LM2936 Ultra-Low Quiescent Current LDO Voltage Regulator

Check for Samples: LM2936-5.0

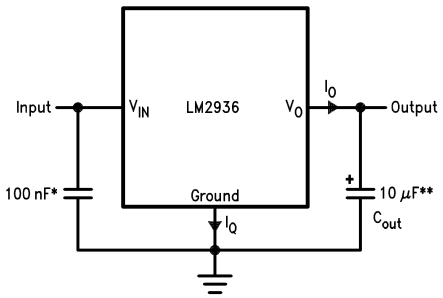
FEATURES

- **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, SO-8 and SOT–23 surface mount packages, and a TO-252 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 Diagram

TO-252

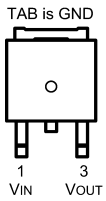


Figure 1. Top View

SOT-223

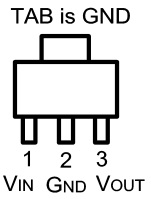


Figure 2. Top View

8-Pin SO (M)

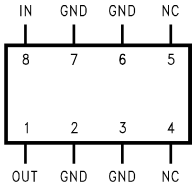


Figure 3. Top View

8-Pin SO (M)

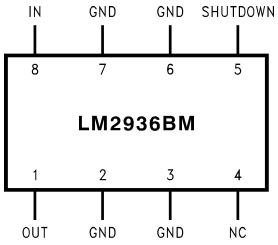


Figure 4. Top View

TO-92

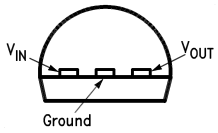


Figure 5. Bottom View

8-Pin Mini SOIC (MM)

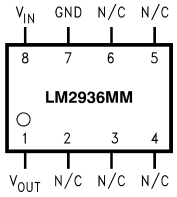


Figure 6. Top View

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)

Input Voltage (Survival)	+60V, −50V
ESD Susceptibility (2)	2000V
Power Dissipation (3)	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) Human body model, 100 pF discharge through a 1.5 kΩ resistor.
(3) 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 (Z03A) θ_{JA}	195°C/W
MSO-8 (MUA08A) θ_{JA}	200°C/W
SO-8 (M08A) θ_{JA}	140°C/W
SO-8 (M08A) θ_{JC}	45°C/W
TO-252 (TD03B) θ_{JA}	136°C/W
TO-252 (TD03B) θ_{JC}	6°C/W
SOT-223 (MP04A) θ_{JA}	149°C/W
SOT-223 (MP04A) 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,		450		mΩ
	$_f$ = 1000 Hz				
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	R_L = 500Ω, T = 1 ms	−50	−80		V
Transient Input Voltage					
Output Voltage with	V_{IN} = −15V, R_L = 500Ω		0.00	−0.30	V
Reverse Polarity Input					
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					
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

(1) Datasheet min/max specification limits are guaranteed 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

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,		450		mΩ
	$_f$ = 1000 Hz				
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	R_L = 500Ω, T = 1 ms	−50	−80		V
Transient Input Voltage					
Output Voltage with	V_{IN} = −15V, R_L = 500Ω		0.00	−0.30	V
Reverse Polarity Input					
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
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

(1) Datasheet min/max specification limits are guaranteed 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

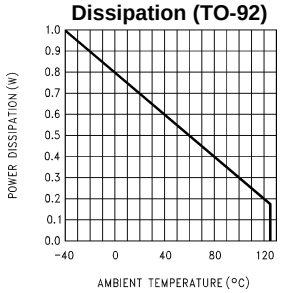
V_{IN} = 14V, I_O = 10 mA, T_J = 25°C, unless otherwise specified. **Boldface** limits apply over entire operating temperature range

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,		450		mΩ
	$_f$ = 1000 Hz				
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	R_L = 500Ω, T = 1 ms	−50	−80		V
Transient Input Voltage					
Output Voltage with	V_{IN} = −15V, R_L = 500Ω		0.00	−0.30	V
Reverse Polarity Input					
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
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

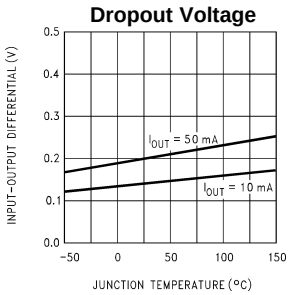
(1) Datasheet min/max specification limits are guaranteed by design, test, or statistical analysis.
(2) Typicals are at 25°C (unless otherwise specified) and represent the most likely parametric norm.
(3) To ensure constant junction temperature, pulse testing is used.

Typical Performance Characteristics

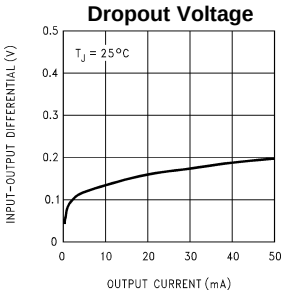
Maximum Power Dissipation (TO-92)



