TS33

Micropower high precision series voltage reference

Datasheet - production data

QFN8 1.5x1.5

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).

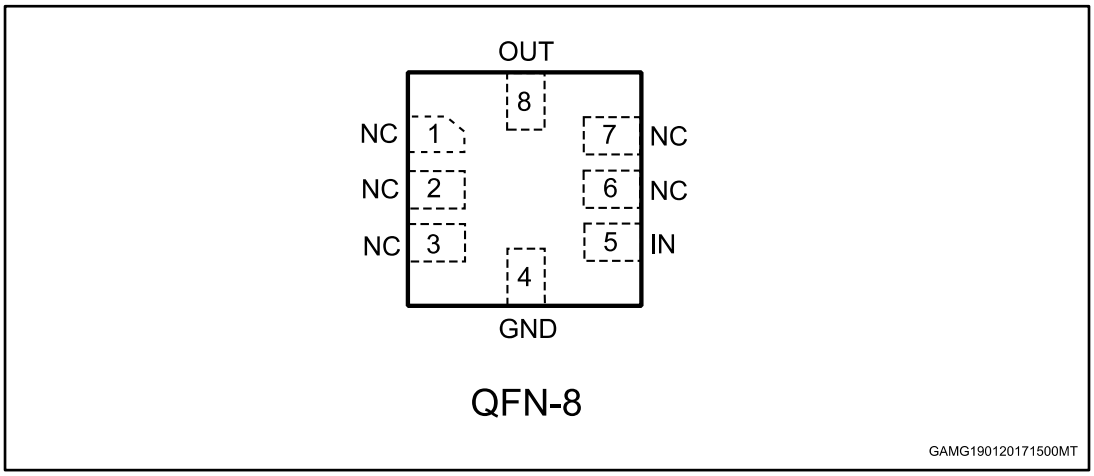
The ultra low operating current is a key advantage for power-restricted designs. In addition, the TS33 is very stable over the entire operating temperature range, making it suitable for high-precision applications.

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

Contents

1 Pin configuration

Figure 1: 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

Notes:

(1)Pd has been calculated with Tamb = 25 °C and T_{jmax} = 150 °C.

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 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 I_{LOAD} = 0 mA T_{amb} = 25 °C		3.0		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} = 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}

4 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 2: Output voltage vs temperature

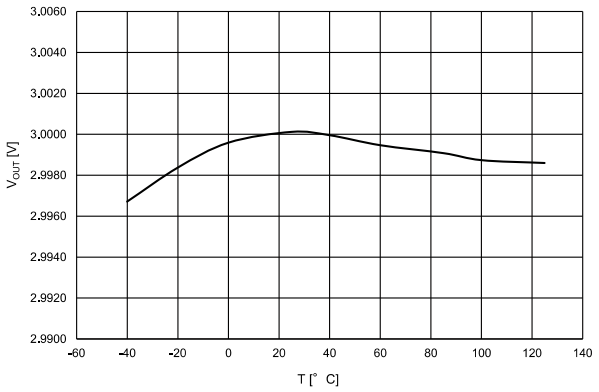


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Figure 3: Output voltage vs input voltage

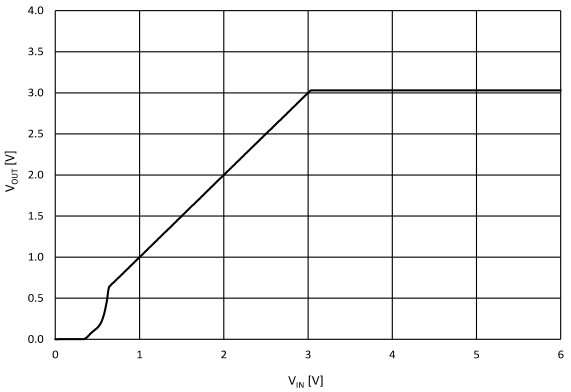

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Figure 4: Quiescent current vs input voltage

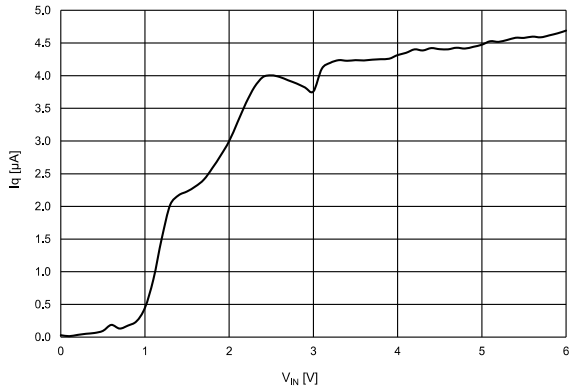

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Figure 5: Dropout voltage vs load current

