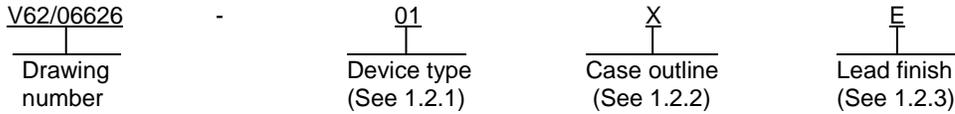


1. SCOPE

1.1 Scope. This drawing documents the general requirements of a high performance low dropout voltage regulator microcircuit, with an operating temperature range of -55°C to +125°C.

1.2 Vendor Item Drawing Administrative Control Number. The manufacturer's PIN is the item of identification. The vendor item drawing establishes an administrative control number for identifying the item on the engineering documentation:



1.2.1 Device type(s).

| <u>Device type</u> | <u>Generic</u> | <u>Output voltage</u> | <u>Circuit function</u> |
|--------------------|----------------|-----------------------|-------------------------------|
| 01 | TPS73601-EP | 1.2 V to 5.5 V | Low dropout voltage regulator |
| 02 | TPS73615-EP | 1.5 V | Low dropout voltage regulator |
| 03 | TPS73618-EP | 1.8 V | Low dropout voltage regulator |
| 04 | TPS73625-EP | 2.5 V | Low dropout voltage regulator |
| 05 | TPS73630-EP | 3.0 V | Low dropout voltage regulator |
| 06 | TPS73632-EP | 3.2 V | Low dropout voltage regulator |
| 07 | TPS73633-EP | 3.3 V | Low dropout voltage regulator |

1.2.2 Case outlines. The case outlines are as specified herein.

| <u>Outline letter</u> | <u>Number of pins</u> | <u>JEDEC PUB 95</u> | <u>Package style</u> |
|-----------------------|-----------------------|---------------------|-----------------------|
| X | 5 | MO-178-AA | Plastic small outline |
| Y | 6 | None | Plastic small outline |
| Z | 8 | None | Plastic small outline |

1.2.3 Lead finishes. The lead finishes are as specified below or other lead finishes as provided by the device manufacture:

| <u>Finish designator</u> | <u>Material</u> |
|--------------------------|----------------------|
| A | Hot solder dip |
| B | Tin-lead plate |
| C | Gold plate |
| D | Palladium |
| E | Gold flash palladium |
| Z | Other |

| | | | |
|---|------------------|--------------------------------|-----------------------------|
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1.3 Absolute maximum ratings. 1/

| | |
|--|-------------------------------------|
| Input voltage range (V_{IN}) | -0.3 V to 6 V |
| Enable voltage range (V_{EN}) | -0.3 V to 6 V |
| Output voltage range (V_{OUT}) | -0.3 V to 5.5 V |
| Peak output current | Internally limited |
| Output short circuit duration | Indefinite |
| Continuous total power dissipation (P_D) | See power dissipation ratings table |
| Junction temperature range (T_J) | -55°C to +150°C |
| Storage temperature range (T_{STG}) | -65°C to +150°C |
| Electrostatic discharge (ESD) rating: | |
| Human body model (HBM) | 2 kV |
| Charge device model (CDM) | 500 V |

1.4 Recommended operating conditions. 2/

| | |
|--|-----------------|
| Operating free-air temperature range (T_A) | -55°C to +125°C |
|--|-----------------|

1.5 Power dissipation ratings.

| Case outline | Board | $R_{\theta JC}$ | $R_{\theta JA}$ | Derating factor above $T_A = 25^\circ\text{C}$ | $T_A \leq 25^\circ\text{C}$ power rating | $T_A = 70^\circ\text{C}$ power rating | $T_A = 85^\circ\text{C}$ power rating |
|--------------|--------------|-----------------|-----------------|--|--|---------------------------------------|---------------------------------------|
| X | Low K 3/ | 64°C/W | 255°C/W | 3.9 mW/°C | 392 mW | 216 mW | 157 mW |
| | High K 4/ | 64°C/W | 180°C/W | 5.6 mW/°C | 556 mW | 306 mW | 222 mW |
| Y | Low K 3/ | 15°C/W | 53°C/W | 18.9 mW/°C | 1887 mW | 1038 mW | 755 mW |
| | High K 4/ | 15°C/W | 45°C/W | 22.2 mW/°C | 2222 mW | 1222 mW | 889 mW |
| Z | High K 4/ 5/ | 1.2°C/W | 40°C/W | 25.0 mW/°C | 2500 mW | 1375 mW | 1000 mW |

