

μA78Mxx Positive-Voltage Regulators

1 Features

- 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

2 Applications

- On-Card Regulation
- Portable Devices
- Computing & Servers
- Telecommunications

3 Description

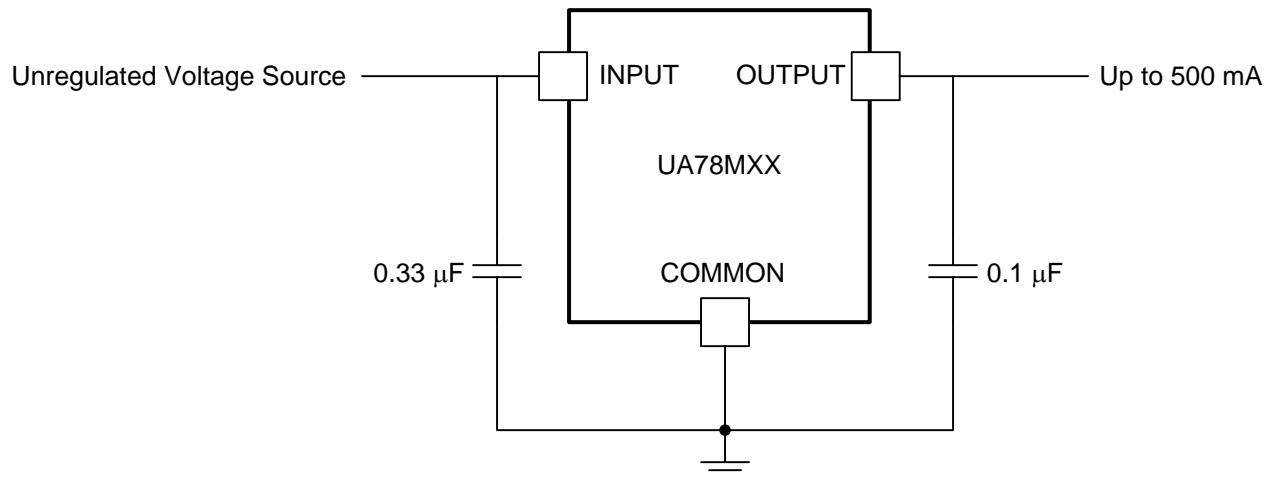
This series of fixed-voltage integrated-circuit voltage regulators is designed for a wide range of applications. The applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. Each of these regulators can deliver up to 500 mA of 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.

Device Information⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
UA78Mxx	SOT-223 (3)	6.50 mm x 3.50 mm
	TO-220 (3)	10.16 mm x 8.82 mm
	TO-252 (3)	6.60 mm x 6.10 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

4 Simplified Schematic



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

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5 Revision History

Changes from Revision S (May 2013) to Revision T

		Page
•	Added <i>Applications</i> , <i>Device Information</i> table, <i>Pin Functions</i> table, <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>Typical Characteristics</i> , <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section.	1

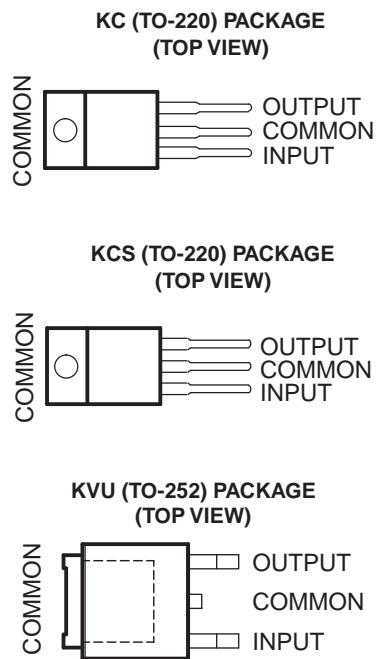
Changes from Revision R (February 2013) to Revision S

		Page
•	Removed Ordering Information table.	1

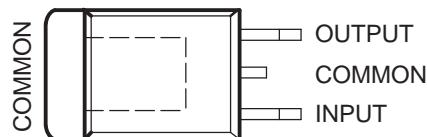
Changes from Revision Q (April 2010) to Revision R

		Page
•	Removed obsolete part information from document.	1

6 Pin Configuration and Functions

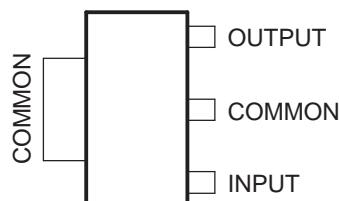


**KTP (PowerFLEX /TO-252*) PACKAGE
(TOP VIEW)**



* Complies with JEDEC TO-252, variation AC

**DCY (SOT-223) PACKAGE
(TOP VIEW)**



Pin Functions

PIN		TYPE	DESCRIPTION
NAME	NO.		
COMMON	2	—	Ground
INPUT	1	I	Supply Input
OUTPUT	3	O	Voltage Output

7 Specifications

7.1 Absolute Maximum Ratings

over virtual junction temperature range (unless otherwise noted)⁽¹⁾

		MIN	MAX	UNIT
V_I	Input voltage		35	V
T_J	Operating virtual junction temperature		150	°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.

7.2 ESD Ratings

		VALUE	UNIT
$V_{(ESD)}$	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins ⁽¹⁾	2500	V
	Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽²⁾	2000	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.3 Recommended Operating Conditions

		MIN	MAX	UNIT
V_I	Input voltage	uA78M33	5.3	25
		uA78M05	7	25
		uA78M06	8	25
		uA78M08	10.5	25
		uA78M09	11.5	26
		uA78M10	12.5	28
		uA78M12	14.5	30
		uA78M15	17.5	30
I_O	Output current		500	mA
T_J	Operating virtual junction temperature	uA78MxxC	0	125
		uA78MxxI	-40	125

7.4 Thermal Information

THERMAL METRIC ⁽¹⁾	UA78Mxx					UNIT
	DCY	KC	KCS	KTP	KVU	
	3 PINS	3 PINS	3 PINS	3 PINS	3 PINS	
$R_{\theta JA}$	53	19	19	28	30.3	°C/W
$R_{\theta JC(to p)}$	30.6	17	17	19	—	
$R_{\theta JC(b ot)}$	—	3	3	1.4	—	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).

7.5 Electrical Characteristics — uA78M33C

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 ⁰	TEST CONDITIONS ⁽¹⁾	uA78M33C			UNIT
		MIN	TYP	MAX	
Output voltage ⁽²⁾	$I_O = 5 \text{ mA}$ to 350 mA , $V_I = 8 \text{ V}$ to 20 V		3.2	3.3	3.4
		$T_J = 0^\circ\text{C}$ to 125°C	3.1	3.3	3.5
Input voltage regulation	$I_O = 200 \text{ mA}$	$V_I = 5.3 \text{ V}$ to 25 V	9	100	mV
		$V_I = 8 \text{ V}$ to 25 V	3	50	
Ripple rejection	$V_I = 8 \text{ V}$ to 18 V , $f = 120 \text{ Hz}$	$I_O = 100 \text{ mA}$, $T_J = 0^\circ\text{C}$ to 125°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 mA	20	100	mV
Temperature coefficient of output voltage	$I_O = 5 \text{ mA}$,	$T_J = 0^\circ\text{C}$ to 125°C	–1		mV/°C
Output noise voltage	$f = 10 \text{ Hz}$ to 100 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 V , $T_J = 0^\circ\text{C}$ to 125°C		0.8		mA
		$I_O = 5 \text{ mA}$ to 350 mA , $T_J = 0^\circ\text{C}$ to 125°C	0.5		
Short-circuit output current	$V_I = 35 \text{ V}$		300		mA
Peak output current			700		mA

(1) All characteristics are measured with a $0.33\text{-}\mu\text{F}$ capacitor across the input and a $0.1\text{-}\mu\text{F}$ 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.

(2) This specification applies only for dc power dissipation permitted by [Absolute Maximum Ratings](#).

