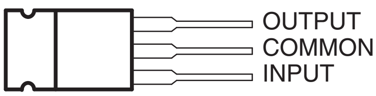
LOW-DROPOUT VOLTAGE REGULATORS

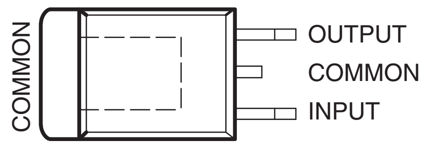
FEATURES

- **Very Low Dropout Voltage, Less Than 0.6 V at 750 mA**
- **Low Quiescent Current**
- **60-V Load-Dump Protection**
- **Overvoltage Protection**
- **Internal Thermal-Overload Protection**
- **Internal Overcurrent-Limiting Circuitry**

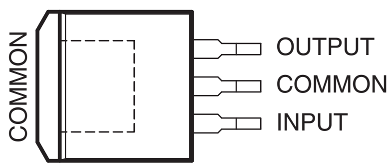
KCS PACKAGE[(1)]
(TOP VIEW)



KVU PACKAGE[(1)]
(TOP VIEW)



KTT PACKAGE[(1)]
(TOP VIEW)



(1) The common terminal is in electrical contact with the mounting base.

DESCRIPTION/ORDERING INFORMATION

The TL750M series devices are low-dropout positive voltage regulators specifically designed for battery-powered systems. The TL750M devices incorporate onboard overvoltage and current-limiting protection circuitry to protect the devices and the regulated system. The devices are fully protected against 60-V load-dump and reverse-battery conditions. Extremely low quiescent current, even during full-load conditions, makes the TL750M series ideal for standby power systems.

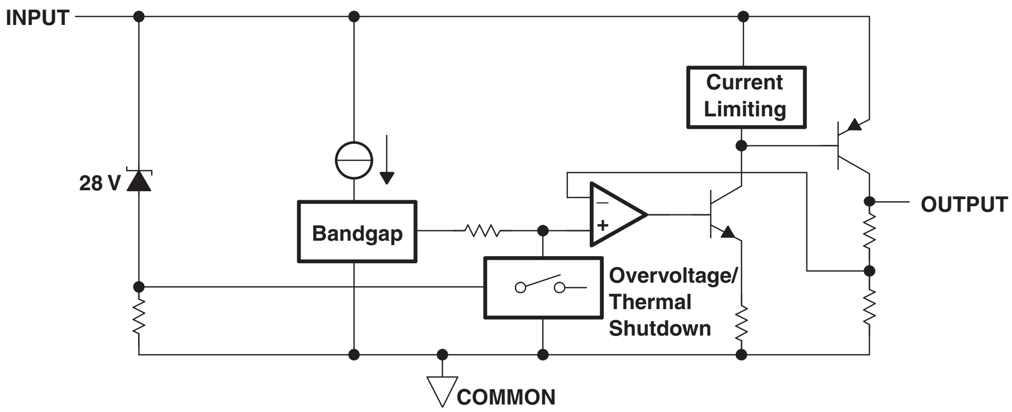
The TL750M offers 5-V, 8-V, 10-V, and 12-V options. The devices are characterized for operation over the virtual junction temperature range 0°C to 125°C.

ORDERING INFORMATION(1)

T_J	V_O TYP	PACKAGE (2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 125°C	5 V	PowerFLEX™ – KVU	Reel of 3000	TL750M05CKVUR	750M05C
		TO-220 – KCS	Tube of 50	TL750M05CKCS	TL750M05C
		TO-263 – KTT	Reel of 500	TL750M05CKTTR	TL750M05C
	8 V	TO-220 – KCS	Tube of 50	TL750M08CKCS	TL750M08C
		PowerFLEX – KVU	Reel of 3000	TL750M08CKVUR	750M08C
	10 V	TO-220 – KCS	Tube of 50	TL750M10CKCS	TL750M10C
		PowerFLEX – KVU	Reel of 3000	TL750M10CKVUR	750M10C
	12 V	TO-220 – KCS	Tube of 50	TL750M12CKCS	TL750M12C
		PowerFLEX – KVU	Reel of 3000	TL750M12CKVUR	750M12C

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

FUNCTIONAL BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS[1]

over virtual junction temperature range (unless otherwise noted)

			MIN	MAX	UNIT
	Continuous input voltage			26	V
	Transient input voltage (see Figure 3)			60	V
	Continuous reverse input voltage			–15	V
	Transient reverse input voltage	t = 100 ms		–50	V
θ_{JA}	Package thermal impedance[2] [3]	KCS package		22	°C/W
		KTT package		25.3	
		KVU package		28	
T_J	Virtual-junction temperature range		0	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.
(2) 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. Due to variation in individual device electrical characteristics and thermal resistance, the built-in thermal-overload protection may be activated at power levels slightly above or below the rated dissipation.
(3) The package thermal impedance is calculated in accordance with JESD 51.

RECOMMENDED OPERATING CONDITIONS

			MIN	MAX	UNIT
V_I	Input voltage	TL750M05	6	26	V
		TL750M08	9	26	
		TL750M10	11	26	
		TL750M12	13	26	
I_O	Output current			750	mA
T_J	Operating virtual-junction temperature		0	125	°C

TL750M05 ELECTRICAL CHARACTERISTICS(1)

V_I = 14 V, I_O = 300 mA, T_J = 25°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TL750M05			UNIT
		MIN	TYP	MAX	
Output voltage		4.95	5	5.05	V
	T_J = 0°C to 125°C	4.9		5.1	
Input voltage regulation	V_I = 9 V to 16 V, I_O = 250 mA		10	25	mV
	V_I = 6 V to 26 V, I_O = 250 mA		12	50	
Ripple rejection	V_I = 8 V to 18 V, f = 120 Hz	50	55		dB
Output regulation voltage	I_O = 5 mA to 750 mA		20	50	mV
Dropout voltage	I_O = 500 mA			0.5	V
	I_O = 750 mA			0.6	
Output noise voltage	f = 10 Hz to 100 kHz		500		μV
Bias current	I_O = 750 mA		60	75	mA
	I_O = 10 mA			5	

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.1-μF capacitor across the input and a 10-μF tantalum capacitor on the output, with equivalent series resistance within the guidelines shown in Figure 1 .

TL750M08 ELECTRICAL CHARACTERISTICS(1)

V_I = 14 V, I_O = 300 mA, T_J = 25°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TL750M08			UNIT
		MIN	TYP	MAX	
Output voltage		7.92	8	8.08	V
	T_J = 0°C to 125°C	7.84		8.16	
Input voltage regulation	V_I = 10 V to 17 V, I_O = 250 mA		12	40	mV
	V_I = 9 V to 26 V, I_O = 250 mA		15	68	
Ripple rejection	V_I = 11 V to 21 V, f = 120 Hz	50	55		dB
Output regulation voltage	I_O = 5 mA to 750 mA		24	80	mV
Dropout voltage	I_O = 500 mA			0.5	V
	I_O = 750 mA			0.6	
Output noise voltage	f = 10 Hz to 100 kHz		500		μV
Bias current	I_O = 750 mA		60	75	mA
	I_O = 10 mA			5	

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.1-μF capacitor across the input and a 10-μF tantalum capacitor on the output, with equivalent series resistance within the guidelines shown in Figure 1 .

