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The technical content of this austriamicrosystems datasheet is still valid.

**Contact information:**

**Headquarters:**

ams AG

Tobelbaderstrasse 30

8141 Unterpremstaetten, Austria

Tel: +43 (0) 3136 500 0

e-Mail: [ams\\_sales@ams.com](mailto:ams_sales@ams.com)

Please visit our website at [www.ams.com](http://www.ams.com)

# AS1351

## Programmable Dual LDO

Data Sheet

### 1 General Description

The AS1351 is a high-performance dual CMOS low-dropout voltage regulator in a single 3x3mm package. The efficient set of programmable power supplies is optimized to deliver the best compromise between quiescent current and regulator performance for mobile phones, PDAs, MP3 players, and other battery powered devices.

The one-time-programmable (OTP) function provides greater design flexibility by allowing for independent programming of the output voltage for each regulator on-site. The OTP function allows for fast prototyping reducing development times and costs significant. Factory trimmed versions for full-production are also available.

Stability is guaranteed with ceramic output capacitors of only 1 $\mu$ F ( $\pm 20\%$  – X5R) up to 4.7 $\mu$ F ( $\pm 20\%$  – X5R). The low equivalent series resistance (ESR) of these capacitors ensures low output impedance at high frequencies.

Regulation performance is excellent even under low dropout conditions, when the power transistor has to operate in linear mode.

The low-noise performance allows direct connection of noise sensitive circuits without additional filtering networks.

The AS1351 is available in a 12-pin QFN 3x3mm package.

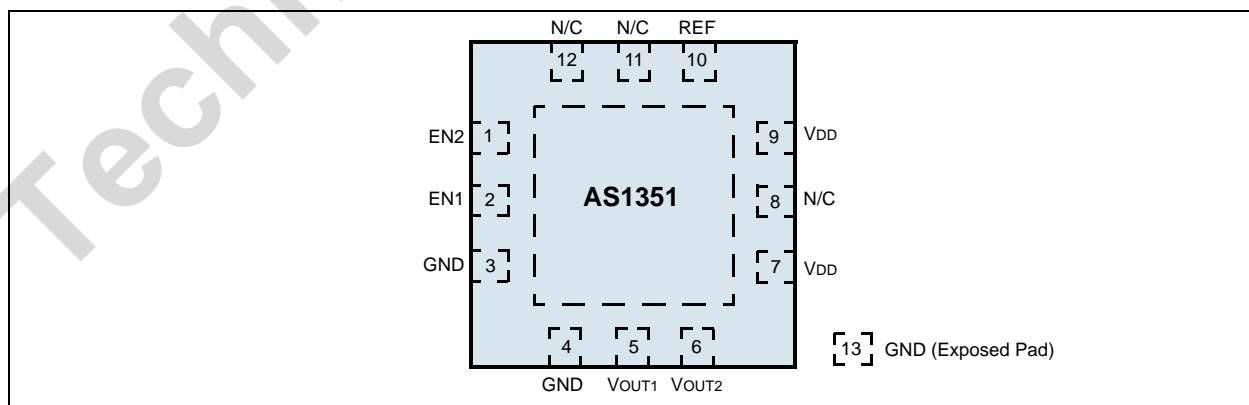
### 2 Key Features

- 2 Independent Voltage Regulators with Shutdown
- Output Current: 200mA each LDO
- One Time Programmable Output Voltage (User- or Factory-Trimmed)
- Programmable Output Voltage Range: 1.8 to 3.3V in 0.1V Steps
- Accuracy:  $\pm 1.5\%$
- PSRR: 70dB at 1kHz, 40dB at 100kHz
- Line Regulation:  $\pm 2\text{mV}$
- Load Regulation:  $\pm 0.6\text{mV}$
- Supply Range: 3 to 5.5V
- 0.2V Dropout Voltage @  $I = 200\text{mA}$
- Shutdown Current:  $\leq 1\mu\text{A}$
- Supply Current Without Load: 125 $\mu\text{A}$  (typ)
- Softstart for Low Inrush Current
- Stable with low ESR Ceramic Capacitors from 1 to 4.7 $\mu\text{F}$
- Low Noise: 40 $\mu\text{V}$  rms @10Hz to 100kHz Bandwidth
- Thermal Protection
- Over-Current Protection
- Temperature Range: -40 to +85°C
- 12-pin QFN 3x3mm Package

