LM2936 Ultra-Low Quiescent Current LDO Voltage Regulator

Check for Samples: LM2936

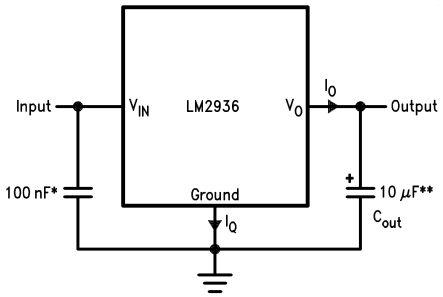
FEATURES

- **Ultra Low Quiescent Current (I_Q ≤ 15 µA for I_O = 100 µA)**
- **Fixed 3.0V, 3.3V or 5.0V with 50 mA Output**
- **±2% Initial Output Tolerance**
- **±3% Output Tolerance Over Line, Load, and Temperature**
- **Dropout Voltage Typically 200 mV @ I_O = 50 mA**
- **Reverse Battery Protection**
- **−50V Reverse Transient Protection**
- **Internal Short Circuit Current Limit**
- **Internal Thermal Shutdown Protection**
- **40V Operating Voltage Limit**
- **60V Operating Voltage Limit for LM2936HV**
- **Shutdown Pin Available with LM2936BM Package**

DESCRIPTION

The LM2936 ultra-low quiescent current regulator features low dropout voltage and low current in the standby mode. With less than 15 µA quiescent current at a 100 µA load, the LM2936 is ideally suited for automotive and other battery operated systems. The LM2936 retains all of the features that are common to low dropout regulators including a low dropout PNP pass device, short circuit protection, reverse battery protection, and thermal shutdown. The LM2936 has a 40V maximum operating voltage limit, a −40°C to +125°C operating temperature range, and ±3% output voltage tolerance over the entire output current, input voltage, and temperature range. The LM2936 is available in a TO-92 package, SOIC-8 and SOT–223 surface mount packages, and a PFM surface mount power package.

Typical Application



* Required if regulator is located more than 2″ from power supply filter capacitor.

** Required for stability. See Electrical Characteristics for required values. Must be rated over intended operating temperature range. Effective series resistance (ESR) is critical, see curve. Locate capacitor as close as possible to the regulator output and ground pins. Capacitance may be increased without bound.

Connection Diagrams

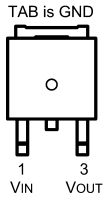


Figure 1. PFM
Top View
See Package Number NDP0003B

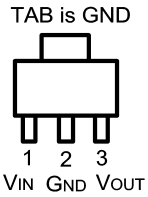


Figure 2. SOT-223
Top View
See Package Number DCY0004A

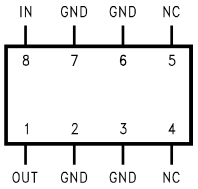


Figure 3. 8-Pin SOIC (D)
Top View
See Package Number D0008A

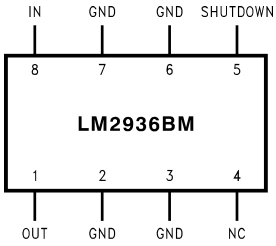


Figure 4. 8-Pin SOIC (D)
Top View
See Package Number D0008A

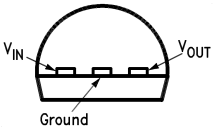


Figure 5. TO-92
Bottom View
See Package Number LP0003A

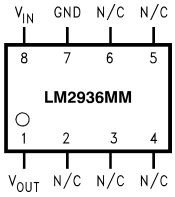


Figure 6. 8-Pin VSSOP (DGK)
Top View
See Package Number DGK0008A

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings (1)(2)

Input Voltage (Survival)	+60V, −50V
ESD Susceptibility (3)	2000V
Power Dissipation (4)	Internally limited
Junction Temperature (T_{Jmax})	150°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	260°C

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. DC and AC electrical specifications do not apply when operating the device beyond its specified operating ratings.
(2) If Military/Aerospace specified devices are required, please contact the TI Sales Office/ Distributors for availability and specifications.
(3) Human body model, 100 pF discharge through a 1.5 kΩ resistor.
(4) The maximum power dissipation is a function of T_{Jmax}, θ_{JA}, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{Jmax} - T_A)/\theta_{JA}$. If this dissipation is exceeded, the die temperature will rise above 150°C and the LM2936 will go into thermal shutdown.

Operating Ratings

Operating Temperature Range	−40°C to +125°C
Maximum Operating Input Voltage - LM2936	+40V
Maximum Operating Input Voltage - LM2936HV only	+60V
Maximum Shutdown Pin Voltage - LM2936BM only	0V to 40V
TO-92 (LP0003A) θ_{JA}	195°C/W
VSSOP-8 (DGK0008A) θ_{JA}	200°C/W
SOIC-8 (D0008A) θ_{JA}	140°C/W
SOIC-8 (D0008A) θ_{JC}	45°C/W
PFM (NDP0003B) θ_{JA}	136°C/W
PFM (NDP0003B) θ_{JC}	6°C/W
SOT-223 (DCY0004A) θ_{JA}	149°C/W
SOT-223 (DCY0004A) θ_{JC}	36°C/W

Electrical Characteristics for LM2936–3.0

V_{IN} = 14V, I_O = 10 mA, T_J = 25°C, unless otherwise specified. **Boldface** limits apply over entire operating temperature range

Parameter	Conditions	Min (1)	Typical (2)	Max (1)	Units
LM2936HV–3.0 Only					
Output Voltage	5.5V ≤ V_{IN} ≤ 48V, 100 µA ≤ I_O ≤ 50 mA (3)	**2.910**	**3.000**	**3.090**	V
Line Regulation	6V ≤ V_{IN} ≤ 60V, I_O = 1mA		10	30	mV
All LM2936–3.0					
Output Voltage		2.940	3.000	3.060	V
	4.0V ≤ V_{IN} ≤ 26V, 100 µA ≤ I_O ≤ 50 mA (3)	**2.910**	**3.000**	**3.090**	
Quiescent Current	I_O = 100 µA, 8V ≤ V_{IN} ≤ 24V		15	20	µA
	I_O = 10 mA, 8V ≤ V_{IN} ≤ 24V		0.20	0.50	mA
	I_O = 50 mA, 8V ≤ V_{IN} ≤ 24V		1.5	2.5	mA
Line Regulation	9V ≤ V_{IN} ≤ 16V		5	10	mV
	6V ≤ V_{IN} ≤ 40V, I_O = 1 mA		10	30	
Load Regulation	100 µA ≤ I_O ≤ 5 mA		10	30	mV
	5 mA ≤ I_O ≤ 50 mA		10	30	
Dropout Voltage	I_O = 100 µA		0.05	0.10	V
	I_O = 50 mA		0.20	0.40	V
Short Circuit Current	V_O = 0V	65	120	250	mA
Output Impedance	I_O = 30 mAdc and 10 mArms, $_f$ = 1000 Hz		450		mΩ
Output Noise Voltage	10 Hz–100 kHz		500		µV
Long Term Stability			20		mV/1000 Hr
Ripple Rejection	V_{ripple} = 1V_{rms}, $_{fripple}$ = 120 Hz	−40	−60		dB
Reverse Polarity Transient Input Voltage	R_L = 500Ω, T = 1 ms	−50	−80		V
Output Voltage with Reverse Polarity Input	V_{IN} = −15V, R_L = 500Ω		0.00	−0.30	V
Maximum Line Transient	R_L = 500Ω, V_O ≤ 3.30V, T = 40ms	60			V
Output Bypass Capacitance (C_{OUT}) ESR	C_{OUT} = 22µF 0.1mA ≤ I_{OUT} ≤ 50mA	0.3		8	Ω
Shutdown Input − LM2936BM–3.0 Only					

(1) Datasheet min/max specification limits are ensured by design, test, or statistical analysis.
(2) Typicals are at 25°C (unless otherwise specified) and represent the most likely parametric norm.
(3) To ensure constant junction temperature, pulse testing is used.

Electrical Characteristics for LM2936–3.0 (continued)

V_{IN} = 14V, I_O = 10 mA, T_J = 25°C, unless otherwise specified. **Boldface** limits apply over entire operating temperature range

Parameter	Conditions	Min (1)	Typical (2)	Max (1)	Units
Output Voltage, V_{OUT}	Output Off, V_{SD}=2.4V, R_{LOAD} = 500Ω		0	0.010	V
Shutdown High Threshold Voltage, V_{IH}	Output Off, R_{LOAD} = 500Ω	2.00	1.1		V
Shutdown Low Threshold Voltage, V_{IL}	Output On, R_{LOAD} = 500Ω		1.1	0.60	V
Shutdown High Current, I_{IH}	Output Off, V_{SD} = 2.4V, R_{LOAD} = 500Ω		12		µA
Quiescent Current	Output Off, V_{SD} = 2.4V, R_{LOAD} = 500Ω Includes I_{IH} Current		30		µA

Electrical Characteristics for LM2936–3.3

V_{IN} = 14V, I_O = 10 mA, T_J = 25°C, unless otherwise specified. **Boldface** limits apply over entire operating temperature range