- 1/ Stresses beyond those listed under “absolute maximum rating” 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/ Use of this product beyond the manufacturers design rules or stated parameters is done at the user’s risk. The manufacturer and/or distributor maintain no responsibility or liability for product used beyond the stated limits.
- 3/ The JEDEC Low K (1s) board design used to derive this data was a 3 inch x 3 inch, 2 layer board with 2 ounce copper traces on top of the board.
- 4/ The JEDEC High K (2s2p) board design used to derive this data was a 3 inch x 3 inch, multilayer board with 1 ounce internal power and ground planes and 2 ounce copper traces on the top and bottom of the board.
- 5/ Based on thermal simulations.

| | | | |
|---|-------------------|---------------------------------|------------------------------|
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2. APPLICABLE DOCUMENTS

JEDEC – SOLID STATE TECHNOLOGY ASSOCIATION (JEDEC)

JEP95 – Registered and Standard Outlines for Semiconductor Devices

(Copies of these documents are available online at <http://www.jedec.org> or from JEDEC – Solid State Technology Association, 3103 North 10th Street, Suite 240–S, Arlington, VA 22201-2107).

3. REQUIREMENTS

3.1 Marking. Parts shall be permanently and legibly marked with the manufacturer’s part number as shown in 6.3 herein and as follows:

- A. Manufacturer’s name, CAGE code, or logo
- B. Pin 1 identifier
- C. ESDS identification (optional)

3.2 Unit container. The unit container shall be marked with the manufacturer’s part number and with items A and C (if applicable) above.

3.3 Electrical characteristics. The maximum and recommended operating conditions and electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.4 Design, construction, and physical dimension. The design, construction, and physical dimensions are as specified herein.

3.5 Diagrams.

3.5.1 Case outlines. The case outlines shall be as shown in 1.2.2 and figure 1.

3.5.2 Terminal connections. The terminal connections shall be as shown in figure 2.

| | | | |
|---|-------------------|---------------------------------|------------------------------|
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TABLE I. Electrical performance characteristics. 1/

| Test | Symbol | Conditions 2/ | Temperature, T _A | Device type | Limits | | Unit |
|--|--|---|-----------------------------|-------------|-----------------|-----------------------|------|
| | | | | | Min | Max | |
| Input voltage range | V _{IN} | 3/ 4/ | -55°C to +125°C | All | 1.7 | 5.5 | V |
| Internal reference | V _{FB} | | T _J = +25°C | 01 | 1.198 | 1.21 | V |
| Output voltage range | V _{OUT} | | -55°C to +125°C | 01 | V _{FB} | 5.5 - V _{DO} | V |
| Output voltage range, accuracy nominal | V _{OUT} | 3/ | T _J = +25°C | All | -0.5 % | +0.5 % | |
| Output voltage range, accuracy over V _{IN} , I _{OUT} , and temperature | V _{OUT} | V _{OUT} + 0.5 V ≤ V _{IN} ≤ 5.5 V, 3/ 10 mA ≤ I _{OUT} ≤ 400 mA | -55°C to +125°C | All | -1% | +1% | |
| Line regulation 3/ | ΔV _{OUT} % / ΔV _{IN} | V _{OUT(nom)} + 0.5 V ≤ V _{IN} ≤ 5.5 V | T _J = +25°C | All | 0.01 typical | | %/V |
| Load regulation | ΔV _{OUT} % / | 1 mA ≤ I _{OUT} ≤ 400 mA | T _J = +25°C | All | 0.002 typical | | %mA |
| | ΔI _{OUT} | 10 mA ≤ I _{OUT} ≤ 400 mA | | | 0.0005 typical | | |
| Dropout voltage 5/ (V _{IN} = V _{OUT(nom)} - 0.1 V) | V _{DO} | I _{OUT} = 400 mA | -55°C to +125°C | All | | 200 | mV |
| Output impedance in dropout | Z _{o(DO)} | 1.7 V ≤ V _{IN} ≤ V _{OUT} + V _{DO} | T _J = +25°C | All | 0.25 typical | | Ω |
| Output current limit | I _{CL} | V _{OUT} = 0.9 x V _{OUT(nom)} | -55°C to +125°C | All | 400 | 800 | mA |
| Short circuit current | I _{SC} | V _{OUT} = 0 V | T _J = +25°C | All | 450 typical | | mA |
| Reverse leakage 6/ current (-I _{IN}) | I _{REV} | V _{EN} ≤ 0.5 V, 0 V ≤ V _{IN} ≤ V _{OUT} | -55°C to +125°C | All | | 15 | μA |
| Ground pin current | I _{GND} | I _{OUT} = 10 mA (I _Q) | -55°C to +125°C | All | | 550 | μA |
| | | I _{OUT} = 400 mA | | | | 1000 | |
| Shutdown current (I _{GND}) | I _{SHDN} | V _{EN} ≤ 0.5 V, V _{OUT} ≤ V _{IN} ≤ 5.5 V | -55°C to +125°C | All | | 1 | μA |