### 3 Applications

The AS1351 is ideal for cordless and mobile phones, MP3 players, CD and DVD players, PDAs, handheld computers, digital cameras, and any other hand-held battery-powered device.

Figure 1. Pinout Assignments (Top View)



## 4 Pinout

### Pin Descriptions

Figure 2. Pin Assignments (Top View – Not To Scale)

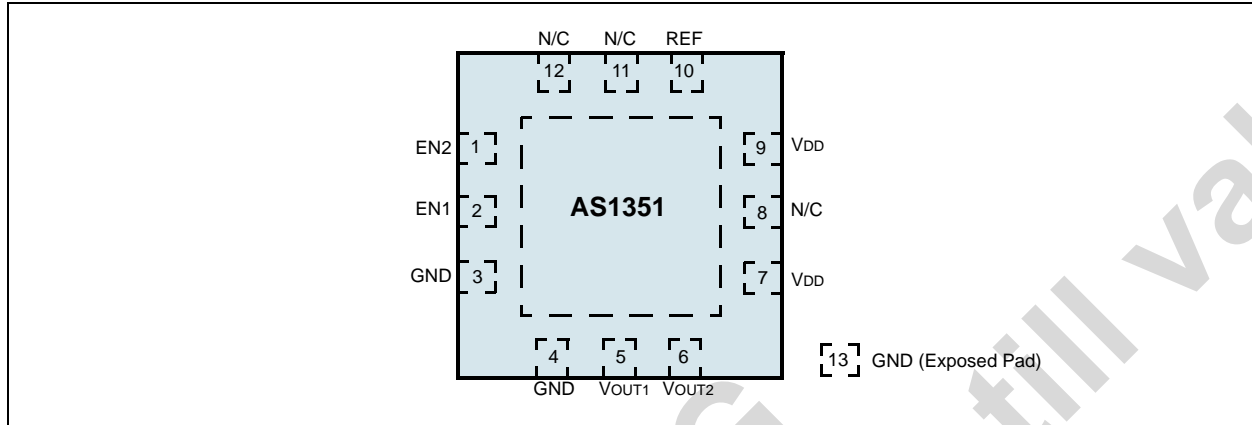


Table 1. Pin Descriptions

Number	Name	Description
1	EN2	Digital input to enable VOUT2.
2	EN1	Digital input to enable VOUT1.
3	GND	Negative supply voltage. †
4	GND	Negative supply voltage. †
5	VOUT1	Regulated analog output voltage 1.
6	VOUT2	Regulated analog output voltage 2.
7	VDD	Positive supply voltage. Pins 7 and 9 must be connected together externally.
8	N/C	Not connected.
9	VDD	Positive supply voltage. Pins 7 and 9 must be connected together externally.
10	REF	Analog reference voltage; connect to 100nF capacitor during normal operation.
11	N/C	Not connected.
12	N/C	Not connected.
13	GND	Negative supply voltage; this pin is the exposed pad. †

† All GND pins (3, 4, and 13) must be connected together externally.