Parameter	Conditions	Min (1)	Typical (2)	Max (1)	Units
LM2936HV–3.3 Only					
Output Voltage	5.5V ≤ V_{IN} ≤ 48V, 100 µA ≤ I_O ≤ 50 mA (3)	**3.201**	**3.300**	**3.399**	V
Line Regulation	6V ≤ V_{IN} ≤ 60V, I_O = 1mA		10	30	mV
All LM2936–3.3					
Output Voltage		3.234	3.300	3.366	V
	4.0V ≤ V_{IN} ≤ 26V, 100 µA ≤ I_O ≤ 50 mA (3)	**3.201**	**3.300**	**3.399**	
Quiescent Current	I_O = 100 µA, 8V ≤ V_{IN} ≤ 24V		15	20	µA
	I_O = 10 mA, 8V ≤ V_{IN} ≤ 24V		0.20	0.50	mA
	I_O = 50 mA, 8V ≤ V_{IN} ≤ 24V		1.5	2.5	mA
Line Regulation	9V ≤ V_{IN} ≤ 16V		5	10	mV
	6V ≤ V_{IN} ≤ 40V, I_O = 1 mA		10	30	
Load Regulation	100 µA ≤ I_O ≤ 5 mA		10	30	mV
	5 mA ≤ I_O ≤ 50 mA		10	30	
Dropout Voltage	I_O = 100 µA		0.05	0.10	V
	I_O = 50 mA		0.20	0.40	V
Short Circuit Current	V_O = 0V	65	120	250	mA
Output Impedance	I_O = 30 mAdc and 10 mArms, $_f$ = 1000 Hz		450		mΩ
Output Noise Voltage	10 Hz–100 kHz		500		µV
Long Term Stability			20		mV/1000 Hr
Ripple Rejection	V_{ripple} = 1V_{rms}, $_{fripple}$ = 120 Hz	−40	−60		dB
Reverse Polarity Transient Input Voltage	R_L = 500Ω, T = 1 ms	−50	−80		V
Output Voltage with Reverse Polarity Input	V_{IN} = −15V, R_L = 500Ω		0.00	−0.30	V
Maximum Line Transient	R_L = 500Ω, V_O ≤ 3.63V, T = 40ms	60			V
Output Bypass Capacitance (C_{OUT}) ESR	C_{OUT} = 22µF 0.1mA ≤ I_{OUT} ≤ 50mA	0.3		8	Ω
Shutdown Input − LM2936BM–3.3 Only					
Output Voltage, V_{OUT}	Output Off, V_{SD}=2.4V, R_{LOAD} = 500Ω		0	0.010	V

(1) Datasheet min/max specification limits are ensured by design, test, or statistical analysis.
(2) Typicals are at 25°C (unless otherwise specified) and represent the most likely parametric norm.
(3) To ensure constant junction temperature, pulse testing is used.

Electrical Characteristics for LM2936–3.3 (continued)

V_{IN} = 14V, I_O = 10 mA, T_J = 25°C, unless otherwise specified. **Boldface** limits apply over entire operating temperature range

Parameter	Conditions	Min (1)	Typical (2)	Max (1)	Units
Shutdown High Threshold Voltage, V_{IH}	Output Off, R_{LOAD} = 500Ω	2.00	1.1		V
Shutdown Low Threshold Voltage, V_{IL}	Output On, R_{LOAD} = 500Ω		1.1	0.60	V
Shutdown High Current, I_{IH}	Output Off, V_{SD} = 2.4V, R_{LOAD} = 500Ω		12		µA
Quiescent Current	Output Off, V_{SD} = 2.4V, R_{LOAD} = 500Ω Includes I_{IH} Current		30		µA

Electrical Characteristics for LM2936–5.0

V_{IN} = 14V, I_O = 10 mA, T_J = 25°C, unless otherwise specified. **Boldface** limits apply over entire operating temperature range

Parameter	Conditions	Min (1)	Typical (2)	Max (1)	Units
LM2936HV–5.0 Only					
Output Voltage	5.5V ≤ V_{IN} ≤ 48V, 100 µA ≤ I_O ≤ 50 mA (3)	**4.85**	**5.00**	**5.15**	V
Line Regulation	6V ≤ V_{IN} ≤ 60V, I_O = 1mA		15	35	mV
All LM2936–5.0					
Output Voltage		4.90	5.00	5.10	V
	5.5V ≤ V_{IN} ≤ 26V, 100 µA ≤ I_O ≤ 50 mA (3)	**4.85**	**5.00**	**5.15**	
Quiescent Current	I_O = 100 µA, 8V ≤ V_{IN} ≤ 24V		9	15	µA
	I_O = 10 mA, 8V ≤ V_{IN} ≤ 24V		0.20	0.50	mA
	I_O = 50 mA, 8V ≤ V_{IN} ≤ 24V		1.5	2.5	mA
Line Regulation	9V ≤ V_{IN} ≤ 16V		5	10	mV
	6V ≤ V_{IN} ≤ 40V, I_O = 1 mA		10	30	
Load Regulation	100 µA ≤ I_O ≤ 5 mA		10	30	mV
	5 mA ≤ I_O ≤ 50 mA		10	30	
Dropout Voltage	I_O = 100 µA		0.05	0.10	V
	I_O = 50 mA		0.20	0.40	V
Short Circuit Current	V_O = 0V	65	120	250	mA
Output Impedance	I_O = 30 mAdc and 10 mArms, $_f$ = 1000 Hz		450		mΩ
Output Noise Voltage	10 Hz–100 kHz		500		µV
Long Term Stability			20		mV/1000 Hr
Ripple Rejection	V_{ripple} = 1V_{rms}, $_{fripple}$ = 120 Hz	−40	−60		dB
Reverse Polarity Transient Input Voltage	R_L = 500Ω, T = 1 ms	−50	−80		V
Output Voltage with Reverse Polarity Input	V_{IN} = −15V, R_L = 500Ω		0.00	−0.30	V
Maximum Line Transient	R_L = 500Ω, V_O ≤ 5.5V, T = 40ms	60			V
Output Bypass Capacitance (C_{OUT}) ESR	C_{OUT} = 10µF 0.1mA ≤ I_{OUT} ≤ 50mA	0.3		8	Ω
Shutdown Input − LM2936BM–5.0 Only					
Output Voltage, V_{OUT}	Output Off, V_{SD}=2.4V, R_{LOAD} = 500Ω		0	0.010	V
Shutdown High Threshold Voltage, V_{IH}	Output Off, R_{LOAD} = 500Ω	2.00	1.1		V

(1) Datasheet min/max specification limits are ensured by design, test, or statistical analysis.
(2) Typicals are at 25°C (unless otherwise specified) and represent the most likely parametric norm.
(3) To ensure constant junction temperature, pulse testing is used.

Electrical Characteristics for LM2936–5.0 (continued)

V_{IN} = 14V, I_O = 10 mA, T_J = 25°C, unless otherwise specified. **Boldface** limits apply over entire operating temperature range

Parameter	Conditions	Min (1)	Typical (2)	Max (1)	Units
Shutdown Low Threshold Voltage, V_{IL}	Output On, R_{LOAD} = 500Ω		1.1	0.60	V
Shutdown High Current, I_{IH}	Output Off, V_{SD} = 2.4V, R_{LOAD} = 500Ω		12		µA
Quiescent Current	Output Off, V_{SD} = 2.4V, R_{LOAD} = 500Ω Includes I_{IH} Current		30		µA

Typical Performance Characteristics

Maximum Power Dissipation (TO-92)

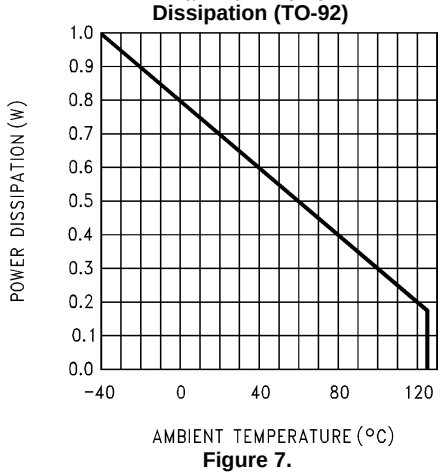


Figure 7.

Dropout Voltage

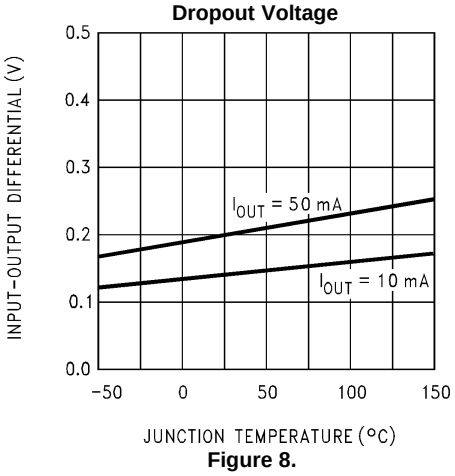


Figure 8.

Dropout Voltage

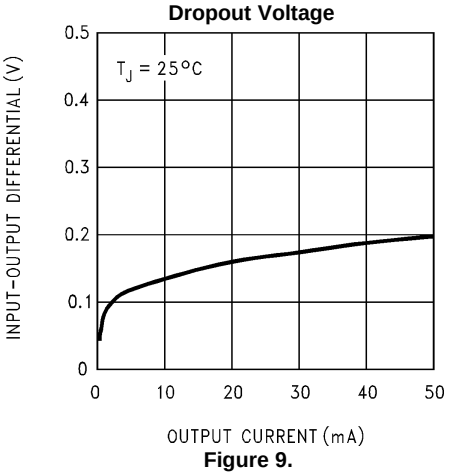


Figure 9.

Quiescent Current

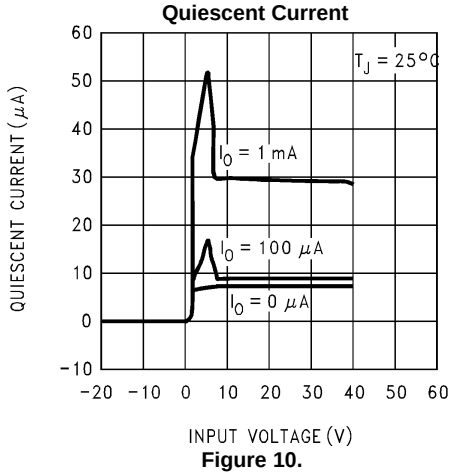


Figure 10.

