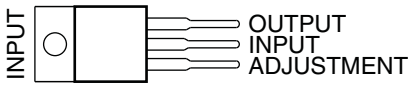
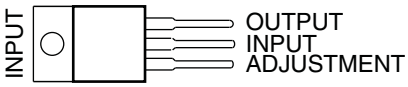
FEATURES

- **Output Voltage Range Adjustable From –1.2 V to –37 V**
- **Output Current Capability of 1.5 A Max**
- **Input Regulation Typically 0.01% Per Input-Voltage Change**
- **Output Regulation Typically 0.3%**
- **Peak Output Current Constant Over Temperature Range of Regulator**
- **Ripple Rejection Typically 77 dB**
- **Direct Replacement for Industry-Standard LM237 and LM337**

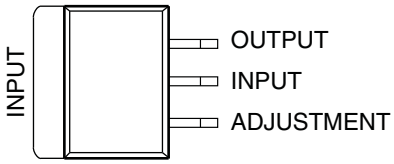
LM237, LM337...KC (TO-220) PACKAGE
(TOP VIEW)



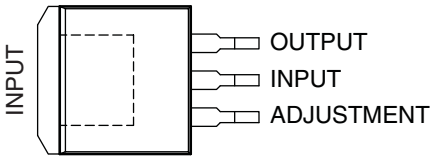
LM337...KCS (TO-220) PACKAGE
(TOP VIEW)



LM337...KTE, KTP, OR KVU PACKAGE
(TOP VIEW)



LM337...KTT (TO-263) PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

The LM237 and LM337 are adjustable 3-terminal negative-voltage regulators capable of supplying in excess of –1.5 A over an output voltage range of –1.2 V to –37 V. They are exceptionally easy to use, requiring only two external resistors to set the output voltage and one output capacitor for frequency compensation. The current design has been optimized for excellent regulation and low thermal transients. In addition, the LM237 and LM337 feature internal current limiting, thermal shutdown, and safe-area compensation, making them virtually immune to failure by overloads.

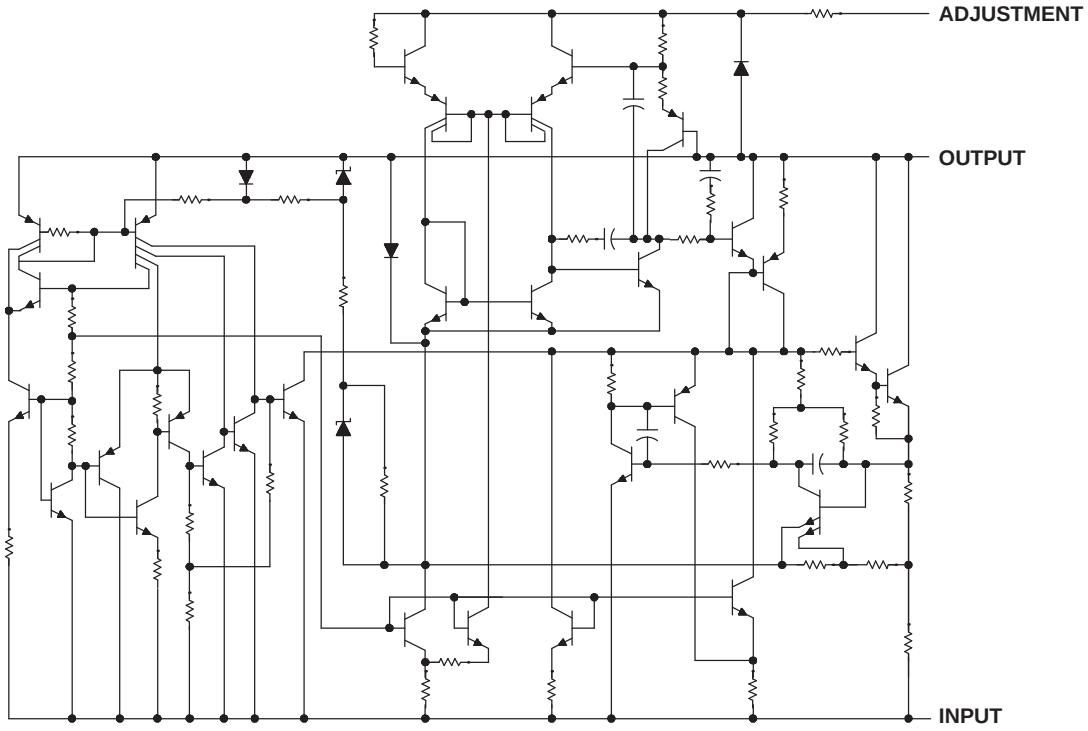
The LM237 and LM337 serve a wide variety of applications, including local on-card regulation, programmable output-voltage regulation, and precision current regulation.

ORDERING INFORMATION

T_J	PACKAGE(1)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–25°C to 150°C	TO-220 – KC	Tube of 50	LM237KC	LM237
0°C to 125°C	PowerFLEX™ – KTE	Reel of 2000	LM337KTER	LM337
	PowerFLEX – KTP	Reel of 3000	LM337KTPR	L337
	TO-220 – KC	Tube of 50	LM337KC	LM337
	TO-220 – KCS	Tube of 50	LM337KCSE3	LM337
	TO-252 – KVU	Reel of 2500	LM337KVURG3	LM337
	TO-263 – KTT	Reel of 500	LM337KTTR	LM337

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

SCHEMATIC DIAGRAM



Absolute Maximum Ratings(1)

over operating temperature ranges (unless otherwise noted)

			MIN	MAX	UNIT
$V_I - V_O$	Input-to-output differential voltage			–40	V
T_J	Operating virtual junction temperature			150	°C
	Lead temperature	1,6 mm (1/16 in) from case for 10 s		260	°C
T_{stg}	Storage temperature range		–65	150	°C

(1) Stresses beyond those listed under "absolute maximum ratings" 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 under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Package Thermal Data(1)

PACKAGE	BOARD	θ_{JC}	θ_{JA}
PowerFLEX (KTE)	High K, JESD 51-5	3°C/W	23°C/W
PowerFLEX (KTP)	High K, JESD 51-5	19°C/W	28°C/W
TO-220 (KC)	High K, JESD 51-5	3°C/W	19°C/W
TO-220 (KCS)	High K, JESD 51-5	3°C/W	24.8°C/W
TO-252 (KVU)	High K, JESD 51-5		30.3°C/W
TO-263 (KTT)	High K, JESD 51-5	18°C/W	25.3°C/W

(1) Maximum power dissipation is a function of $T_J(max)$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.