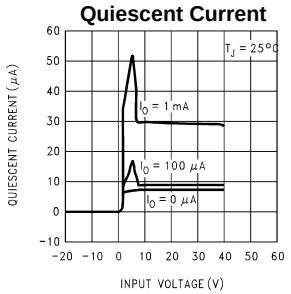
Dropout Voltage



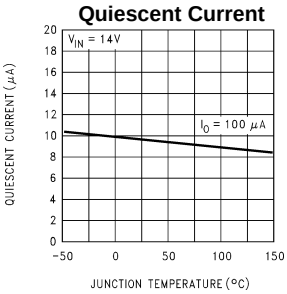
Dropout Voltage



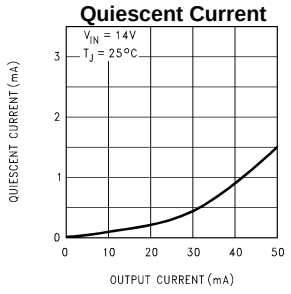
Quiescent Current



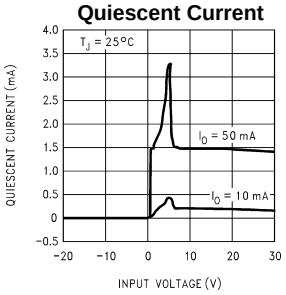
Quiescent Current



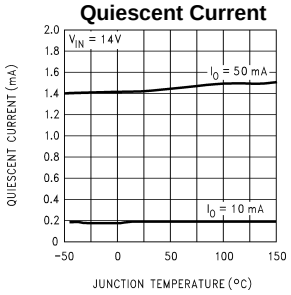
Quiescent Current



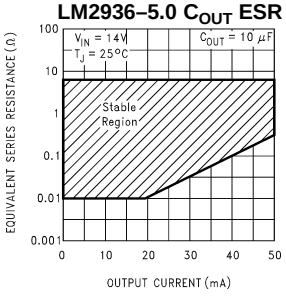
Quiescent Current



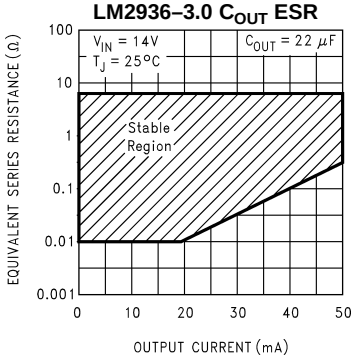
Quiescent Current



LM2936–5.0 C_{OUT} ESR

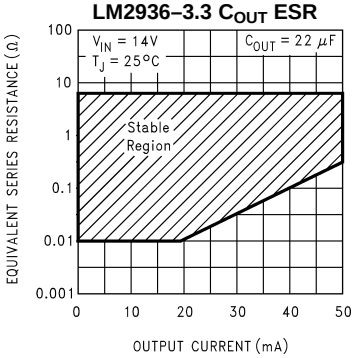


LM2936–3.0 C_{OUT} ESR

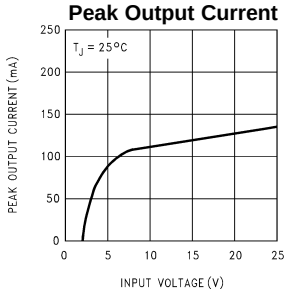


Typical Performance Characteristics (continued)

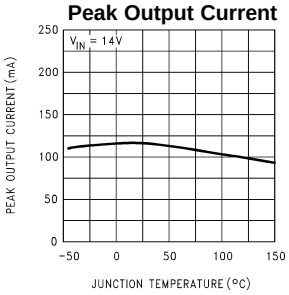
LM2936–3.3 C_{OUT} ESR



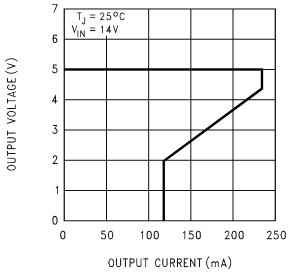
Peak Output Current



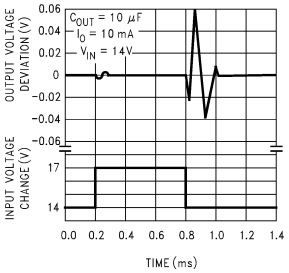
Peak Output Current



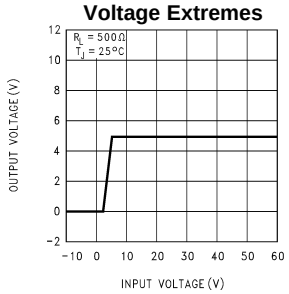
LM2936–5.0 Current Limit



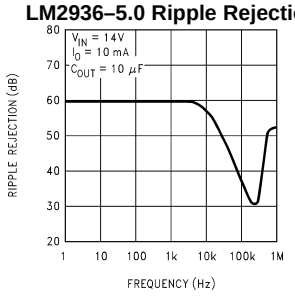
LM2936–5.0 Line Transient Response



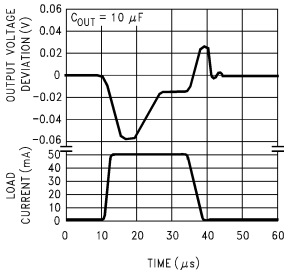
LM2936–5.0 Output at Voltage Extremes



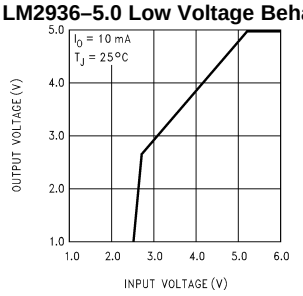
LM2936–5.0 Ripple Rejection



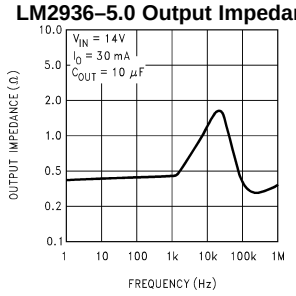
LM2936–5.0 Load Transient Response



LM2936–5.0 Low Voltage Behavior



LM2936–5.0 Output Impedance



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 guaranteed 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 SO-8 and TO-252 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 SO-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 TO-252 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