Quiescent Current

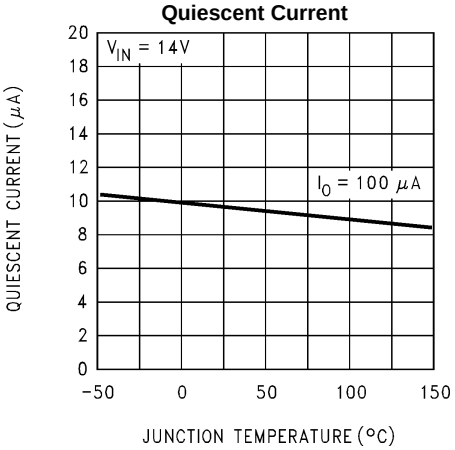


Figure 11.

Quiescent Current

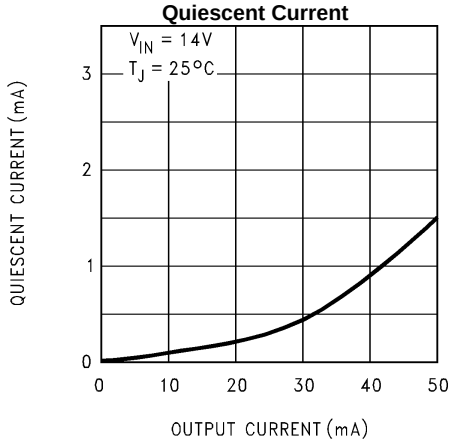


Figure 12.

Typical Performance Characteristics (continued)

Quiescent Current

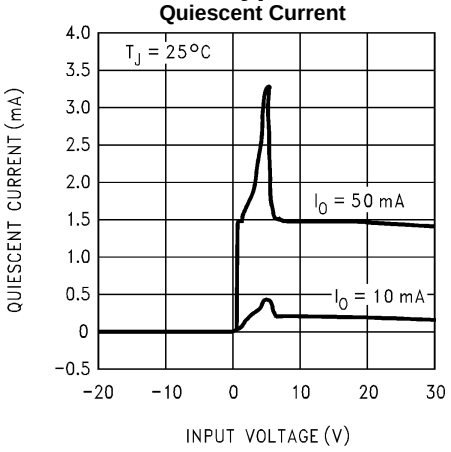


Figure 13.

Quiescent Current

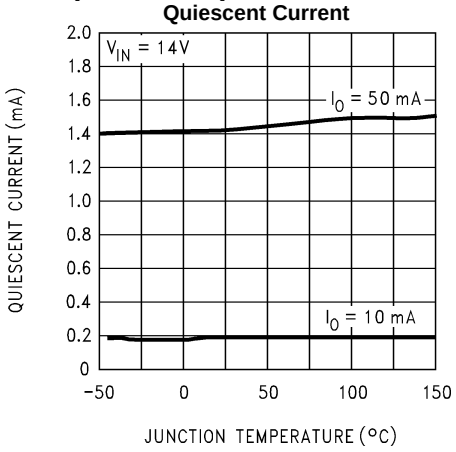


Figure 14.

LM2936–5.0 C_{OUT} ESR

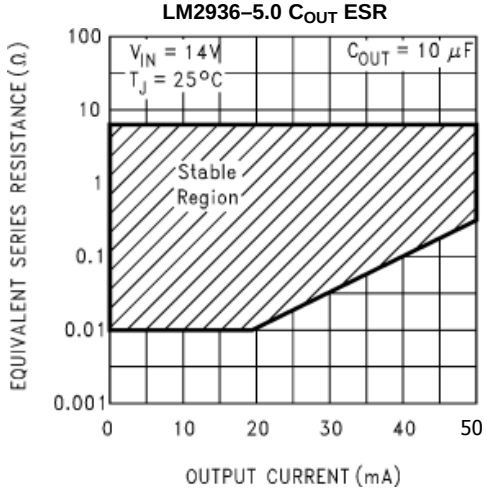


Figure 15.

LM2936–3.0 C_{OUT} ESR

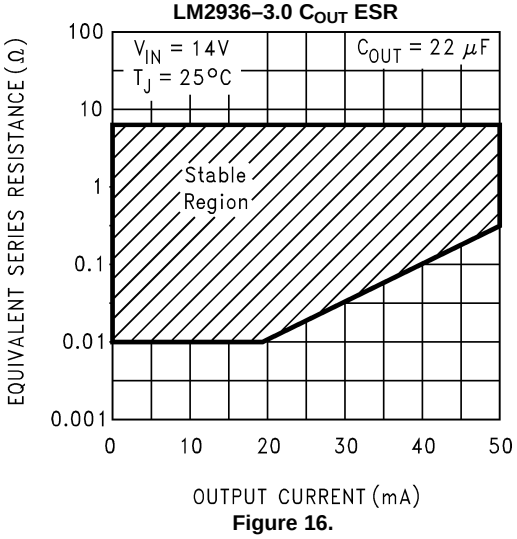


Figure 16.

LM2936–3.3 C_{OUT} ESR

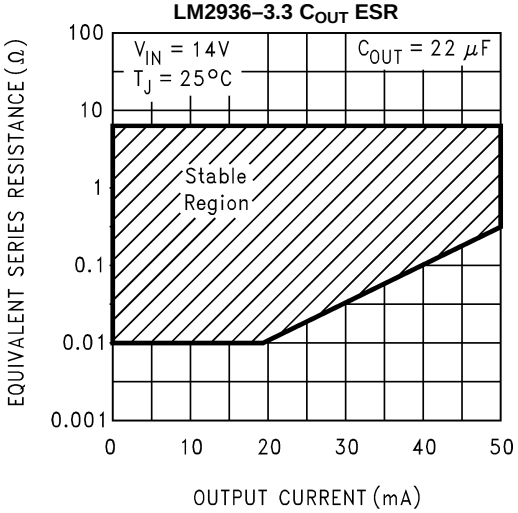


Figure 17.

Peak Output Current

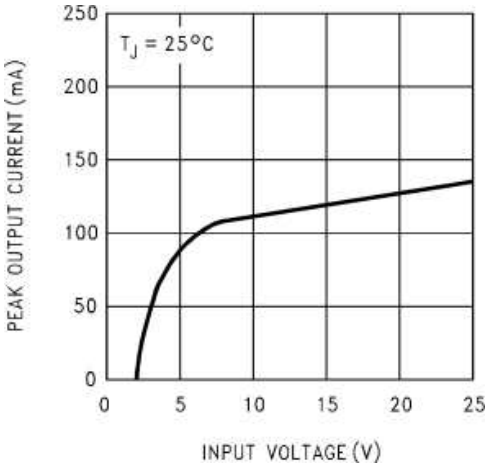


Figure 18.

Typical Performance Characteristics (continued)

Peak Output Current

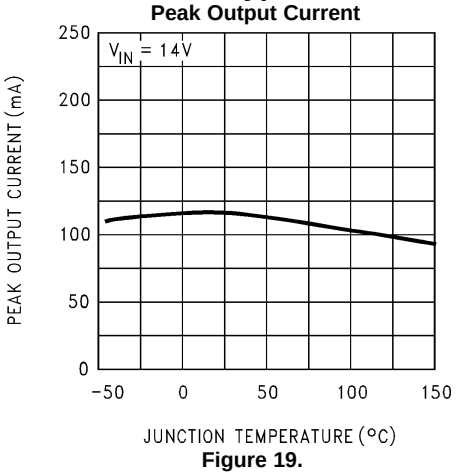


Figure 19.

LM2936–5.0 Current Limit

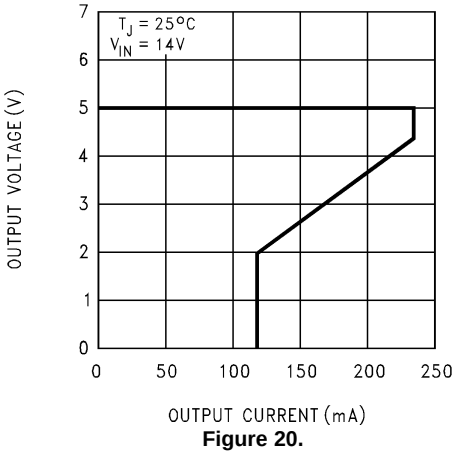


Figure 20.

LM2936–5.0 Line Transient Response

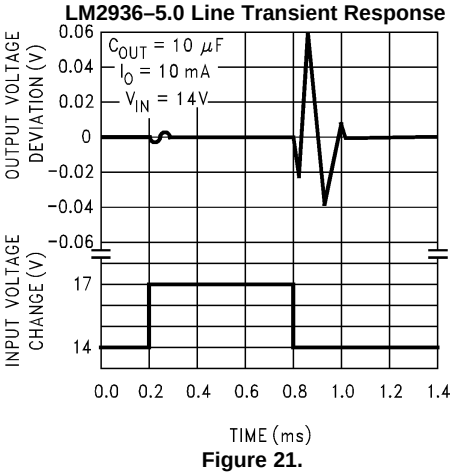


Figure 21.

