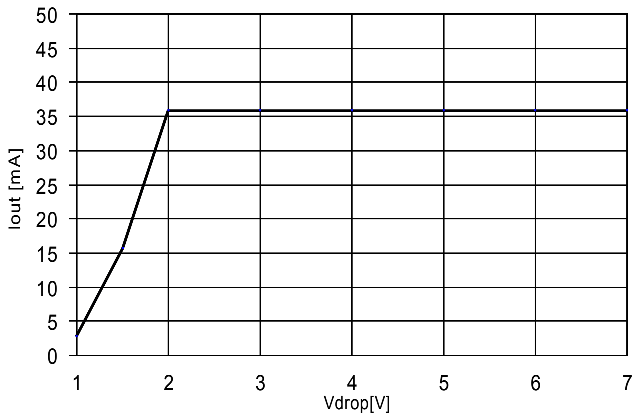
GAMG251120160935MT

Figure 10. Temperature drift



GAMG251120160936MT

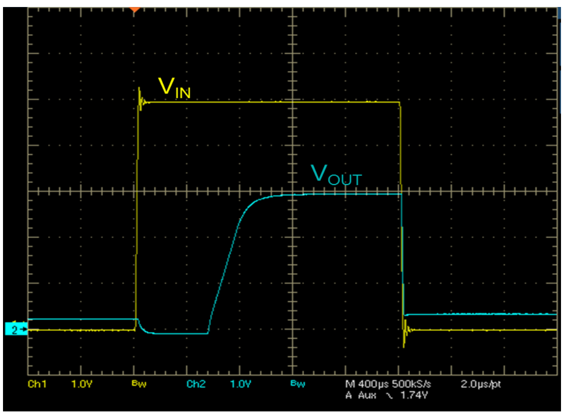
Figure 11. Short-circuit current vs. dropout voltage



T = 25 °C, Cin = 1 µF, Cout = 1 µF

GAMG251120160937MT

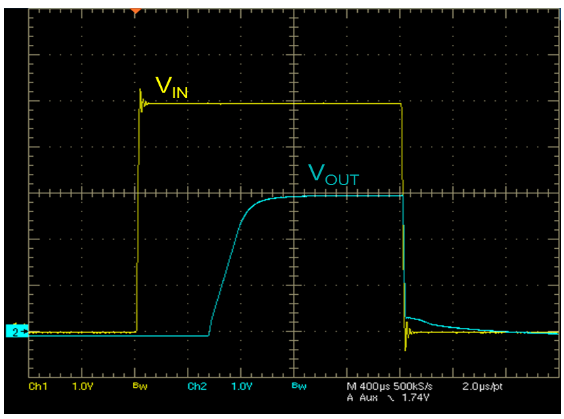
Figure 12. Startup transient (no load)



V_{IN} from 0 to 5V, V_{OUT}=3V, I_{OUT}=0mA, C_{IN}= C_{OUT}= 1µF

GAMG251120160938MT

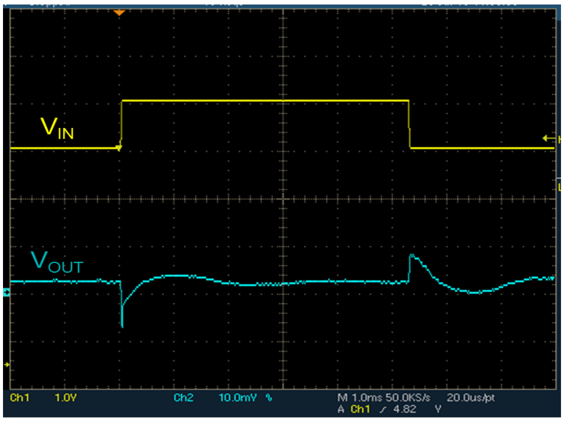
Figure 13. Startup transient (I_{OUT} = 5 mA)