See footnotes at end of table.

| | | | |
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TABLE I. Electrical performance characteristics – Continued. 1/

| Test | Symbol | Conditions <u>2/</u> | Temperature, T _A | Device type | Limits | | Unit |
|---|---------------------|--|--------------------------------|----------------|-----------------------------------|-----------------|-------------------|
| | | | | | Min | Max | |
| FB pin current | I _{FB} | | -55°C to +125°C | 01 | | 0.45 | μA |
| Power supply rejection ratio (ripple rejection) | PSRR | f = 100 Hz, I _{OUT} = 400 mA | T _J = +25°C | All | 58 typical | | dB |
| | | f = 10 kHz, I _{OUT} = 400 mA | | | 37 typical | | |
| Output noise voltage, BW = 10 Hz – 100 kHz | V _N | C _{OUT} = 10 μF, no C _{NR} | T _J = +25°C | All | 27 x V _{OUT} typical | | μV _{RMS} |
| | | C _{OUT} = 10 μF, C _{NR} = 0.01 μF | | | 8.5 x V _{OUT} typical | | |
| Startup time | t _{STR} | V _{OUT} = 3 V, R _L = 30 Ω, C _{OUT} = 1 μF, C _{NR} = 0.01 μF | T _J = +25°C | All | 600 typical | | μs |
| Enable high (enabled) | V _{EN(HI)} | | -55°C to +125°C | All | 1.7 | V _{IN} | V |
| Enable low (shutdown) | V _{EN(LO)} | | -55°C to +125°C | All | 0 | 0.5 | V |
| Enable pin current (enabled) | I _{EN(HI)} | V _{EN} = 5.5 V | -55°C to +125°C | All | | 0.1 | μA |
| Thermal shutdown temperature | T _{SD} | Shutdown, temperature increasing | T _J = +25°C | All | 160 typical | | °C |
| | | Reset, temperature decreasing | | | 140 typical | | |
| Operating ambient temperature | T _A | | | All | -55 | +125 | °C |

1/ Testing and other quality control techniques are used to the extent deemed necessary to assure product performance over the specified temperature range. Product may not necessarily be tested across the full temperature range and all parameters may not necessarily be tested. In the absence of specific parametric testing, product performance is assured by characterization and/or design.

2/ Unless otherwise specified, V_{IN} = V_{OUT(nom)} + 0.5 V (3/), I_{OUT} = 10 mA, V_{EN} = 1.7 V, and C_{OUT} = 0.1 μF.

3/ Minimum V_{IN} = V_{OUT} + V_{DO} or 1.7 V, whichever is greater.