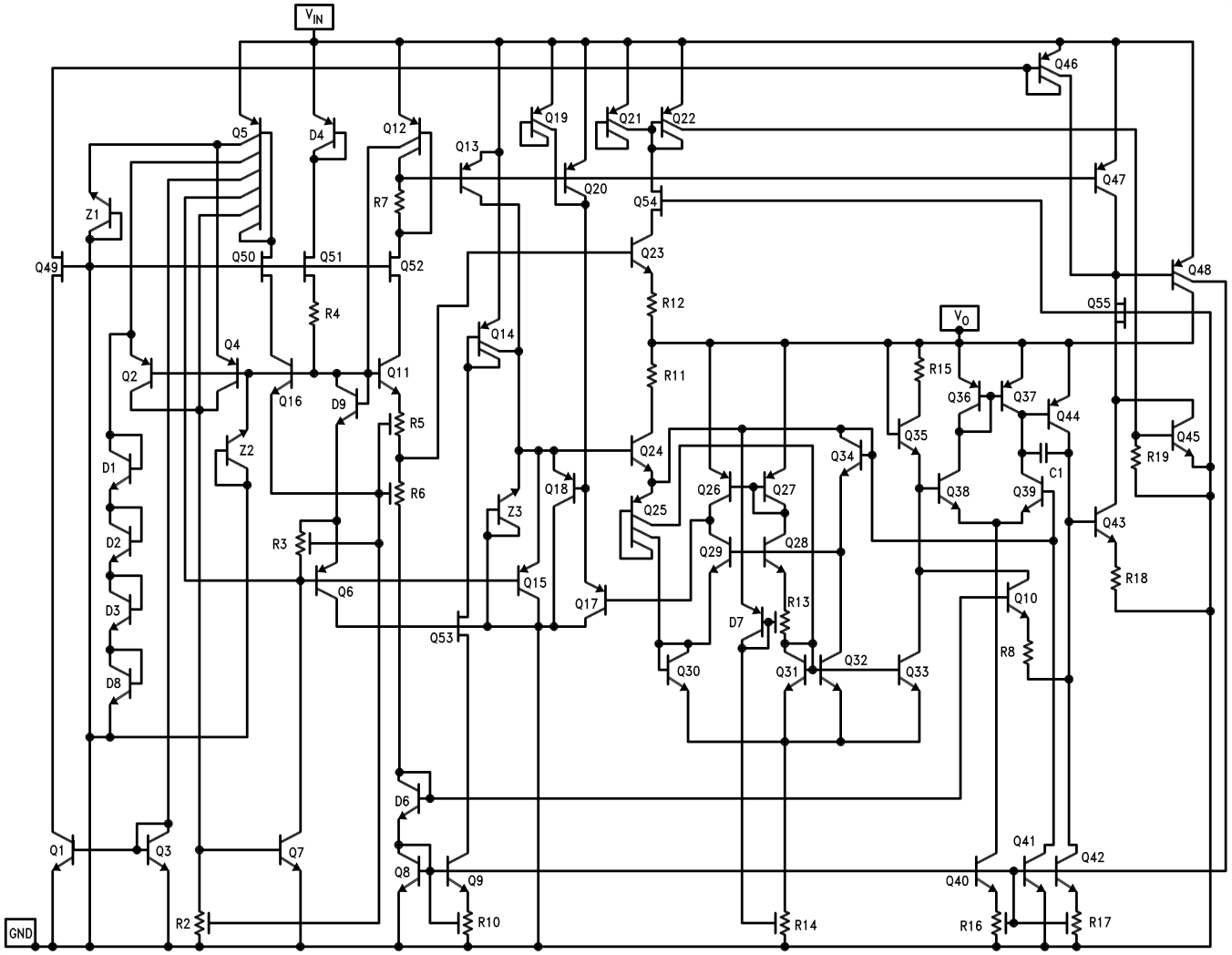


Figure 7.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
LM2936BM-3.3	ACTIVE	SOIC	D	8	95	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936BM-3.3/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936BM-5.0	ACTIVE	SOIC	D	8	95	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936BM-5.0/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936BMX-3.3	ACTIVE	SOIC	D	8	2500	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936BMX-3.3/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936BMX-5.0	ACTIVE	SOIC	D	8	2500	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936BMX-5.0/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936DT-3.0	ACTIVE	PFM	NDP	3	75	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936DT-3.0/NOPB	ACTIVE	PFM	NDP	3	75	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	
LM2936DT-3.3	ACTIVE	PFM	NDP	3	75	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936DT-3.3/NOPB	ACTIVE	PFM	NDP	3	75	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	
LM2936DT-5.0	ACTIVE	PFM	NDP	3	75	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936DT-5.0/NOPB	ACTIVE	PFM	NDP	3	75	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	
LM2936DTX-3.0/NOPB	ACTIVE	PFM	NDP	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	
LM2936DTX-3.3	ACTIVE	PFM	NDP	3	2500	TBD	Call TI	Call TI	
LM2936DTX-3.3/NOPB	ACTIVE	PFM	NDP	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	
LM2936DTX-5.0	ACTIVE	PFM	NDP	3	2500	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936DTX-5.0/NOPB	ACTIVE	PFM	NDP	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	
LM2936HVBMA-3.3	ACTIVE	SOIC	D	8	95	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936HVBMA-3.3/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936HVBMA-5.0	ACTIVE	SOIC	D	8	95	TBD	CU SNPB	Level-1-235C-UNLIM	

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
LM2936HVBMA-5.0/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936HVBMAX3.3	ACTIVE	SOIC	D	8	2500	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936HVBMAX3.3/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936HVBMAX5.0	ACTIVE	SOIC	D	8	2500	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936HVBMAX5.0/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936HVMA-5.0	ACTIVE	SOIC	D	8	95	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936HVMA-5.0/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936HVMAX-5.0	ACTIVE	SOIC	D	8	2500	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936HVMAX-5.0/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936M-3.0	ACTIVE	SOIC	D	8	95	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936M-3.0/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936M-3.3	ACTIVE	SOIC	D	8	95	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936M-3.3/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936M-5.0	ACTIVE	SOIC	D	8	95	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936M-5.0/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936MM-3.0	ACTIVE	VSSOP	DGK	8	1000	TBD	CU SNPB	Level-1-260C-UNLIM	
LM2936MM-3.0/NOPB	ACTIVE	VSSOP	DGK	8	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936MM-3.3	ACTIVE	VSSOP	DGK	8	1000	TBD	CU SNPB	Level-1-260C-UNLIM	
LM2936MM-3.3/NOPB	ACTIVE	VSSOP	DGK	8	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936MM-5.0	ACTIVE	VSSOP	DGK	8	1000	TBD	CU SNPB	Level-1-260C-UNLIM	
LM2936MM-5.0/NOPB	ACTIVE	VSSOP	DGK	8	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936MMX-3.3	ACTIVE	VSSOP	DGK	8	3500	TBD	CU SNPB	Level-1-260C-UNLIM	