V_{IN} from 0 to 5V, V_{OUT}=3V, I_{OUT}=5mA, C_{IN}= C_{OUT}= 1µF

GAMG251120160939MT

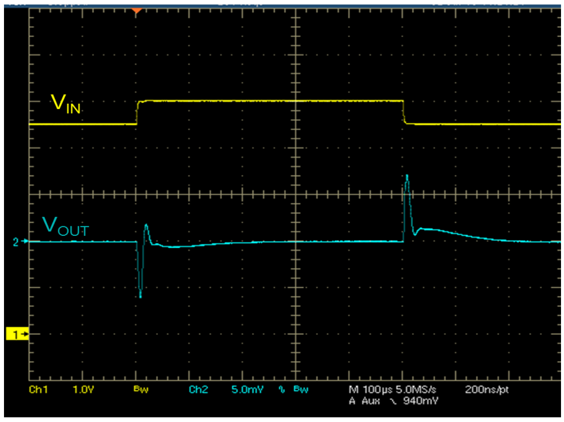
Figure 14. **Line transient (no load)**



V_{IN} = 5V, V_{OUT}=3V, I_{OUT}=0mA, C_{OUT}= 1µF, ΔV_{IN} = 500mV

GAMG251120160940MT

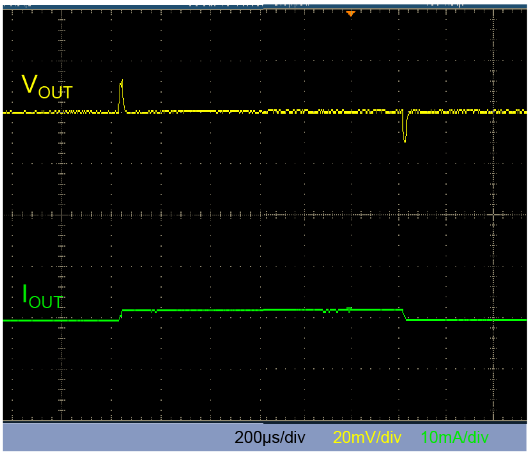
Figure 15. **Line transient (I_{OUT} = 1 mA)**



V_{IN} = 5V, V_{OUT}=3V, I_{OUT}=1mA, C_{OUT}= 1µF, ΔV_{IN} = 500mV

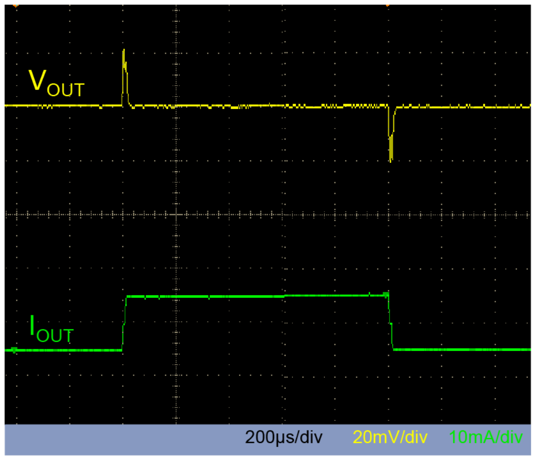
GAMG251120160941MT

Figure 16. **Load transient (I_{OUT} = +/-1 mA)**



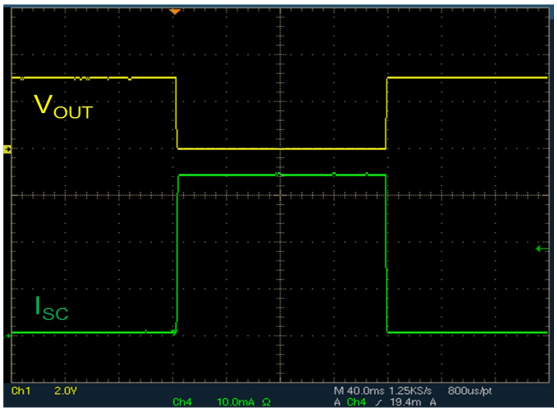
V_{OUT}=3V, I_{OUT}= ± 1mA, C_{IN}=C_{OUT}=1µF