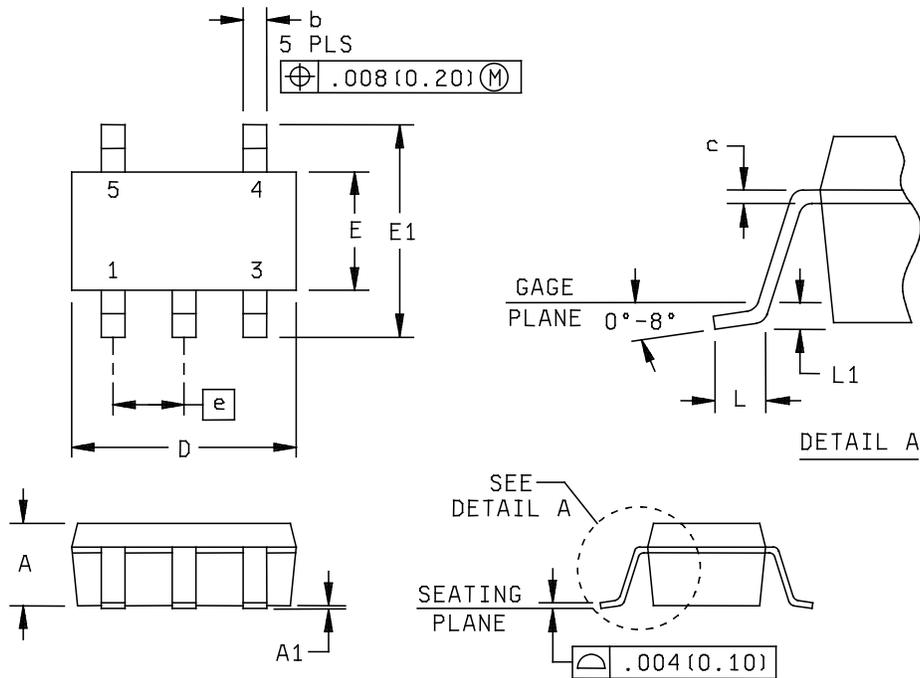
4/ For V_{OUT(nom)} < 1.6 V, when V_{IN} ≤ 1.6 V, the output will lock to V_{IN} and may result in a damaging over voltage level on the output. To avoid this situation, disable the device before powering down the V_{IN}.

5/ V_{DO} is not measure for the device type 02 (V_{OUT(nom)} = 1.5 V) since minimum V_{IN} = 1.7 V.

6/ See applications section of the vendor's datasheet for more information.

| | | | |
|---|-------------------|---------------------------------|------------------------------|
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Case X



| Dimensions | | | | | | | | | |
|------------|--------|------|-------------|------|--------|----------|------|-------------|------|
| Symbol | Inches | | Millimeters | | Symbol | Inches | | Millimeters | |
| | Min | Max | Min | Max | | Min | Max | Min | Max |
| A | --- | .057 | --- | 1.45 | E1 | .102 | .118 | 2.60 | 3.00 |
| A1 | .000 | .005 | 0.00 | 0.15 | e | .037 NOM | | 0.95 NOM | |
| b | .011 | .019 | 0.30 | 0.50 | L | .011 | .021 | 0.30 | 0.55 |
| c | .003 | .008 | 0.08 | 0.22 | L1 | .009 | --- | 0.25 | --- |
| D | .108 | .120 | 2.75 | 3.05 | n | 5 leads | | 5 leads | |
| E | .057 | .068 | 1.45 | 1.75 | | | | | |