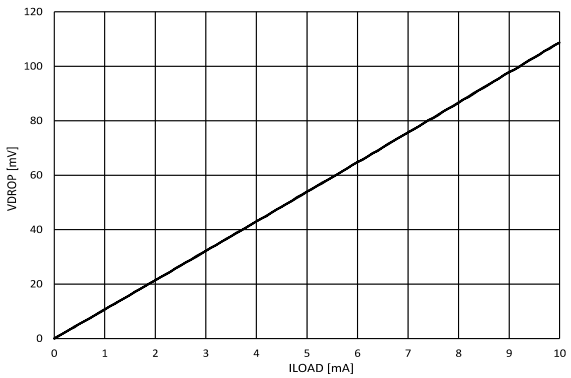

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Figure 6: SVR vs frequency

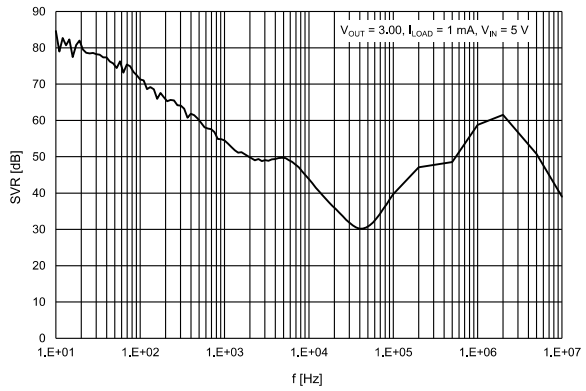

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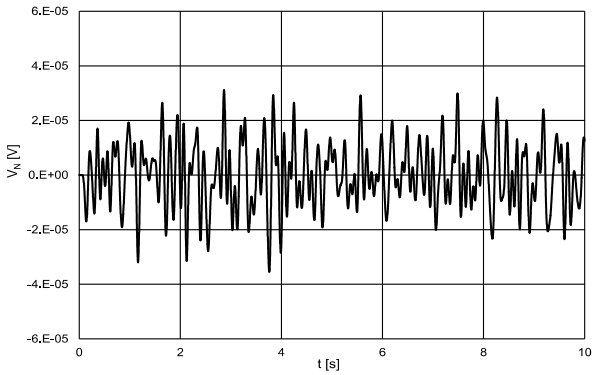
Figure 7: Low frequency noise



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

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Figure 8: Temperature drift

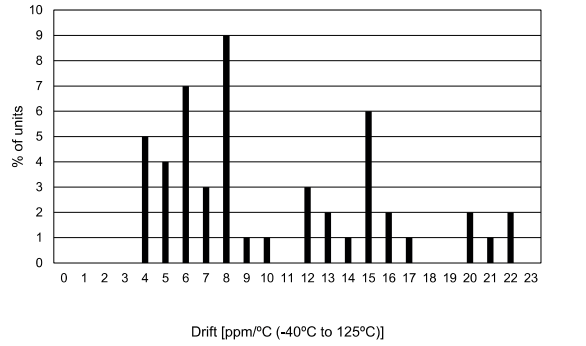

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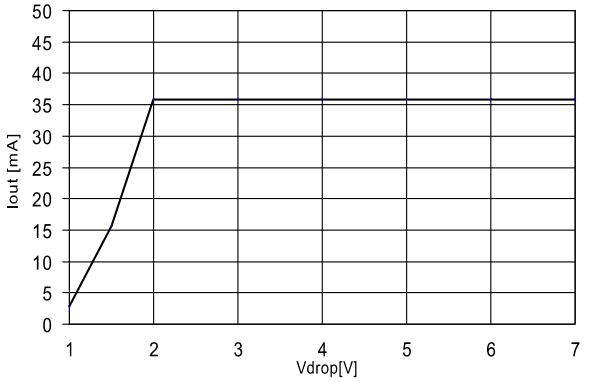
Figure 9: Short-circuit current vs dropout voltage



T = 25 °C, Cin = 1 µF, Cout = 1 µF

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Figure 10: Startup transient (no load)