7.6 Electrical Characteristics — uA78M33I

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 ⁽¹⁾	uA78M33I			UNIT
		MIN	TYP	MAX	
Output voltage ⁽²⁾	$I_O = 5 \text{ mA}$ to 350 mA , $V_I = 8 \text{ V}$ to 20 V		3.2	3.3	3.4
		$T_J = -40^\circ\text{C}$ to 125°C	3.1	3.3	3.5
Input voltage regulation	$I_O = 200 \text{ mA}$	$V_I = 5.3 \text{ V}$ to 25 V	9	100	mV
		$V_I = 8 \text{ V}$ to 25 V	3	50	
Ripple rejection	$V_I = 8 \text{ V}$ to 18 V , $f = 120 \text{ Hz}$	$I_O = 100 \text{ mA}$, $T_J = -40^\circ\text{C}$ to 125°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 mA	20	100	mV
Temperature coefficient of output voltage	$I_O = 5 \text{ mA}$,	$T_J = -40^\circ\text{C}$ to 125°C	–1		mV/°C
Output noise voltage	$f = 10 \text{ Hz}$ to 100 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 V , $T_J = -40^\circ\text{C}$ to 125°C		0.8		mA
		$I_O = 5 \text{ mA}$ to 350 mA , $T_J = -40^\circ\text{C}$ to 125°C	0.5		
Short-circuit output current	$V_I = 35 \text{ V}$		300		mA
Peak output current			700		mA

(1) All characteristics are measured with a $0.33\text{-}\mu\text{F}$ capacitor across the input and a $0.1\text{-}\mu\text{F}$ 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.

(2) This specification applies only for dc power dissipation permitted by [Absolute Maximum Ratings](#).

7.7 Electrical Characteristics — uA78M05C

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

PARAMETER	TEST CONDITIONS ⁽¹⁾	uA78M05C			UNIT
		MIN	TYP	MAX	
Output voltage ⁽²⁾	$I_O = 5$ mA to 350 mA, $V_I = 7$ V to 20 V		4.8	5	5.2
		$T_J = 0^\circ\text{C}$ to 125°C	4.75		5.25
Input voltage regulation	$I_O = 200$ mA	$V_I = 7$ V to 25 V		3	100
		$V_I = 8$ V to 25 V		1	50
Ripple rejection	$V_I = 8$ V to 18 V, $f = 120$ Hz	$I_O = 100$ mA, $T_J = 0^\circ\text{C}$ to 125°C	62		dB
		$I_O = 300$ mA	62	80	
Output voltage regulation	$I_O = 5$ mA to 500 mA		20	100	mV
			10	50	
Temperature coefficient of output voltage	$I_O = 5$ mA,	$T_J = 0^\circ\text{C}$ to 125°C		-1	mV/°C
Output noise voltage	$f = 10$ Hz to 100 kHz		40	200	µV
Dropout voltage			2		V
Bias current			4.5	6	mA
Bias current change	$I_O = 200$ mA, $V_I = 8$ V to 25 V, $T_J = 0^\circ\text{C}$ to 125°C		0.8		mA
		$I_O = 5$ mA to 350 mA, $T_J = 0^\circ\text{C}$ to 125°C	0.5		
Short-circuit output current	$V_I = 35$ V		300		mA
Peak output current			0.7		A

(1) 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.

(2) This specification applies only for dc power dissipation permitted by *Absolute Maximum Ratings*.

7.8 Electrical Characteristics — uA78M05I

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

PARAMETER	TEST CONDITIONS ⁽¹⁾	uA78M05I			UNIT
		MIN	TYP	MAX	
Output voltage ⁽²⁾	$I_O = 5$ mA to 350 mA, $V_I = 7$ V to 20 V		4.8	5	5.2
		$T_J = -40^\circ\text{C}$ to 125°C	4.75		5.25
Input voltage regulation	$I_O = 200$ mA	$V_I = 7$ V to 25 V		3	100
		$V_I = 8$ V to 25 V		1	50
Ripple rejection	$V_I = 8$ V to 18 V, $f = 120$ Hz	$I_O = 100$ mA, $T_J = -40^\circ\text{C}$ to 125°C	62		dB
		$I_O = 300$ mA	62	80	
Output voltage regulation	$I_O = 5$ mA to 500 mA		20	100	mV
			10	50	
Temperature coefficient of output voltage	$I_O = 5$ mA,	$T_J = -40^\circ\text{C}$ to 125°C		-1	mV/°C
Output noise voltage	$f = 10$ Hz to 100 kHz		40	200	µV
Dropout voltage			2		V
Bias current			4.5	6	mA
Bias current change	$I_O = 200$ mA, $V_I = 8$ V to 25 V, $T_J = -40^\circ\text{C}$ to 125°C		0.8		mA
		$I_O = 5$ mA to 350 mA, $T_J = -40^\circ\text{C}$ to 125°C	0.5		
Short-circuit output current	$V_I = 35$ V		300		mA
Peak output current			0.7		A

(1) 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.

(2) This specification applies only for dc power dissipation permitted by *Absolute Maximum Ratings*.

7.9 Electrical Characteristics — uA78M06C

at specified virtual junction temperature, $V_I = 11$ V, $I_O = 350$ mA, $T_J = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS ⁽¹⁾			uA78M06C	UNIT
	MIN	TYP	MAX		
Output voltage ⁽²⁾	$I_O = 5$ mA to 350 mA, $V_I = 8$ V to 21 V	$T_J = 0^\circ\text{C}$ to 125°C	5.75	6	6.25
			5.7		6.3
Input voltage regulation	$I_O = 200$ mA	$V_I = 8$ V to 25 V		5	100
		$V_I = 9$ V to 25 V		1.5	50
Ripple rejection	$V_I = 8$ V to 18 V, $f = 120$ Hz	$I_O = 100$ mA, $T_J = 0^\circ\text{C}$ to 125°C	59	dB	
		$I_O = 300$ mA	59		
Output voltage regulation	$I_O = 5$ mA to 500 mA		20	120	mV
	$I_O = 5$ mA to 200 mA		10	60	
Temperature coefficient of output voltage	$I_O = 5$ mA, $T_J = 0^\circ\text{C}$ to 125°C		-1		mV/°C
Output noise voltage	$f = 10$ Hz to 100 kHz		45		µV
Dropout voltage			2		V
Bias current			4.5	6	mA
Bias current change	$V_I = 9$ V to 25 V, $I_O = 200$ mA, $T_J = 0^\circ\text{C}$ to 125°C		0.8	mA	
	$I_O = 5$ mA to 350 mA, $T_J = 0^\circ\text{C}$ to 125°C		0.5		
Short-circuit output current	$V_I = 35$ V		270		mA
Peak output current			0.7		A

(1) 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.

(2) This specification applies only for dc power dissipation permitted by [Absolute Maximum Ratings](#).

7.10 Electrical Characteristics — uA78M08C

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

PARAMETER	TEST CONDITIONS ⁽¹⁾			uA78M08C	UNIT
	MIN	TYP	MAX		
Output voltage ⁽²⁾	$V_I = 10.5$ V to 23 V, $I_O = 5$ mA to 350 mA	$T_J = 0^\circ\text{C}$ to 125°C	7.7	8	8.3
			7.6		8.4
Input voltage regulation	$I_O = 200$ mA	$V_I = 10.5$ V to 25 V	6	100	mV
		$V_I = 11$ V to 25 V	2	50	
Ripple rejection	$V_I = 11$ V to 21.5 V, $f = 120$ Hz	$I_O = 100$ mA, $T_J = 0^\circ\text{C}$ to 125°C	56	dB	
		$I_O = 300$ mA	56		
Output voltage regulation	$I_O = 5$ mA to 500 mA		25	160	mV
	$I_O = 5$ mA to 200 mA		10	80	
Temperature coefficient of output voltage	$I_O = 5$ mA, $T_J = 0^\circ\text{C}$ to 125°C		-1		mV/°C
Output noise voltage	$f = 10$ Hz to 100 kHz		52		µV
Dropout voltage			2		V
Bias current			4.6	6	mA
Bias current change	$V_I = 10.5$ V to 25 V, $I_O = 200$ mA, $T_J = 0^\circ\text{C}$ to 125°C		0.8	mA	
	$I_O = 5$ mA to 350 mA, $T_J = 0^\circ\text{C}$ to 125°C		0.5		
Short-circuit output current	$V_I = 35$ V		250		mA
Peak output current			0.7		A

(1) 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.

(2) This specification applies only for dc power dissipation permitted by [Absolute Maximum Ratings](#).