Recommended Operating Conditions

			MIN	MAX	UNIT
I_O	Output current	$\|V_I - V_O\| \le 40$ V, P ≤ 15 W	10	1500	mA
		$\|V_I - V_O\| \le 10$ V, P ≤ 15 W	6	1500	
T_J	Operating virtual junction temperature	LM237	–25	150	°C
		LM337	0	125	

Electrical Characteristics

over recommended ranges of operating virtual junction temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS(1)		LM237			LM337			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Input regulation(2)	$V_I - V_O$ = –3 V to –40 V	T_J = 25°C		0.01	0.02		0.01	0.04	%/V
		T_J = MIN to MAX		0.02	0.05		0.02	0.07	
Ripple rejection	V_O = –10 V, f = 120 Hz			60			60		dB
	V_O = –10 V, f = 120 Hz, C_{ADJ} = 10 µF		66	77		66	77		
Output regulation	I_O = 10 mA to 1.5 A, T_J = 25°C	$\|V_O\| \le 5$ V			25			50	mV
		$\|V_O\| \ge 5$ V		0.3	0.5		0.3	1	%
	I_O = 10 mA to 1.5 A	$\|V_O\| \le 5$ V			50			70	mV
		$\|V_O\| \ge 5$ V			1			1.5	%
Output-voltage change with temperature	T_J = MIN to MAX			0.6			0.6		%
Output-voltage long-term drift	After 1000 h at T_J = MAX and $V_I - V_O$ = –40 V			0.3	1		0.3	1	%
Output noise voltage	f = 10 Hz to 10 kHz, T_J = 25°C			0.003			0.003		%
Minimum output current to maintain regulation	$\|V_I - V_O\| \le 40$ V			2.5	5		2.5	10	mA
	$\|V_I - V_O\| \le 10$ V			1.2	3		1.5	6	
Peak output current	$\|V_I - V_O\| \le 15$ V		1.5	2.2		1.5	2.2		A
	$\|V_I - V_O\| \le 40$ V, T_J = 25°C		0.24	0.4		0.15	0.4		
ADJUSTMENT current				65	100		65	100	µA
Change in ADJUSTMENT current	$V_I - V_O$ = –2.5 V to –40 V, I_O = 10 mA to MAX, T_J = 25°C			2	5		2	5	µA
Reference voltage (OUTPUT to ADJUSTMENT)	$V_I - V_O$ = –3 V to –40 V, I_O = 10 mA to 1.5 A, P ≤ rated dissipation	T_J = 25°C	–1.225	–1.25	–1.275	–1.213	–1.25	–1.287	V
		T_J = MIN to MAX	–1.2	–1.25	–1.3	–1.2	–1.25	–1.3	
Thermal regulation	Initial T_J = 25°C, 10-ms pulse			0.002	0.02		0.003	0.04	%/W

(1) Unless otherwise noted, the following test conditions apply: $|V_I - V_O|$ = 5 V and I_O = 0.5 A. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions. All characteristics are measured with a 0.1-µF capacitor across the input and a 1-µF capacitor across the output. Pulse-testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately.

(2) Input regulation is expressed here as the percentage change in output voltage per 1-V change at the input.

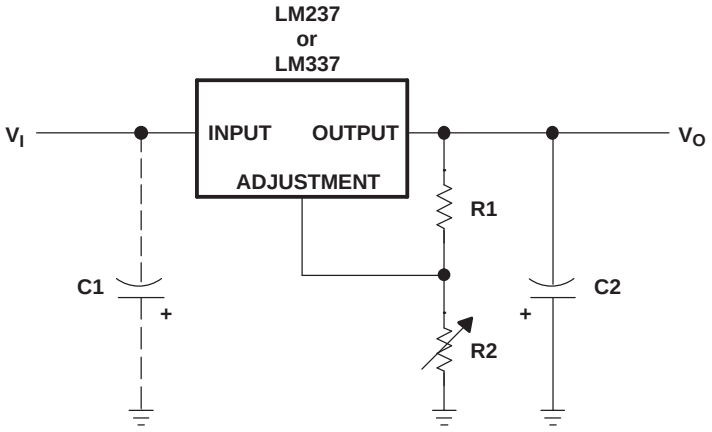
Electrical Characteristics

T_J = 25°C

PARAMETER	TEST CONDITIONS(1)		LM237, LM337			UNIT
			MIN	TYP	MAX	
Input regulation(2)	$V_I - V_O$ = –3 V to –40 V			0.01	0.04	%/V
Ripple rejection	V_O = –10 V, f = 120 Hz			60		dB
	V_O = –10 V, f = 120 Hz, C_{ADJ} = 10 µF		66	77		
Output regulation	I_O = 10 mA to 1.5 A	$\|V_O\| \le 5$ V			50	mV
		$\|V_O\| \ge 5$ V		0.3	1	%
Output noise voltage	f = 10 Hz to 10 kHz			0.003		%
Minimum output current to maintain regulation	$\|V_I - V_O\| \le 40$ V			2.5	10	mA
	$\|V_I - V_O\| \le 10$ V			1.5	6	
Peak output current	$\|V_I - V_O\| \le 15$ V		1.5	2.2		A
	$\|V_I - V_O\| \le 40$ V		0.15	0.4		
ADJUSTMENT current				65	100	µA
Change in ADJUSTMENT current	$V_I - V_O$ = –2.5 V to –40 V, I_O = 10 mA to MAX			2	5	µA
Reference voltage (OUTPUT to ADJUSTMENT)	$V_I - V_O$ = –3 V to –40 V, I_O = 10 mA to 1.5 A, P ≤ rated dissipation		–1.213	–1.25	–1.287	V

(1) Unless otherwise noted, the following test conditions apply: $|V_I - V_O|$ = 5 V and I_O = 0.5 A. All characteristics are measured with a 0.1-µF capacitor across the input and a 1-µF capacitor across the output. Pulse-testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately.
(2) Input regulation is expressed here as the percentage change in output voltage per 1-V change at the input.