Figure 17. **Load transient (I_{OUT} = +/-5 mA)**



V_{OUT}=3V, I_{OUT}= ± 5mA, C_{IN}=C_{OUT}=1µF

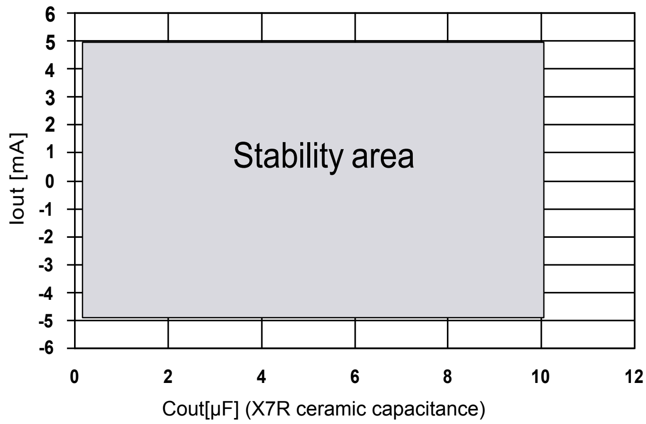
Figure 18. **Short-circuit response**



V_{IN}=5V, T=25°C, C_{IN}=1µF, C_{OUT}=1µF

GAMG251120160944MT

Figure 19. **Stability plan**



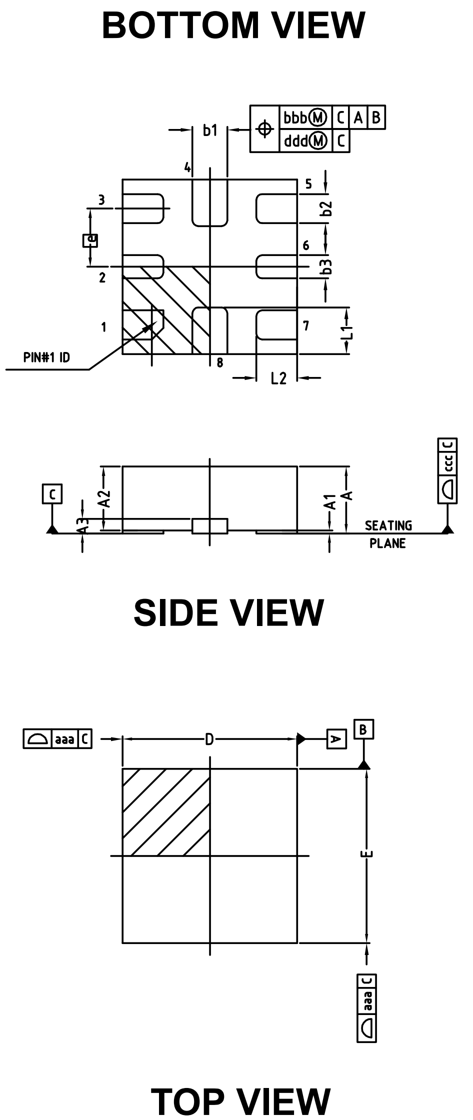
GAMG251120160945MT

6 Package information

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

6.1 QFN8 package information

Figure 20. QFN8 package outline



DM00182817_A

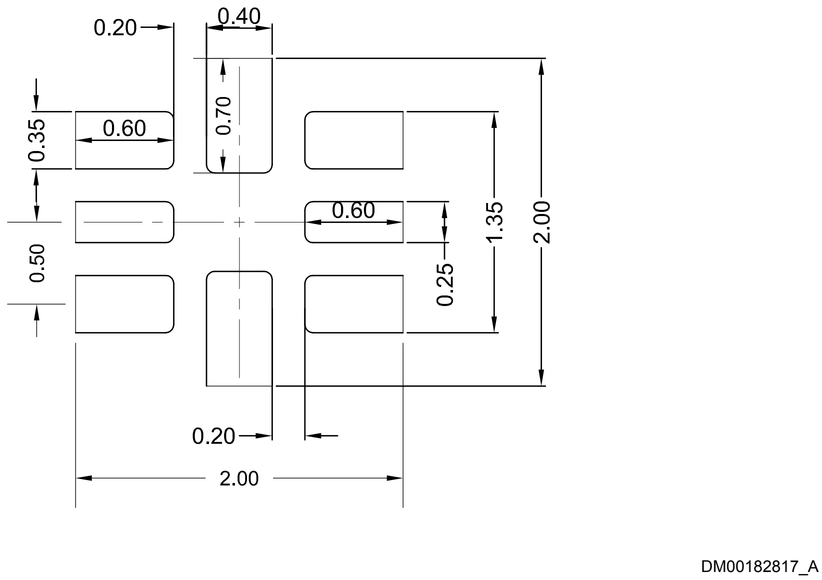
Table 7. **QFN8 mechanical data**

Dim.	mm			Note
	Min.	Typ.	Max.	
A	0.40	-	0.55	4
A1	0.00	-	0.05	12
A2	0.33	0.43	0.53	4
A3		-		4
b1	0.25	0.3	0.35	4.9
b2	0.20	0.25	0.30	
b3	0.15	0.20	0.25	
D	1.40	1.50	1.60	4
e		0.50		4
E	1.40	1.50	1.60	4
L1	0.30	0.40	0.50	4
L2	0.25	0.35	0.45	4
N	8			15

Table 8. **QFN8 tolerance of form and position**

Symbol	Tolerance of form and position
aaa	0.15
bbb	0.10
ccc	0.08
ddd	0.05
eee	0.10

Figure 21. QFN8 recommended footprint



7 Ordering information

Table 9. **Order codes**

Part number	Output voltage (V)	Precision	Package	Temperature range
TS3312AQPR	1.25	±0.15 %	QFN8	-40 to +125 °C
TS3325AQPR [(1)]	2.5			
TS3330AQPR	3.0			
TS3333AQPR	3.3			

1. *In development.*

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
05-Sep-2017	1	Initial release.
26-Sep-2018	2	Added new order codes TS3325AQPR and TS3333AQPR in Table 9. Order codes.

Contents

List of tables

List of figures

Данный компонент на территории Российской Федерации

Вы можете приобрести в компании MosChip.

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

http://moschip.ru/get-element

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:
moschip.ru
moschip.ru_4
moschip.ru_6
moschip.ru_9