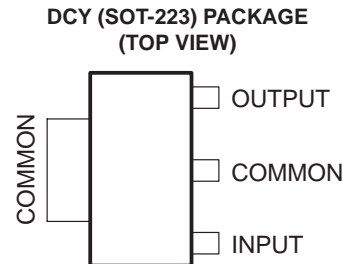
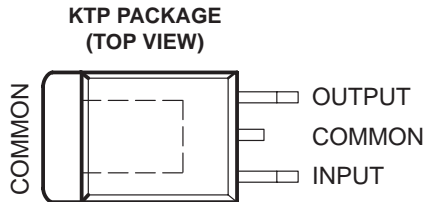


# uA78Mxx-Q1 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS537B – JUNE 2004 – REVISED SEPTEMBER 2008

- Qualified for Automotive Applications
- 3-Terminal Regulators
- Output Current Up To 500 mA
- No External Components
- Internal Thermal-Overload Protection
- High Power-Dissipation Capability
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation



## description/ordering information

This series of fixed-voltage integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. Each of these regulators can deliver up to 500 mA of output current. The internal current-limiting and thermal-shutdown features of these regulators essentially make them immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents and also as the power-pass element in precision regulators.

## ORDERING INFORMATION†

T <sub>J</sub>	V <sub>O(NOM)</sub> (V)	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 125°C	3.3	PowerFLEX™ (KTP)	Reel of 3000	UA78M33QKTPRQ1	78M33CQ
		SOT-223 (DCY)	Reel of 2500	UA78M33QDCYRQ1	C3Q
	5	PowerFLEX™ (KTP)	Reel of 3000	UA78M05QKTPRQ1	78M05CQ
		SOT-223 (DCY)	Reel of 2500	UA78M05QDCYRQ1	C5Q
	8	PowerFLEX™ (KTP)	Reel of 3000	UA78M08QKTPRQ1	78M08CQ
		SOT-223 (DCY)	Reel of 2500	UA78M08QDCYRQ1	C8Q
10	PowerFLEX™ (KTP)	Reel of 3000	UA78M10QKTPRQ1	78M10CQ	

† 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](http://www.ti.com).

‡ Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PowerFLEX is a trademark of Texas Instruments.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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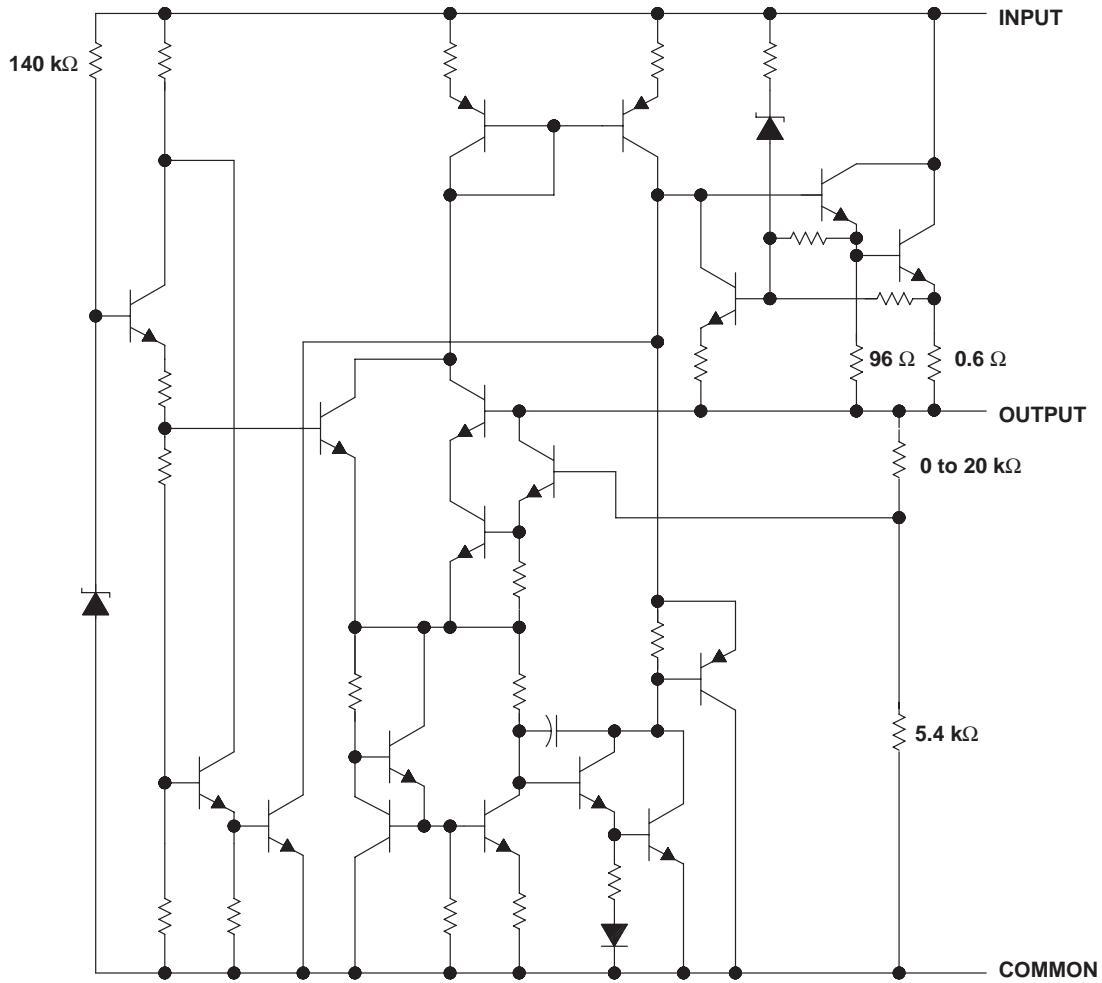
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# uA78Mxx-Q1 SERIES POSITIVE-VOLTAGE REGULATORS