APPLICATION INFORMATION



R1 typically is 120 Ω.

$$R2 = R1\left(\frac{-V_O}{-1.25} - 1\right)$$, where V_O is the output in volts.

C1 is a 1-μF solid tantalum capacitor required only if the regulator is more than 10 cm (4 in) from the power-supply filter capacitor.
C2 is a 1-μF solid tantalum or 10-μF aluminum electrolytic capacitor required for stability.

Figure 1. Adjustable Negative-Voltage Regulator

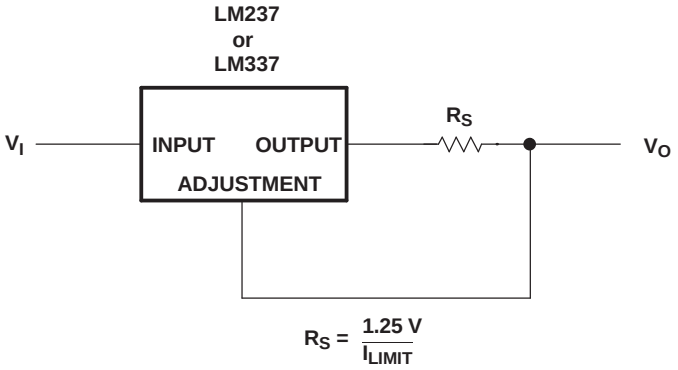


Figure 2. Current-Limiting Circuit

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
LM237KC	NRND	TO-220	KC	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
LM237KCE3	NRND	TO-220	KC	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
LM237KCSE3	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
LM237KTER	OBSOLETE	PFM	KTE	3		TBD	Call TI	Call TI
LM337KC	NRND	TO-220	KC	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
LM337KCE3	NRND	TO-220	KC	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
LM337KCSE3	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
LM337KTER	NRND	PFM	KTE	3	2000	TBD	CU SN	Level-3-240C-168 HR
LM337KTPR	NRND	PFM	KTP	2	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM
LM337KTPRG3	NRND	PFM	KTP	2	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM
LM337KTTR	ACTIVE	DDPAK/ TO-263	KTT	3	500	Green (RoHS & no Sb/Br)	CU SN	Level-3-245C-168 HR
LM337KTTRG3	ACTIVE	DDPAK/ TO-263	KTT	3	500	Green (RoHS & no Sb/Br)	CU SN	Level-3-245C-168 HR
LM337KVURG3	ACTIVE	PFM	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR
LM337Y	OBSOLETE	DIESALE	Y	0		TBD	Call TI	Call TI

(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)

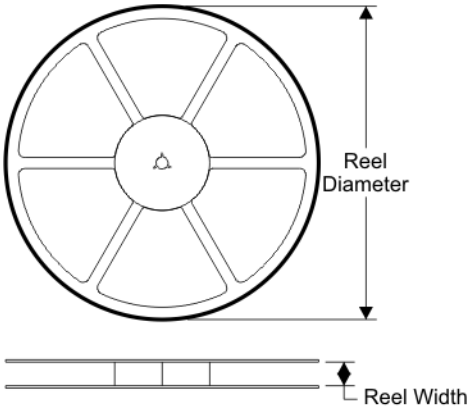
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

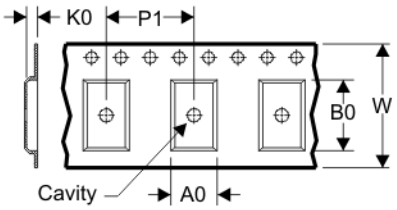
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL BOX INFORMATION

REEL DIMENSIONS

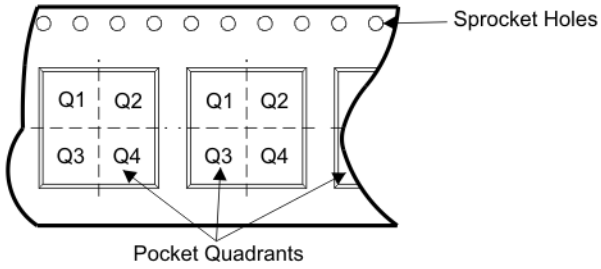


TAPE DIMENSIONS



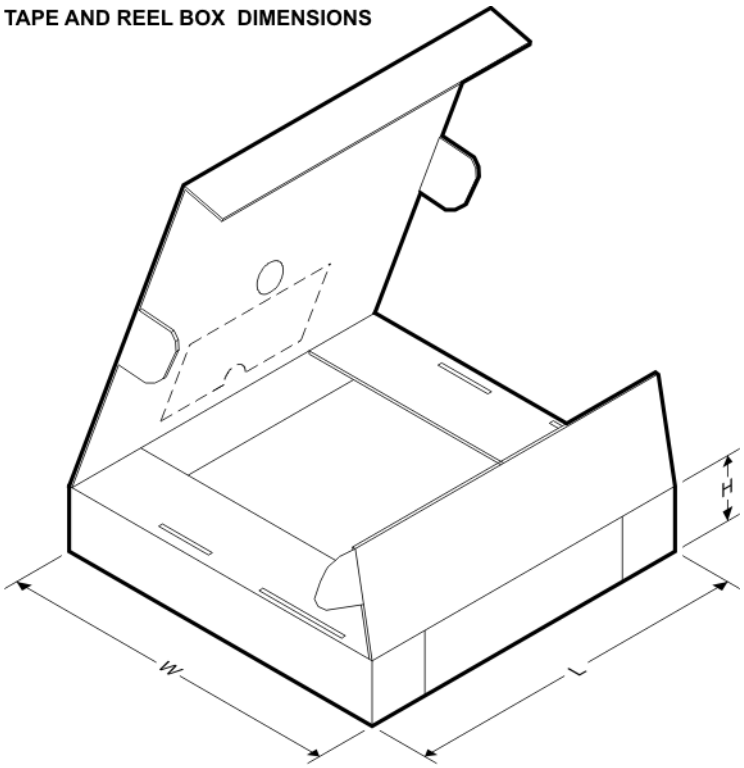
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Device	Package	Pins	Site	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM337KTTR	KTT	3	SITE 45	330	24	10.6	15.8	4.9	16	24	Q2
LM337KVURG3	KVU	3	SITE 45	330	16	6.9	10.5	2.7	8	16	Q2