## 5 Absolute Maximum Ratings

Stresses beyond those listed in Table 2 may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 2. Absolute Maximum Ratings

Parameter	Min	Max	Units	Comments
VDD to GND	-0.3	7	V	
Any other pin to GND	-0.3	VDD + 0.3	V	
Continuous Power Dissipation QFN12 3x3mm	590	1500	mW	Min value measured at T <sub>AMB</sub> = 85°C; max value measured at T <sub>AMB</sub> = 25°C.
Package-Body Peak Temperature		260	°C	The reflow peak soldering temperature (body temperature) specified is in accordance with IPC/JEDEC J-STD-020C "Moisture/Reflow Sensitivity Classification for non-hermetic Solid State Surface Mount Devices".
Operating Ambient Temperature	-40	85	°C	
Storage Temperature	-65	150	°C	
Electrostatic Discharge Protection (ESD) Level	1		kV	HBM – Norm: MIL 883 E method 3015.

## 6 Electrical Characteristics

$V_{DD} = 4V$ ;  $T_{AMB} = -40$  to  $+85^{\circ}C$  (Typ values are for  $T_{AMB} = 25^{\circ}C$ );  $C_{LOAD} = 1\mu F$  (Ceramic); unless otherwise specified.

Table 3. Electrical Characteristics

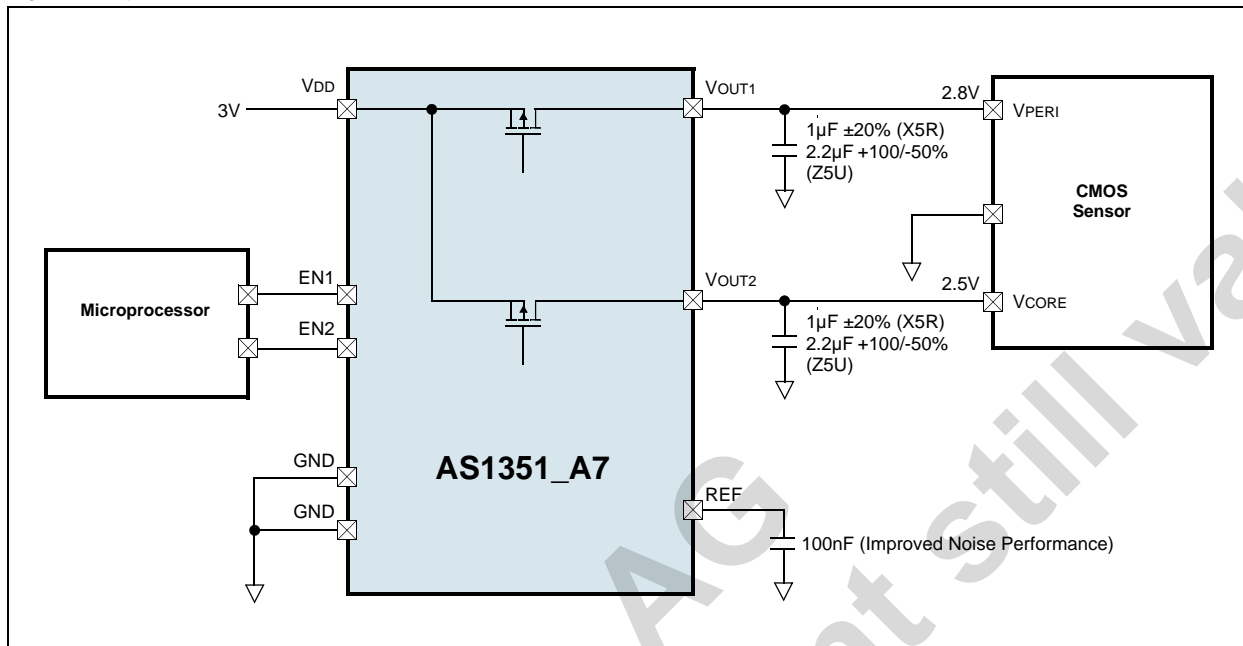
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>DD</sub>	Supply Voltage Range		3		5.5	V
V <sub>OUT</sub>	Output Voltage Range		1.8		3.3	V
R <sub>ON</sub>	On Resistance				1	Ω
PSRR <sup>1</sup>	Power Supply Rejection Ratio	f = 1kHz, C <sub>REF</sub> = 100nF	70			dB