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## schematic



Resistor values shown are nominal.

# uA78Mxx-Q1 SERIES POSITIVE-VOLTAGE REGULATORS

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## absolute maximum ratings over virtual junction temperature range (unless otherwise noted)†

Input voltage, $V_I$ .....	35 V
Operating virtual junction temperature, $T_J$ .....	150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds .....	260°C
Storage temperature range, $T_{Stg}$ .....	–65°C to 150°C

† 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 (see Note 1)

PACKAGE	BOARD	$\theta_{JC}$	$\theta_{JA}$
PowerFLEX (KTP)	High K, JESD 51-5	19°C/W	28°C/W
SOT-223 (DCY)	High K, JESD 51-7	4°C/W	53°C/W

NOTE 1: Maximum power dissipation is a function of  $T_J(\max)$ ,  $\theta_{JA}$ , 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	
$V_I$	Input voltage	$\mu$ A78M33	5.3	25	V
		$\mu$ A78M05	7	25	
		$\mu$ A78M06	8	25	
		$\mu$ A78M08	10.5	25	
		$\mu$ A78M09	11.5	26	
		$\mu$ A78M10	12.5	28	
		$\mu$ A78M12	14.5	30	
$I_O$	Output current		500	mA	
$T_J$	Operating virtual junction temperature	–40	125	°C	

# uA78Mxx-Q1 SERIES POSITIVE-VOLTAGE REGULATORS

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electrical characteristics at specified virtual junction temperature,  $V_I = 8\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $T_J = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS†	μA78M33Q			UNIT	
		MIN	TYP	MAX		
Output voltage‡	$I_O = 5\text{ mA to }350\text{ mA}$ , $V_I = 8\text{ V to }20\text{ V}$		3.2	3.3	3.4	V
		$T_J = -40^\circ\text{C to }125^\circ\text{C}$	3.1	3.3	3.5	
Input voltage regulation	$I_O = 200\text{ mA}$	$V_I = 5.3\text{ V to }25\text{ V}$		9	100	mV
		$V_I = 8\text{ V to }25\text{ V}$		3	50	
Ripple rejection	$V_I = 8\text{ V to }18\text{ V}$ , $f = 120\text{ Hz}$	$I_O = 100\text{ mA}$ , $T_J = -40^\circ\text{C to }125^\circ\text{C}$	62			dB
		$I_O = 300\text{ mA}$	62	80		
Output voltage regulation	$V_I = 8\text{ V}$ , $I_O = 5\text{ mA to }500\text{ mA}$		20	100	mV	
Temperature coefficient of output voltage	$I_O = 5\text{ mA}$ , $T_J = -40^\circ\text{C to }125^\circ\text{C}$		-1		mV/°C	
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$		40	200	μV	
Dropout voltage			2		V	
Bias current			4.5	6	mA	
Bias current change	$I_O = 200\text{ mA}$ , $V_I = 8\text{ V to }25\text{ V}$ , $T_J = -40^\circ\text{C to }125^\circ\text{C}$			0.8	mA	
	$I_O = 5\text{ mA to }350\text{ mA}$ , $T_J = -40^\circ\text{C to }125^\circ\text{C}$			0.5		
Short-circuit output current	$V_I = 35\text{ V}$		300		mA	
Peak output current			700		mA	