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
LM2936MMX-3.3/NOPB	ACTIVE	VSSOP	DGK	8	3500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936MMX-5.0	ACTIVE	VSSOP	DGK	8	3500	TBD	CU SNPB	Level-1-260C-UNLIM	
LM2936MMX-5.0/NOPB	ACTIVE	VSSOP	DGK	8	3500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936MP-3.0	ACTIVE	SOT-223	DCY	4	1000	TBD	CU SNPB	Level-1-260C-UNLIM	
LM2936MP-3.0/NOPB	ACTIVE	SOT-223	DCY	4	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936MP-3.3	ACTIVE	SOT-223	DCY	4	1000	TBD	CU SNPB	Level-1-260C-UNLIM	
LM2936MP-3.3/NOPB	ACTIVE	SOT-223	DCY	4	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936MP-5.0	ACTIVE	SOT-223	DCY	4	1000	TBD	CU SNPB	Level-1-260C-UNLIM	
LM2936MP-5.0/NOPB	ACTIVE	SOT-223	DCY	4	1000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936MPX-3.0	ACTIVE	SOT-223	DCY	4	2000	TBD	CU SNPB	Level-1-260C-UNLIM	
LM2936MPX-3.0/NOPB	ACTIVE	SOT-223	DCY	4	2000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936MPX-3.3	ACTIVE	SOT-223	DCY	4	2000	TBD	CU SNPB	Level-1-260C-UNLIM	
LM2936MPX-3.3/NOPB	ACTIVE	SOT-223	DCY	4	2000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936MPX-5.0	ACTIVE	SOT-223	DCY	4	2000	TBD	CU SNPB	Level-1-260C-UNLIM	
LM2936MPX-5.0/NOPB	ACTIVE	SOT-223	DCY	4	2000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936MX-3.3	ACTIVE	SOIC	D	8	2500	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936MX-3.3/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936MX-5.0	ACTIVE	SOIC	D	8	2500	TBD	CU SNPB	Level-1-235C-UNLIM	
LM2936MX-5.0/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	
LM2936Z-3.0/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	Call TI	Level-1-NA-UNLIM	
LM2936Z-3.3/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	Call TI	Level-1-NA-UNLIM	
LM2936Z-5.0/LFT1	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	Call TI	Level-1-NA-UNLIM	

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
LM2936Z-5.0/LFT3	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	Call TI	Level-1-NA-UNLIM	
LM2936Z-5.0/LFT4	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	Call TI	Level-1-NA-UNLIM	
LM2936Z-5.0/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	Call TI	Level-1-NA-UNLIM	

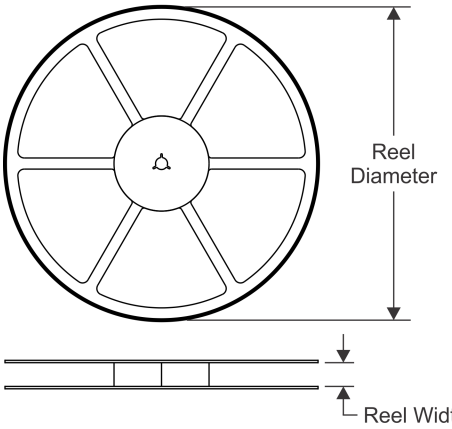
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, 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)

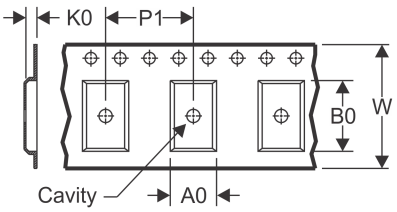
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

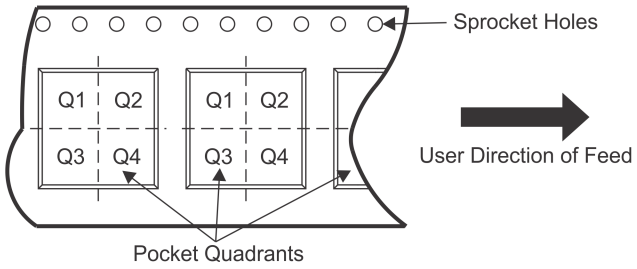


TAPE DIMENSIONS



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

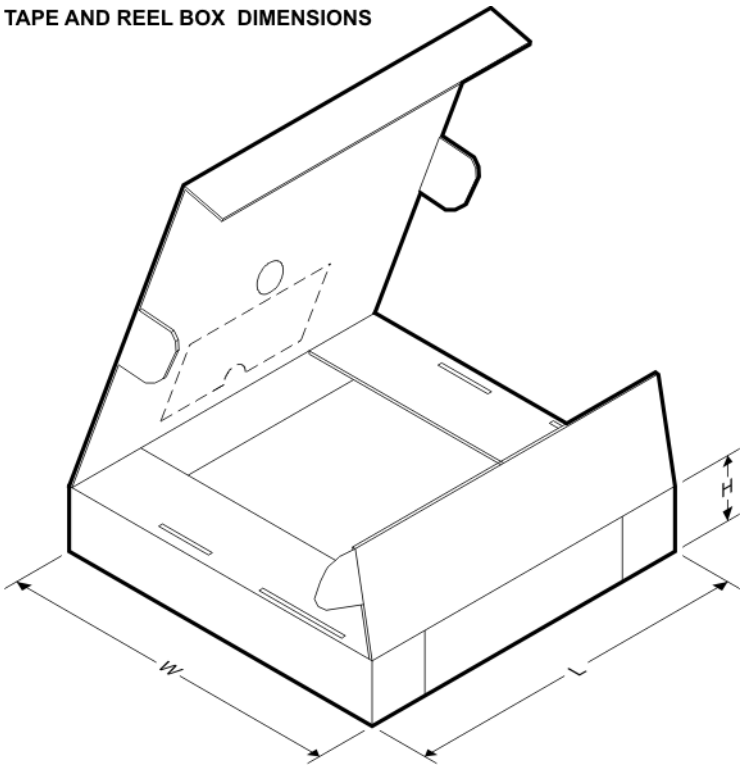


*All dimensions are nominal

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	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
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	PFM	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM2936DTX-3.3/NOPB	PFM	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM2936DTX-5.0	PFM	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM2936DTX-5.0/NOPB	PFM	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	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

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-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
LM2936MM-5.0	VSSOP	DGK	8	1000	178.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
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	VSSOP	DGK	8	3500	330.0	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	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
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	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	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