		f = 100kHz, C <sub>REF</sub> = 100nF	40			
I <sub>OFF</sub>	Shut Down Current	ENx = Low			1	μA
I <sub>VDD</sub>	Supply Current	Without Load		125	200	μA
t <sub>set</sub> <sup>1</sup>	Output Voltage Settling Time	I <sub>LOAD</sub> Switched from 0 to 100mA			50	μs
t <sub>start</sub> <sup>1</sup>	Start-Up Time <sup>2</sup>	C <sub>REF</sub> = 100nF Pre-charged			300	μs
		C <sub>REF</sub> = 0nF Uncharged		300		μs
		C <sub>REF</sub> = 100nF Uncharged		15		ms
V <sub>OUT</sub>	Output Voltage Tolerance	I <sub>LOAD</sub> = 0mA, T <sub>AMB</sub> = 25°C	-1.5		1.5	%
		I <sub>LOAD</sub> = 0 to 200mA	-2		2	% <sup>1</sup>
V <sub>LINE</sub> REG	Line Regulation, Static	V <sub>DD</sub> = 5.5V	-1		1	%
		V <sub>DD</sub> = 3 to 4.5V	-2		2	mV <sup>1</sup>
V <sub>LOAD</sub> REG	Load Regulation, Static	I <sub>LOAD</sub> = 0 to 50 mA		0.3	2.5	mV <sup>1</sup>
		I <sub>LOAD</sub> = 0 to 200 mA (referenced to 100mA)		0.6	5	mV <sup>1</sup>
V <sub>IH</sub>	Enable Input Voltage High		0.6 x V <sub>DD</sub>			V
V <sub>IL</sub>	Enable Input Voltage Low				0.8	V
I <sub>LOAD</sub>	Output Current		0		200	mA
I <sub>LIMIT</sub>	Output Current Limitation			400		mA
V <sub>Noise</sub>	Output Noise Voltage	10 to 100kHz, C <sub>REF</sub> = 100nF		40		μV <sub>RMS</sub>
	Thermal Protection			145		°C