† All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output. Pulse-testing techniques maintain  $T_J$  as close to  $T_A$  as possible. Thermal effects must be taken into account separately.

‡ This specification applies only for dc power dissipation permitted by absolute maximum ratings.

electrical characteristics at specified virtual junction temperature,  $V_I = 10\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $T_J = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS†	μA78M05Q			UNIT	
		MIN	TYP	MAX		
Output voltage	$I_O = 5\text{ mA to }350\text{ mA}$ , $V_I = 7\text{ V to }20\text{ V}$		4.8	5	5.2	V
		$T_J = -40^\circ\text{C to }125^\circ\text{C}$	4.75		5.25	
Input voltage regulation	$I_O = 200\text{ mA}$	$V_I = 7\text{ V to }25\text{ V}$		3	100	mV
		$V_I = 8\text{ V to }25\text{ V}$		1	50	
Ripple rejection	$V_I = 8\text{ V to }18\text{ V}$ , $f = 120\text{ Hz}$	$I_O = 100\text{ mA}$ , $T_J = -40^\circ\text{C to }125^\circ\text{C}$	62			dB
		$I_O = 300\text{ mA}$	62	80		
Output voltage regulation	$I_O = 5\text{ mA to }500\text{ mA}$		20	100	mV	
	$I_O = 5\text{ mA to }200\text{ mA}$		10	50		
Temperature coefficient of output voltage	$I_O = 5\text{ mA}$ , $T_J = -40^\circ\text{C to }125^\circ\text{C}$		-1		mV/°C	
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$		40	200	μV	
Dropout voltage			2		V	
Bias current			4.5	6	mA	
Bias current change	$I_O = 200\text{ mA}$ , $V_I = 8\text{ V to }25\text{ V}$ , $T_J = -40^\circ\text{C to }125^\circ\text{C}$			0.8	mA	
	$I_O = 5\text{ mA to }350\text{ mA}$ , $T_J = -40^\circ\text{C to }125^\circ\text{C}$			0.5		
Short-circuit output current	$V_I = 35\text{ V}$		300		mA	
Peak output current			0.7		A	

† All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output. Pulse-testing techniques maintain  $T_J$  as close to  $T_A$  as possible. Thermal effects must be taken into account separately.