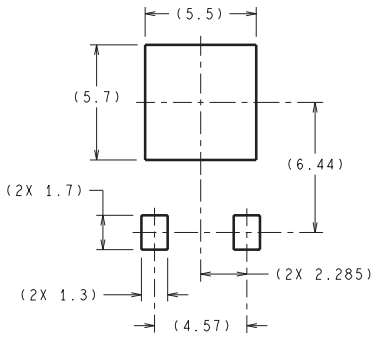


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM2936BMX-3.3	SOIC	D	8	2500	349.0	337.0	45.0
LM2936BMX-3.3/NOPB	SOIC	D	8	2500	349.0	337.0	45.0
LM2936BMX-5.0	SOIC	D	8	2500	349.0	337.0	45.0
LM2936BMX-5.0/NOPB	SOIC	D	8	2500	349.0	337.0	45.0
LM2936DTX-3.0/NOPB	PFM	NDP	3	2500	358.0	343.0	63.0
LM2936DTX-3.3/NOPB	PFM	NDP	3	2500	358.0	343.0	63.0
LM2936DTX-5.0	PFM	NDP	3	2500	354.0	340.0	35.0
LM2936DTX-5.0/NOPB	PFM	NDP	3	2500	358.0	343.0	63.0
LM2936HVBMAX3.3	SOIC	D	8	2500	349.0	337.0	45.0
LM2936HVBMAX3.3/NOPB	SOIC	D	8	2500	349.0	337.0	45.0
LM2936HVBMAX5.0	SOIC	D	8	2500	349.0	337.0	45.0
LM2936HVBMAX5.0/NOPB	SOIC	D	8	2500	349.0	337.0	45.0
LM2936HVMAX-5.0	SOIC	D	8	2500	349.0	337.0	45.0
LM2936HVMAX-5.0/NOPB	SOIC	D	8	2500	349.0	337.0	45.0
LM2936MM-3.0	VSSOP	DGK	8	1000	203.0	190.0	41.0
LM2936MM-3.0/NOPB	VSSOP	DGK	8	1000	203.0	190.0	41.0
LM2936MM-3.3	VSSOP	DGK	8	1000	203.0	190.0	41.0
LM2936MM-3.3/NOPB	VSSOP	DGK	8	1000	203.0	190.0	41.0
LM2936MM-5.0	VSSOP	DGK	8	1000	203.0	190.0	41.0

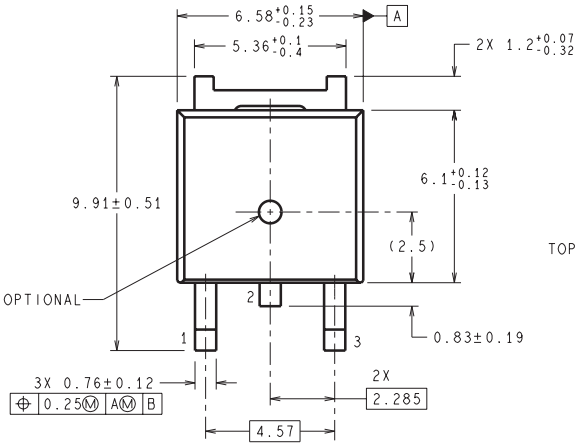
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM2936MM-5.0/NOPB	VSSOP	DGK	8	1000	203.0	190.0	41.0
LM2936MMX-3.3	VSSOP	DGK	8	3500	349.0	337.0	45.0
LM2936MMX-3.3/NOPB	VSSOP	DGK	8	3500	349.0	337.0	45.0
LM2936MMX-5.0	VSSOP	DGK	8	3500	349.0	337.0	45.0
LM2936MMX-5.0/NOPB	VSSOP	DGK	8	3500	349.0	337.0	45.0
LM2936MP-3.0	SOT-223	DCY	4	1000	349.0	337.0	45.0
LM2936MP-3.0/NOPB	SOT-223	DCY	4	1000	349.0	337.0	45.0
LM2936MP-3.3	SOT-223	DCY	4	1000	349.0	337.0	45.0
LM2936MP-3.3/NOPB	SOT-223	DCY	4	1000	349.0	337.0	45.0
LM2936MP-5.0	SOT-223	DCY	4	1000	349.0	337.0	45.0
LM2936MP-5.0/NOPB	SOT-223	DCY	4	1000	349.0	337.0	45.0
LM2936MPX-3.0	SOT-223	DCY	4	2000	354.0	340.0	35.0
LM2936MPX-3.0/NOPB	SOT-223	DCY	4	2000	354.0	340.0	35.0
LM2936MPX-3.3	SOT-223	DCY	4	2000	354.0	340.0	35.0
LM2936MPX-3.3/NOPB	SOT-223	DCY	4	2000	354.0	340.0	35.0
LM2936MPX-5.0	SOT-223	DCY	4	2000	354.0	340.0	35.0
LM2936MPX-5.0/NOPB	SOT-223	DCY	4	2000	354.0	340.0	35.0
LM2936MX-3.3	SOIC	D	8	2500	349.0	337.0	45.0
LM2936MX-3.3/NOPB	SOIC	D	8	2500	349.0	337.0	45.0
LM2936MX-5.0	SOIC	D	8	2500	349.0	337.0	45.0
LM2936MX-5.0/NOPB	SOIC	D	8	2500	349.0	337.0	45.0