**Notes:**

1. Guaranteed by design and verified by lab evaluation.
2. Startup is performed if any EN pin goes high.

## 7 Typical Application

Figure 3. Typical AS1351\_ux Application

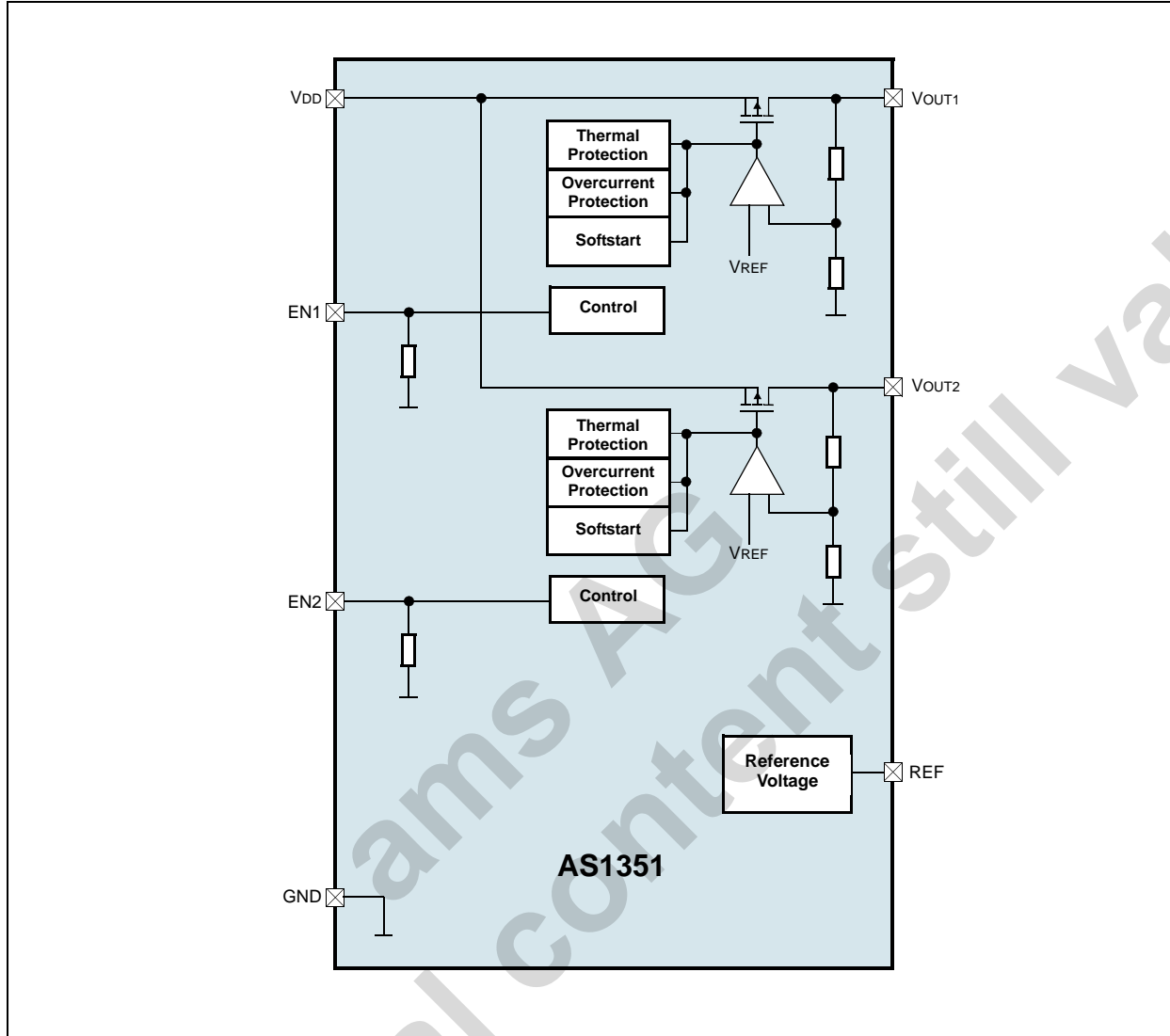


### One-Time Programming Procedure Output Voltages

The two LDOs can be programmed and burned to any output voltage between 1.8V and 3.3V in steps of 0.1V. Customers can burn the desired output voltages onsite using the austriamicrosystems programming board.

Furthermore, the AS1351 is available in pre-programmed versions with fixed output voltages (see Ordering Information on page 9.)