TL750M10 ELECTRICAL CHARACTERISTICS[1]

V_I = 14 V, I_O = 300 mA, T_J = 25°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TL750M10			UNIT
		MIN	TYP	MAX	
Output voltage		9.9	10	10.1	V
	T_J = 0°C to 125°C	9.8		10.2	
Input voltage regulation	V_I = 12 V to 18 V, I_O = 250 mA		15	43	mV
	V_I = 11 V to 26 V, I_O = 250 mA		20	75	
Ripple rejection	V_I = 13 V to 23 V, f = 120 Hz	50	55		dB
Output regulation voltage	I_O = 5 mA to 750 mA		30	100	mV
Dropout voltage	I_O = 500 mA			0.5	V
	I_O = 750 mA			0.6	
Output noise voltage	f = 10 Hz to 100 kHz		1000		μV
Bias current	I_O = 750 mA		60	75	mA
	I_O = 10 mA			5	

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.1-μF capacitor across the input and a 10-μF tantalum capacitor on the output, with equivalent series resistance within the guidelines shown in Figure 1 .

TL750M12 ELECTRICAL CHARACTERISTICS[1]

V_I = 14 V, I_O = 300 mA, T_J = 25°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TL750M12			UNIT
		MIN	TYP	MAX	
Output voltage		11.88	12	12.12	V
	T_J = 0°C to 125°C	11.76		12.24	
Input voltage regulation	V_I = 14 V to 19 V, I_O = 250 mA		15	43	mV
	V_I = 13 V to 26 V, I_O = 250 mA		20	78	
Ripple rejection	V_I = 13 V to 23 V, f = 120 Hz	50	55		dB
Output regulation voltage	I_O = 5 mA to 750 mA		30	120	mV
Dropout voltage	I_O = 500 mA			0.5	V
	I_O = 750 mA			0.6	
Output noise voltage	f = 10 Hz to 100 kHz		1000		μV
Bias current	I_O = 750 mA		60	75	mA
	I_O = 10 mA			5	

(1) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.1-μF capacitor across the input and a 10-μF tantalum capacitor on the output, with equivalent series resistance within the guidelines shown in Figure 1 .

PARAMETER MEASUREMENT INFORMATION

The TL750Mxx is a low-dropout regulator. This means that the capacitance loading is important to the performance of the regulator because it is a vital part of the control loop. The capacitor value and the equivalent series resistance (ESR) both affect the control loop and must be defined for the load range and the temperature range. Figure 1 and Figure 2 can establish the capacitance value and ESR range for the best regulator performance.

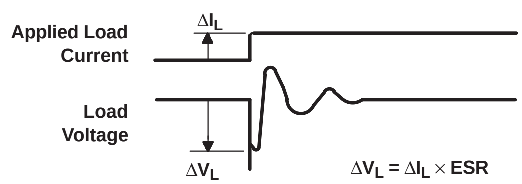
Figure 1 shows the recommended range of ESR for a given load with a 10-μF capacitor on the output. This figure also shows a maximum ESR limit of 2 Ω and a load-dependent minimum ESR limit.

For applications with varying loads, the lightest load condition should be chosen because it is the worst case. Figure 2 shows the relationship of the reciprocal of ESR to the square root of the capacitance with a minimum capacitance limit of 10 μF and a maximum ESR limit of 2 Ω. This figure establishes the amount that the minimum ESR limit shown in Figure 1 can be adjusted for different capacitor values.

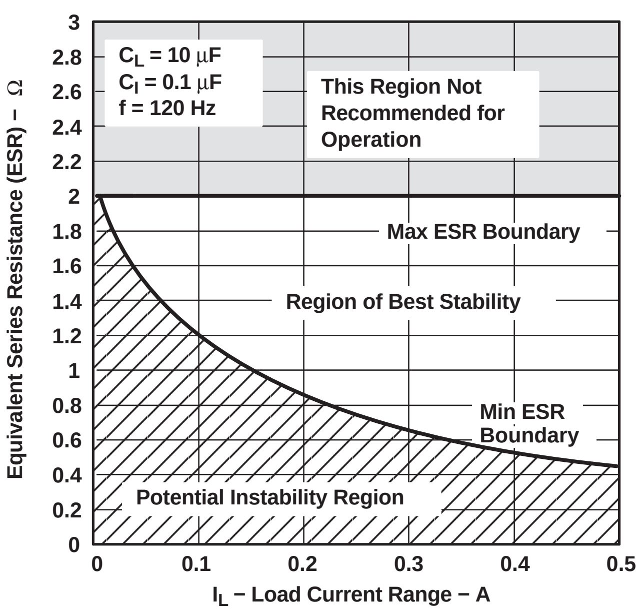
For example, where the minimum load needed is 200 mA, Figure 1 suggests an ESR range of 0.8 Ω to 2 Ω for 10 μF. Figure 2 shows that changing the capacitor from 10 μF to 400 μF can change the ESR minimum by greater than 3/0.5 (or 6). Therefore, the new minimum ESR value is 0.8/6 (or 0.13 Ω). This allows an ESR range of 0.13 Ω to 2 Ω , achieving an expanded ESR range by using a larger capacitor at the output. For better stability in low-current applications, a small resistance placed in series with the capacitor (see Table 1) is recommended, so that ESRs better approximate those shown in Figure 1 and Figure 2.

Table 1. Compensation for Increased Stability at Low Currents

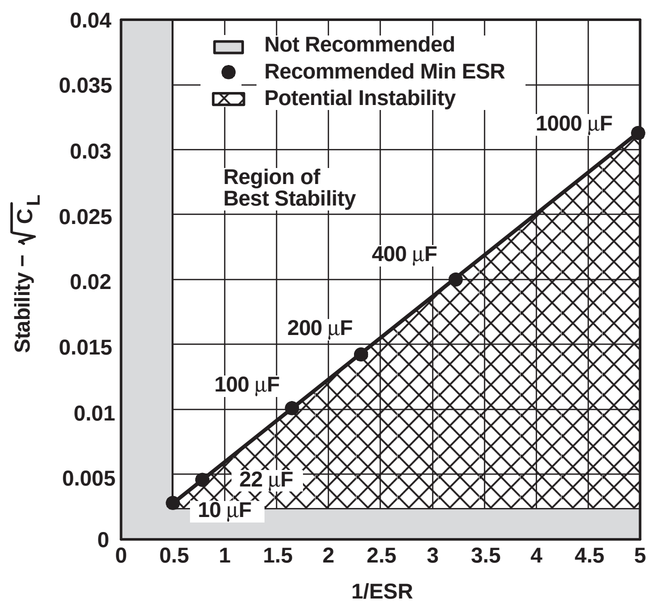
MANUFACTURER	CAPACITANCE	ESR TYP	PART NUMBER	ADDITIONAL RESISTANCE
AVX	15 μF	0.9 Ω	TAJB156M010S	1 Ω
KEMET	33 μF	0.6 Ω	T491D336M010AS	0.5 Ω



OUTPUT CAPACITOR
EQUIVALENT SERIES RESISTANCE (ESR)
vs
LOAD CURRENT RANGE



STABILITY
vs
EQUIVALENT SERIES RESISTANCE (ESR)



TYPICAL CHARACTERISTICS

Table 2. Table of Graphs

		FIGURE
Transient input voltage vs Time		3
Output voltage vs Input voltage		4
Input current vs Input voltage	I_O = 10 mA	5
	I_O = 100 mA	6
Dropout voltage vs Output current		7
Quiescent voltage vs Output current		8
Load transient response		9
Line transient response		10

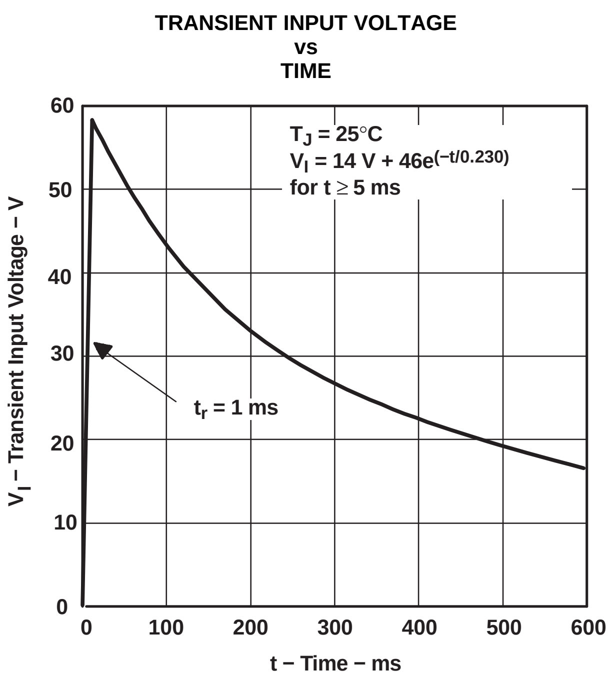


Figure 3.