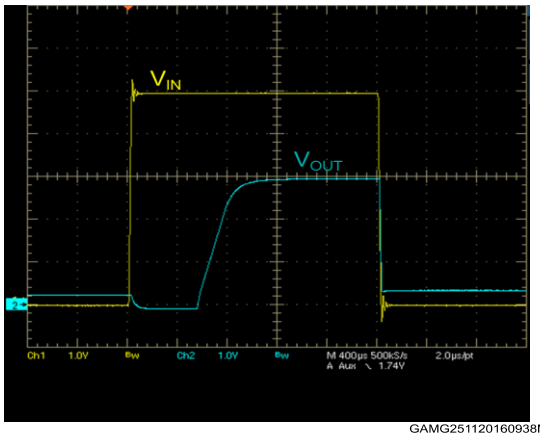

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Figure 11: Startup transient (I_{OUT} = 5 mA)

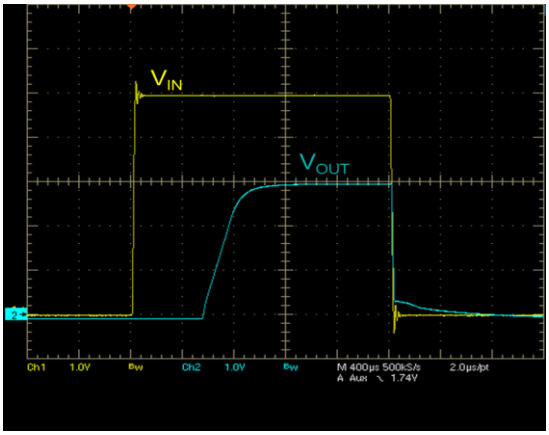

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Figure 12: Line transient (no load)

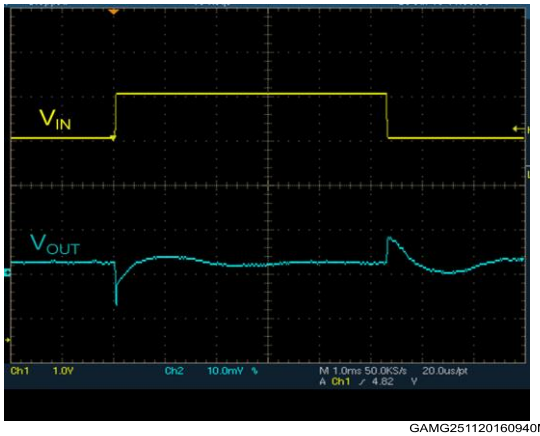

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Figure 13: Line transient (I_{OUT} = 1 mA)

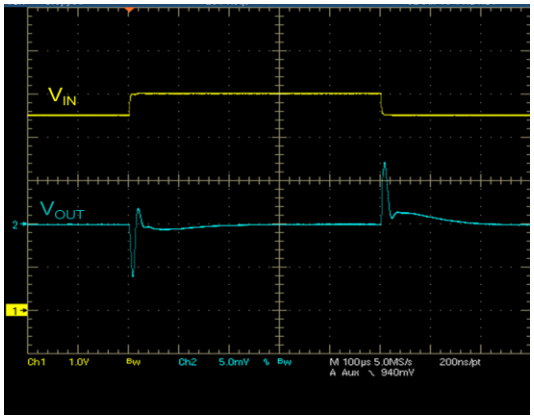

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Figure 14: Load transient (I_{OUT} = +/-1 mA)

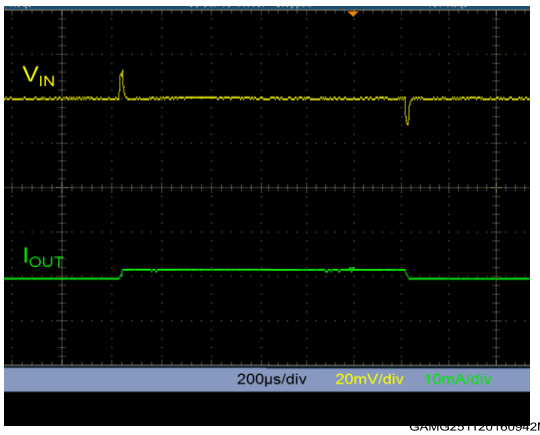

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Figure 15: Load transient (I_{OUT} = +/-5 mA)