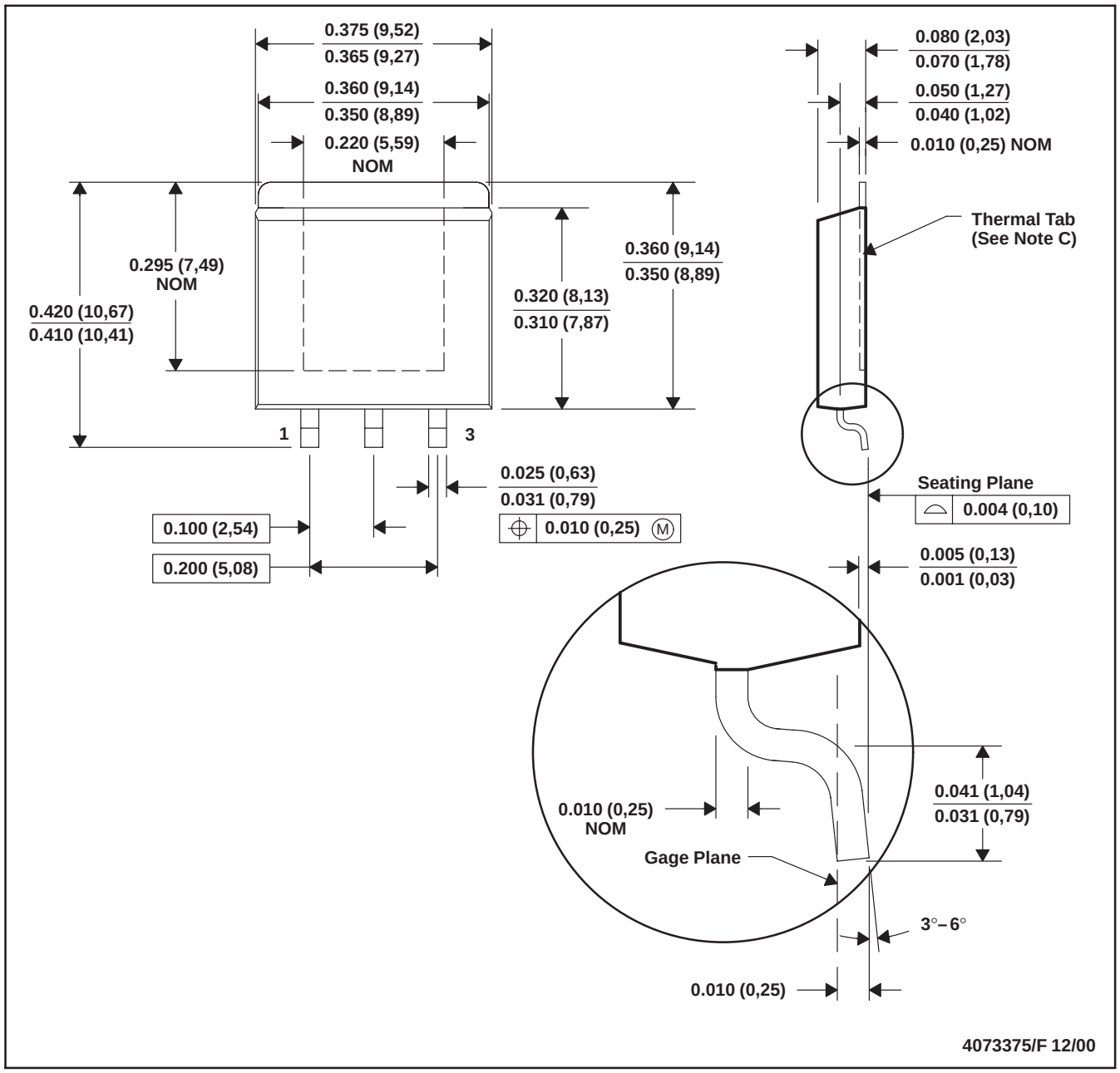
TAPE AND REEL BOX DIMENSIONS



Device	Package	Pins	Site	Length (mm)	Width (mm)	Height (mm)
LM337KTTR	KTT	3	SITE 45	340.0	340.0	38.0
LM337KVURG3	KVU	3	SITE 45	340.0	340.0	38.0