# uA78Mxx-Q1 SERIES POSITIVE-VOLTAGE REGULATORS

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**electrical characteristics at specified virtual junction temperature,  $V_I = 14\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $T_J = 25^\circ\text{C}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONST		$\mu\text{A78M08Q}$			UNIT
			MIN	TYP	MAX	
Output voltage	$V_I = 10.5\text{ V to }23\text{ V}$ , $I_O = 5\text{ mA to }350\text{ mA}$		7.7	8	8.3	V
		$T_J = -40^\circ\text{C to }125^\circ\text{C}$	7.6		8.4	
Input voltage regulation	$I_O = 200\text{ mA}$	$V_I = 10.5\text{ V to }25\text{ V}$		6	100	mV
		$V_I = 11\text{ V to }25\text{ V}$		2	50	
Ripple rejection	$V_I = 11.5\text{ V to }21.5\text{ V}$ , $f = 120\text{ Hz}$	$I_O = 100\text{ mA}$ , $T_J = -40^\circ\text{C to }125^\circ\text{C}$	56			dB
		$I_O = 300\text{ mA}$	56	80		
Output voltage regulation	$I_O = 5\text{ mA to }500\text{ mA}$			25	160	mV
	$I_O = 5\text{ mA to }200\text{ mA}$			10	80	
Temperature coefficient of output voltage	$I_O = 5\text{ mA}$ ,	$T_J = -40^\circ\text{C to }125^\circ\text{C}$		-1		mV/ $^\circ\text{C}$
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$			52		$\mu\text{V}$
Dropout voltage				2		V
Bias current				4.6	6	mA
Bias current change	$V_I = 10.5\text{ V to }25\text{ V}$ ,	$I_O = 200\text{ mA}$ ,	$T_J = -40^\circ\text{C to }125^\circ\text{C}$		0.8	mA
	$I_O = 5\text{ mA to }350\text{ mA}$ ,	$T_J = -40^\circ\text{C to }125^\circ\text{C}$			0.5	
Short-circuit output current	$V_I = 35\text{ V}$			250		mA
Peak output current				0.7		A

† All characteristics are measured with a 0.33- $\mu\text{F}$  capacitor across the input and a 0.1- $\mu\text{F}$  capacitor across the output. Pulse-testing techniques maintain  $T_J$  as close to  $T_A$  as possible. Thermal effects must be taken into account separately.

**electrical characteristics at specified virtual junction temperature,  $V_I = 17\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $T_J = 25^\circ\text{C}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONST		$\mu\text{A78M10Q}$			UNIT
			MIN	TYP	MAX	
Output voltage	$V_I = 12.5\text{ V to }25\text{ V}$ , $I_O = 5\text{ mA to }350\text{ mA}$		9.6	10	10.4	V
		$T_J = -40^\circ\text{C to }125^\circ\text{C}$	9.5		10.5	
Input voltage regulation	$I_O = 200\text{ mA}$	$V_I = 12.5\text{ V to }28\text{ V}$		7	100	mV
		$V_I = 14\text{ V to }28\text{ V}$		2	50	
Ripple rejection	$V_I = 15\text{ V to }25\text{ V}$ , $f = 120\text{ Hz}$	$I_O = 100\text{ mA}$ , $T_J = -40^\circ\text{C to }125^\circ\text{C}$	59			dB
		$I_O = 300\text{ mA}$	55	80		
Output voltage regulation	$I_O = 5\text{ mA to }500\text{ mA}$			25	200	mV
	$I_O = 5\text{ mA to }200\text{ mA}$			10	100	
Temperature coefficient of output voltage	$I_O = 5\text{ mA}$ ,	$T_J = -40^\circ\text{C to }125^\circ\text{C}$		-1		mV/ $^\circ\text{C}$
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$			64		$\mu\text{V}$
Dropout voltage				2		V
Bias current				4.7	6	mA
Bias current change	$V_I = 12.5\text{ V to }28\text{ V}$ ,	$I_O = 200\text{ mA}$ ,	$T_J = -40^\circ\text{C to }125^\circ\text{C}$		0.8	mA
	$I_O = 5\text{ mA to }350\text{ mA}$ ,	$T_J = -40^\circ\text{C to }125^\circ\text{C}$			0.5	
Short-circuit output current	$V_I = 35\text{ V}$			245		mA
Peak output current				0.7		A

† All characteristics are measured with a 0.33- $\mu\text{F}$  capacitor across the input and a 0.1- $\mu\text{F}$  capacitor across the output. Pulse-testing techniques maintain  $T_J$  as close to  $T_A$  as possible. Thermal effects must be taken into account separately.