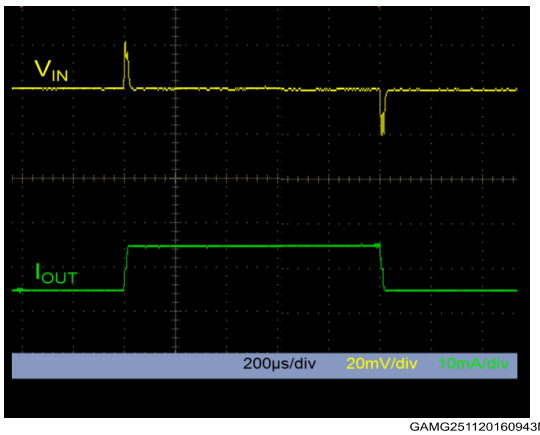

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Figure 16: Short-circuit response

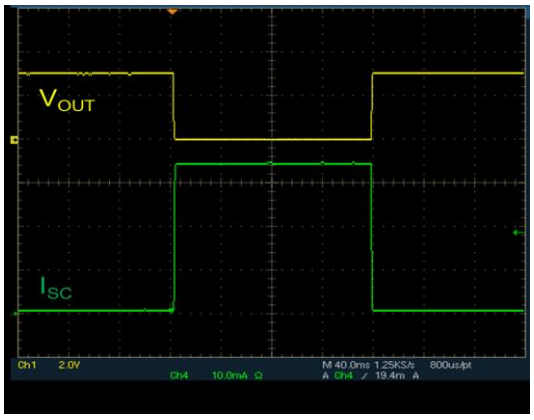

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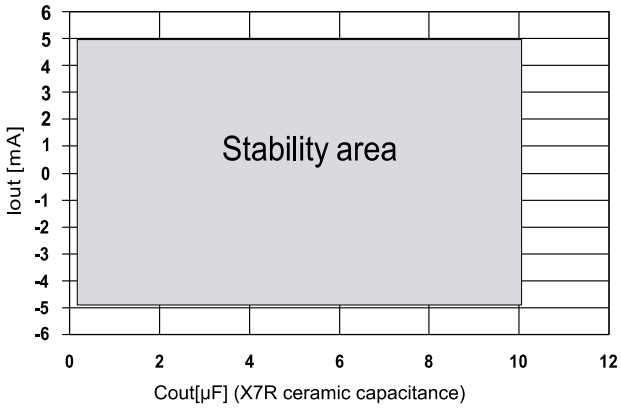
Figure 17: Stability plan



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5 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.