7.11 Electrical Characteristics — uA78M09C

at specified virtual junction temperature, $V_I = 16$ V, $I_O = 350$ mA, $T_J = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS ⁽¹⁾	uA78M09C			UNIT
		MIN	TYP	MAX	
Output voltage ⁽²⁾	$V_I = 11.5$ V to 24 V, $I_O = 5$ mA to 350 mA			8.6 9 9.4	V
				8.5 9.5	
Input voltage regulation	$I_O = 200$ mA	$V_I = 11.5$ V to 26 V		6 100	mV
		$V_I = 12$ V to 26 V		2 50	
Ripple rejection	$V_I = 13$ V to 23 V, $f = 120$ Hz	$I_O = 100$ mA, $T_J = 0^\circ\text{C}$ to 125°C		56	dB
		$I_O = 300$ mA		56 80	
Output voltage regulation	$I_O = 5$ mA to 500 mA			25 180	mV
	$I_O = 5$ mA to 200 mA			10 90	
Temperature coefficient of output voltage	$I_O = 5$ mA, $T_J = 0^\circ\text{C}$ to 125°C			-1	mV/°C
Output noise voltage	$f = 10$ Hz to 100 kHz			58	µV
Dropout voltage				2	V
Bias current				4.6 6	mA
Bias current change	$V_I = 11.5$ V to 26 V, $I_O = 200$ mA, $T_J = 0^\circ\text{C}$ to 125°C			0.8	mA
	$I_O = 5$ mA to 350 mA, $T_J = 0^\circ\text{C}$ to 125°C			0.5	
Short-circuit output current	$V_I = 35$ V			250	mA
Peak output current				0.7	A

(1) 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.

(2) This specification applies only for dc power dissipation permitted by [Absolute Maximum Ratings](#).

7.12 Electrical Characteristics — uA78M10C

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

PARAMETER	TEST CONDITIONS ⁽¹⁾	uA78M10C			UNIT
		MIN	TYP	MAX	
Output voltage ⁽²⁾	$V_I = 12.5$ V to 25 V, $I_O = 5$ mA to 350 mA			9.6 10 10.4	V
				9.5 10.5	
Input voltage regulation	$I_O = 200$ mA	$V_I = 12.5$ V to 28 V		7 100	mV
		$V_I = 14$ V to 28 V		2 50	
Ripple rejection	$V_I = 15$ V to 25 V, $f = 120$ Hz	$I_O = 100$ mA, $T_J = 0^\circ\text{C}$ to 125°C		59	dB
		$I_O = 300$ mA		55 80	
Output voltage regulation	$I_O = 5$ mA to 500 mA			25 200	mV
	$I_O = 5$ mA to 200 mA			10 100	
Temperature coefficient of output voltage	$I_O = 5$ mA, $T_J = 0^\circ\text{C}$ to 125°C			-1	mV/°C
Output noise voltage	$f = 10$ Hz to 100 kHz			64	µV
Dropout voltage				2	V
Bias current				4.7 6	mA
Bias current change	$V_I = 12.5$ V to 28 V, $I_O = 200$ mA, $T_J = 0^\circ\text{C}$ to 125°C			0.8	mA
	$I_O = 5$ mA to 350 mA, $T_J = 0^\circ\text{C}$ to 125°C			0.5	
Short-circuit output current	$V_I = 35$ V			245	mA
Peak output current				0.7	A

(1) 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.

(2) This specification applies only for dc power dissipation permitted by [Absolute Maximum Ratings](#).

7.13 Electrical Characteristics — uA78M12C

at specified virtual junction temperature, $V_I = 19$ V, $I_O = 350$ mA, $T_J = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS ⁽¹⁾	uA78M12C			UNIT
		MIN	TYP	MAX	
Output voltage ⁽²⁾	$V_I = 14.5$ V to 27 V, $I_O = 5$ mA to 350 mA	11.5	12	12.5	V
	$T_J = 0^\circ\text{C}$ to 125°C	11.4	12.6		
Input voltage regulation	$I_O = 200$ mA	$V_I = 14.5$ V to 30 V	8	100	mV
	$V_I = 16$ V to 30 V	2	50		
Ripple rejection	$V_I = 15$ V to 25 V, $f = 120$ Hz	$I_O = 100$ mA, $T_J = 0^\circ\text{C}$ to 125°C	55		dB
		$I_O = 300$ mA	55	80	
Output voltage regulation	$I_O = 5$ mA to 500 mA		25	240	mV
	$I_O = 5$ mA to 200 mA		10	120	
Temperature coefficient of output voltage	$I_O = 5$ mA, $T_J = 0^\circ\text{C}$ to 125°C		–1		mV/°C
Output noise voltage	$f = 10$ Hz to 100 kHz		75		µV
Dropout voltage			2		V
Bias current			4.8	6	mA
Bias current change	$V_I = 14.5$ V to 30 V, $I_O = 200$ mA, $T_J = 0^\circ\text{C}$ to 125°C		0.8		mA
	$I_O = 5$ mA to 350 mA, $T_J = 0^\circ\text{C}$ to 125°C		0.5		
Short-circuit output current	$V_I = 35$ V		240		mA
Peak output current			0.7		A

(1) 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.

(2) This specification applies only for dc power dissipation permitted by [Absolute Maximum Ratings](#).

7.14 Typical Characteristics

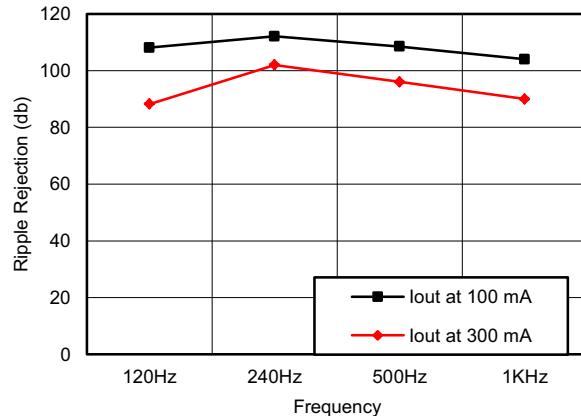


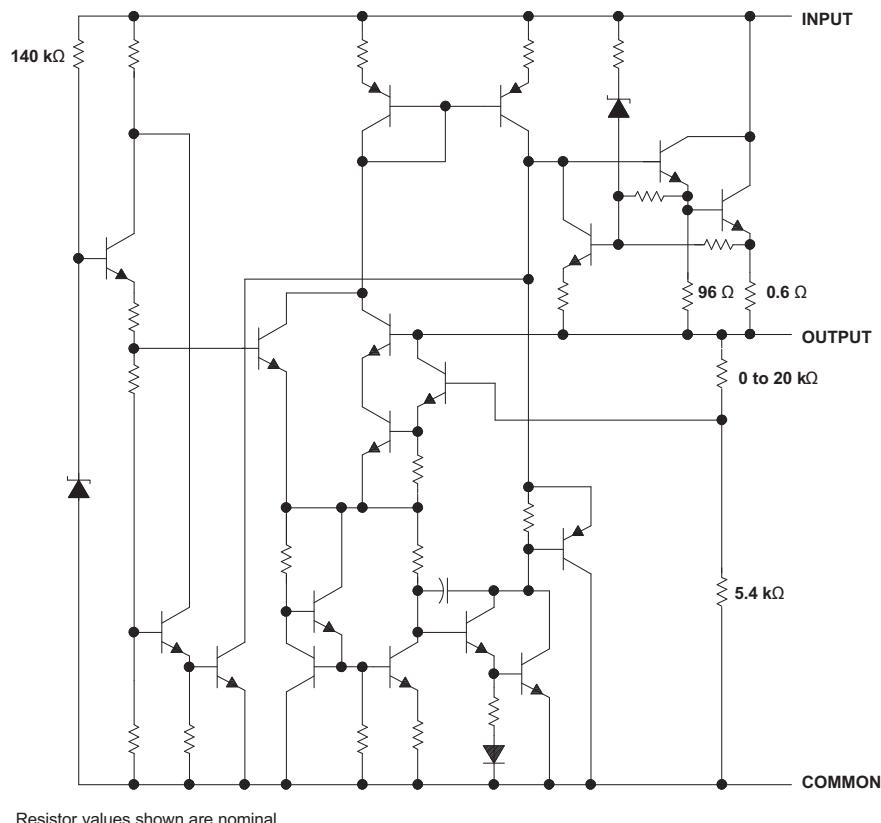
Figure 1. Ripple Rejection vs Frequency
 $V_{\text{INPUT}} = 8$ V to 18 V, $T_A = 25^\circ\text{C}$

8 Detailed Description

8.1 Overview

This series of fixed-voltage integrated-circuit voltage regulators is designed for a wide range of applications. The 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.

8.2 Functional Block Diagram



8.3 Feature Description

- 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

8.4 Device Functional Modes

8.4.1 Fixed-Output Mode

These devices are available in fixed-output voltages. See the orderable part list for the desired output.

9 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

The UA78Mxx devices are ideal for use as linear regulators with few external components needed for a working design. They are also useful for attenuating power supply noise.