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
UA78M05QDCYRG4Q1	ACTIVE	SOT-223	DCY	4	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UA78M05QKTPRQ1	OBSOLETE	PFM	KTP	2		TBD	Call TI	Call TI
UA78M33QDCYRG4Q1	ACTIVE	SOT-223	DCY	4	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
UA78M33QKTPRQ1	OBSOLETE	PFM	KTP	2		TBD	Call TI	Call TI

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

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**OTHER QUALIFIED VERSIONS OF UA78M05-Q1, UA78M33-Q1 :**

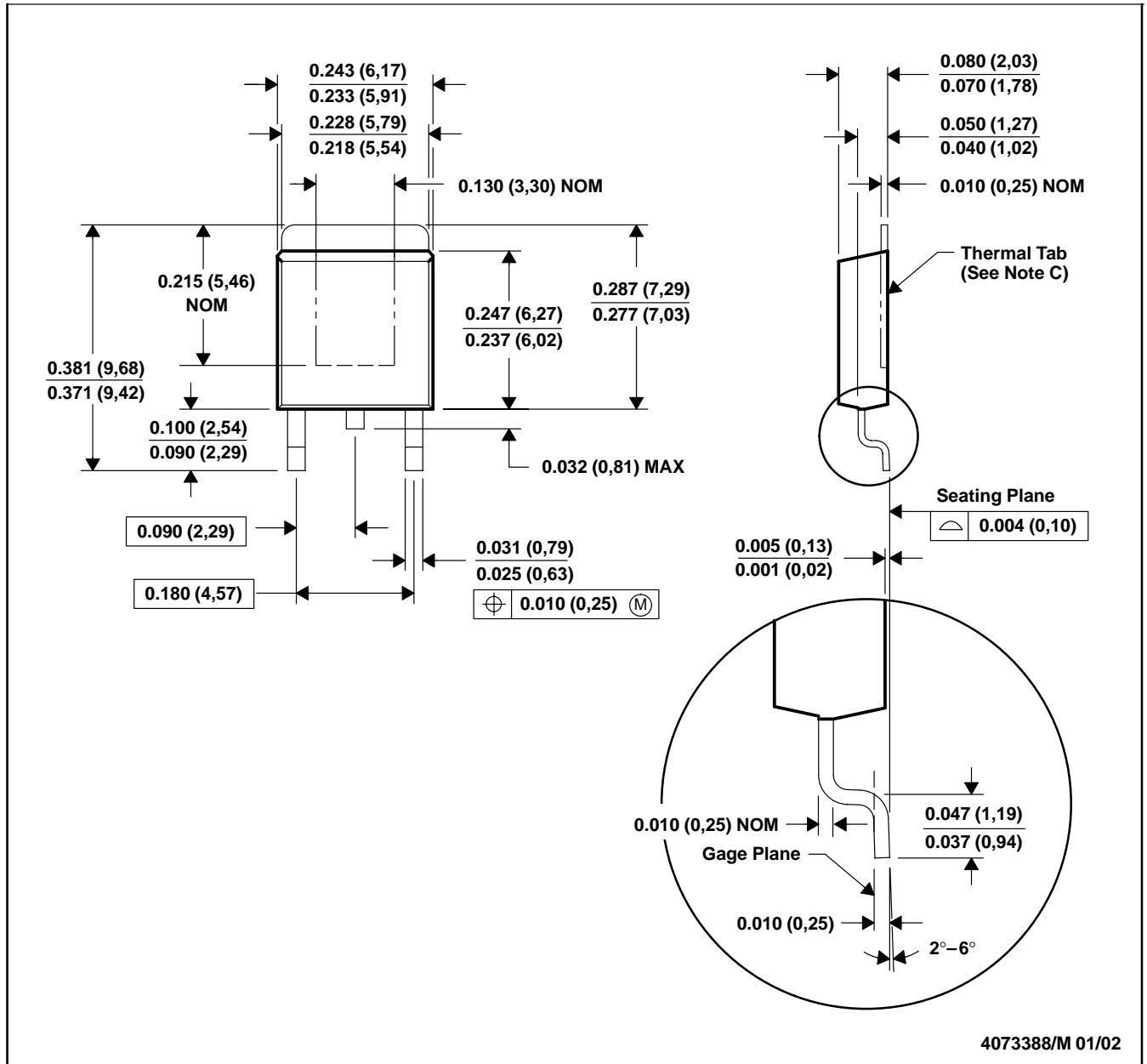
- Catalog: [UA78M05](#), [UA78M33](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

KTP (R-PSFM-G2)