LM2936–5.0 Output at Voltage Extremes

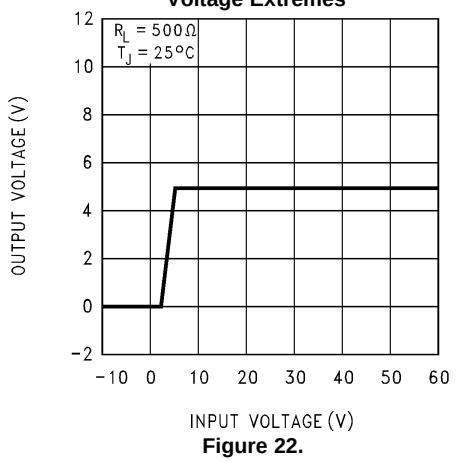


Figure 22.

LM2936–5.0 Ripple Rejection

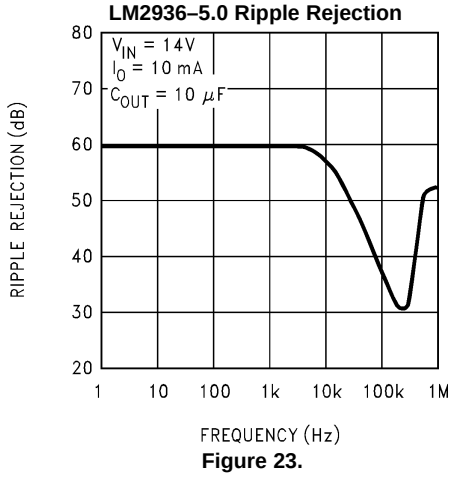


Figure 23.

LM2936–5.0 Load Transient Response

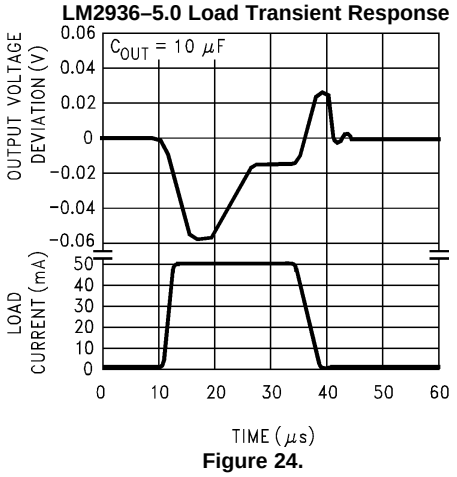


Figure 24.

Typical Performance Characteristics (continued)

LM2936–5.0 Low Voltage Behavior

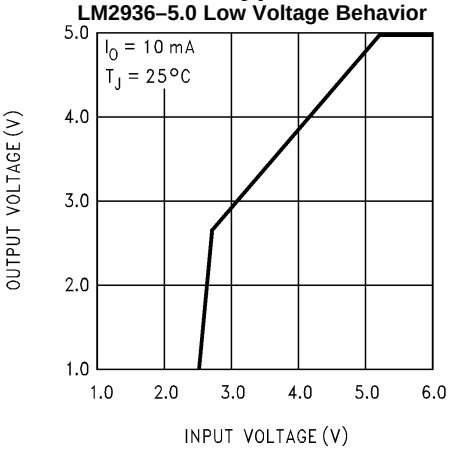


Figure 25.

LM2936–5.0 Output Impedance

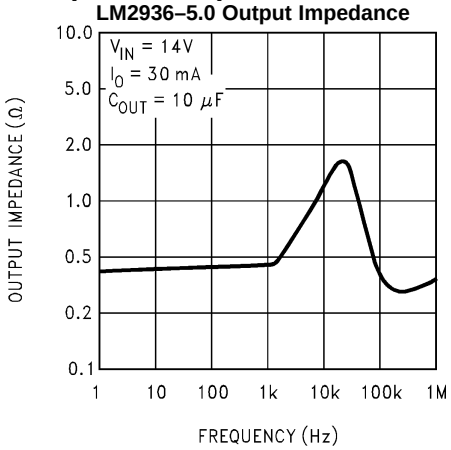


Figure 26.

APPLICATIONS INFORMATION

Unlike other PNP low dropout regulators, the LM2936 remains fully operational to 40V. Owing to power dissipation characteristics of the available packages, full output current cannot be ensured for all combinations of ambient temperature and input voltage. As an example, consider an LM2936Z–5.0 operating at 25°C ambient. Using the formula for maximum allowable power dissipation given in (1), we find that P_{Dmax} = 641 mW at 25°C. Including the small contribution of the quiescent current to total power dissipation the maximum input voltage (while still delivering 50 mA output current) is 17.3V. The LM2936Z–5.0 will go into thermal shutdown if it attempts to deliver full output current with an input voltage of more than 17.3V. Similarly, at 40V input and 25°C ambient the LM2936Z–5.0 can deliver 18 mA maximum.

Under conditions of higher ambient temperatures, the voltage and current calculated in the previous examples will drop. For instance, at the maximum ambient of 125°C the LM2936Z–5.0 can only dissipate 128 mW, limiting the input voltage to 7.34V for a 50 mA load, or 3.5 mA output current for a 40V input.

The junction to ambient thermal resistance θ_{JA} rating has two distinct components: the junction to case thermal resistance rating θ_{JC}; and the case to ambient thermal resistance rating θ_{CA}. The relationship is defined as: $\theta_{JA} = \theta_{JC} + \theta_{CA}$.

For the SOIC-8 and PFM surface mount packages the θ_{JA} rating can be improved by using the copper mounting pads on the printed circuit board as a thermal conductive path to extract heat from the package.

On the SOIC-8 package the four ground pins are thermally connected to the backside of the die. Adding approximately 0.04 square inches of 2 oz. copper pad area to these four pins will improve the θ_{JA} rating to approximately 110°C/W. If this extra pad are is placed directly beneath the package there should not be any impact on board density.

On the PFM package the ground tab is thermally connected to the backside of the die. Adding 1 square inch of 2 oz. copper pad area directly under the ground tab will improve the θ_{JA} rating to approximately 50°C/W.

While the LM2936 has an internally set thermal shutdown point of typically 160°C, this is intended as a safety feature only. Continuous operation near the thermal shutdown temperature should be avoided as it may have a negative affect on the life of the device.

While the LM2936 maintains regulation to 60V, it will not withstand a short circuit above 40V because of safe operating area limitations in the internal PNP pass device. Above 60V the LM2936 will break down with catastrophic effects on the regulator and possibly the load as well. Do not use this device in a design where the input operating voltage may exceed 40V, or where transients are likely to exceed 60V.

SHUTDOWN PIN

The LM2936BM has a pin for shutting down the regulator output. Applying a Logic Level High (>2.0V) to the Shutdown pin will cause the output to turn off. Leaving the Shutdown pin open, connecting it to Ground, or applying a Logic Level Low (<0.6V) will allow the regulator output to turn on.

(1) The maximum power dissipation is a function of T_{Jmax}, θ_{JA}, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{Jmax} - T_A)/\theta_{JA}$. If this dissipation is exceeded, the die temperature will rise above 150°C and the LM2936 will go into thermal shutdown.

Equivalent Schematic Diagram

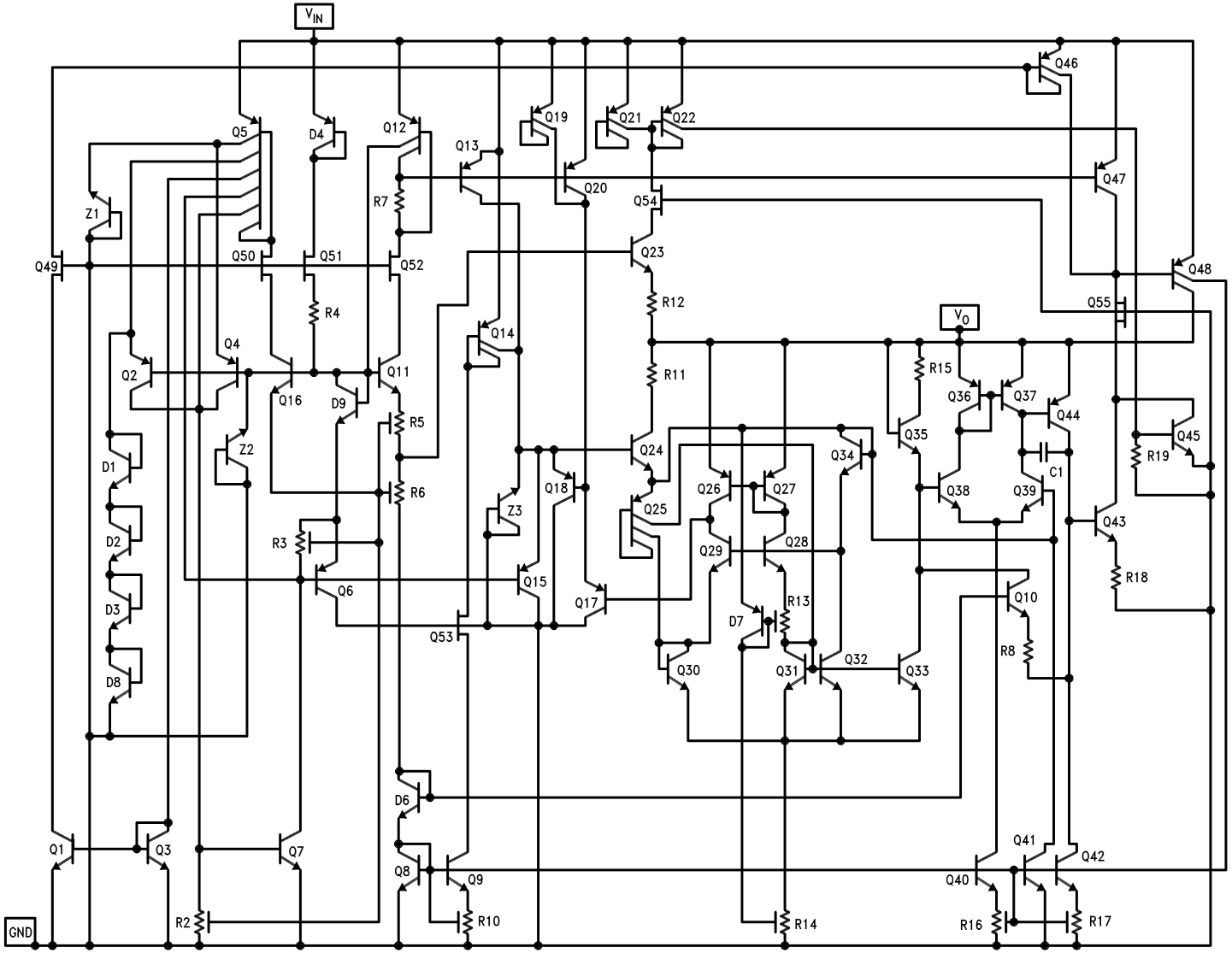


Figure 27.