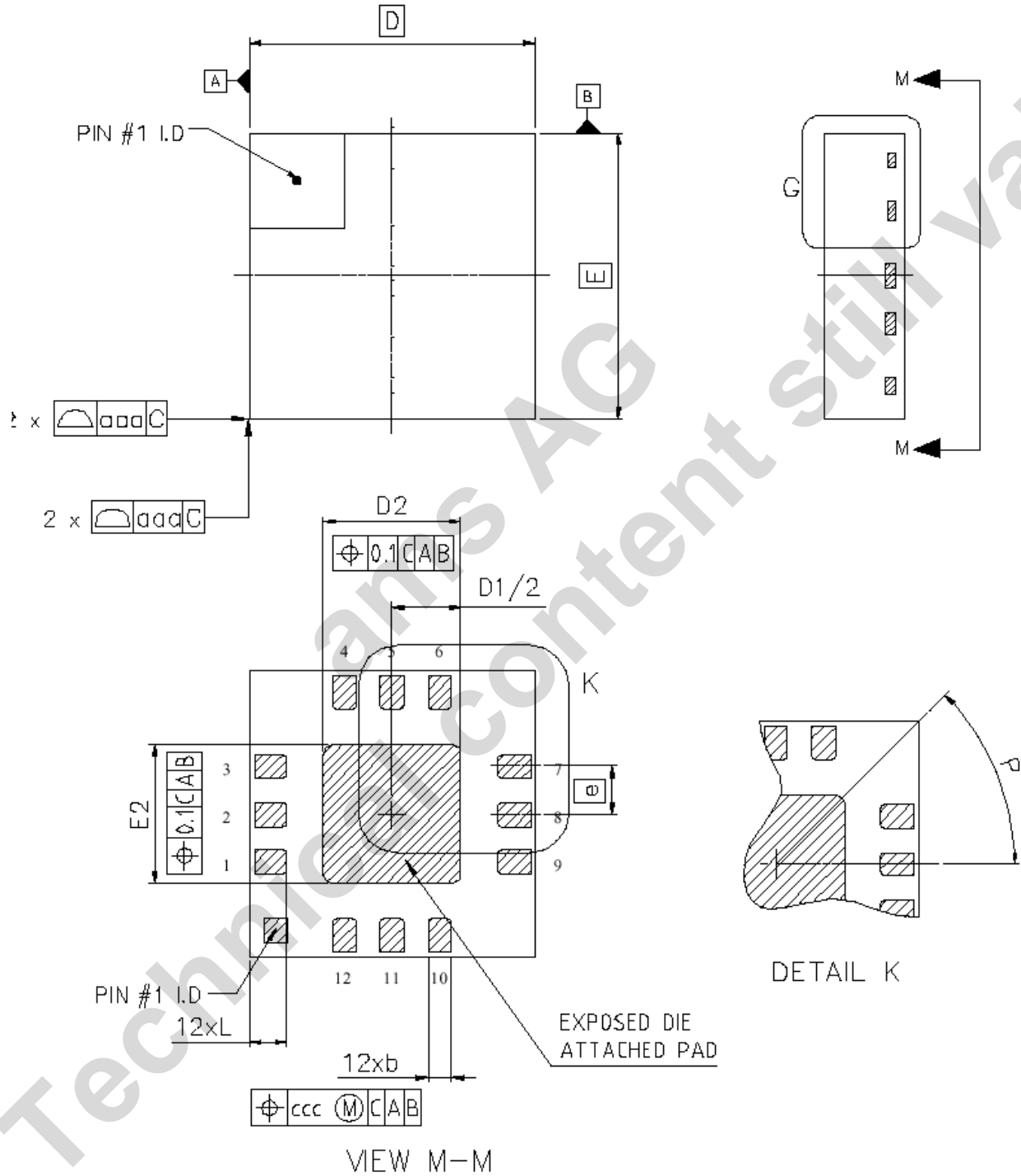
Figure 4. AS1351 Block Diagram



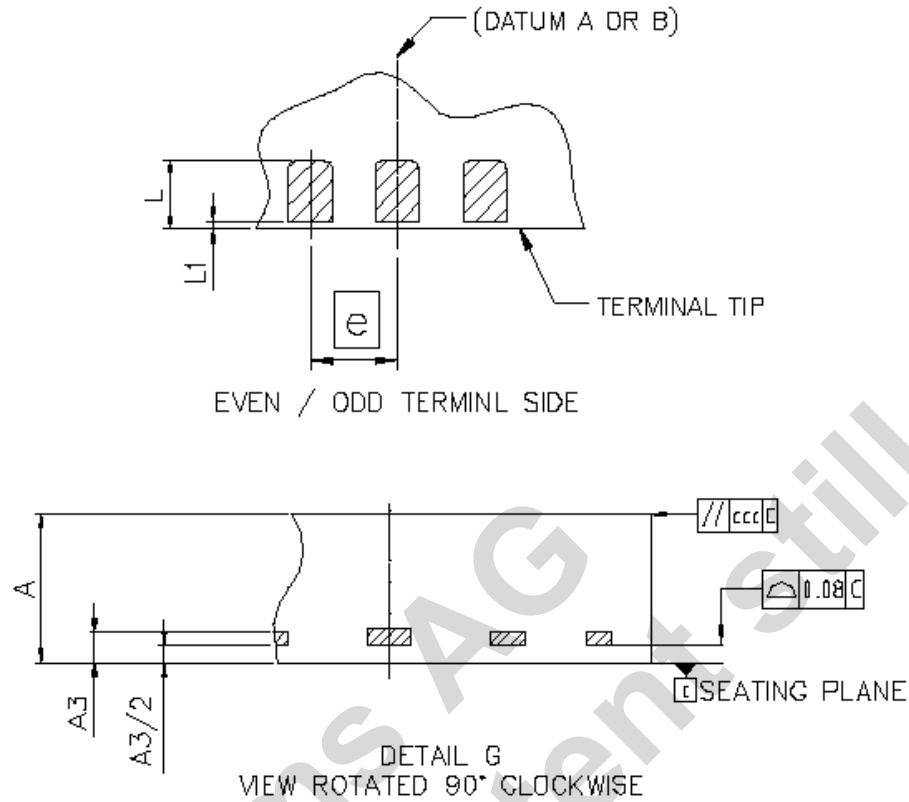
## Package Drawings and Markings

The AS1351 is available in a 12-pin QFN 3x3mm package and a wafer bumped package.

Figure 5. 12-Pin QFN 3x3mm Package.







DIM	MIN	NOM	MAX	NOTES
A	0.75	0.85	0.95	1.0 DIMENSIONING & TOLERANCEING CONFIRM TO ASME Y14.5M-1994. 2.0 ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES. 3.0 DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.25mm AND 0.30mm FROM TERMINAL TIP. DIMENSION L1 REPRESENTS TERMINAL FULL BACK FROM PACKAGE EDGE UP TO 0.1mm IS ACCEPTABLE. 4.0 COPLANARITY APPLIES TO THE EXPOSED HEAT SLUG AS WELL AS THE TERMINAL. 5.0 RADIUS ON TERMINAL IS OPTIONAL.
A1		0.203 REF		
b	0.20	0.25	0.30	
D		3.00 BSC		
E		3.00 BSC		
D2	1.35	1.45	1.55	
E2	1.35	1.45	1.55	
e		0.50 BSC		
L	0.30	0.40	0.50	
L1			0.10	
P		45° BSC		
aaa		0.10		
ccc		0.10		

## 8 Ordering Information

The AS1351 is available with preset LDO output voltages or customer-specific versions (with a minimum order quantity of 30,000). Each customer-specific device is factory trimmed to the desired output voltage (see Table 4).