9.2 Typical Application

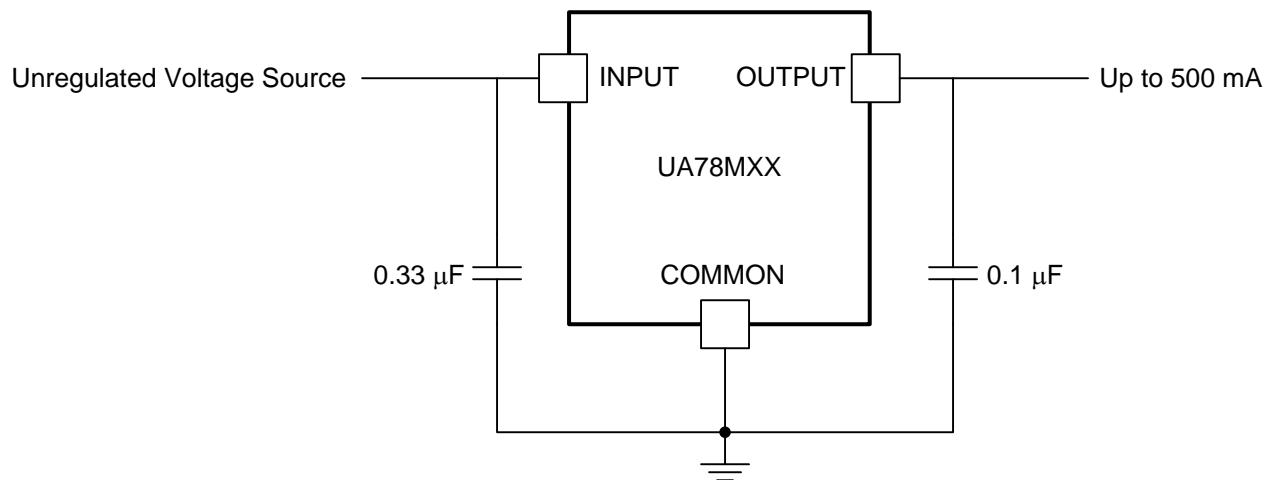


Figure 2. Fixed-Output Regulator

9.2.1 Design Requirements

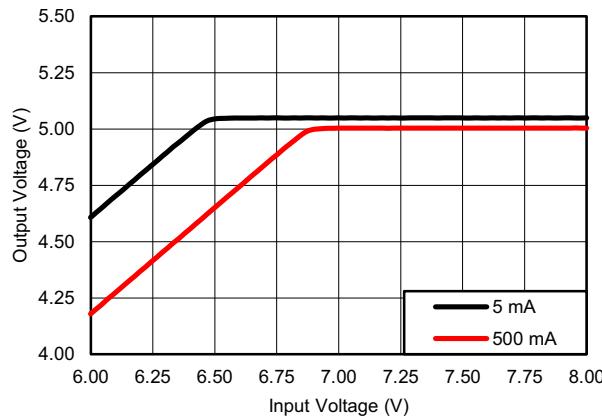
An 0.33- μ F decoupling capacitor on the input and a 0.1- μ F decoupling capacitor on the output are recommended for the UA78Mxx to behave as close to datasheet specifications as possible.

9.2.2 Detailed Design Procedure

The customer's end application will determine how the schematic for UA78Mxx is designed. For example, if there is a load connected to a negative voltage as its ground, a clamp diode may be necessary on the output. In the event of an input short circuit or another case where the output voltage can be higher than the input, a diode shunt can be connected across the device with the anode at the output and cathode at the input.

Typical Application (continued)

9.2.3 Application Curves



**Figure 3. V_OUTPUT vs V_INPUT for
 $I_{OUTPUT} = 5 \text{ mA}$ and 500 mA (25°C)**

10 Power Supply Recommendations

See [Recommended Operating Conditions](#) for the recommended power supply voltages for each variation of the UA78Mxx. Different orderable part numbers will be able to tolerate different levels of voltage. It is also recommended to have a decoupling capacitor on the output to limit noise on the input.

11 Layout

11.1 Layout Guidelines

Keep trace widths large enough to eliminate problematic $I \times R$ voltage drops at the input and output terminals. Input decoupling capacitors should be placed as close to the UA78MXX as possible.

11.2 Layout Example

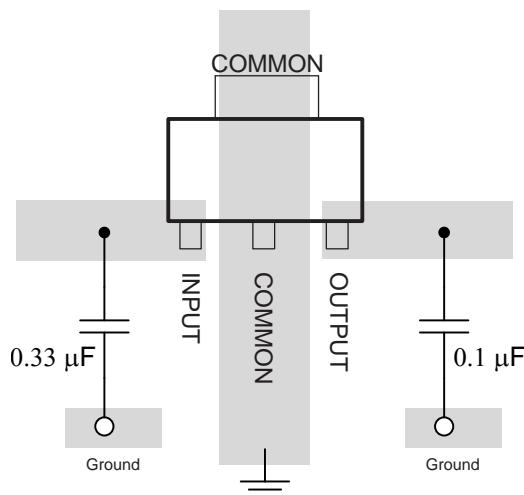


Figure 4. Layout Diagram

12 Device and Documentation Support

12.1 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 1. Related Links

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
uA78M05	Click here				
uA78M06	Click here				
uA78M08	Click here				
uA78M09	Click here				
uA78M10	Click here				
uA78M12	Click here				
uA78M33	Click here				

12.2 Trademarks

All trademarks are the property of their respective owners.

12.3 Electrostatic Discharge Caution



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.

12.4 Glossary

[SLYZ022 — TI Glossary](#).

This glossary lists and explains terms, acronyms, and definitions.

13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
UA78M05CDCY	ACTIVE	SOT-223	DCY	4	80	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 125	C5	Samples
UA78M05CDCYG3	ACTIVE	SOT-223	DCY	4	80	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 125	C5	Samples
UA78M05CDCYR	ACTIVE	SOT-223	DCY	4	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 125	C5	Samples
UA78M05CDCYRG3	ACTIVE	SOT-223	DCY	4	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 125	C5	Samples
UA78M05CKC	OBsolete	TO-220	KC	3		TBD	Call TI	Call TI	0 to 125	UA78M05C	
UA78M05CKCS	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	0 to 125	UA78M05C	Samples
UA78M05CKCSE3	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	0 to 125	UA78M05C	Samples
UA78M05CKTPR	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M05C	
UA78M05CKTPRG3	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M05C	
UA78M05CKVURG3	ACTIVE	TO-252	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	0 to 125	78M05C	Samples
UA78M05IDCY	ACTIVE	SOT-223	DCY	4	80	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	J5	Samples
UA78M05IDCYG3	ACTIVE	SOT-223	DCY	4	80	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	J5	Samples
UA78M05IDCYR	ACTIVE	SOT-223	DCY	4	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	J5	Samples
UA78M05IDCYRG3	ACTIVE	SOT-223	DCY	4	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	-40 to 125	J5	Samples
UA78M05IKC	OBsolete	TO-220	KC	3		TBD	Call TI	Call TI	-40 to 125	UA78M05I	
UA78M05IKCE3	OBsolete	TO-220	KC	3		TBD	Call TI	Call TI	-40 to 125	UA78M05I	
UA78M05IKCS	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	-40 to 125	UA78M05I	Samples
UA78M05IKCSE3	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	-40 to 125	UA78M05I	Samples
UA78M05IKTPR	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	-40 to 125	UA78M05I	
UA78M05IKTPRG3	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	-40 to 125	UA78M05I	