MPFM001E – OCTOBER 1994 – REVISED JANUARY 2001

KTE (R-PSFM-G3) **PowerFLEX™ PLASTIC FLANGE-MOUNT**

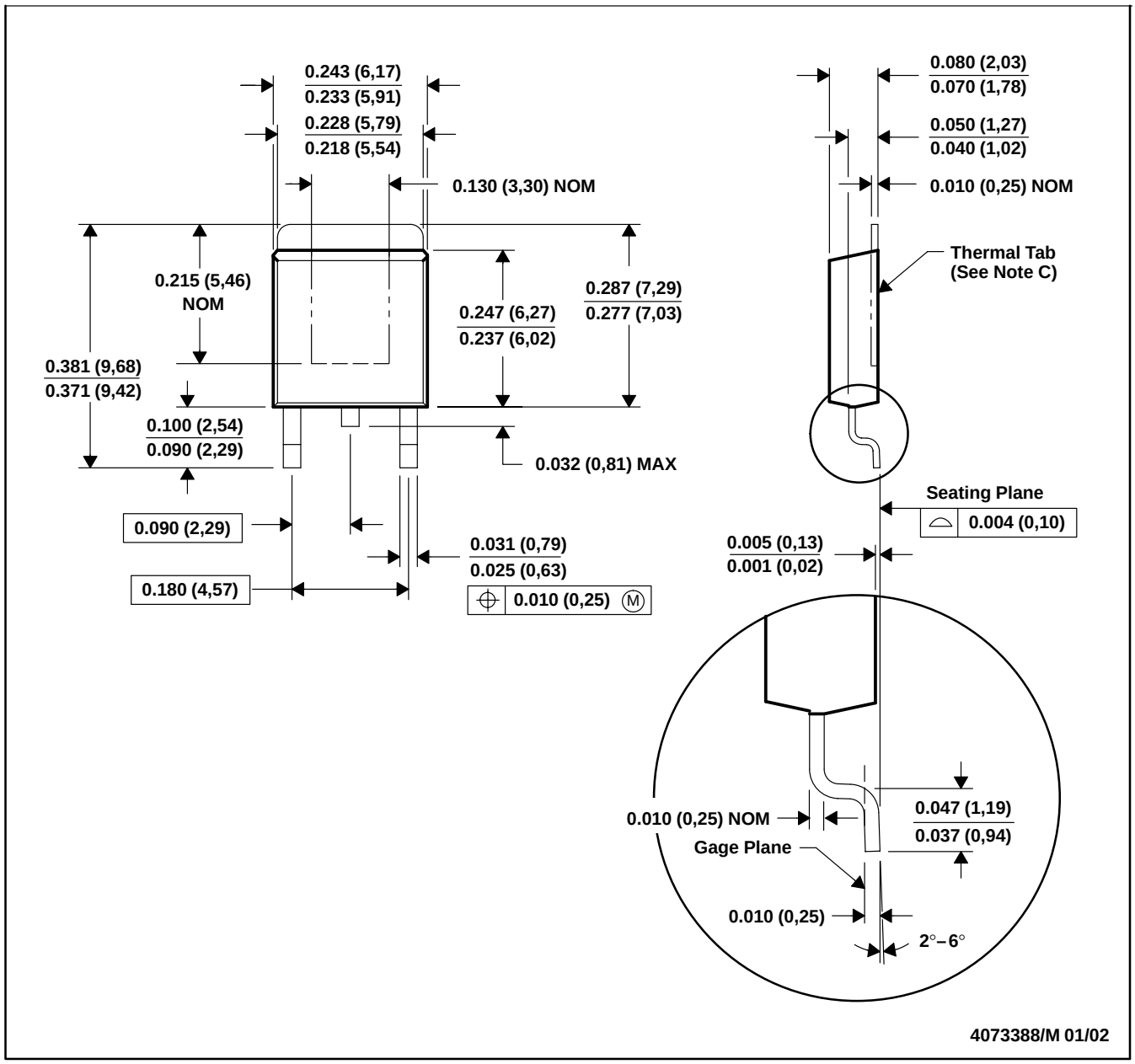


NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. The center lead is in electrical contact with the thermal tab.
D. Dimensions do not include mold protrusions, not to exceed 0.006 (0,15).
E. Falls within JEDEC MO-169

PowerFLEX is a trademark of Texas Instruments.

MPSF001F – JANUARY 1996 – REVISED JANUARY 2002

KTP (R-PSFM-G2) **PowerFLEX™ PLASTIC FLANGE-MOUNT PACKAGE**



NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. The center lead is in electrical contact with the thermal tab.
D. Dimensions do not include mold protrusions, not to exceed 0.006 (0,15).
E. Falls within JEDEC TO-252 variation AC.