REVISION HISTORY

Changes from Revision M (March 2013) to Revision N	Page
• Changed layout of National Data Sheet to TI format	12

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM2936BM-3.3/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	LM293 6B3.3	Samples
LM2936BM-5.0/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	LM293 6B5.0	Samples
LM2936BMX-3.3/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	LM293 6B3.3	Samples
LM2936BMX-5.0	NRND	SOIC	D	8	2500	TBD	Call TI	Call TI	-40 to 125	LM293 6B5.0	
LM2936BMX-5.0/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	LM293 6B5.0	Samples
LM2936DT-3.0	NRND	TO-252	NDP	3	75	TBD	Call TI	Call TI	-40 to 125	LM2936D T-3.0	
LM2936DT-3.0/NOPB	ACTIVE	TO-252	NDP	3	75	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	LM2936D T-3.0	Samples
LM2936DT-3.3/NOPB	ACTIVE	TO-252	NDP	3	75	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	LM2936D T-3.3	Samples
LM2936DT-5.0	NRND	TO-252	NDP	3	75	TBD	Call TI	Call TI	-40 to 125	LM2936D T-5.0	
LM2936DT-5.0/NOPB	ACTIVE	TO-252	NDP	3	75	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	LM2936D T-5.0	Samples
LM2936DTX-3.0/NOPB	ACTIVE	TO-252	NDP	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	LM2936D T-3.0	Samples
LM2936DTX-3.3	ACTIVE	TO-252	NDP	3	2500	TBD	Call TI	Call TI	-40 to 125		Samples
LM2936DTX-3.3/NOPB	ACTIVE	TO-252	NDP	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	LM2936D T-3.3	Samples
LM2936DTX-5.0	NRND	TO-252	NDP	3	2500	TBD	Call TI	Call TI	-40 to 125	LM2936D T-5.0	
LM2936DTX-5.0/NOPB	ACTIVE	TO-252	NDP	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	LM2936D T-5.0	Samples
LM2936HVBMA-3.3	NRND	SOIC	D	8	95	TBD	Call TI	Call TI	-40 to 125	2936H BM3.3	
LM2936HVBMA-3.3/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	2936H BM3.3	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM2936HVBMA-5.0	NRND	SOIC	D	8	95	TBD	Call TI	Call TI	-40 to 125	2936H BM5.0	
LM2936HVBMA-5.0/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	2936H BM5.0	Samples
LM2936HVBMAX3.3	NRND	SOIC	D	8	2500	TBD	Call TI	Call TI		2936H BM3.3	
LM2936HVBMAX3.3/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM		2936H BM3.3	Samples
LM2936HVBMAX5.0/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM		2936H BM5.0	Samples
LM2936HVMA-5.0	NRND	SOIC	D	8	95	TBD	Call TI	Call TI	-40 to 125	2936H M-5.0	
LM2936HVMA-5.0/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	2936H M-5.0	Samples
LM2936HVMAX-5.0	NRND	SOIC	D	8	2500	TBD	Call TI	Call TI	-40 to 125	2936H M-5.0	
LM2936HVMAX-5.0/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	2936H M-5.0	Samples
LM2936M-3.0/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	LM293 6M-3	Samples
LM2936M-3.3	NRND	SOIC	D	8	95	TBD	Call TI	Call TI	-40 to 125	LM293 6-3.3	
LM2936M-3.3/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	LM293 6-3.3	Samples
LM2936M-5.0	NRND	SOIC	D	8	95	TBD	Call TI	Call TI	-40 to 125	LM293 6M-5	
LM2936M-5.0/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	SN | CU SN	Level-1-260C-UNLIM	-40 to 125	LM293 6M-5	Samples
LM2936MM-3.0	NRND	VSSOP	DGK	8	1000	TBD	Call TI	Call TI	-40 to 125	KBC	
LM2936MM-3.0/NOPB	ACTIVE	VSSOP	DGK	8	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	KBC	Samples
LM2936MM-3.3	NRND	VSSOP	DGK	8	1000	TBD	Call TI	Call TI	-40 to 125	KBB	
LM2936MM-3.3/NOPB	ACTIVE	VSSOP	DGK	8	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	KBB	Samples
LM2936MM-5.0/NOPB	ACTIVE	VSSOP	DGK	8	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	KBA	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM2936MMX-3.3/NOPB	ACTIVE	VSSOP	DGK	8	3500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	KBB	Samples
LM2936MMX-5.0	NRND	VSSOP	DGK	8	3500	TBD	Call TI	Call TI	-40 to 125	KBA	
LM2936MMX-5.0/NOPB	ACTIVE	VSSOP	DGK	8	3500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	KBA	Samples
LM2936MP-3.0/NOPB	ACTIVE	SOT-223	DCY	4	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM		KACA	Samples
LM2936MP-3.3	NRND	SOT-223	DCY	4	1000	TBD	Call TI	Call TI	-40 to 125	KABA	
LM2936MP-3.3/NOPB	ACTIVE	SOT-223	DCY	4	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	KABA	Samples
LM2936MP-5.0	NRND	SOT-223	DCY	4	1000	TBD	Call TI	Call TI	-40 to 125	KAAA	
LM2936MP-5.0/NOPB	ACTIVE	SOT-223	DCY	4	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	KAAA	Samples
LM2936MPX-3.0	NRND	SOT-223	DCY	4	2000	TBD	Call TI	Call TI	-40 to 125	KACA	
LM2936MPX-3.0/NOPB	ACTIVE	SOT-223	DCY	4	2000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	KACA	Samples
LM2936MPX-3.3/NOPB	ACTIVE	SOT-223	DCY	4	2000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	KABA	Samples
LM2936MPX-5.0/NOPB	ACTIVE	SOT-223	DCY	4	2000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	KAAA	Samples
LM2936MX-3.3	NRND	SOIC	D	8	2500	TBD	Call TI	Call TI	-40 to 125	LM2936-3.3	
LM2936MX-3.3/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 125	LM2936-3.3	Samples
LM2936MX-5.0	NRND	SOIC	D	8	2500	TBD	Call TI	Call TI	-40 to 125	LM2936M-5	
LM2936MX-5.0/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	SN | CU SN	Level-1-260C-UNLIM	-40 to 125	LM2936M-5	Samples
LM2936Z-3.0/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SN | CU SN	N / A for Pkg Type	-40 to 125	LM2936Z-3	Samples
LM2936Z-3.3/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SN | CU SN	N / A for Pkg Type	-40 to 125	LM2936Z-3.3	Samples
LM2936Z-5.0/LFT1	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	SN | CU SN	N / A for Pkg Type		LM2936Z-5	Samples
LM2936Z-5.0/LFT3	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	SN | CU SN	N / A for Pkg Type		LM2936Z-5	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM2936Z-5.0/LFT4	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	SN | CU SN	N / A for Pkg Type		LM293 6Z-5	Samples
LM2936Z-5.0/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SN | CU SN	N / A for Pkg Type	-40 to 125	LM293 6Z-5	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

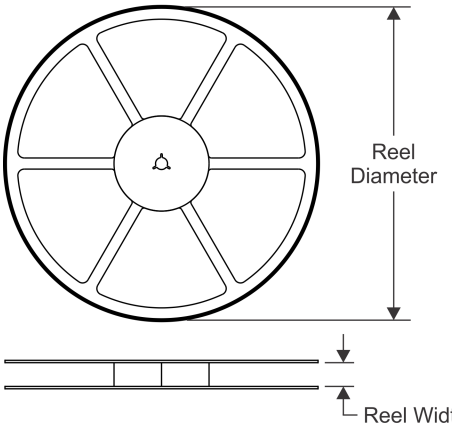
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

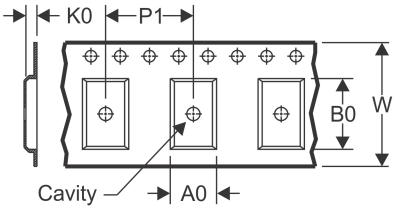
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