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
UA78M05IKVURG3	ACTIVE	TO-252	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	-40 to 125	78M05I	Samples
UA78M06CKC	OBsolete	TO-220	KC	3		TBD	Call TI	Call TI	0 to 125		
UA78M06CKTPR	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M06C	
UA78M06CKTPRG3	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M06C	
UA78M06CKVURG3	ACTIVE	TO-252	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	0 to 125	78M06C	Samples
UA78M08CDCY	ACTIVE	SOT-223	DCY	4	80	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 125	C8	Samples
UA78M08CDCYG3	ACTIVE	SOT-223	DCY	4	80	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 125	C8	Samples
UA78M08CDCYR	ACTIVE	SOT-223	DCY	4	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 125	C8	Samples
UA78M08CKC	OBsolete	TO-220	KC	3		TBD	Call TI	Call TI	0 to 125	UA78M08C	
UA78M08CKCE3	OBsolete	TO-220	KC	3		TBD	Call TI	Call TI	0 to 125	UA78M08C	
UA78M08CKCS	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	0 to 125	UA78M08C	Samples
UA78M08CKCSE3	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	0 to 125	UA78M08C	Samples
UA78M08CKTPR	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M08C	
UA78M08CKTPRG3	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M08C	
UA78M08CKVURG3	ACTIVE	TO-252	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	0 to 125	78M08C	Samples
UA78M09CKC	OBsolete	TO-220	KC	3		TBD	Call TI	Call TI	0 to 125		
UA78M09CKTP	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125		
UA78M09CKTPR	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M09C	
UA78M09CKTPRG3	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M09C	
UA78M09CKVURG3	ACTIVE	TO-252	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	0 to 125	78M09C	Samples
UA78M10CKC	OBsolete	TO-220	KC	3		TBD	Call TI	Call TI	0 to 125		
UA78M10CKTPR	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M10C	
UA78M10CKTPRG3	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M10C	
UA78M10CKVURG3	ACTIVE	TO-252	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	0 to 125	78M10C	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
UA78M12CKC	OBsolete	TO-220	KC	3		TBD	Call TI	Call TI	0 to 125	UA78M12C	
UA78M12CKCS	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	0 to 125	UA78M12C	Samples
UA78M12CKCSE3	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	0 to 125	UA78M12C	Samples
UA78M12CKTPR	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M12C	
UA78M12CKTPRG3	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M12C	
UA78M12CKVURG3	ACTIVE	TO-252	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	0 to 125	78M12C	Samples
UA78M33CDCY	ACTIVE	SOT-223	DCY	4	80	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 125	C3	Samples
UA78M33CDCYG3	ACTIVE	SOT-223	DCY	4	80	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 125	C3	Samples
UA78M33CDCYR	ACTIVE	SOT-223	DCY	4	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 125	C3	Samples
UA78M33CDCYRG3	ACTIVE	SOT-223	DCY	4	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	0 to 125	C3	Samples
UA78M33CKC	OBsolete	TO-220	KC	3		TBD	Call TI	Call TI	0 to 125	UA78M33C	
UA78M33CKCE3	OBsolete	TO-220	KC	3		TBD	Call TI	Call TI	0 to 125	UA78M33C	
UA78M33CKCS	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	0 to 125	UA78M33C	Samples
UA78M33CKCSE3	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS)	CU SN	N / A for Pkg Type	0 to 125	UA78M33C	Samples
UA78M33CKTPR	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M33C	
UA78M33CKTPRG3	OBsolete	PFM	KTP	2		TBD	Call TI	Call TI	0 to 125	UA78M33C	
UA78M33CKVURG3	ACTIVE	TO-252	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	0 to 125	78M33C	Samples
UA78M33IKVURG3	ACTIVE	TO-252	KVU	3	2500	Green (RoHS & no Sb/Br)	CU SN	Level-3-260C-168 HR	-40 to 125	78M33I	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBsolete: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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

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

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

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on 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.

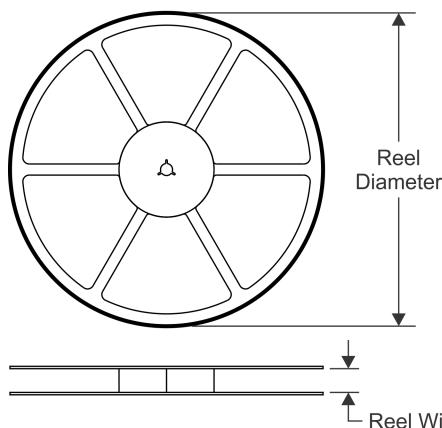
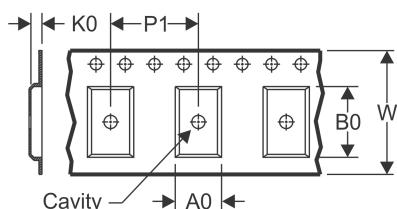
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF UA78M05, UA78M10, UA78M33 :

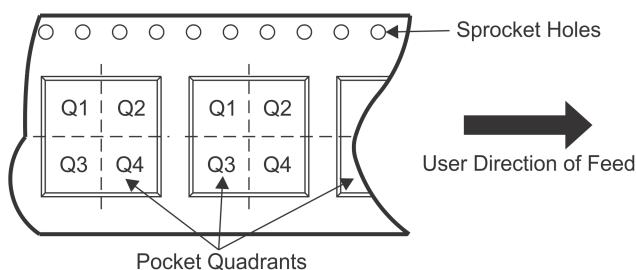
- Automotive: [UA78M05-Q1](#), [UA78M10-Q1](#), [UA78M33-Q1](#)

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
UA78M05CKVURG3	TO-252	KVU	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
UA78M05IDCYR	SOT-223	DCY	4	2500	330.0	12.4	7.05	7.4	1.9	8.0	12.0	Q3
UA78M05IKVURG3	TO-252	KVU	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
UA78M06CKVURG3	TO-252	KVU	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
UA78M08CDCYR	SOT-223	DCY	4	2500	330.0	12.4	7.05	7.4	1.9	8.0	12.0	Q3
UA78M08CKVURG3	TO-252	KVU	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
UA78M09CKVURG3	TO-252	KVU	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
UA78M10CKVURG3	TO-252	KVU	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
UA78M12CKVURG3	TO-252	KVU	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
UA78M33CDCYR	SOT-223	DCY	4	2500	330.0	12.4	7.05	7.4	1.9	8.0	12.0	Q3
UA78M33CKVURG3	TO-252	KVU	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
UA78M33IKVURG3	TO-252	KVU	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2

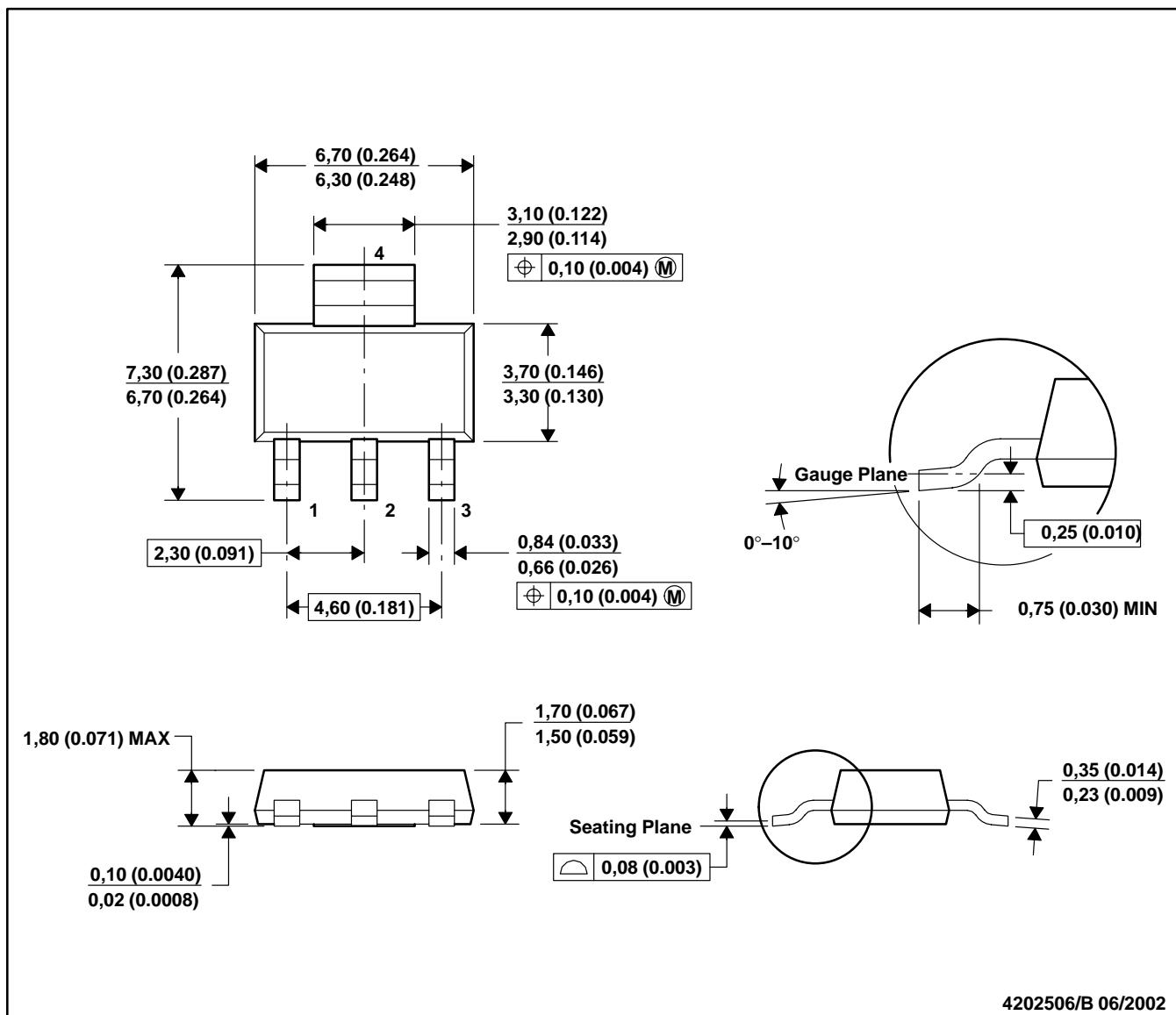
TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
UA78M05CKVURG3	TO-252	KVU	3	2500	340.0	340.0	38.0
UA78M05IDCYR	SOT-223	DCY	4	2500	340.0	340.0	38.0
UA78M05IKVURG3	TO-252	KVU	3	2500	340.0	340.0	38.0
UA78M06CKVURG3	TO-252	KVU	3	2500	340.0	340.0	38.0
UA78M08CDCYR	SOT-223	DCY	4	2500	340.0	340.0	38.0
UA78M08CKVURG3	TO-252	KVU	3	2500	340.0	340.0	38.0
UA78M09CKVURG3	TO-252	KVU	3	2500	340.0	340.0	38.0
UA78M10CKVURG3	TO-252	KVU	3	2500	340.0	340.0	38.0
UA78M12CKVURG3	TO-252	KVU	3	2500	340.0	340.0	38.0
UA78M33CDCYR	SOT-223	DCY	4	2500	340.0	340.0	38.0
UA78M33CKVURG3	TO-252	KVU	3	2500	340.0	340.0	38.0
UA78M33IKVURG3	TO-252	KVU	3	2500	340.0	340.0	38.0