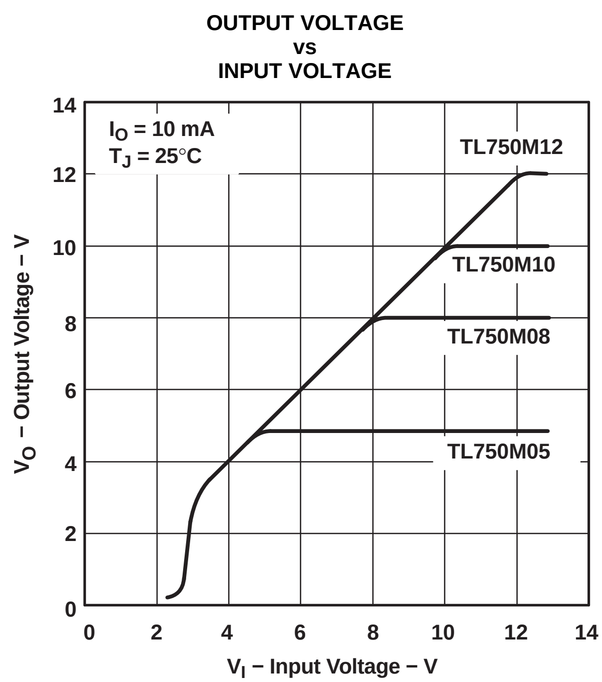


Figure 4.

INPUT CURRENT
vs
INPUT VOLTAGE

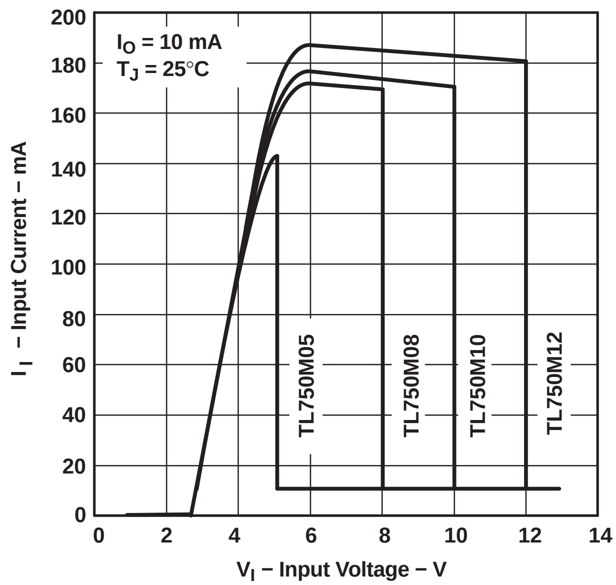


Figure 5.

INPUT CURRENT
vs
INPUT VOLTAGE

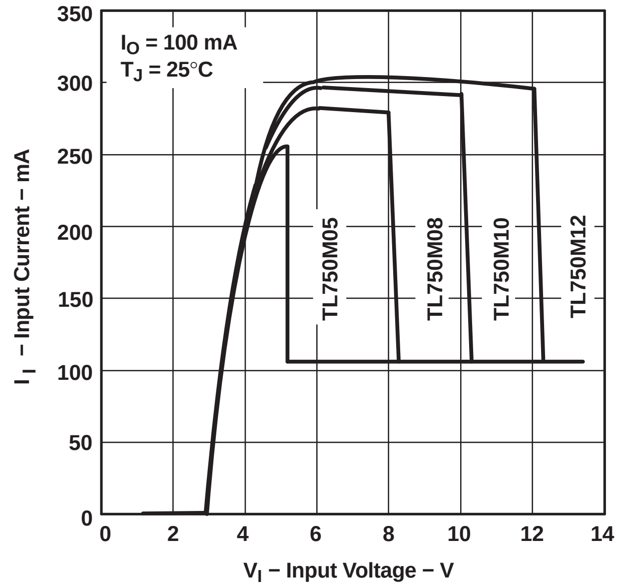


Figure 6.

DROPOUT VOLTAGE
vs
OUTPUT CURRENT

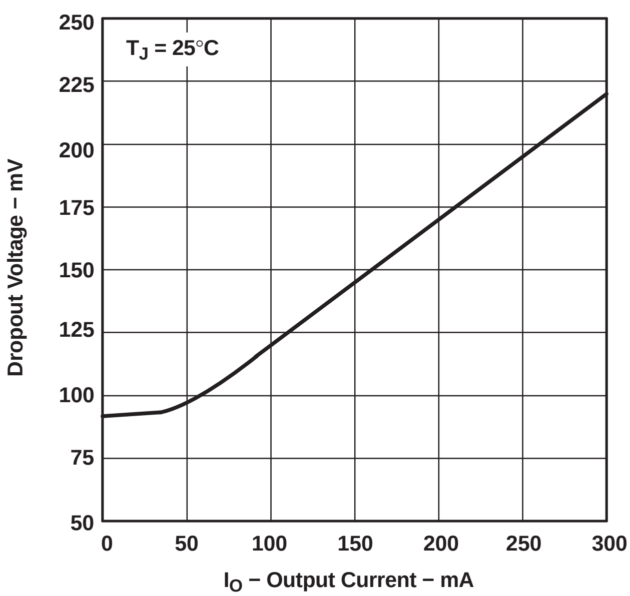


Figure 7.

QUIESCENT CURRENT
vs
OUTPUT CURRENT

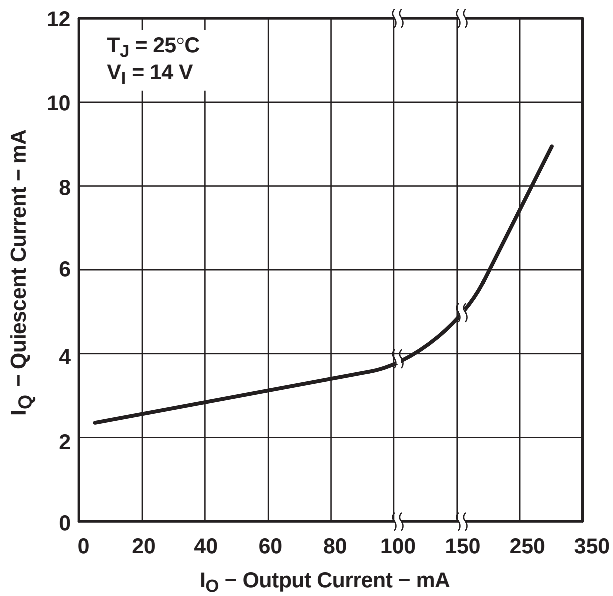


Figure 8.