PowerFLEX™ PLASTIC FLANGE-MOUNT PACKAGE

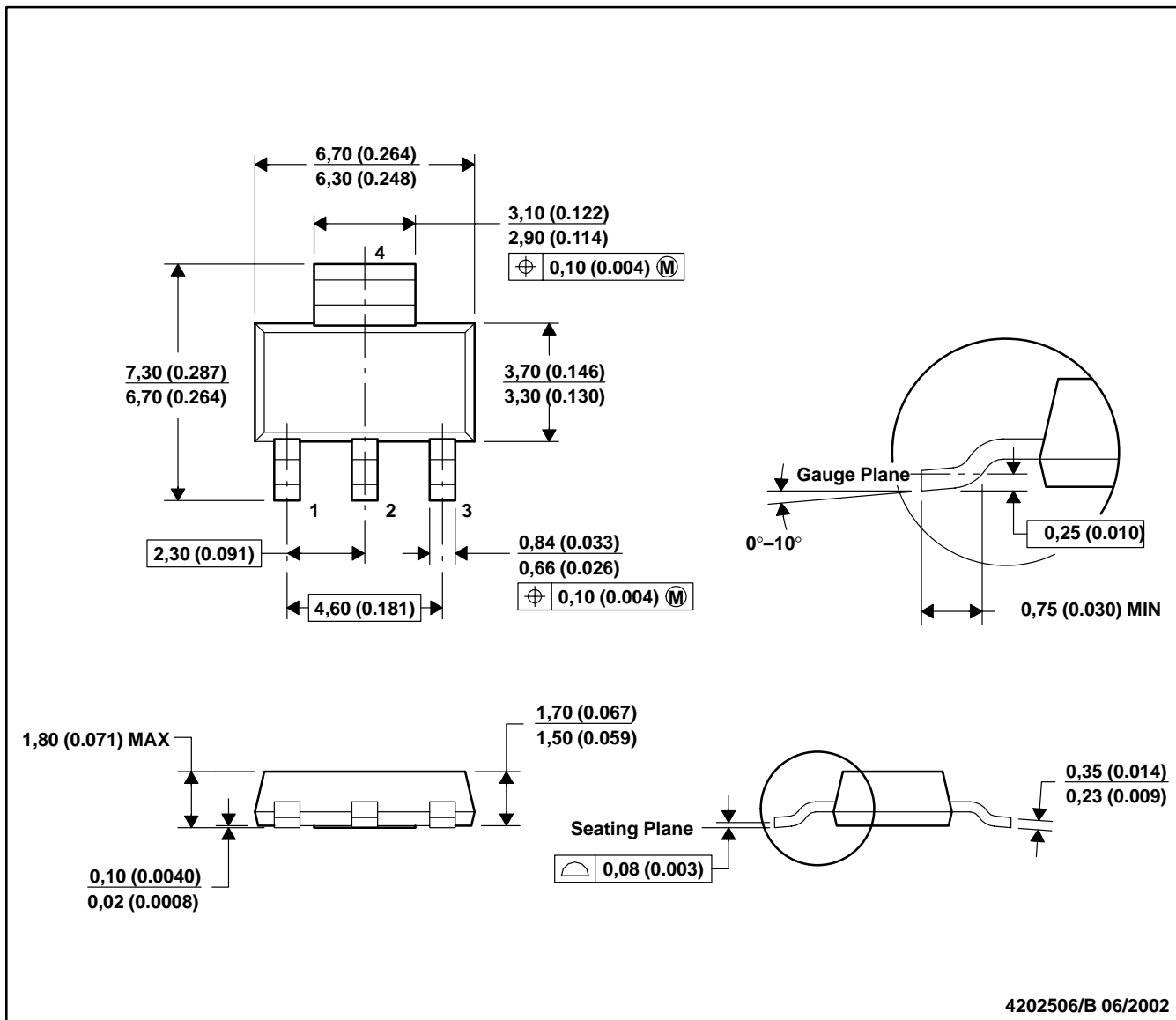


- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. The center lead is in electrical contact with the thermal tab.  
 D. Dimensions do not include mold protrusions, not to exceed 0.006 (0,15).  
 E. Falls within JEDEC TO-252 variation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

PowerFLEX is a trademark of Texas Instruments.