DCY (R-PDSO-G4)

PLASTIC SMALL-OUTLINE



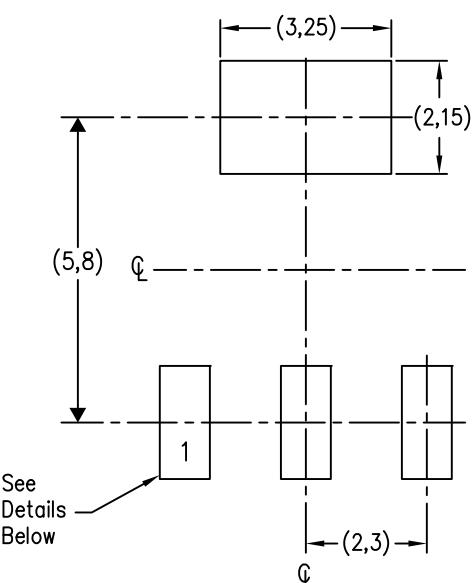
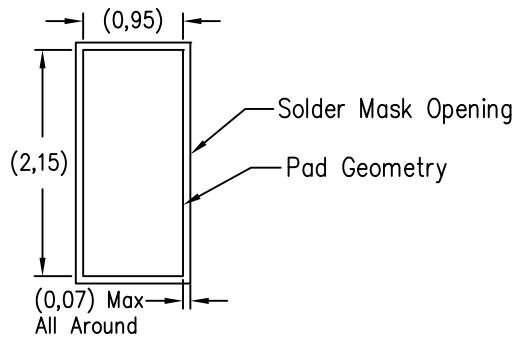
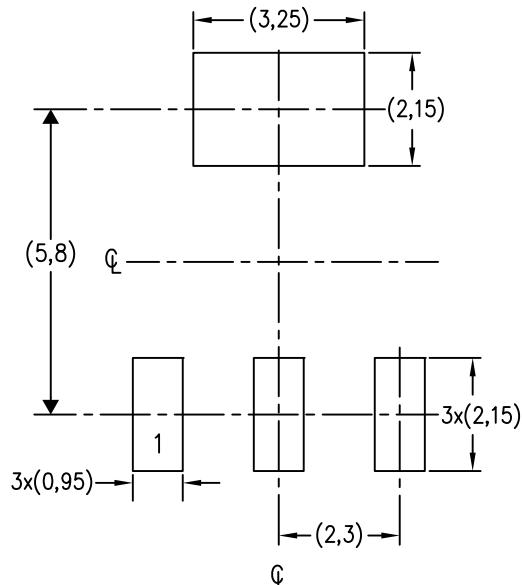
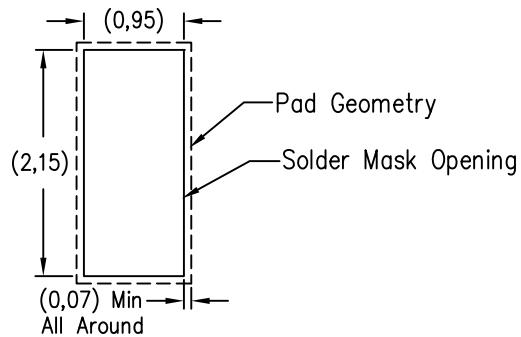
NOTES: A. All linear dimensions are in millimeters (inches).
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion.
 D. Falls within JEDEC TO-261 Variation AA.

4202506/B 06/2002

DCY (R-PDSO-G4)

PLASTIC SMALL OUTLINE

Example Board Layout

Example Stencil Design
0.125 Thick Stencil
(Note D)Example, non-solder mask defined pad.
(Preferred)

Example, solder mask defined pad.

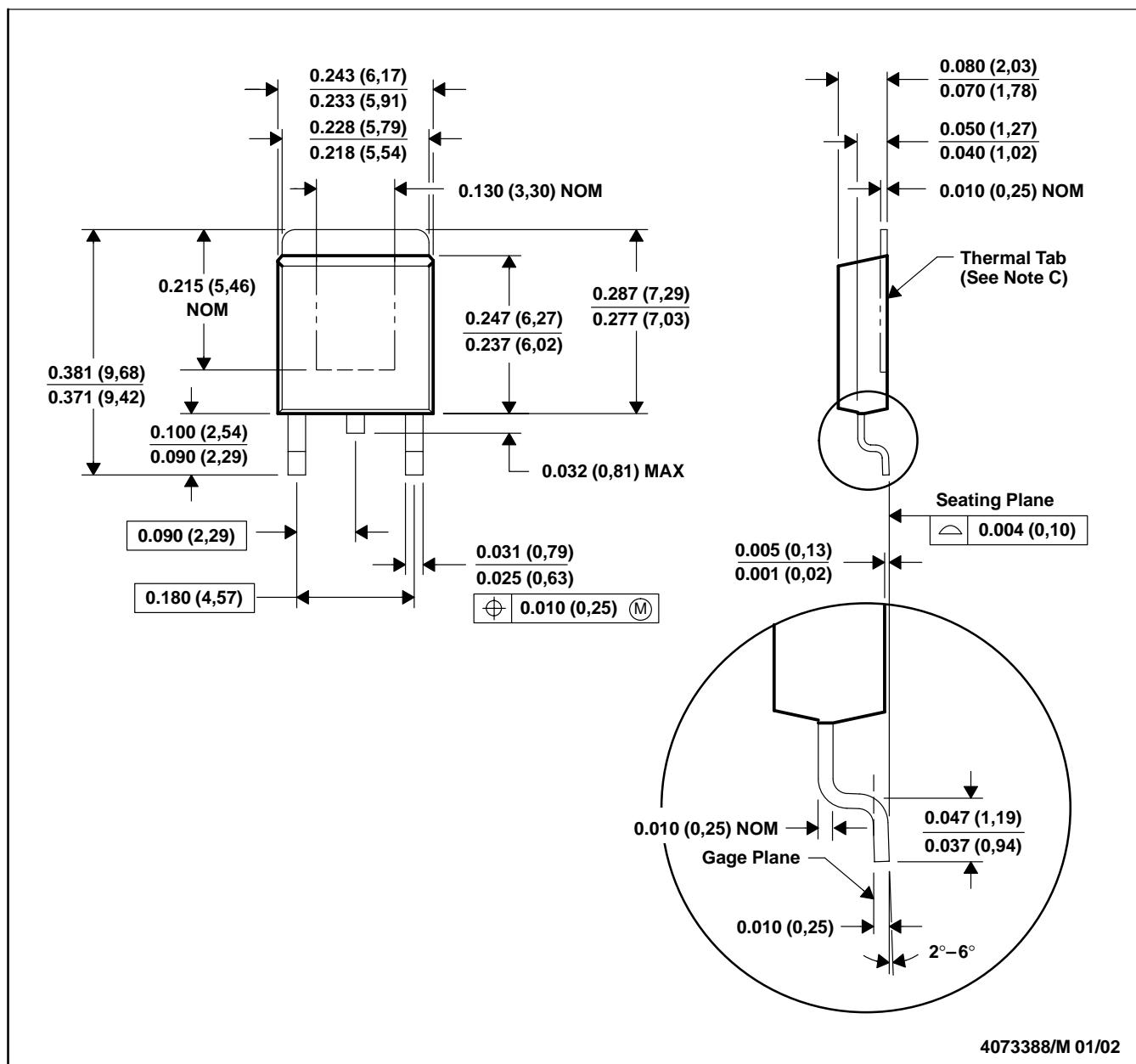
4210278/C 07/13

NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- Publication IPC-7351 is recommended for alternate designs.
- Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil recommendations. Refer to IPC 7525 for stencil design considerations.