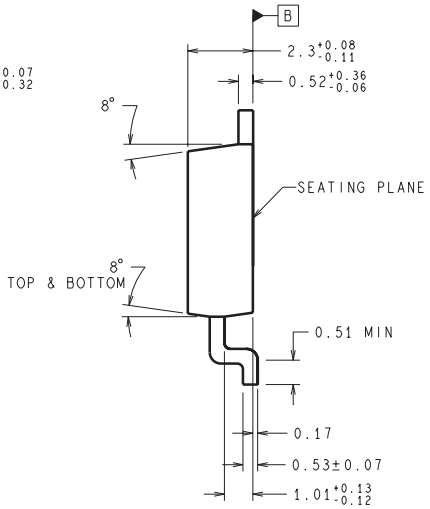
NDP0003B

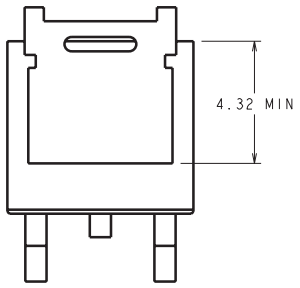


LAND PATTERN RECOMMENDATION

DIMENSIONS ARE IN MILLIMETERS
DIMENSIONS IN ( ) FOR REFERENCE ONLY

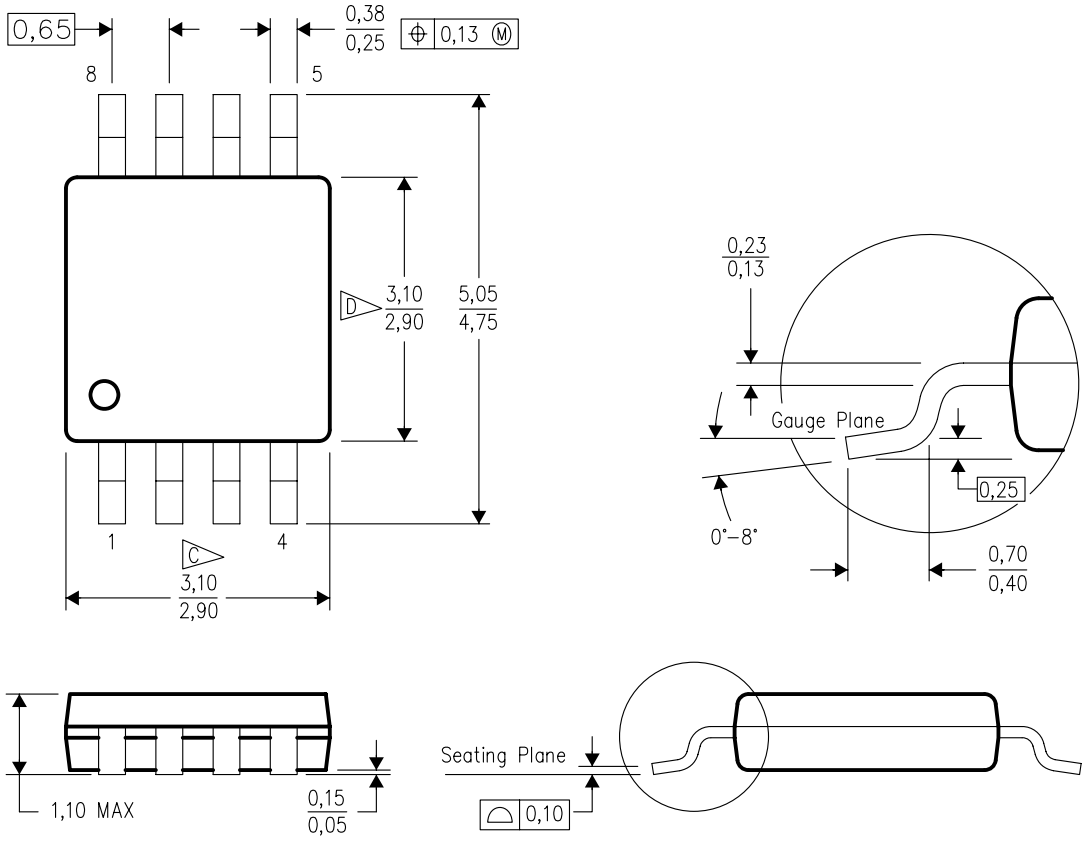






TD03B (Rev F)

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

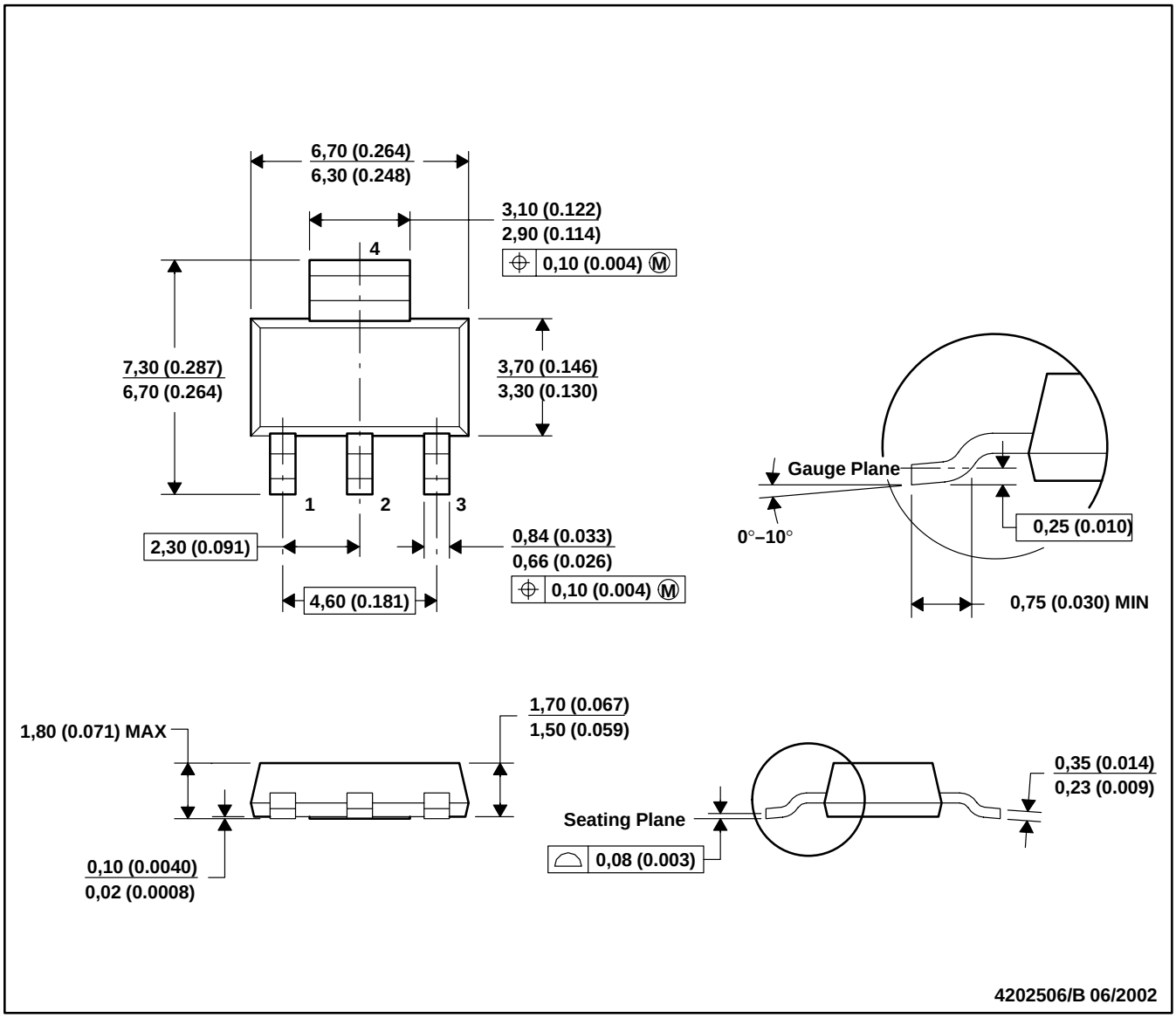


4073329/E 05/06

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.