LOAD TRANSIENT RESPONSE

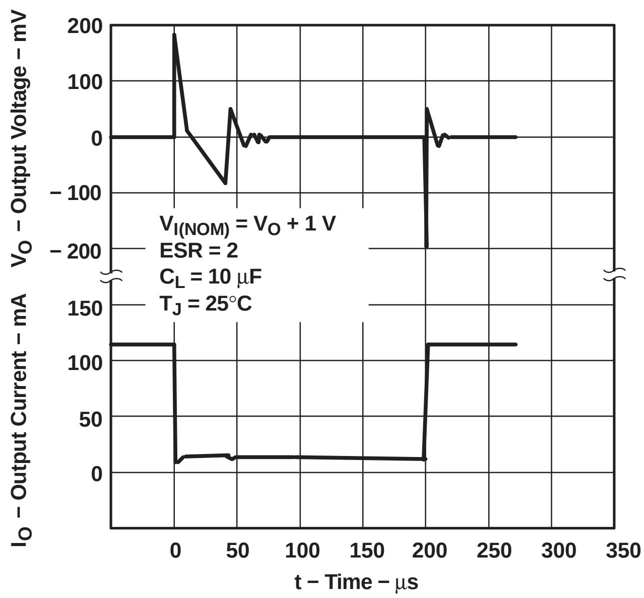


Figure 9.

LINE TRANSIENT RESPONSE

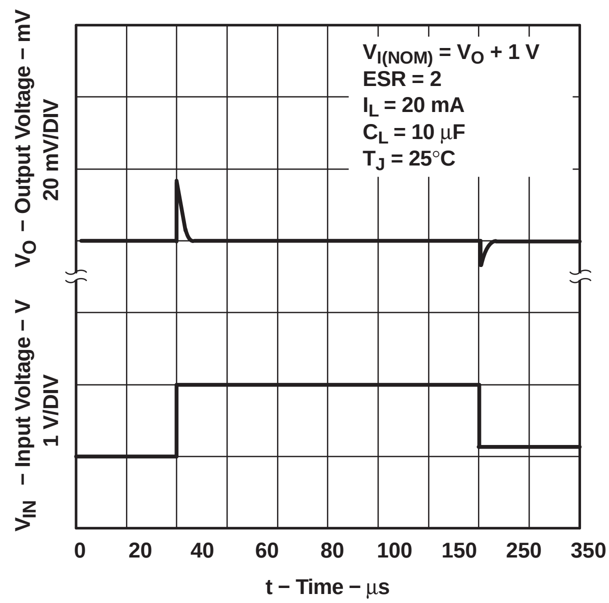


Figure 10.

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)
TL750M05CKC	OBSOLETE	TO-220	KC	3		TBD	Call TI	Call TI	Samples Not Available
TL750M05CKCE3	OBSOLETE	TO-220	KC	3		TBD	Call TI	Call TI	Samples Not Available
TL750M05CKCSE3	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	Request Free Samples
TL750M05CKTER	OBSOLETE	PFM	KTE	3		TBD	Call TI	Call TI	Samples Not Available
TL750M05CKTPR	OBSOLETE	PFM	KTP	2		TBD	Call TI	Call TI	Samples Not Available
TL750M05CKTPRG3	OBSOLETE	PFM	KTP	2		TBD	Call TI	Call TI	Samples Not Available
TL750M05CKTTR	ACTIVE	DDPAK/ TO-263	KTT	3	500	Green (RoHS & no Sb/Br)	CU SN	Level-3-245C-168 HR	Request Free Samples
TL750M05CKTTRG3	ACTIVE	DDPAK/ TO-263	KTT	3	500	Green (RoHS & no Sb/Br)	CU SN	Level-3-245C-168 HR	Request Free Samples
TL750M05CKVURG3	ACTIVE	PFM	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	Request Free Samples
TL750M08CKCE3	OBSOLETE	TO-220	KC	3		TBD	Call TI	Call TI	Samples Not Available
TL750M08CKCSE3	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	Request Free Samples
TL750M08CKTPRG3	OBSOLETE	PFM	KTP	2		TBD	Call TI	Call TI	Samples Not Available
TL750M08CKVURG3	ACTIVE	PFM	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	Request Free Samples
TL750M10CKC	OBSOLETE	TO-220	KC	3		TBD	Call TI	Call TI	Samples Not Available
TL750M10CKCE3	OBSOLETE	TO-220	KC	3		TBD	Call TI	Call TI	Samples Not Available
TL750M10CKCSE3	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	Request Free Samples
TL750M10CKTER	OBSOLETE	PFM	KTE	3		TBD	Call TI	Call TI	Samples Not Available
TL750M10CKTPR	OBSOLETE	PFM	KTP	2		TBD	Call TI	Call TI	Samples Not Available
TL750M10CKTPRG3	OBSOLETE	PFM	KTP	2		TBD	Call TI	Call TI	Samples Not Available
TL750M10CKVURG3	ACTIVE	PFM	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	Request Free Samples
TL750M12CKC	OBSOLETE	TO-220	KC	3		TBD	Call TI	Call TI	Samples Not Available
TL750M12CKCE3	OBSOLETE	TO-220	KC	3		TBD	Call TI	Call TI	Samples Not Available
TL750M12CKCSE3	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	Request Free Samples
TL750M12CKTPRG3	OBSOLETE	PFM	KTP	2		TBD	Call TI	Call TI	Samples Not Available
TL750M12CKVURG3	ACTIVE	PFM	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	Request Free 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.

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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.

OTHER QUALIFIED VERSIONS OF TL750M05, TL750M08, TL750M12 :

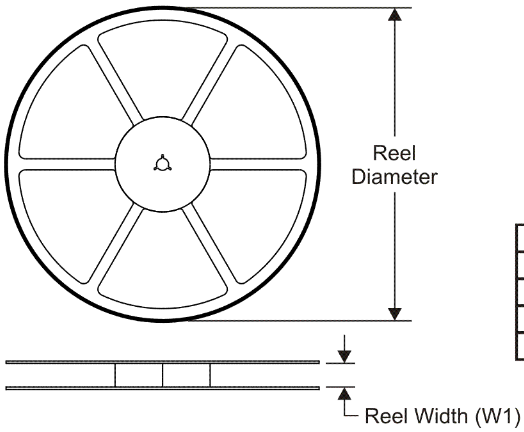
- Automotive: TL750M05-Q1, TL750M08-Q1, TL750M12-Q1

NOTE: Qualified Version Definitions:

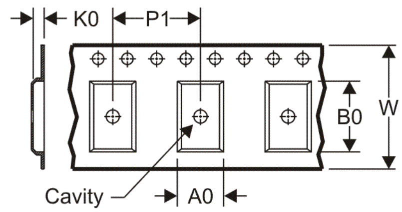
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