Part	Programming	Pin Package
AS1351	LDO values not programmed	12-pin QFN 3x3
AS1351_A7	V <sub>OUT1</sub> = 2.8V, V <sub>OUT2</sub> = 2.5V	12-pin QFN 3x3
AS1351_ux	Customer-specific LDO values	12-pin QFN 3x3
AS1351_uxF	Customer-specific LDO values	Bumped Wafer

**Where:**

*u* = Customer-specific V<sub>OUT1</sub> value suffix.

*x* = Customer-specific V<sub>OUT2</sub> value suffix.

Table 4. Output Voltages Suffix Guide

Part	Suffix	Output Voltage
AS1351_ux	F	3.3 V
	E	3.2 V
	D	3.1 V
	C	3.0 V
	B	2.9 V
	A	2.8 V
	9	2.7 V
	8	2.6 V
	7	2.5 V
	6	2.4 V
	5	2.3 V
	4	2.2 V
	3	2.1 V
	2	2.0 V
	1	1.9 V
0	1.8 V	

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## Contact Information

### Headquarters

austriamicrosystems AG  
A-8141 Schloss Premstaetten, Austria

Tel: +43 (0) 3136 500 0  
Fax: +43 (0) 3136 525 01

For Sales Offices, Distributors and Representatives, please visit:

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