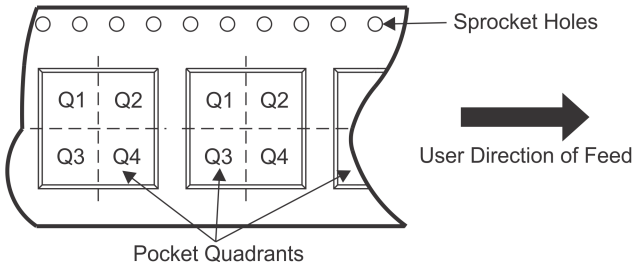


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

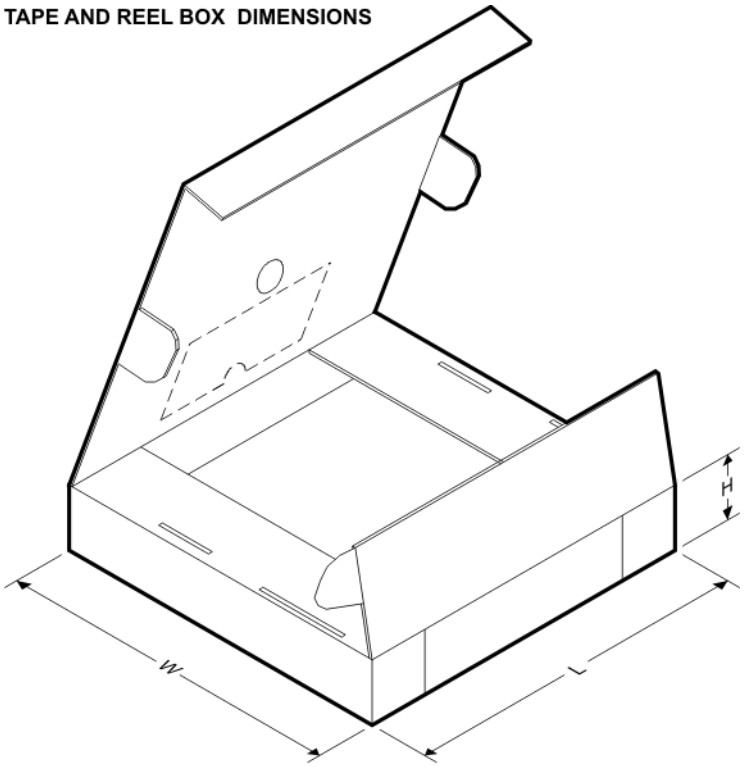


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM2936BMX-3.3/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM2936BMX-5.0	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM2936BMX-5.0/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM2936DTX-3.0/NOPB	TO-252	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM2936DTX-3.3/NOPB	TO-252	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM2936DTX-5.0	TO-252	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM2936DTX-5.0/NOPB	TO-252	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM2936HVBMAX3.3	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM2936HVBMAX3.3/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM2936HVBMAX5.0/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM2936HVMAX-5.0	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM2936HVMAX-5.0/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM2936MM-3.0	VSSOP	DGK	8	1000	178.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
LM2936MM-3.0/NOPB	VSSOP	DGK	8	1000	178.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
LM2936MM-3.3	VSSOP	DGK	8	1000	178.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
LM2936MM-3.3/NOPB	VSSOP	DGK	8	1000	178.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM2936MM-5.0/NOPB	VSSOP	DGK	8	1000	178.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
LM2936MMX-3.3/NOPB	VSSOP	DGK	8	3500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
LM2936MMX-5.0	VSSOP	DGK	8	3500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
LM2936MMX-5.0/NOPB	VSSOP	DGK	8	3500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
LM2936MP-3.0/NOPB	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM2936MP-3.3	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM2936MP-3.3/NOPB	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM2936MP-5.0	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM2936MP-5.0/NOPB	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM2936MPX-3.0	SOT-223	DCY	4	2000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM2936MPX-3.0/NOPB	SOT-223	DCY	4	2000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM2936MPX-3.3/NOPB	SOT-223	DCY	4	2000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM2936MPX-5.0/NOPB	SOT-223	DCY	4	2000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM2936MX-3.3	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM2936MX-3.3/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM2936MX-5.0	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
LM2936MX-5.0/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1

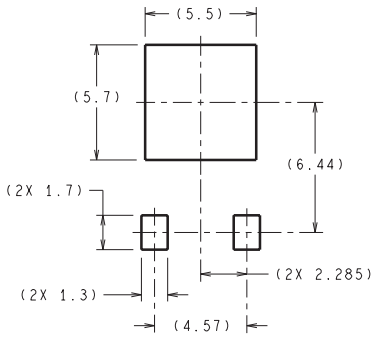
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

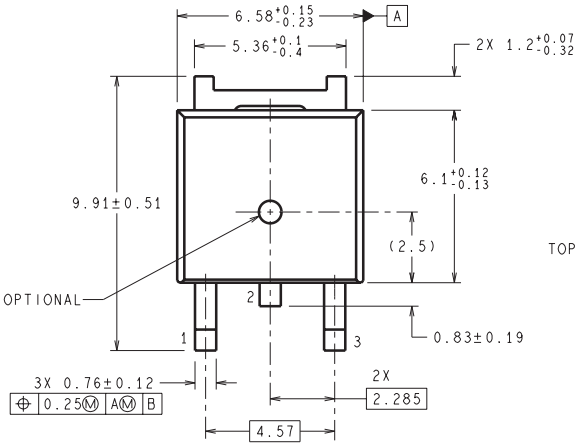
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM2936BMX-3.3/NOPB	SOIC	D	8	2500	367.0	367.0	35.0
LM2936BMX-5.0	SOIC	D	8	2500	367.0	367.0	35.0
LM2936BMX-5.0/NOPB	SOIC	D	8	2500	367.0	367.0	35.0
LM2936DTX-3.0/NOPB	TO-252	NDP	3	2500	367.0	367.0	38.0
LM2936DTX-3.3/NOPB	TO-252	NDP	3	2500	367.0	367.0	38.0
LM2936DTX-5.0	TO-252	NDP	3	2500	367.0	367.0	35.0
LM2936DTX-5.0/NOPB	TO-252	NDP	3	2500	367.0	367.0	38.0
LM2936HVBMAX3.3	SOIC	D	8	2500	367.0	367.0	35.0
LM2936HVBMAX3.3/NOPB	SOIC	D	8	2500	367.0	367.0	35.0
LM2936HVBMAX5.0/NOPB	SOIC	D	8	2500	367.0	367.0	35.0
LM2936HVMAX-5.0	SOIC	D	8	2500	367.0	367.0	35.0
LM2936HVMAX-5.0/NOPB	SOIC	D	8	2500	367.0	367.0	35.0
LM2936MM-3.0	VSSOP	DGK	8	1000	210.0	185.0	35.0
LM2936MM-3.0/NOPB	VSSOP	DGK	8	1000	210.0	185.0	35.0
LM2936MM-3.3	VSSOP	DGK	8	1000	210.0	185.0	35.0
LM2936MM-3.3/NOPB	VSSOP	DGK	8	1000	210.0	185.0	35.0
LM2936MM-5.0/NOPB	VSSOP	DGK	8	1000	210.0	185.0	35.0
LM2936MMX-3.3/NOPB	VSSOP	DGK	8	3500	367.0	367.0	35.0
LM2936MMX-5.0	VSSOP	DGK	8	3500	367.0	367.0	35.0
LM2936MMX-5.0/NOPB	VSSOP	DGK	8	3500	367.0	367.0	35.0
LM2936MP-3.0/NOPB	SOT-223	DCY	4	1000	367.0	367.0	35.0
LM2936MP-3.3	SOT-223	DCY	4	1000	367.0	367.0	35.0
LM2936MP-3.3/NOPB	SOT-223	DCY	4	1000	367.0	367.0	35.0
LM2936MP-5.0	SOT-223	DCY	4	1000	367.0	367.0	35.0
LM2936MP-5.0/NOPB	SOT-223	DCY	4	1000	367.0	367.0	35.0
LM2936MPX-3.0	SOT-223	DCY	4	2000	367.0	367.0	35.0
LM2936MPX-3.0/NOPB	SOT-223	DCY	4	2000	367.0	367.0	35.0
LM2936MPX-3.3/NOPB	SOT-223	DCY	4	2000	367.0	367.0	35.0
LM2936MPX-5.0/NOPB	SOT-223	DCY	4	2000	367.0	367.0	35.0
LM2936MX-3.3	SOIC	D	8	2500	367.0	367.0	35.0
LM2936MX-3.3/NOPB	SOIC	D	8	2500	367.0	367.0	35.0
LM2936MX-5.0	SOIC	D	8	2500	367.0	367.0	35.0
LM2936MX-5.0/NOPB	SOIC	D	8	2500	367.0	367.0	35.0

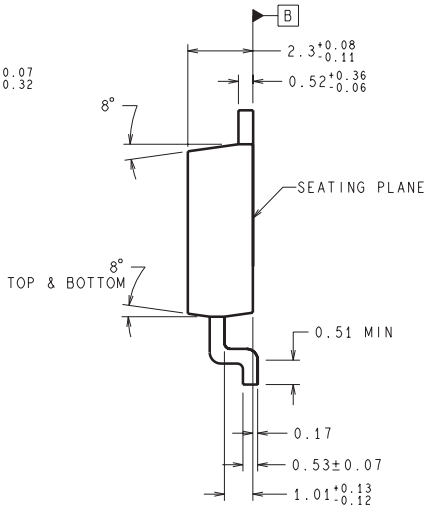
NDP0003B

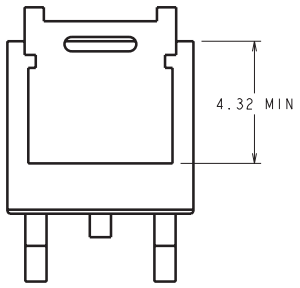


LAND PATTERN RECOMMENDATION

DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS IN ( ) FOR REFERENCE ONLY