KTP (R-PSFM-G2)

PowerFLEX™ PLASTIC FLANGE-MOUNT PACKAGE



NOTES:

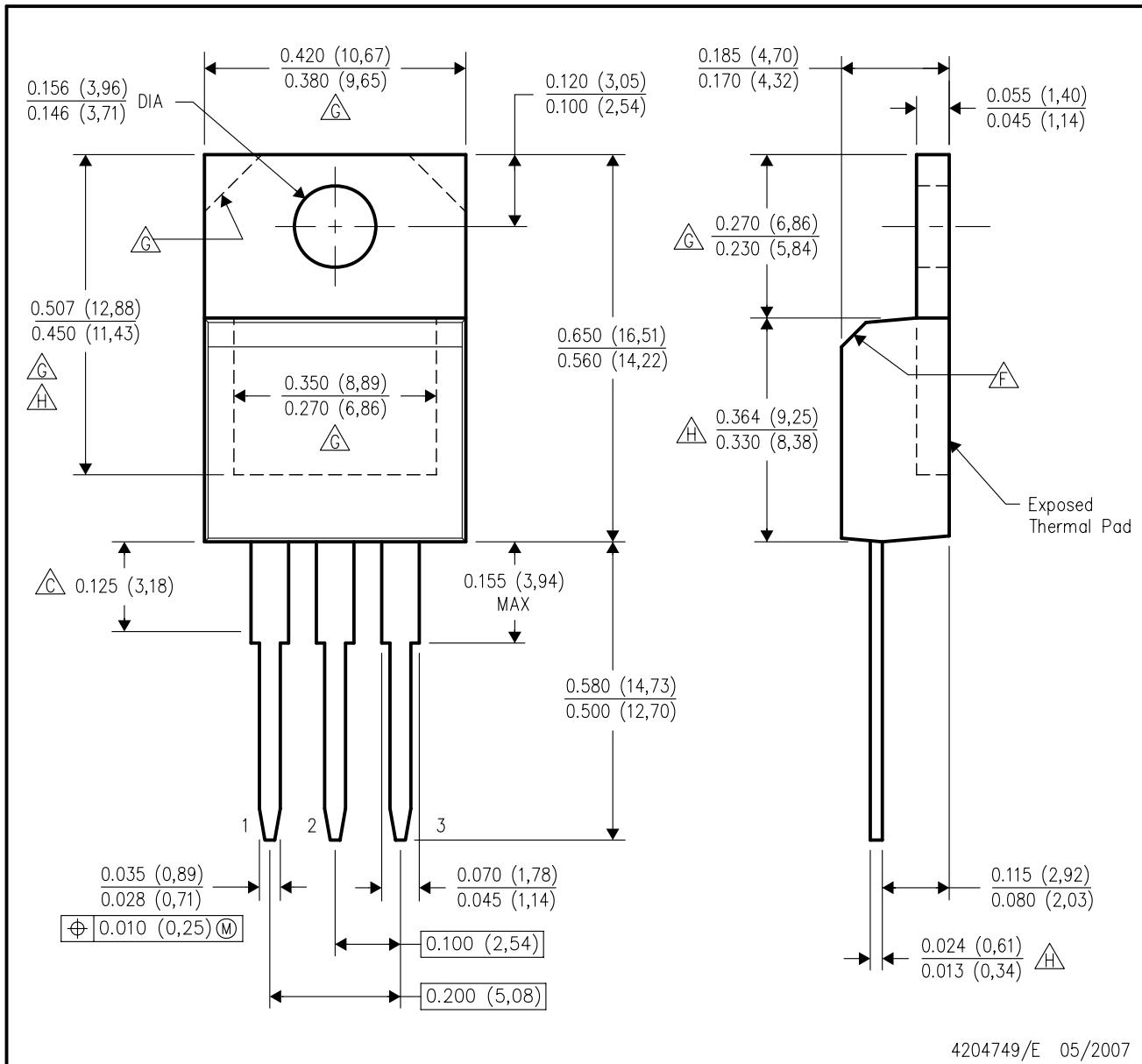
- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. The center lead is in electrical contact with the thermal tab.
- D. Dimensions do not include mold protrusions, not to exceed 0.006 (0,15).
- E. Falls within JEDEC TO-252 variation AC.

PowerFLEX is a trademark of Texas Instruments.



KCS (R-PSFM-T3)

PLASTIC FLANGE-MOUNT PACKAGE



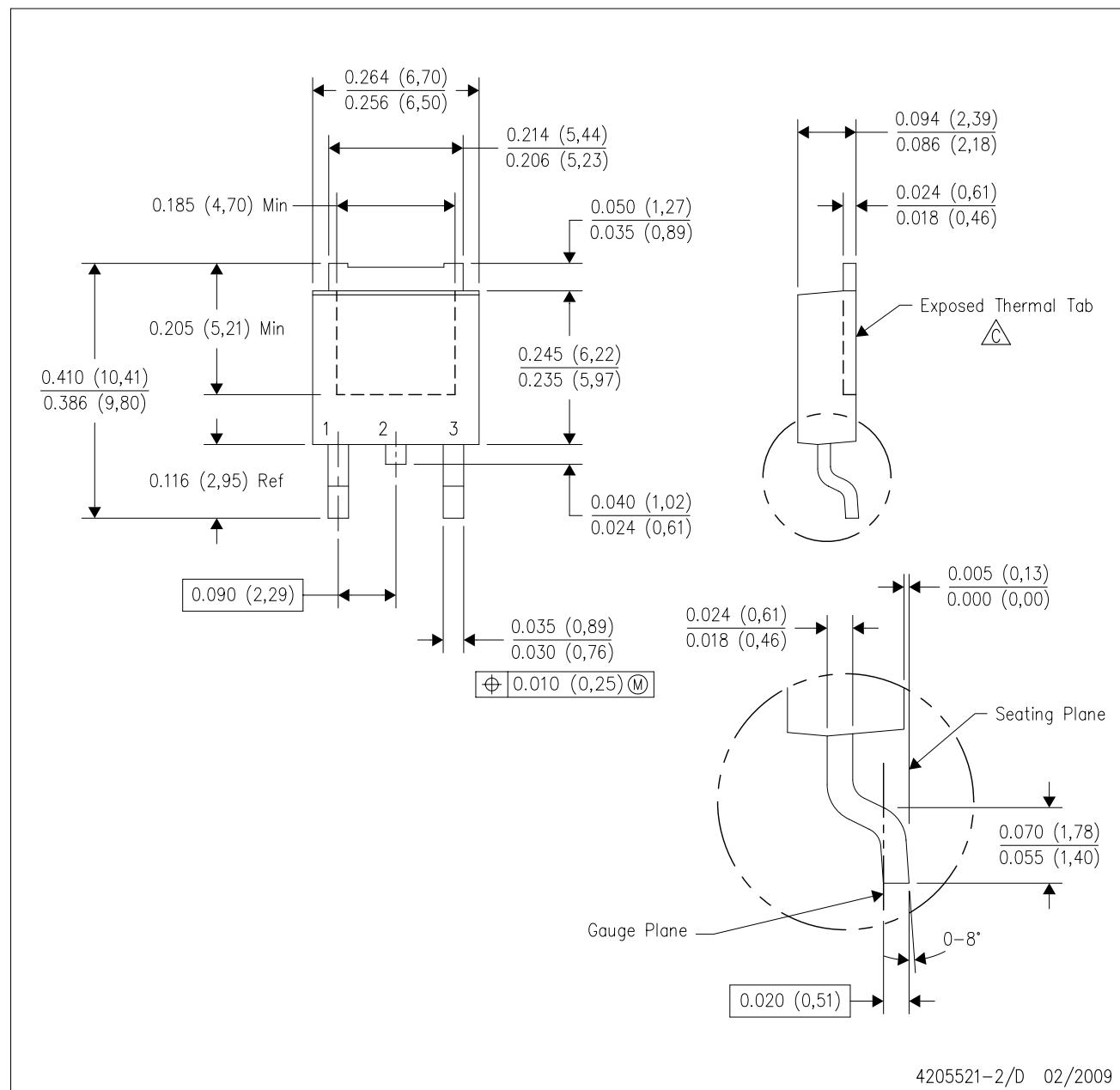
NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.