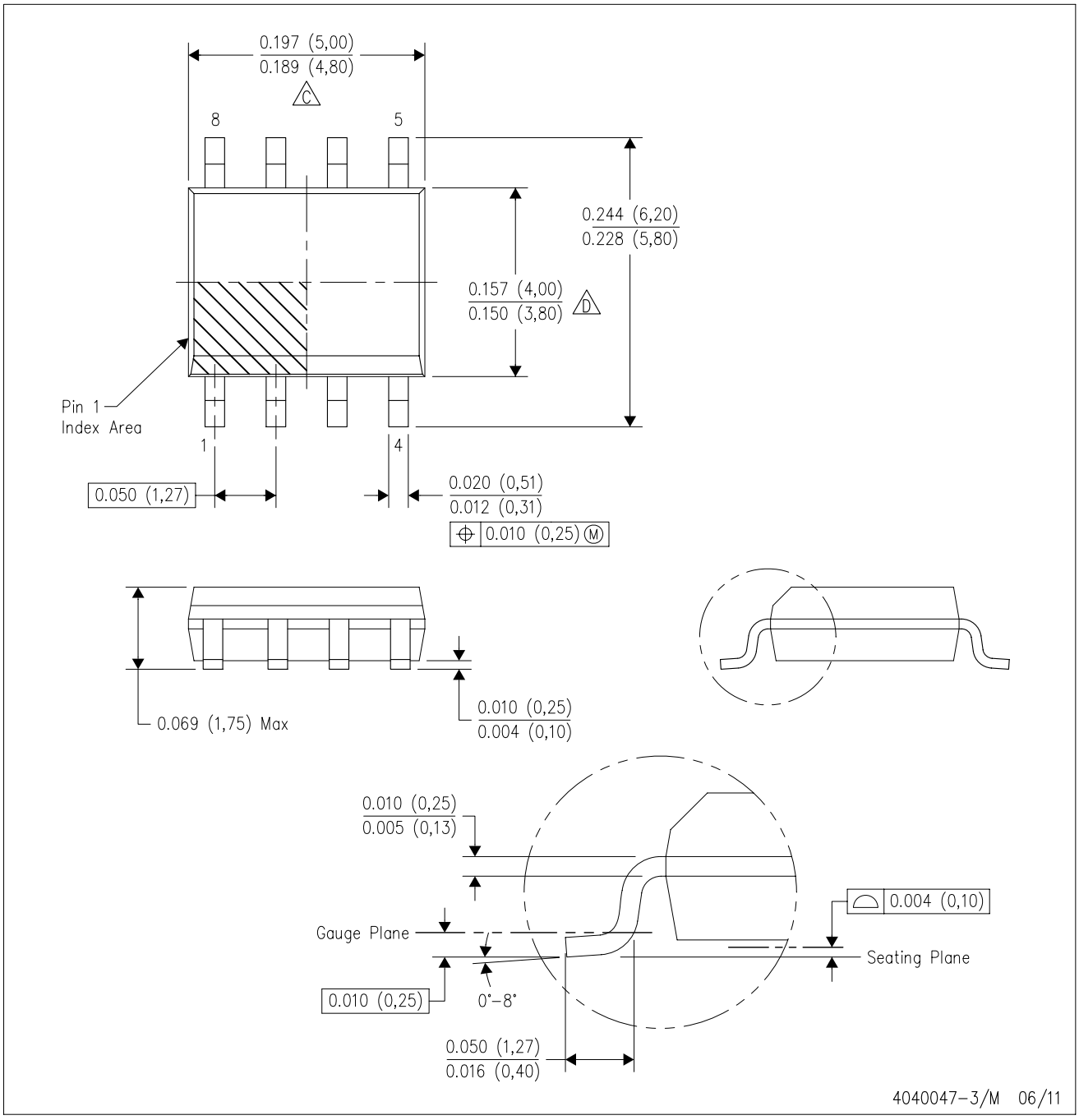
MPDS094A – APRIL 2001 – REVISED JUNE 2002