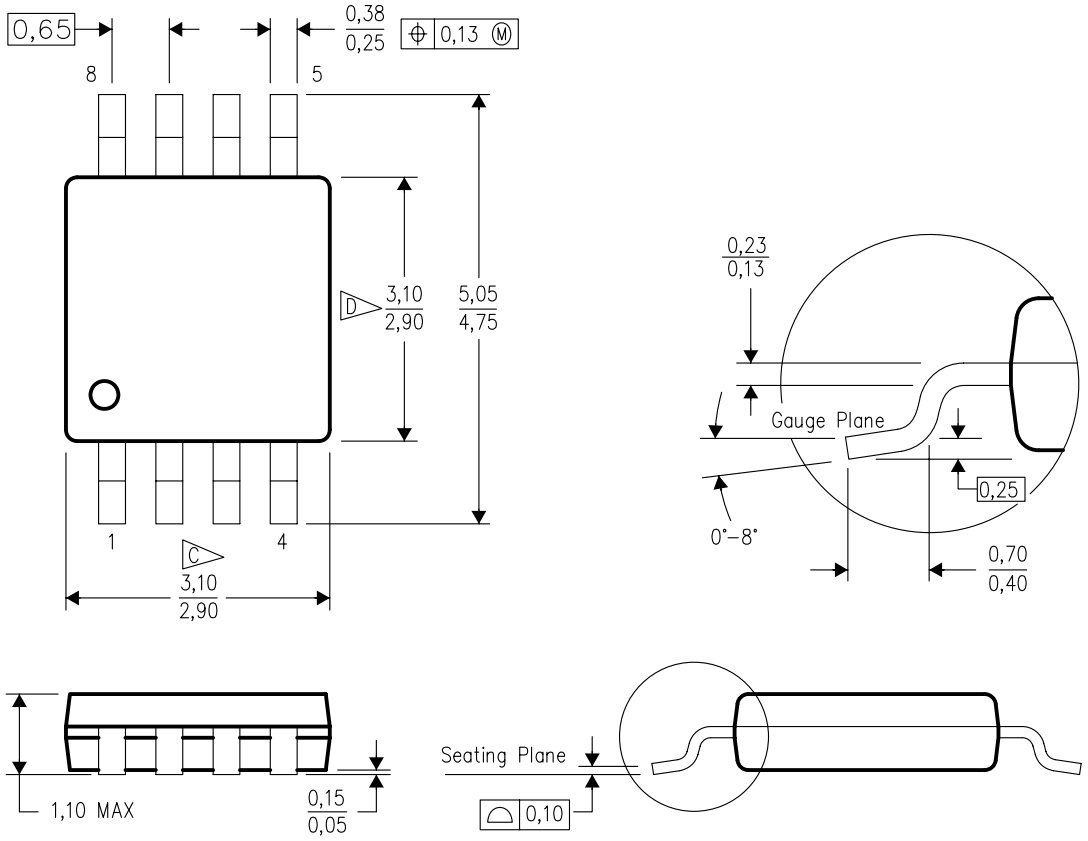






TD03B (Rev F)

DGK (S–PDSO–G8) PLASTIC SMALL–OUTLINE PACKAGE



4073329/E 05/06

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
E. Falls within JEDEC MO–187 variation AA, except interlead flash.

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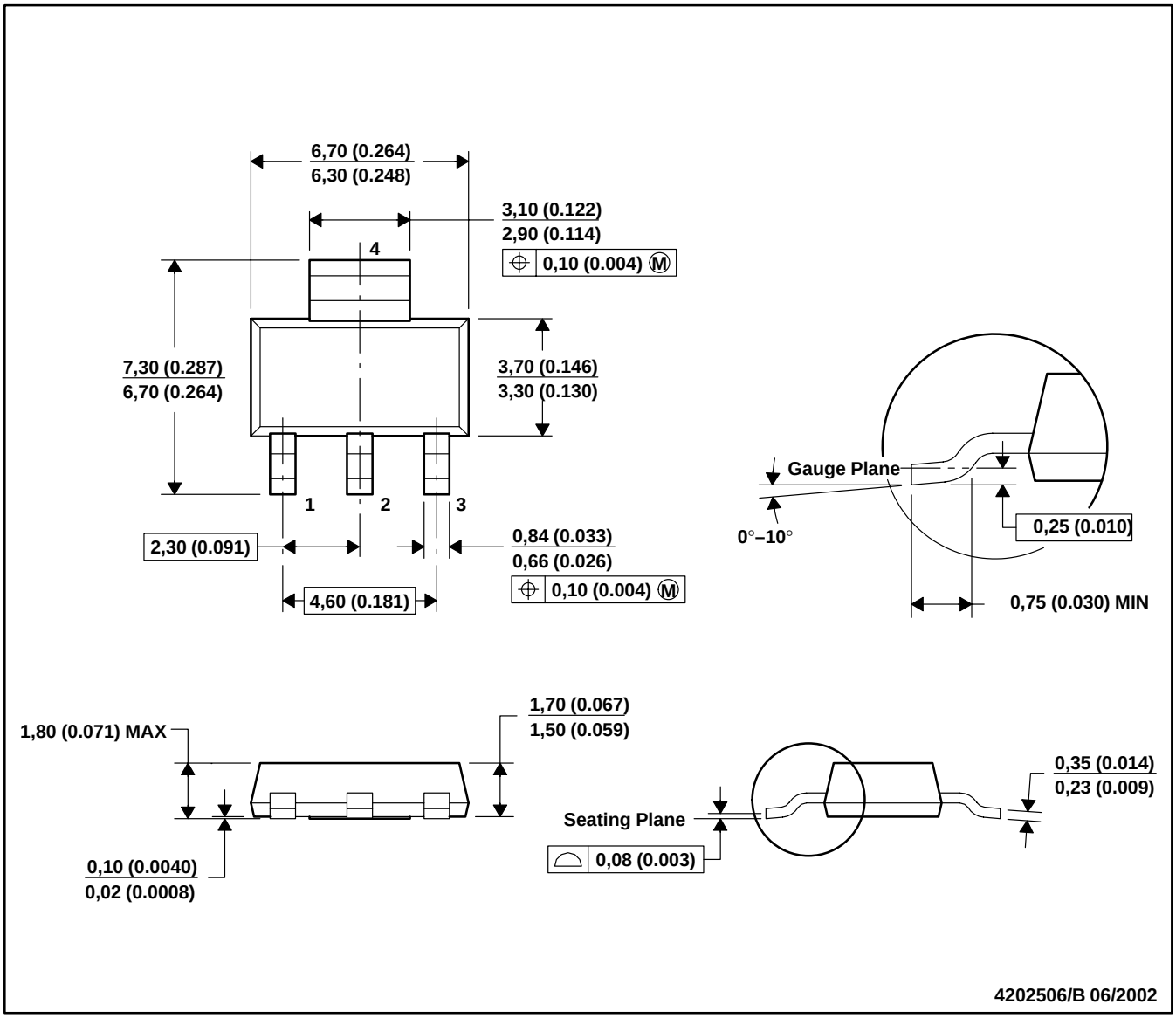
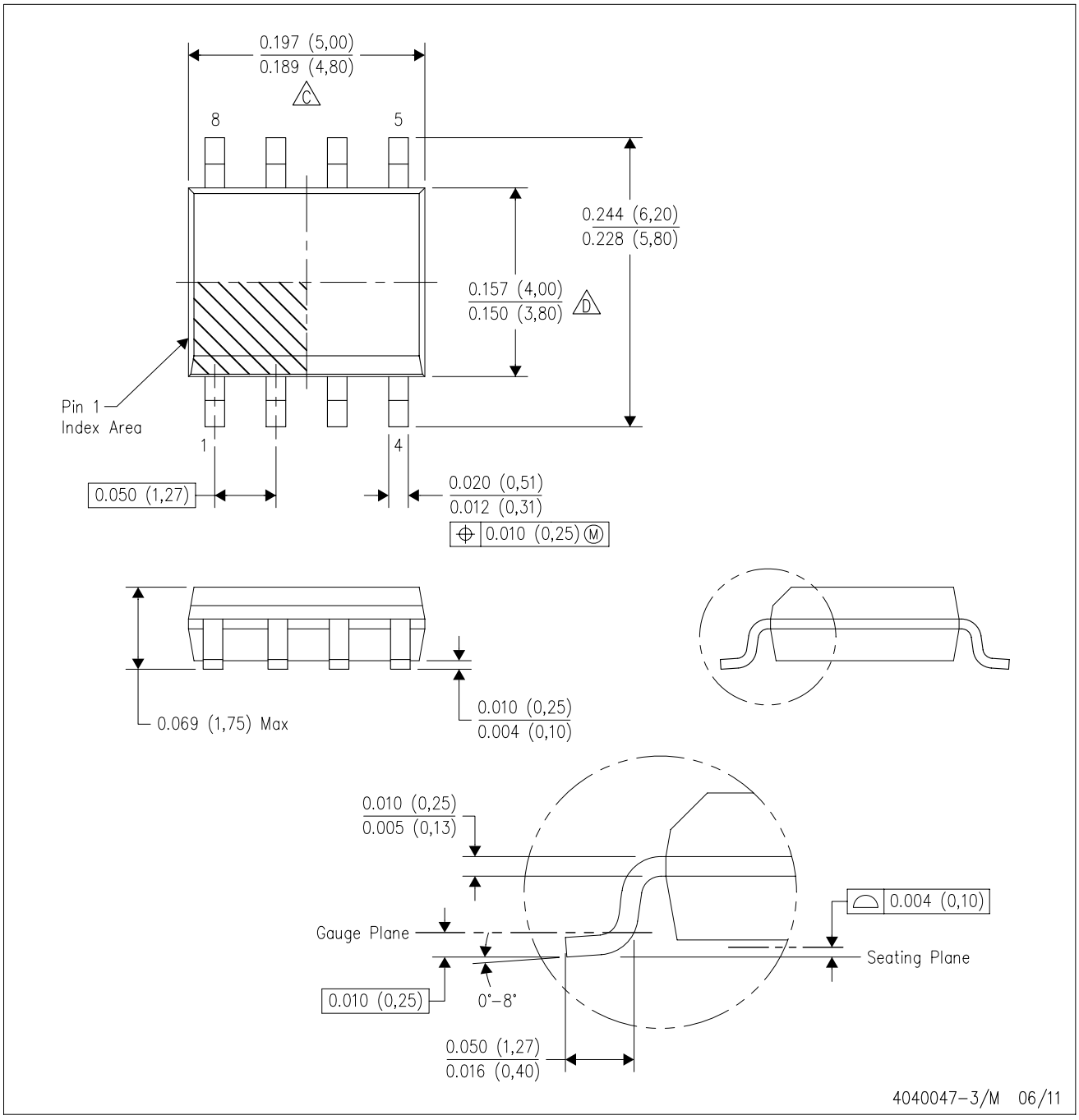
DCY (R-PDSO-G4) **PLASTIC SMALL-OUTLINE**