REEL DIMENSIONS

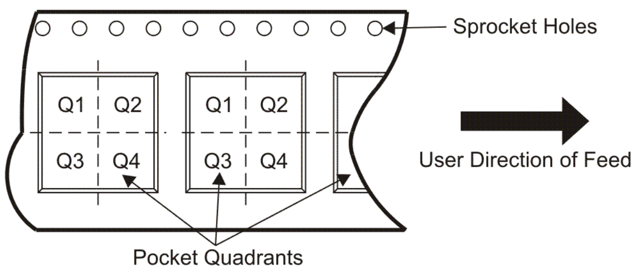


TAPE DIMENSIONS



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

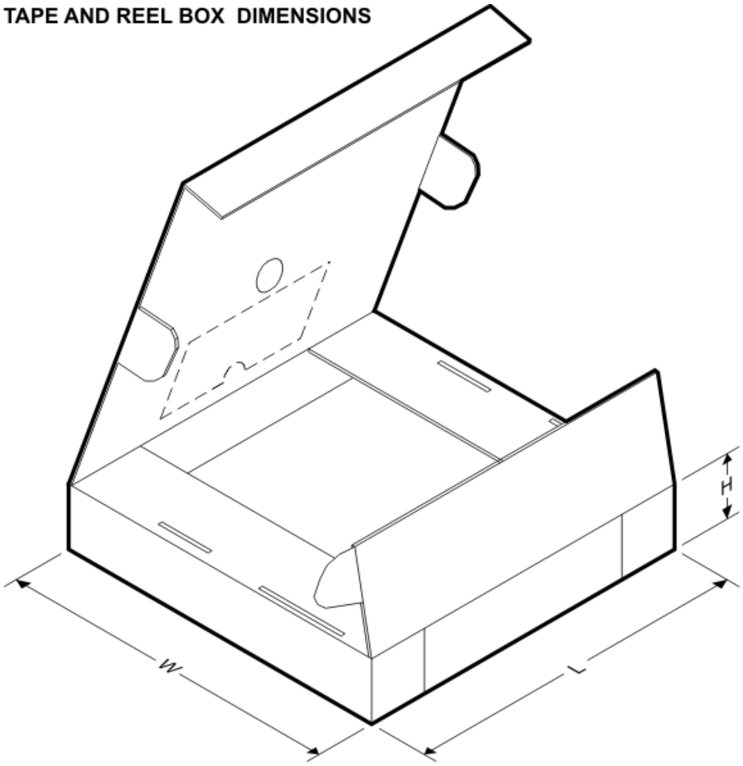
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TL750M05CKTTR	DDPAK/ TO-263	KTT	3	500	330.0	24.4	10.6	15.8	4.9	16.0	24.0	Q2
TL750M05CKVURG3	PFM	KVU	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
TL750M08CKVURG3	PFM	KVU	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
TL750M10CKVURG3	PFM	KVU	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
TL750M12CKVURG3	PFM	KVU	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2

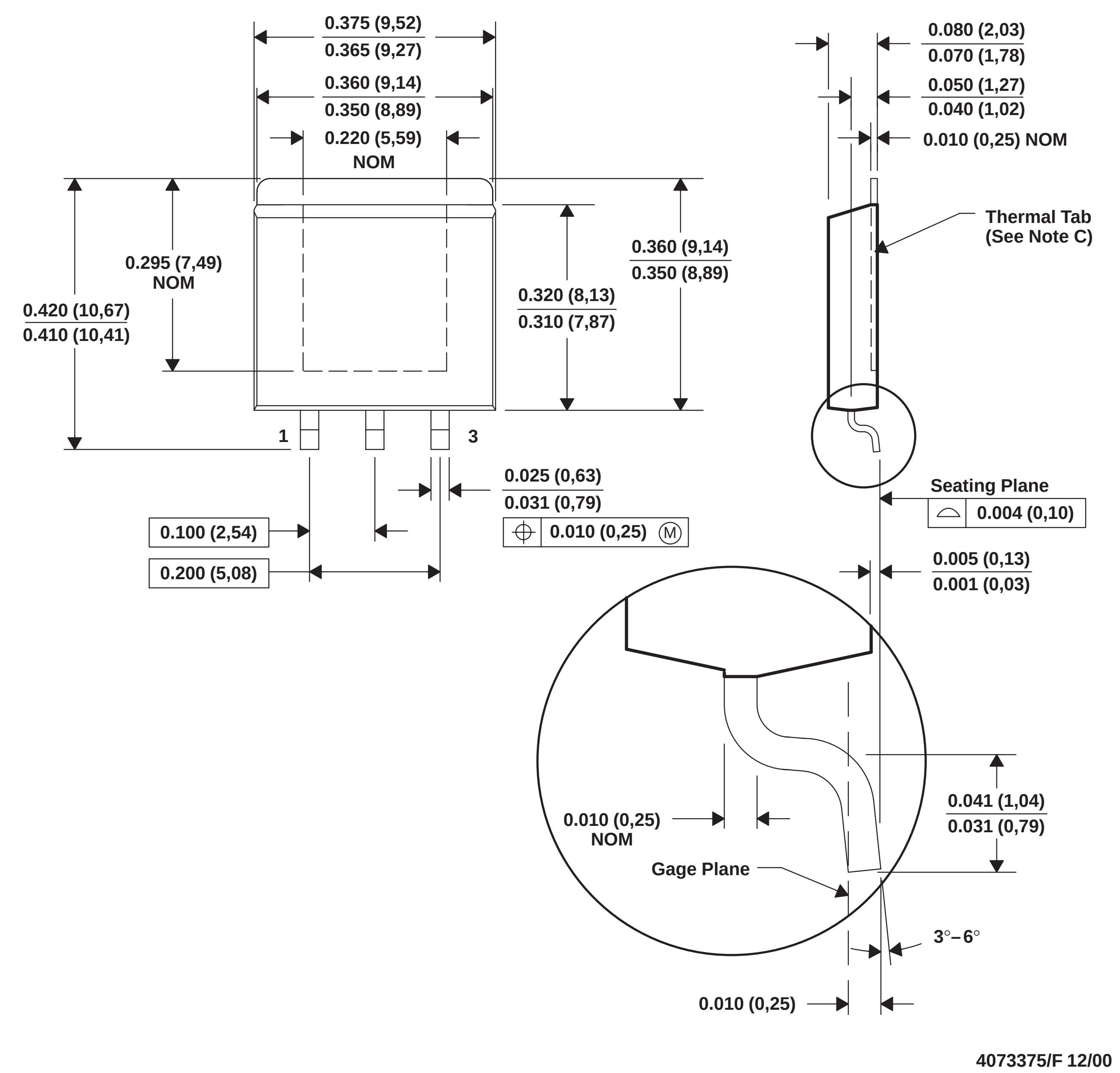
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TL750M05CKTTR	DDPAK/TO-263	KTT	3	500	340.0	340.0	38.0
TL750M05CKVURG3	PFM	KVU	3	2500	340.0	340.0	38.0
TL750M08CKVURG3	PFM	KVU	3	2500	340.0	340.0	38.0
TL750M10CKVURG3	PFM	KVU	3	2500	340.0	340.0	38.0
TL750M12CKVURG3	PFM	KVU	3	2500	340.0	340.0	38.0