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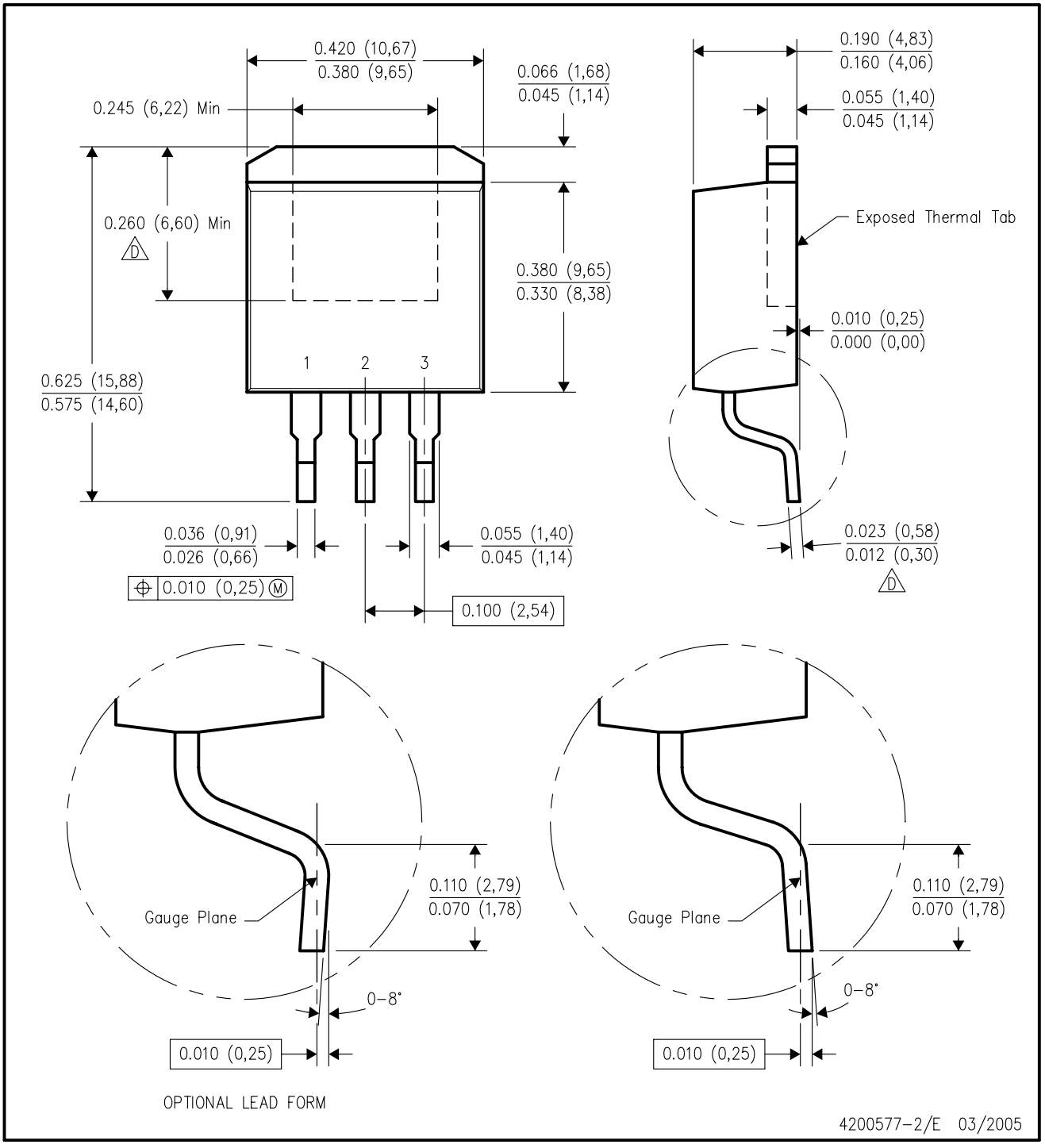
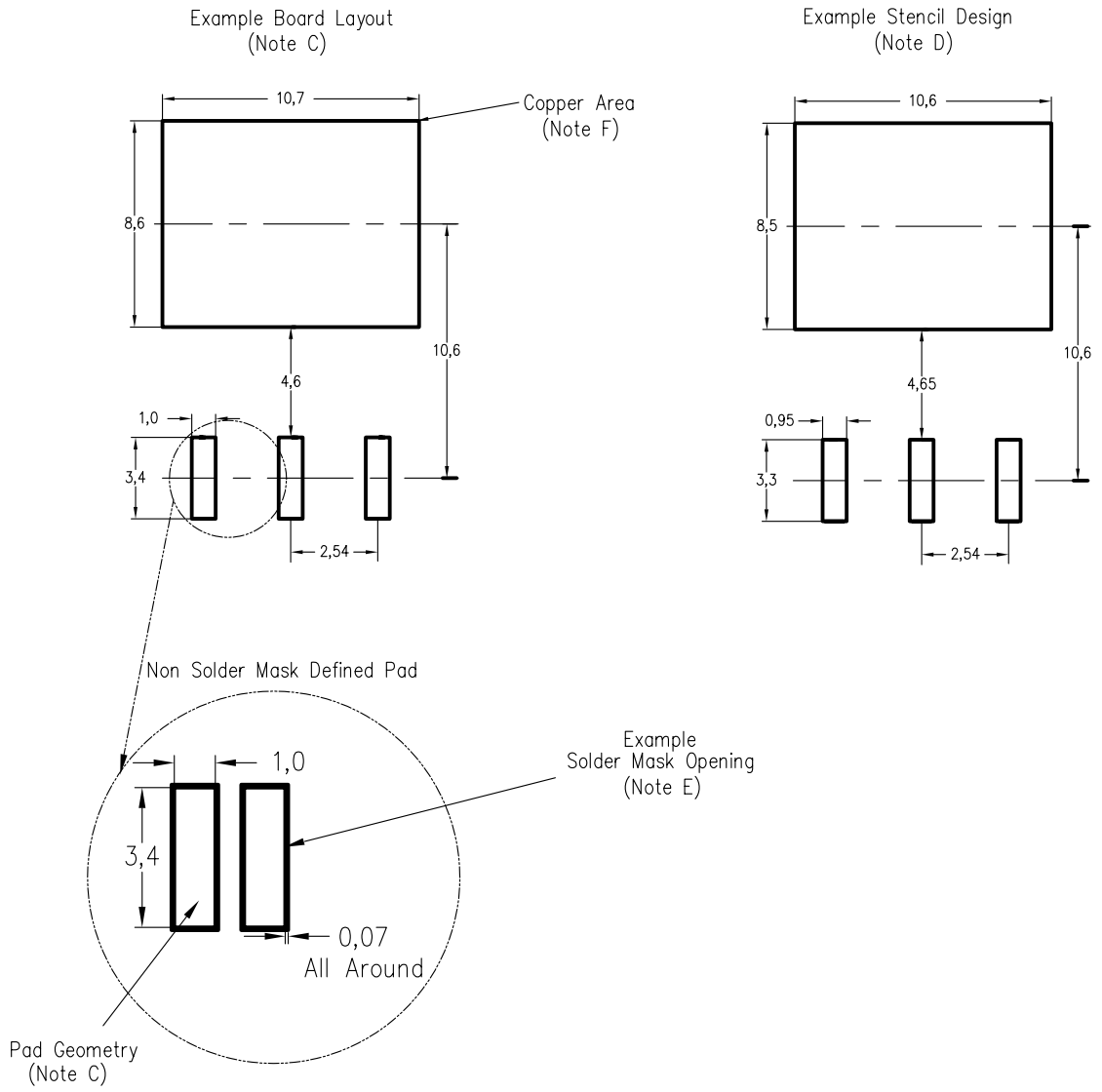
KTT (R–PSFM–G3) PLASTIC FLANGE–MOUNT PACKAGE