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



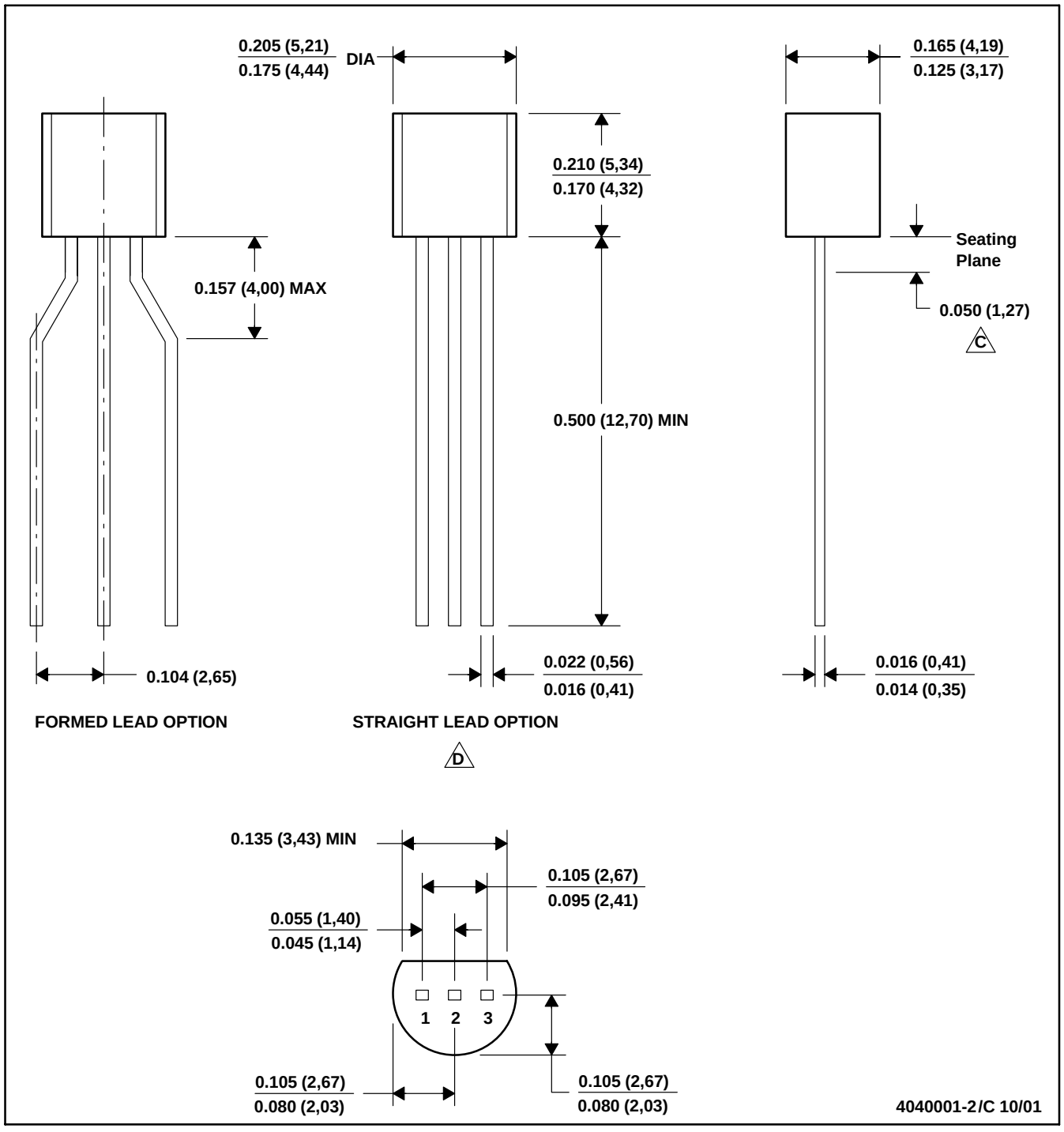
NOTES: A. All linear dimensions are in millimeters (inches).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC TO-261 Variation AA.

D (R–PDSO–G8) PLASTIC SMALL OUTLINE



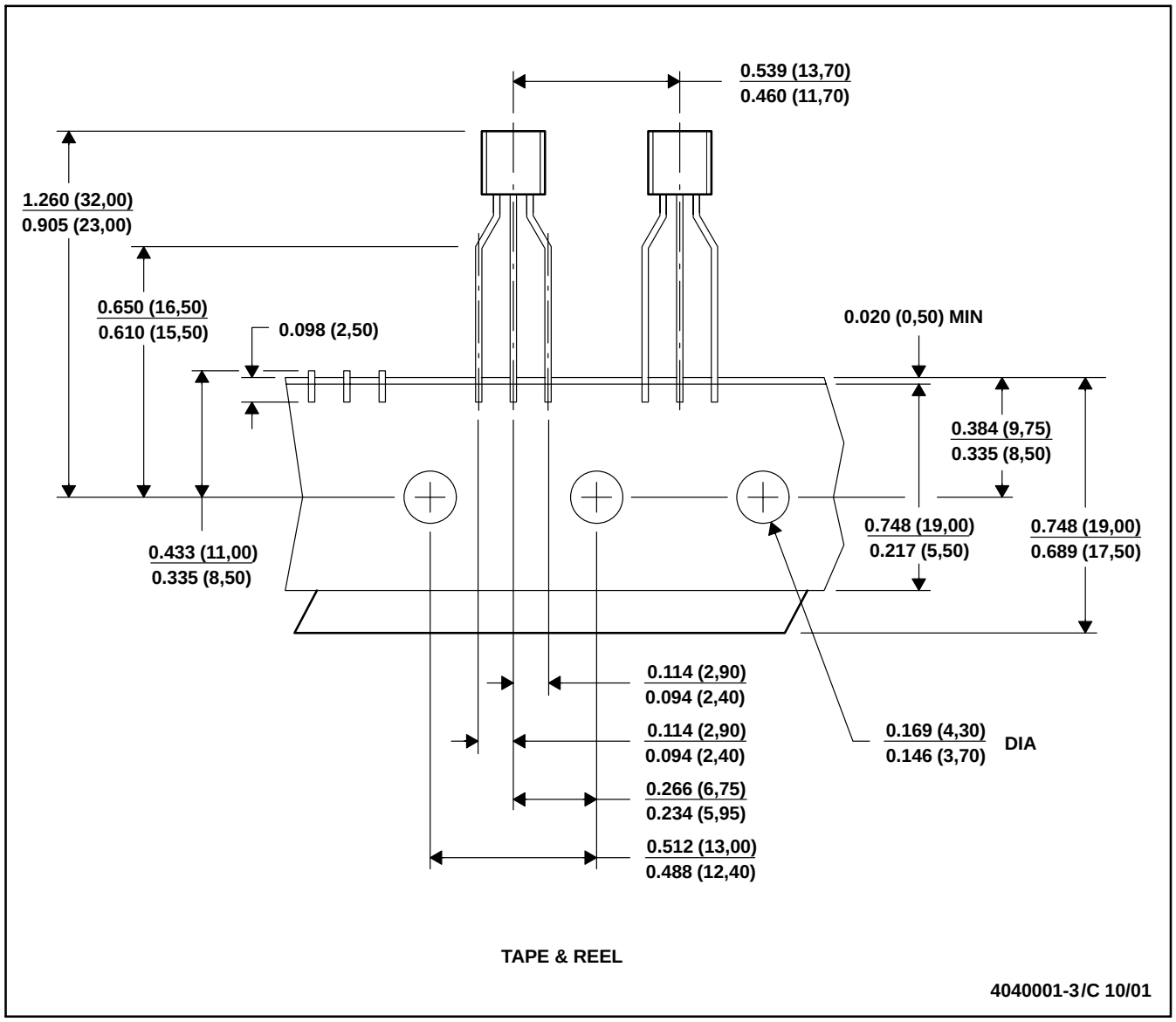
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead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

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 Format Lead Option package.

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