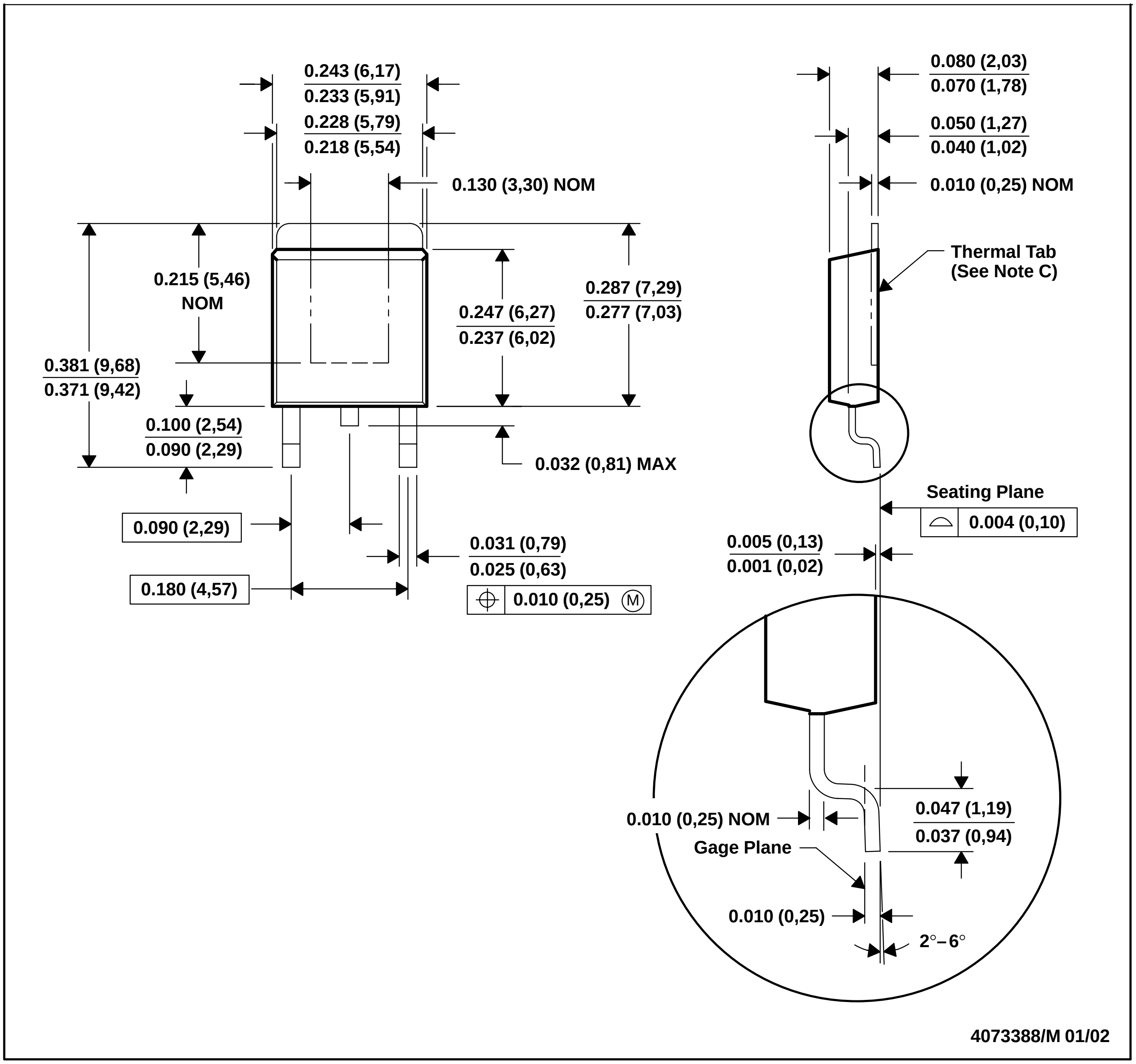
KTE (R-PSFM-G3) **PowerFLEX™ PLASTIC FLANGE-MOUNT**



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

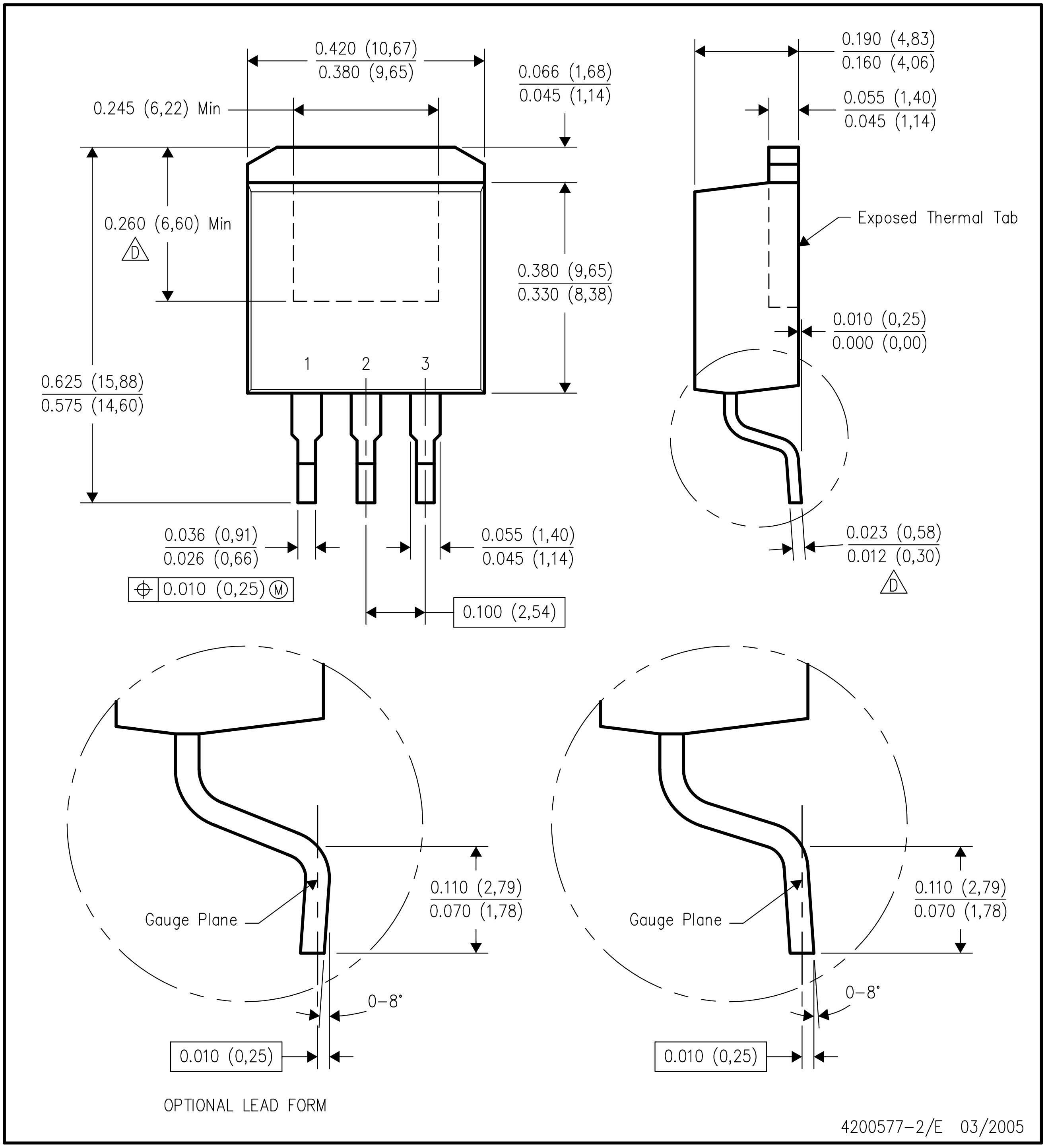
MPSF001F – JANUARY 1996 – REVISED JANUARY 2002