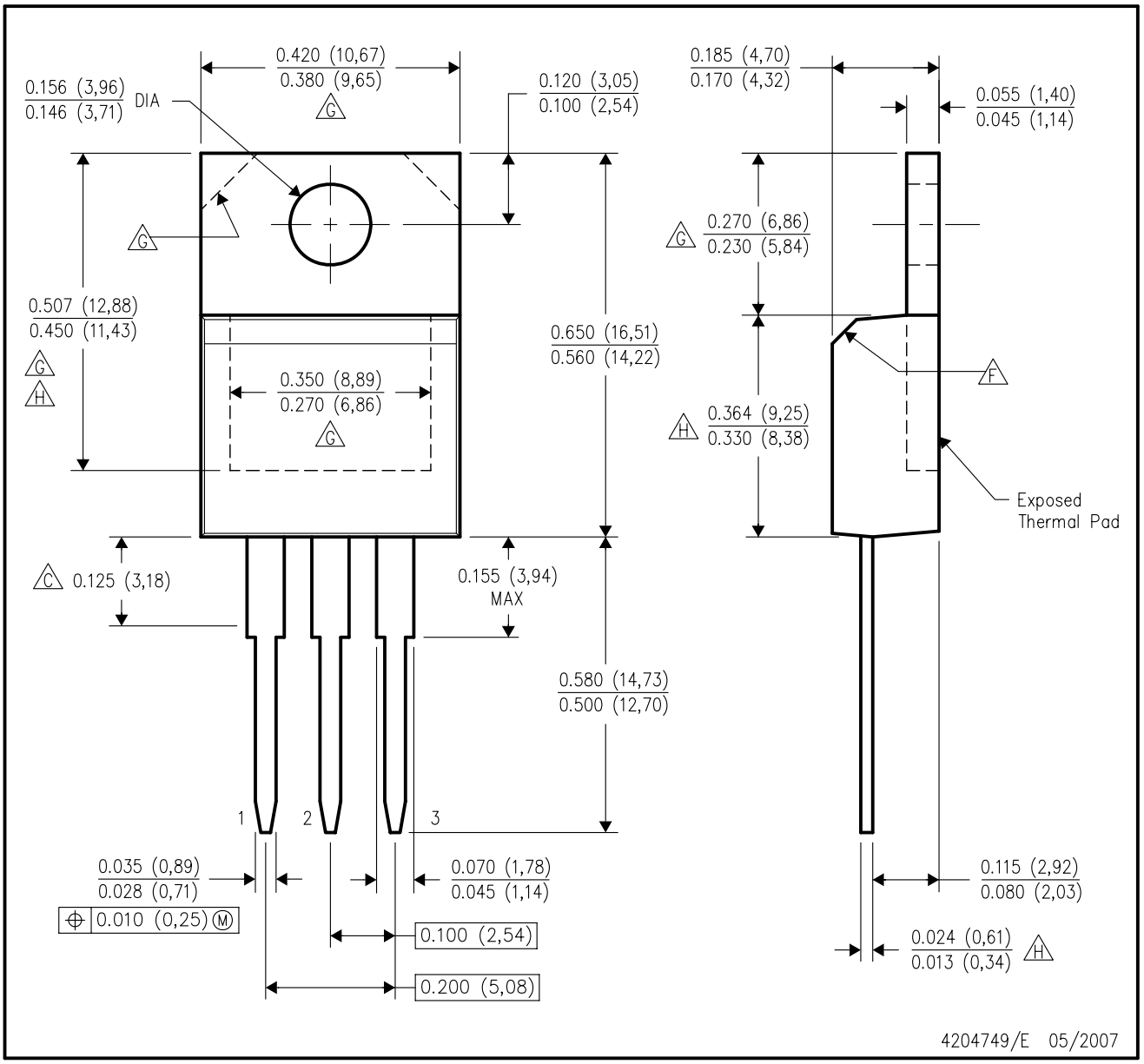
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash or protrusion not to exceed 0.005 (0,13) per side.
D. Falls within JEDEC TO–263 variation AA, except minimum lead thickness and minimum exposed pad length.

KTT (R–PSFM–G3)



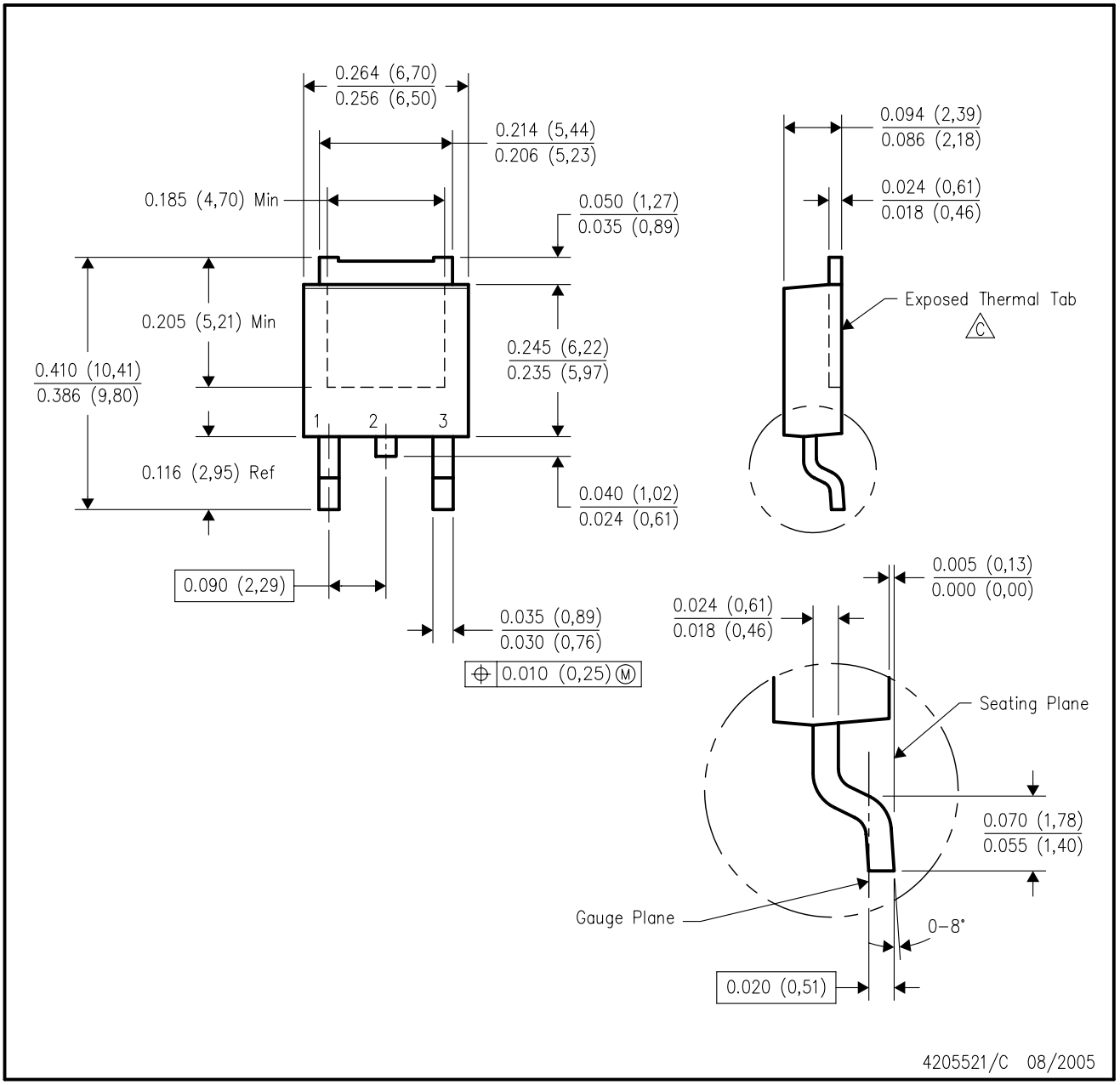
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–SM–782 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.
F. This package is designed to be soldered to a thermal pad on the board. Refer to the Product Datasheet for specific thermal information, via requirements, and recommended thermal pad size. For thermal pad sizes larger than shown a solder mask defined pad is recommended in order to maintain the solderable pad geometry while increasing copper area.