DCY (R-PDSO-G4)

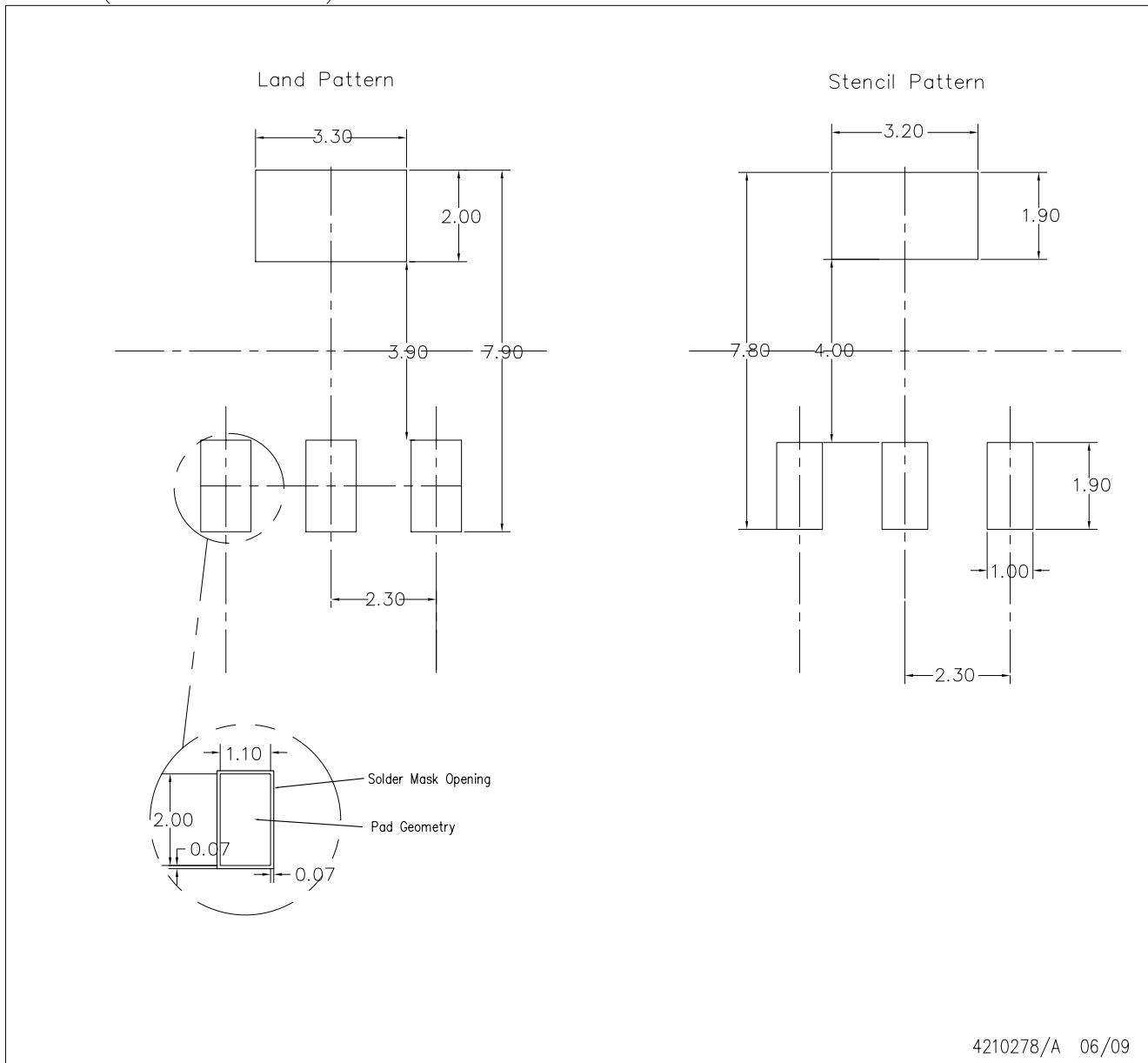
PLASTIC SMALL-OUTLINE



- 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.



DCY (R-PDSO-G4)



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - D. Publication IPC-7351 is recommended for alternate designs.
  - E. 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.

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