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



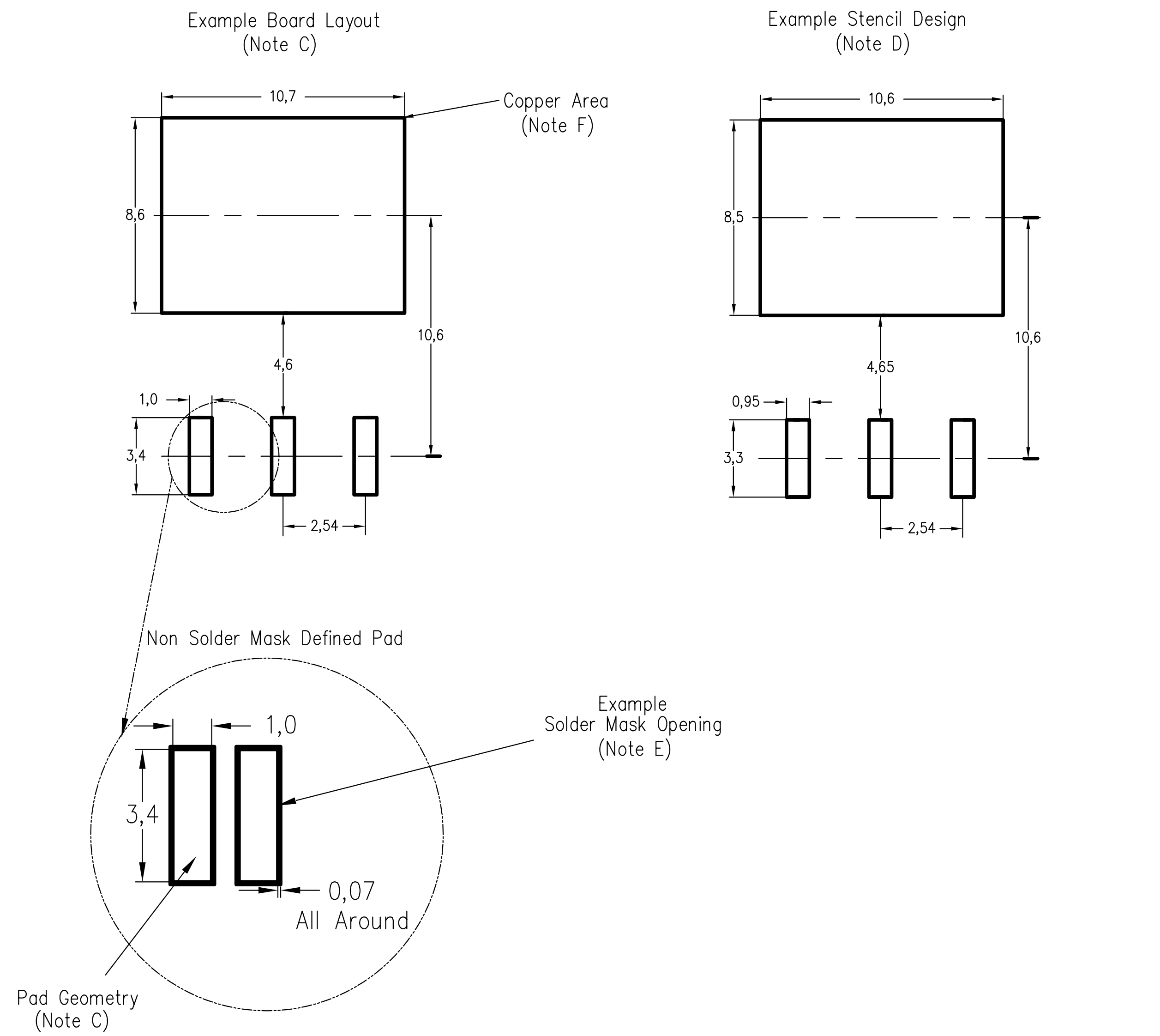
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. The center lead is in electrical contact with the thermal tab.
D. Dimensions do not include mold protrusions, not to exceed 0.006 (0,15).
E. Falls within JEDEC TO-252 variation AC.

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.

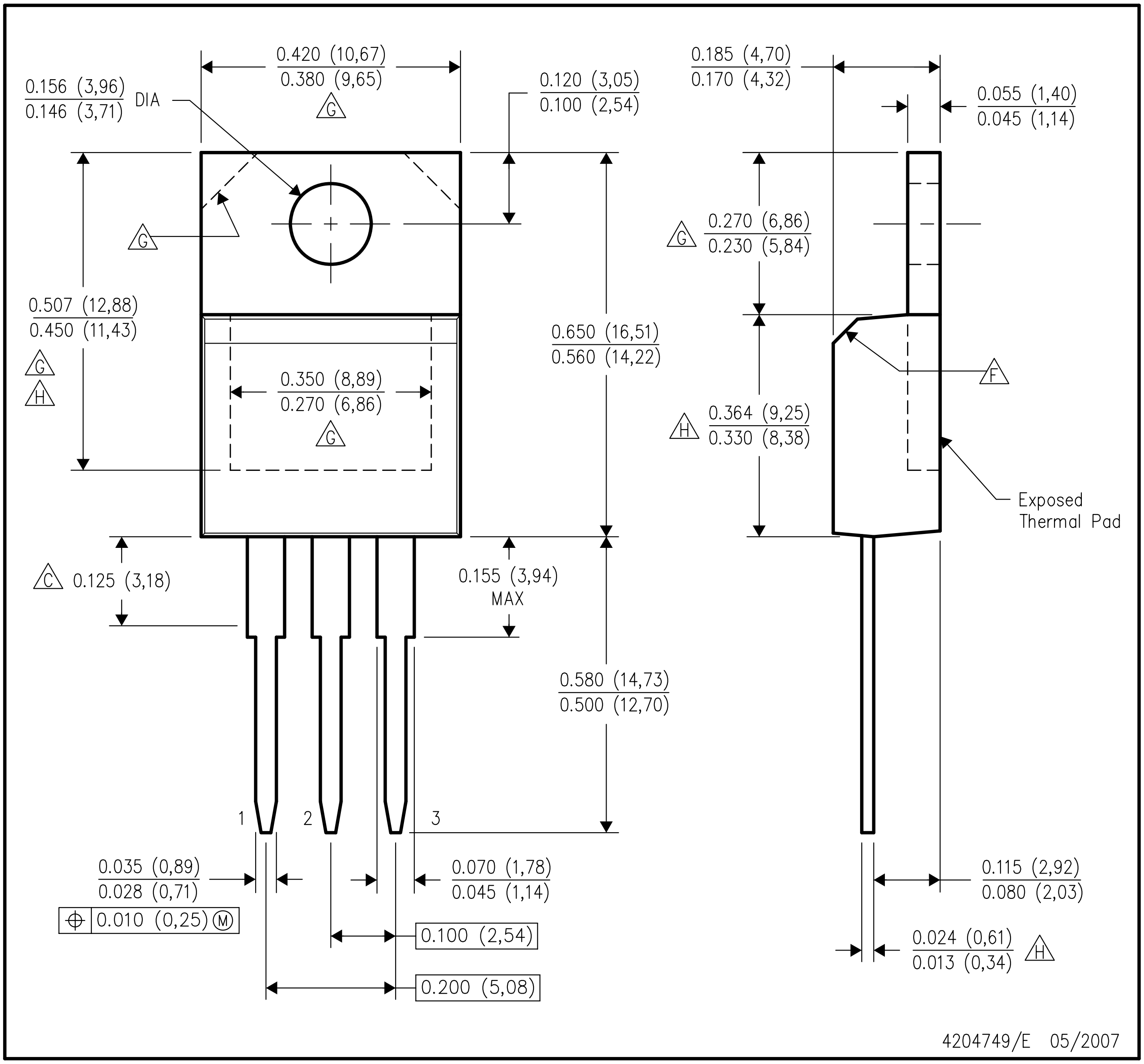
KTT (R–PSFM–G3)



4208208–2/B 03/07

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.