KCS (R–PSFM–T3) PLASTIC FLANGE–MOUNT PACKAGE



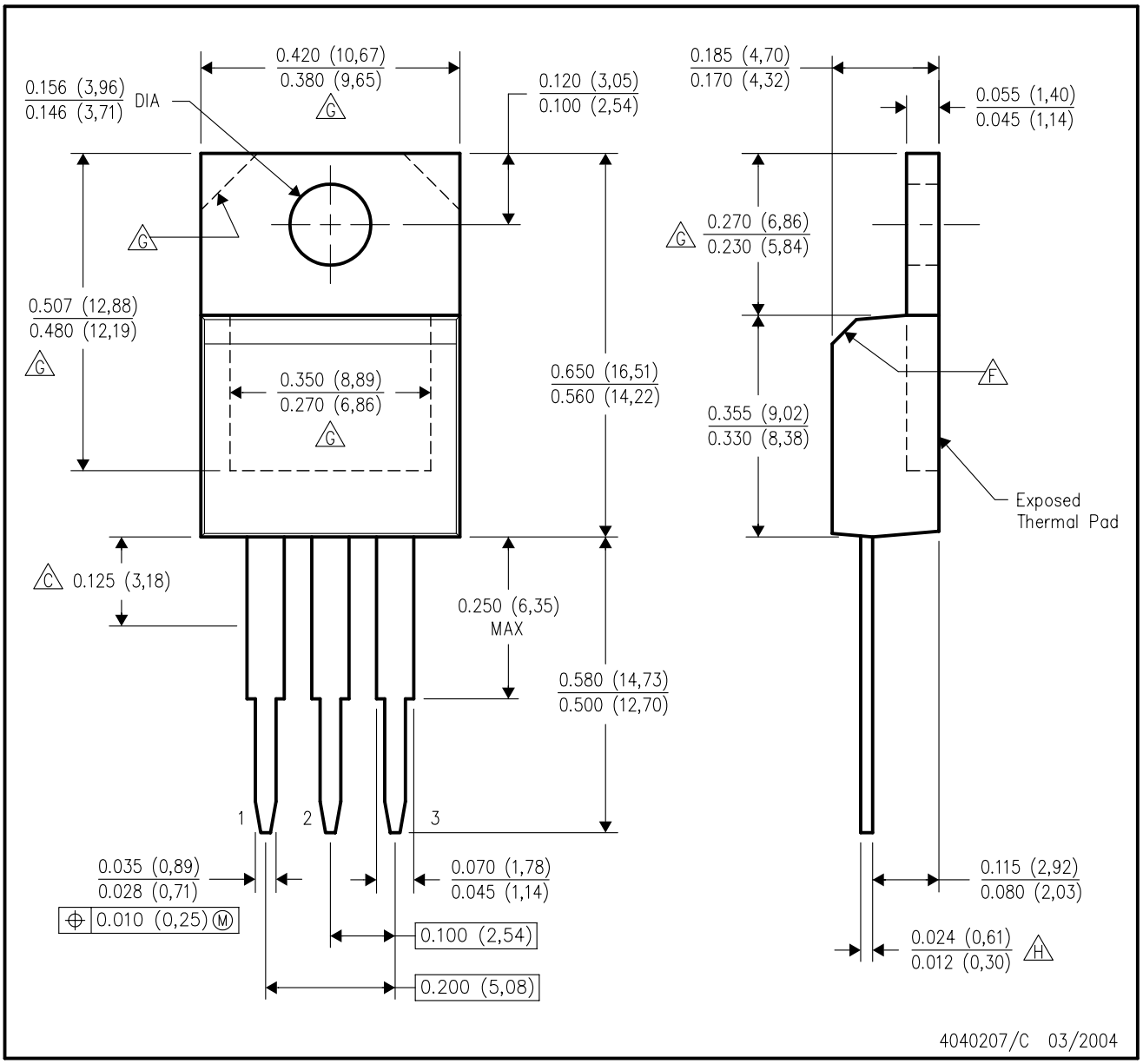
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Lead dimensions are not controlled within this area.
D. All lead dimensions apply before solder dip.
E. The center lead is in electrical contact with the mounting tab.
F. The chamfer is optional.
G. Thermal pad contour optional within these dimensions.
H. Falls within JEDEC TO–220 variation AB, except minimum lead thickness, minimum exposed pad length, and maximum body length.

KVU (R–PSFM–G3) PLASTIC FLANGE–MOUNT PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. The center lead is in electrical contact with the exposed thermal tab.
D. Body Dimensions do not include mold flash or protrusions. Mold flash and protrusion shall not exceed 0.006 (0,15) per side.
E. Falls within JEDEC TO–252 variation AA.

KC (R–PSFM–T3) PLASTIC FLANGE–MOUNT 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. All lead dimensions apply before solder dip.
- E. The center lead is in electrical contact with the mounting tab.
- F. The chamfer is optional.
- G. Thermal pad contour optional within these dimensions.
- H. Falls within JEDEC TO–220 variation AB, except minimum lead thickness.

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