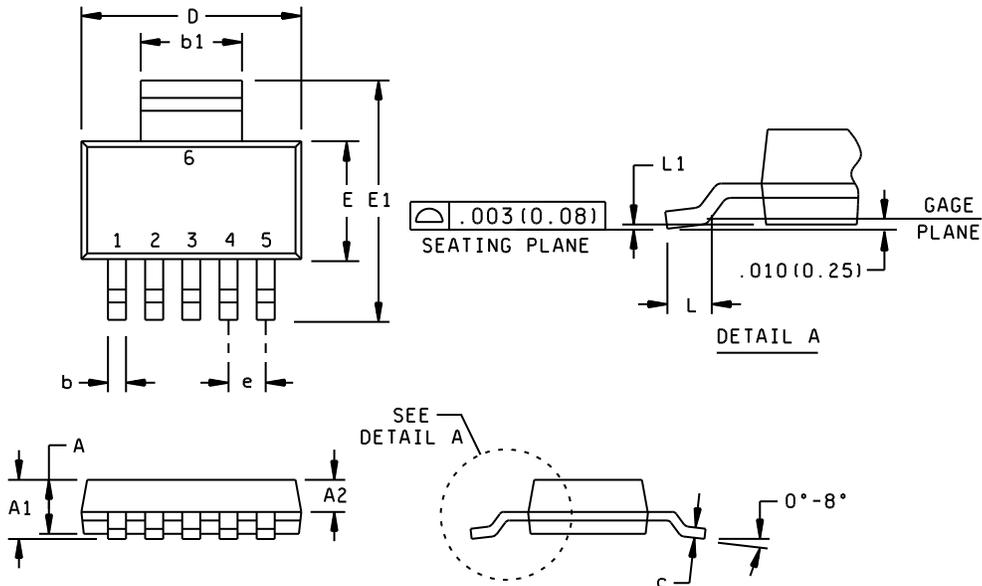
NOTES:

1. Controlling dimensions are millimeters, inches dimensions are given for reference only.
2. This drawing is subject to change without notice.
3. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 mm (0.006 inch) per side.
4. Falls with JEDEC MO-178 Variation AA.

FIGURE 1. Case outlines.

| | | | |
|---|-------------------------|---------------------------------------|------------------------------------|
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Case Y



| Dimensions | | | | | | | | | |
|------------|--------|-------|-------------|------|--------|-----------|-------|-------------|------|
| Symbol | Inches | | Millimeters | | Symbol | Inches | | Millimeters | |
| | Min | Max | Min | Max | | Min | Max | Min | Max |
| A | 0.061 | 0.065 | 1.55 | 1.65 | E | 1.36 | 1.40 | 3.45 | 3.55 |
| A1 | --- | 0.071 | --- | 1.80 | E1 | 0.270 | 0.286 | 6.86 | 7.26 |
| A2 | 0.034 | 0.036 | 0.87 | 0.91 | e | 0.050 NOM | | 1.27 NOM | |
| b | 0.016 | 0.020 | 0.41 | 0.51 | L | 0.036 | 0.045 | 0.91 | 1.14 |
| b1 | 0.116 | 0.120 | 2.95 | 3.05 | L1 | 0.001 | 0.004 | 0.02 | 0.10 |
| c | 0.009 | 0.013 | 0.24 | 0.32 | n | 6 leads | | 6 leads | |
| D | 0.254 | 0.258 | 6.45 | 6.55 | | | | | |

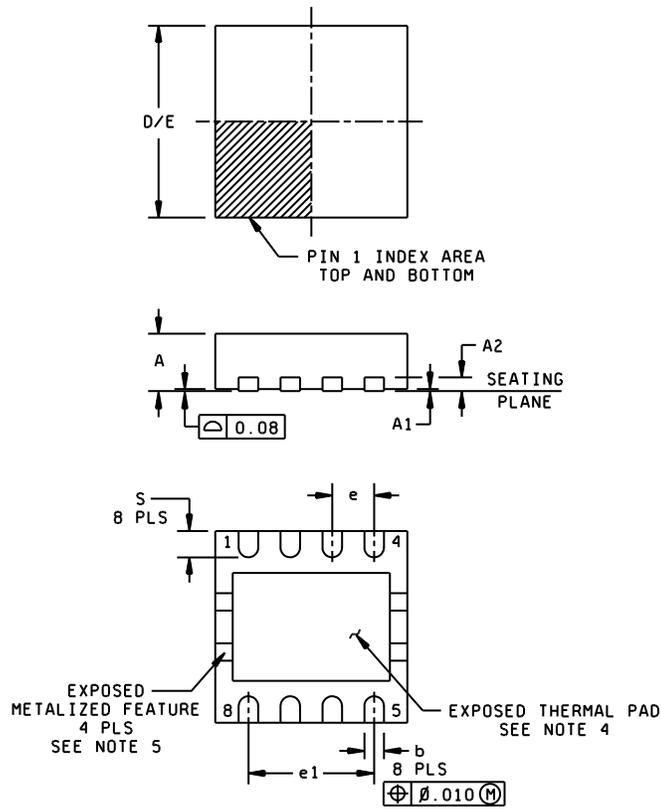
NOTES:

1. Controlling dimensions are in inches, millimeter dimensions are given for reference only.
2. This drawing is subject to change without notice.
3. Body length and width dimensions are determined at the outermost extremes of the plastic body exclusive of mold flash, tie bar burrs, gate burrs and interlead flash, but including any mismatch between the top and the bottom of the plastic body.
4. Lead width dimension does not include dambar protrusion.
5. Lead width and thickness dimensions apply to solder plated leads.
6. Interlead flash allow 0.008 inches maximum.
7. Gate burr/protrusion maximum 0.006 inches.

FIGURE 1. Case outlines – Continued.

| | | | |
|---|-------------------|---------------------------------|------------------------------|
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Case Z



| Dimensions | | | | | | | | | |
|------------|-------------|------|-----------|-------|--------|-------------|------|-----------|-------|
| Symbol | Millimeters | | Inches | | Symbol | Millimeters | | Inches | |
| | Min | Max | Min | Max | | Min | Max | Min | Max |
| A | 0.80 | 1.00 | 0.031 | 0.039 | e | 0.65 NOM | | 0.026 NOM | |
| A1 | 0.00 | 0.05 | 0.000 | 0.002 | e1 | 1.95 NOM | | 0.077 NOM | |
| A2 | 0.20 REF | | 0.008 REF | | S | 0.30 | 0.50 | 0.012 | 0.020 |
| b | 0.25 | 0.37 | 0.010 | 0.015 | n | 8 leads | | 8 leads | |
| D/E | 2.85 | 3.15 | 0.112 | 0.124 | | | | | |

NOTES:

1. All linear dimensions are in millimeters, inches dimensions are given for reference only.
2. This drawing is subject to change without notice.
3. Small Outline No-Lead (SON) package configuration.
4. The package thermal pad must be soldered to the board for thermal and mechanical performance.
5. Metalized features are supplier options and may not be on the package.

FIGURE 1. Case outlines – Continued.

| | | | |
|---|------------------|--------------------------------|-----------------------------|
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| Device types | All | |
|-----------------|-----------------|--|
| Case outline | X | |
| Terminal number | Terminal symbol | Description |
| 1 | IN | Unregulated input supply. |
| 2 | GND | Ground. |
| 3 | EN | Driving the enable pin (EN) high turns on the regulator. Driving this pin low puts the regulator into shutdown mode. See the vendor datasheet shutdown section under applications information for more details. EN can be connected to IN if not used. |
| 4 | NR | Fixed voltage versions only – connecting an external capacitor to this pin bypasses noise generated by the internal bandgap, reducing output noise to low levels. |
| 4 | FB | Adjustable voltage version only – this is the input to the control loop error amplifier and is used to set the output voltage of the device. |
| 5 | OUT | Output of the regulator. There are no output capacitor requirements for stability. |

| Device types | All | |
|-----------------|-----------------|--|
| Case outline | Y | |
| Terminal number | Terminal symbol | Description |
| 1 | IN | Unregulated input supply. |
| 2 | OUT | Output of the regulator. There are no output capacitor requirements for stability. |
| 3 | GND | Ground. |
| 4 | NR | Fixed voltage versions only – connecting an external capacitor to this pin bypasses noise generated by the internal bandgap, reducing output noise to low levels. |
| 4 | FB | Adjustable voltage version only – this is the input to the control loop error amplifier and is used to set the output voltage of the device. |
| 5 | EN | Driving the enable pin (EN) high turns on the regulator. Driving this pin low puts the regulator into shutdown mode. See the vendor datasheet shutdown section under applications information for more details. EN can be connected to IN if not used. |
| 6 | GND | Ground. |