5.1 QFN8 package information

Figure 18: QFN8 package outline

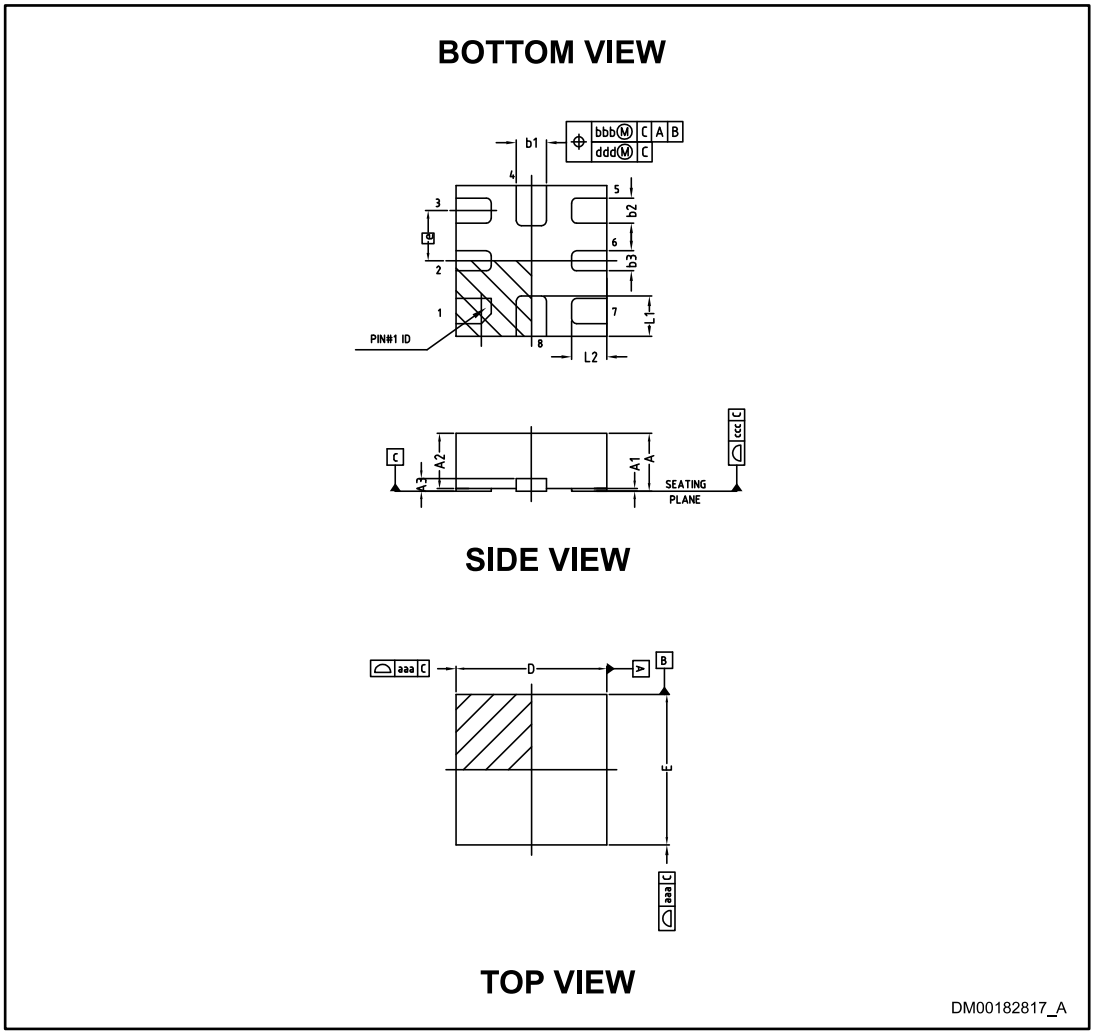


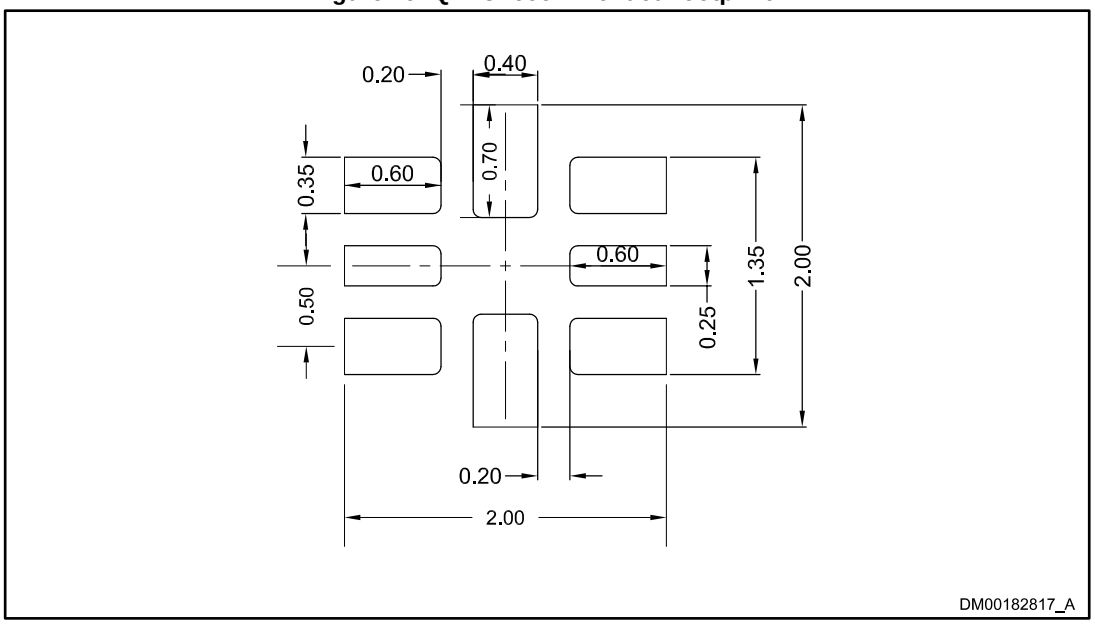
Table 6: QFN8 mechanical data

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 7: 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
Note	1.4
Ref	

Figure 19: QFN8 recommended footprint



6 Ordering information

Table 8: Order codes

Part number	Output voltage (V)	Precision	Package	Temperature range
TS3312AQPR (1)	1.25	+/-0.15 %	QFN8	-40 to +125 °C
TS3330AQPR	3.0	+/-0.15 %		

Notes:

(1)Available on request.

7 Revision history

Table 9: Document revision history

Date	Revision	Changes
05-Sep-2017	1	Initial release.

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