- $\triangle C$: 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.
- $\triangle F$: The chamfer is optional.
- $\triangle G$: Thermal pad contour optional within these dimensions.
- $\triangle H$: Falls within JEDEC TO-220 variation AB, except minimum lead thickness, minimum exposed pad length, and maximum body length.

MECHANICAL DATA

KVU (R-PSFM-G3)

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NOTES: A. All linear dimensions are in inches (millimeters).
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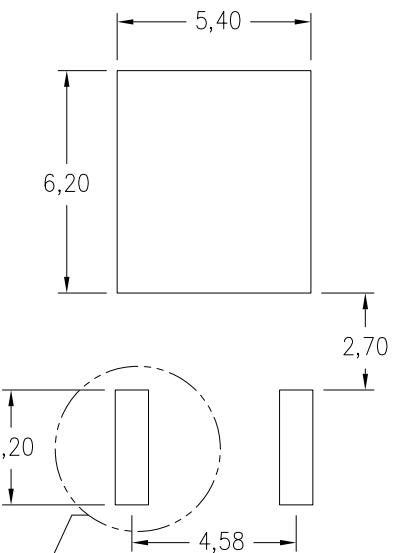
 C The center lead is in electrical contact with the exposed thermal tab.
D. Body Dimensions do not include mold flash or protrusions. Mold flash and protrusion shall not exceed 0.006 (0.15) per side.
E. Falls within JEDEC TO-252 variation AA.

LAND PATTERN DATA

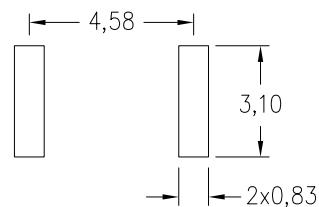
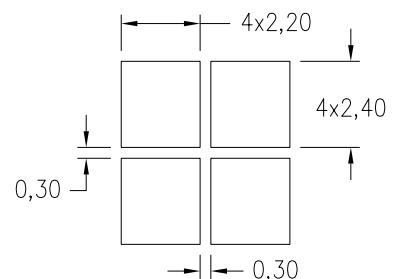
KVU (R-PSFM-G3)

PLASTIC FLANGE MOUNT PACKAGE

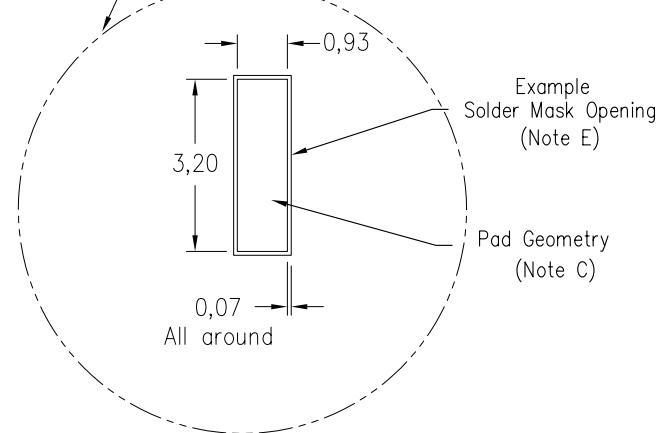
Example Board Layout



Stencil Openings
Based on a stencil thickness
of .127mm (.005inch).
(Note D)



63% solder coverage on center pad



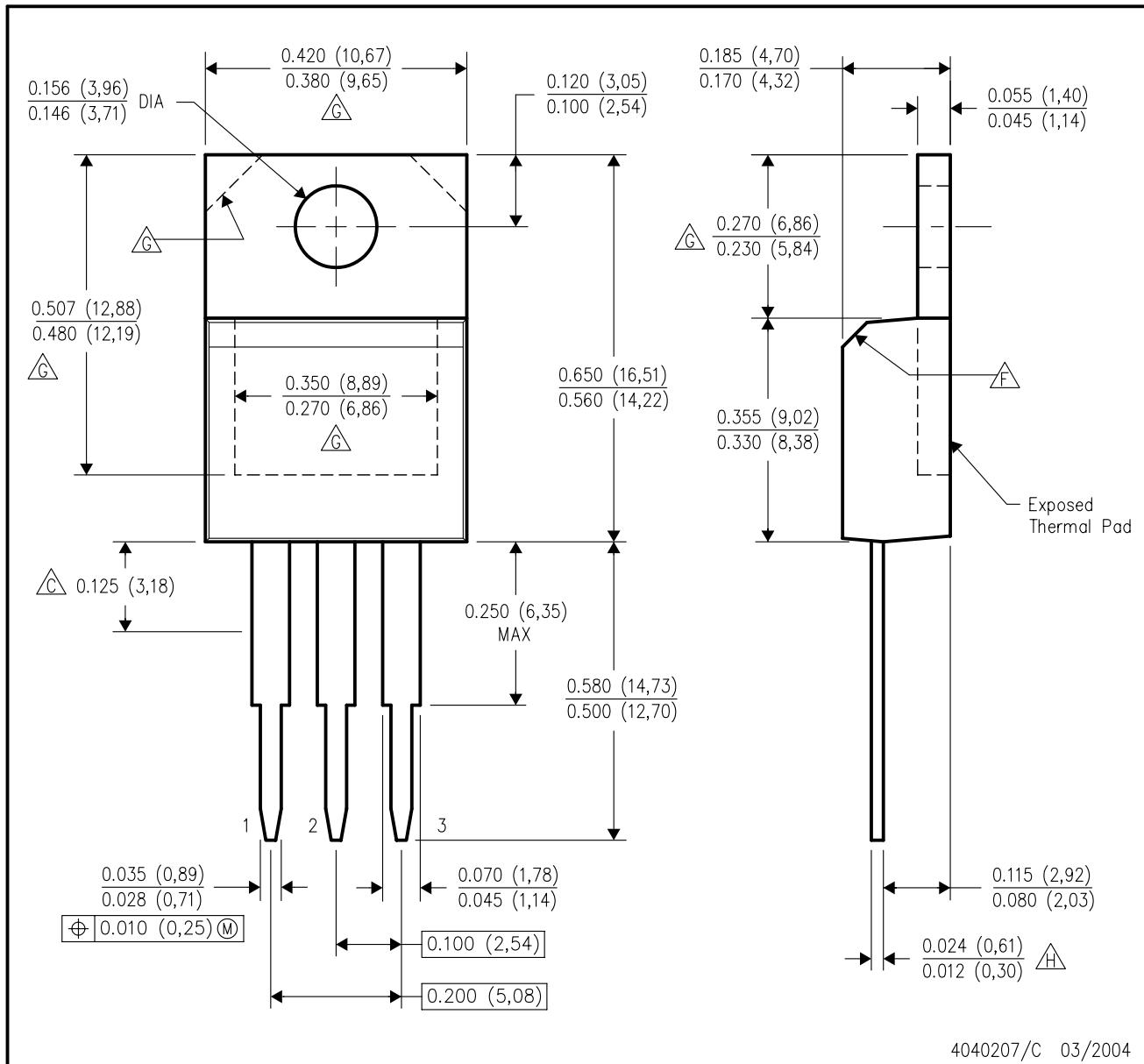
4211592-2/B 03/12

NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-SM-782 is an alternate information source for PCB land pattern 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 for other stencil recommendations.
- E. Customers should contact their board fabrication site for recommended solder mask tolerances and via tenting recommendations for vias placed in thermal pad.

KC (R-PSFM-T3)

PLASTIC FLANGE-MOUNT PACKAGE



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- 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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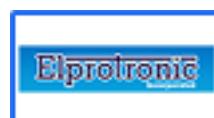
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