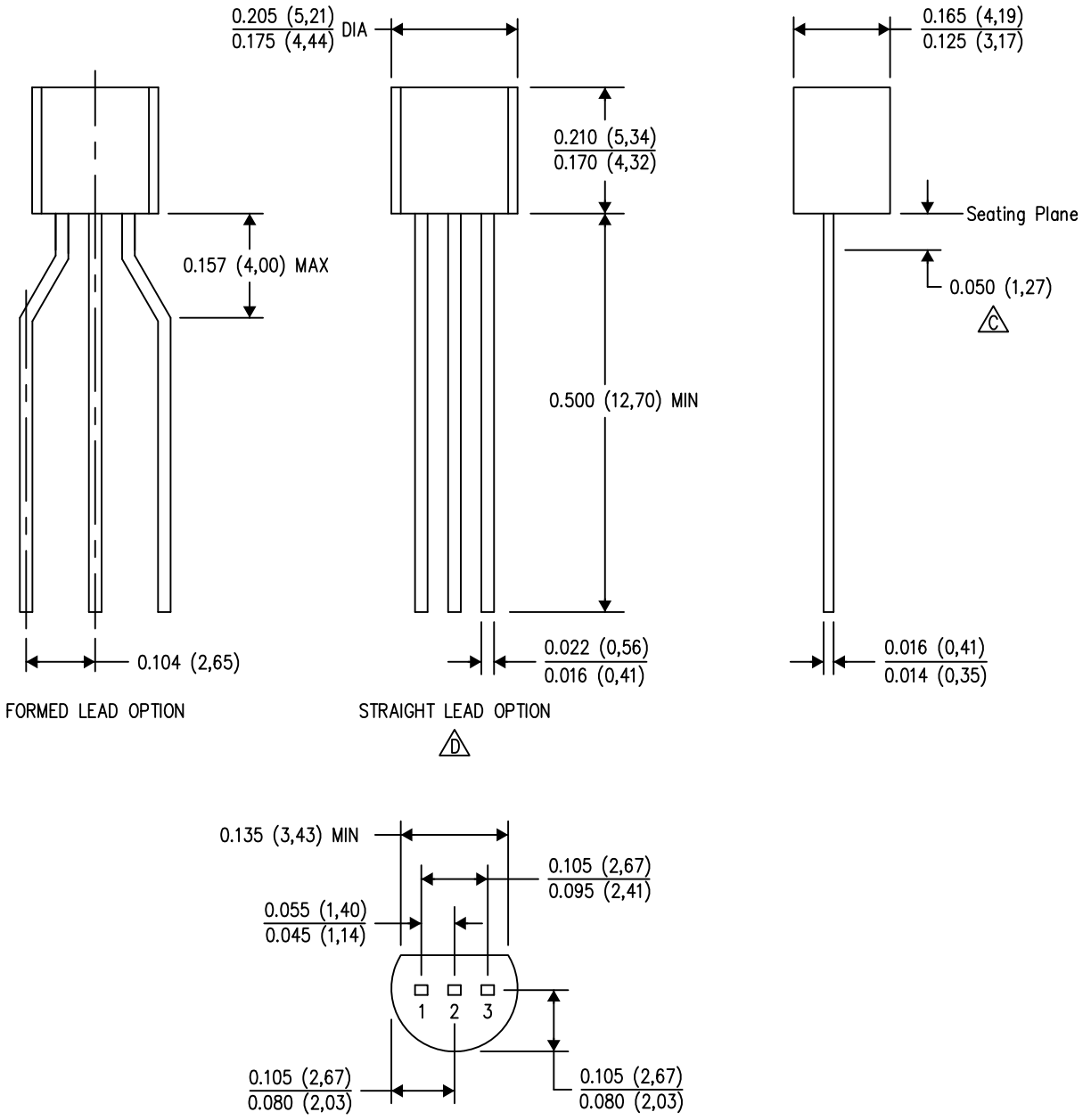
NOTES: A. All linear dimensions are in millimeters (inches).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC TO-261 Variation AA.

D (R–PDSO–G8) PLASTIC SMALL OUTLINE



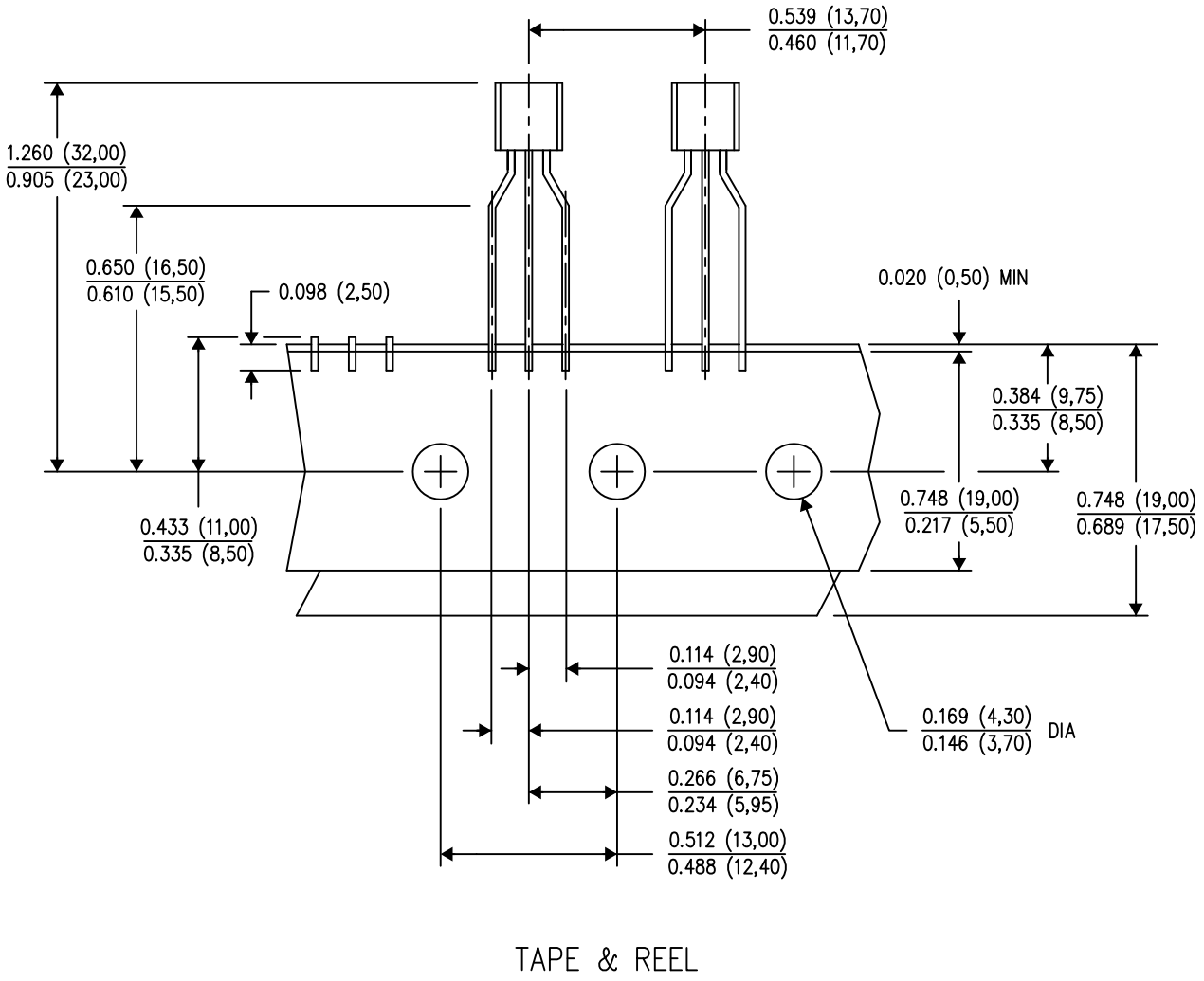
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AA.

LP (O–PBCY–W3) PLASTIC CYLINDRICAL PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Lead dimensions are not controlled within this area.
D. Falls within JEDEC TO–226 Variation AA (TO–226 replaces TO–92).
E. Shipping Method:
Straight lead option available in bulk pack only.
Formed lead option available in tape & reel or ammo pack.
Specific products can be offered in limited combinations of shipping mediums and lead options.
Consult product folder for more information on available options.

LP (O–PBCY–W3) PLASTIC CYLINDRICAL PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Tape and Reel information for the Formed Lead Option package.

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