FIGURE 2. Terminal connections.

| | | | |
|---|-------------------|---------------------------------|------------------------------|
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| Device types | All | |
|-----------------|-----------------|--|
| Case outline | Z | |
| Terminal number | Terminal symbol | Description |
| 1 | OUT | Output of the regulator. There are no output capacitor requirements for stability. |
| 2 | N/C | No internal connection. |
| 3 | NR | Fixed voltage versions only – connecting an external capacitor to this pin bypasses noise generated by the internal bandgap, reducing output noise to low levels. |
| 3 | FB | Adjustable voltage version only – this is the input to the control loop error amplifier and is used to set the output voltage of the device. |
| 4 | GND | Ground. |
| 5 | EN | Driving the enable pin (EN) high turns on the regulator. Driving this pin low puts the regulator into shutdown mode. See the vendor datasheet shutdown section under applications information for more details. EN can be connected to IN if not used. |
| 6 | N/C | No internal connection. |
| 7 | N/C | No internal connection. |
| 8 | IN | Unregulated input supply. |

FIGURE 2. Terminal connections - Continued.

| | | | |
|---|-------------------|---------------------------------|------------------------------|
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4. VERIFICATION

4.1 Product assurance requirements. The manufacturer is responsible for performing all inspection and test requirements as indicated in their internal documentation. Such procedures should include proper handling of electrostatic sensitive devices, classification, packaging, and labeling of moisture sensitive devices, as applicable.

5. PREPARATION FOR DELIVERY

5.1 Packaging. Preservation, packaging, labeling, and marking shall be in accordance with the manufacturer's standard commercial practices for electrostatic discharge sensitive devices.

6. NOTES

6.1 ESDS. Devices are electrostatic discharge sensitive and are classified as ESDS class 1 minimum.

6.2 Configuration control. The data contained herein is based on the salient characteristics of the device manufacturer's data book. The device manufacturer reserves the right to make changes without notice. This drawing will be modified as changes are provided.

6.3 Suggested source(s) of supply. Identification of the suggested source(s) of supply herein is not to be construed as a guarantee of present or continued availability as a source of supply for the item. DLA Land and Maritime maintains an online database of all current sources of supply at <http://www.landandmaritime.dla.mil/Programs/Smcr/>.

| Vendor item drawing administrative control number <u>1/</u> | Device manufacturer CAGE code | Vendor part number <u>2/</u> | Top-side Marking |
|---|-------------------------------|------------------------------|------------------|
| V62/06626-01XE | 01295 | TPS73601MDBVREP <u>3/</u> | PJRM |
| V62/06626-01YE | 01295 | TPS73601MDCQREP <u>3/</u> | PWZM |
| V62/06626-01ZE | 01295 | TPS73601MDRBREP <u>3/</u> | PMNM |
| V62/06626-02XE | 01295 | TPS73615MDBVREP | T59 |
| V62/06626-03XE | 01295 | TPS73618MDBVREP | T60 |
| V62/06626-04XE | 01295 | TPS73625MDBVREP | T61 |
| V62/06626-05XE | 01295 | TPS73630MDBVREP | T62 |
| V62/06626-06XE | 01295 | TPS73632MDBVREP | T63 |
| V62/06626-07XE | 01295 | TPS73633MDBVREP | T64 |

- 1/ The vendor item drawing establishes an administrative control number for identifying the item on the engineering documentation.
- 2/ Additional output voltages from 1.25 V to 4.3 V in 100 mV increments are available on a quick turn basis using innovative factory EEPROM programming. Minimum order quantities apply; contact factory for details and availability.
- 3/ For fixed, 1.2 V operation, tie FB to OUT.

CAGE code

01295

Source of supply

Texas Instruments, Inc.
 Semiconductor Group
 8505 Forest Ln.
 PO Box 660199
 Dallas, TX 75243
 Point of contact: U.S. Highway 75 South
 P.O. Box 84, M/S 853
 Sherman, TX 75090-9493

| | | | |
|---|------------------|--------------------------------|-----------------------------|
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