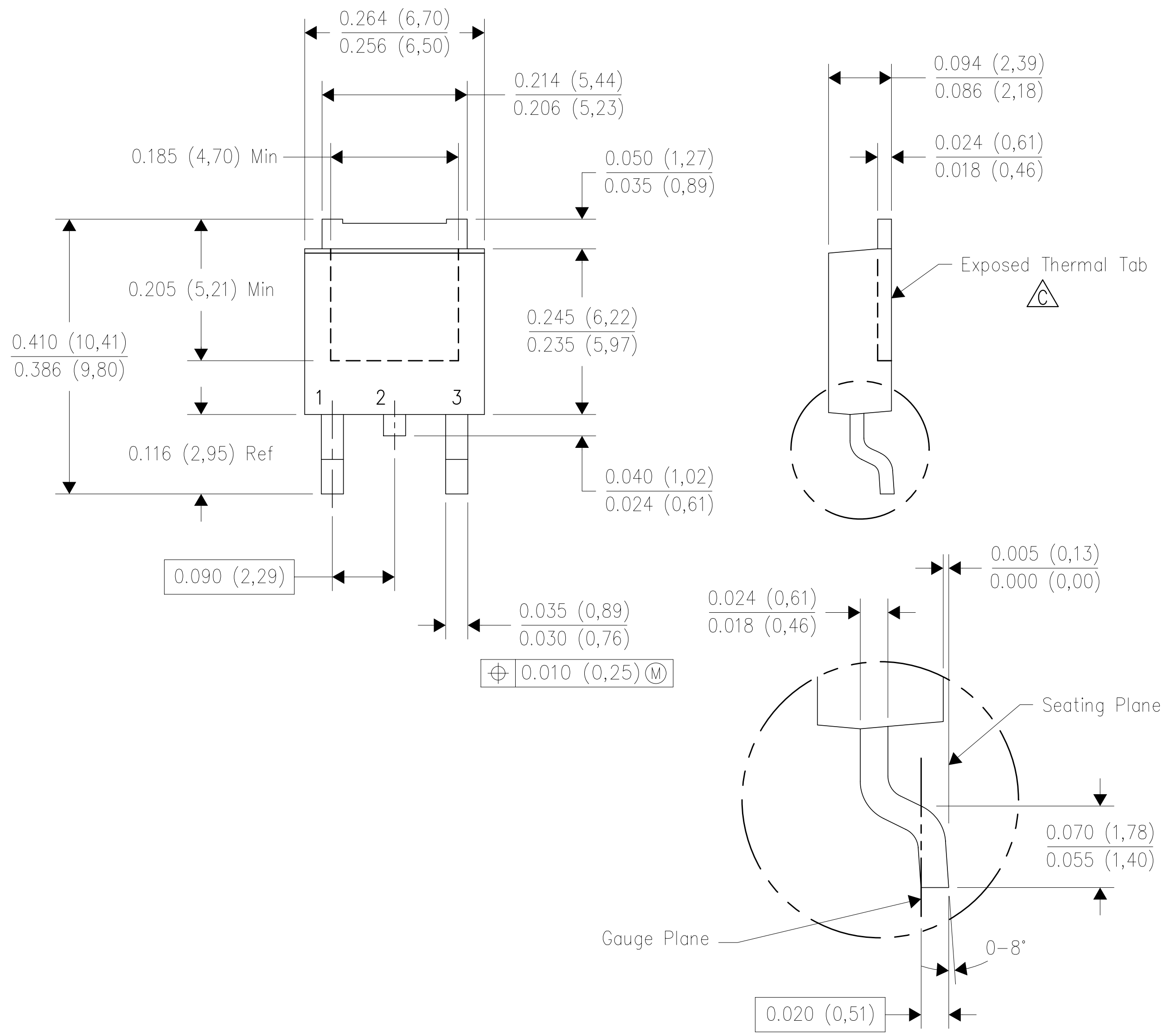
KCS (R–PSFM–T3) PLASTIC FLANGE–MOUNT PACKAGE



4204749/E 05/2007

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.

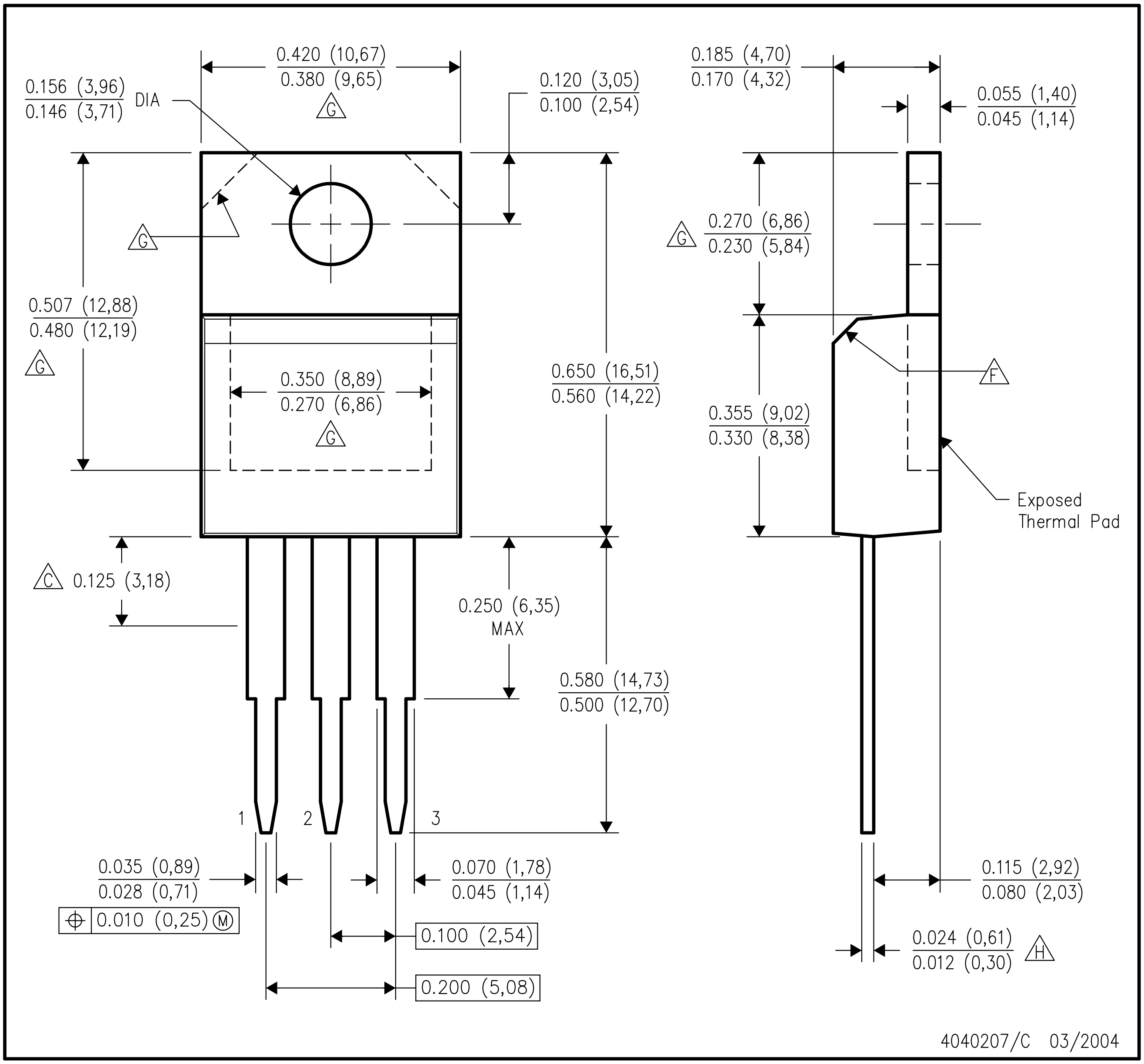
KVU (R–PSFM–G3) PLASTIC FLANGE–MOUNT PACKAGE



4205521–2/D 02/2009

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.