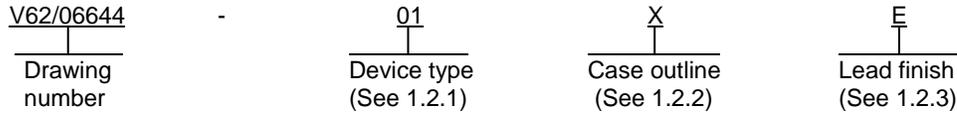




1. SCOPE

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 voltages</u>	<u>Circuit function</u>
01	TPS73201-EP	1.2 V <sup>1/</sup>	Low dropout voltage regulator
02	TPS73215-EP	1.5 V	Low dropout voltage regulator
03	TPS73216-EP	1.6 V	Low dropout voltage regulator
04	TPS73218-EP	1.8 V	Low dropout voltage regulator
05	TPS73225-EP	2.5 V	Low dropout voltage regulator
06	TPS73230-EP	3.0 V	Low dropout voltage regulator
07	TPS73233-EP	3.3 V	Low dropout voltage regulator
08	TPS73250-EP	5.0 V	Low dropout voltage regulator

1.2.2 Case outline(s). The case outline(s) 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

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

<sup>1/</sup> For fixed 1.2 V operation, tie FB to OUT.

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1.3 Absolute maximum ratings. 2/

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 1.5, dissipation ratings table
Storage temperature range ( $T_{STG}$ )	-65°C to +150°C
Electrostatic discharge rating (ESD):	
Human body model	2 kV
Charged device model	500 V

1.4 Recommended operating conditions. 3/

Ambient temperature range ( $T_A$ )	-55°C to +125°C
-------------------------------------	-----------------

1.5 Power dissipation ratings. 4/

Package	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	$T_A = 125^\circ\text{C}$ power rating
Case X	Low K 5/	64°C/W	255°C/W	3.9 mW/°C	450 mW	275 mW	215 mW	58 mW
	High K 6/	64°C/W	180°C/W	5.6 mW/°C	638 mW	388 mW	305 mW	83 mW

- 2/ 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.
- 3/ 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.
- 4/ See power dissipation in the applications section of the vendor datasheet for more information related to thermal design.
- 5/ The JEDEC Low-K (1s) board design used to derive this data was a 3 inch x 3 inch, two layer board with 2 ounce copper traces on top of the board.
- 6/ 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.

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## 2. APPLICABLE DOCUMENTS

JEDEC Solid State Technology Association

JEDEC PUB 95 – Registered and Standard Outlines for Semiconductor Devices

(Applications for copies should be addressed to the JEDEC Office, 3103 North 10th Street, Suite 240-S, Arlington, VA 22201-2107 or online at <http://www.jedec.org>)

## 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 outline. The case outline 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.

3.5.3 Block diagrams. The block diagrams shall be as shown in figure 3.

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TABLE I. Electrical performance characteristics. 1/

Test	Symbol	Conditions <u>2/</u>	Temperature, T <sub>A</sub>	Device type	Limits		Unit
					Min	Max	
Input voltage range	V <sub>IN</sub>	<u>3/</u>	-55°C to +125°C	All	1.7	5.5	V
Internal reference	V <sub>FB</sub>		+25°C	01	1.198	1.21	V
Output voltage range	V <sub>OUT</sub>	<u>4/</u>	-55°C to +125°C	01	V <sub>FB</sub>	5.5 - V <sub>DO</sub>	V
Accuracy <u>3/</u>	V <sub>OUT</sub>	Nominal	+25°C	All	±0.5 typical		%
		V <sub>IN</sub> , I <sub>OUT</sub> , and T, V <sub>OUT</sub> + 0.5 V ≤ V <sub>IN</sub> ≤ 5.5 V, 10 mA ≤ I <sub>OUT</sub> ≤ 250 mA	-55°C to +125°C	All	-1	+1	%
Line regulation <u>3/</u>	ΔV <sub>OUT</sub> % / ΔV <sub>IN</sub>	V <sub>OUT(nom)</sub> + 0.5 V ≤ V <sub>IN</sub> ≤ 5.5 V	+25°C	All	0.01 typical		%/V
Load regulation	ΔV <sub>OUT</sub> % / ΔI <sub>OUT</sub>	1 mA ≤ I <sub>OUT</sub> ≤ 250 mA	+25°C	All	0.002 typical		%/mA
		10 mA ≤ I <sub>OUT</sub> ≤ 250 mA			0.0005 typical		
Dropout voltage <u>5/</u>	V <sub>DO</sub>	(V <sub>IN</sub> = V <sub>OUT(nom)</sub> - 0.1 V), I <sub>OUT</sub> = 250 mA	-55°C to +125°C	All		150	mV
Output impedance in dropout	Z <sub>O(DO)</sub>	1.7 V ≤ V <sub>IN</sub> ≤ V <sub>OUT</sub> + V <sub>DO</sub>	+25°C	All	0.25 typical		Ω
Output current limit	I <sub>CL</sub>	V <sub>OUT</sub> = 0.9 X V <sub>OUT(nom)</sub>	-55°C to +125°C	All	250	600	mA
Short circuit current	I <sub>SC</sub>	V <sub>OUT</sub> = 0 V	+25°C	All	300 typical		mA
Reverse leakage <u>6/</u> current (-I <sub>IN</sub> )	I <sub>REV</sub>	V <sub>EN</sub> ≤ 0.5 V, 0 V ≤ V <sub>IN</sub> ≤ V <sub>OUT</sub>	-55°C to +125°C	All		15	μA
Ground pin current	I <sub>GND</sub>	I <sub>OUT</sub> = 10 mA (I <sub>Q</sub> )	-55°C to +125°C	All		550	μA
		I <sub>OUT</sub> = 250 mA				950	
Shutdown current (I <sub>GND</sub> )	I <sub>SHDN</sub>	V <sub>EN</sub> ≤ 0.5 V, V <sub>OUT</sub> ≤ V <sub>IN</sub> ≤ 5.5 V	-55°C to +125°C	All		1	μA
FEEDBACK (FB) pin current	I <sub>FB</sub>		-55°C to +125°C	01		0.45	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 <sub>A</sub>	Device type	Limits		Unit
					Min	Max	
Power supply rejection ratio (ripple rejection)	PSRR	f = 100 Hz, I <sub>OUT</sub> = 250 mA	+25°C	All	58 typical		dB
		f = 10 kHz, I <sub>OUT</sub> = 250 mA			37 typical		
Output noise voltage	V <sub>N</sub>	C <sub>OUT</sub> = 10 μF, no CNR, BW = 10 Hz to 100 kHz	+25°C	All	27 x V <sub>OUT</sub> typical		μV <sub>RMS</sub>
		C <sub>OUT</sub> = 10 μF, CNR = 0.01 μF, BW = 10 Hz to 100 kHz			8.5 x V <sub>OUT</sub> typical		
Start up time	t <sub>STR</sub>	V <sub>OUT</sub> = 3 V, R <sub>L</sub> = 30 Ω, C <sub>OUT</sub> = 1 μF, CNR = 0.01 μF	+25°C	All	600 typical		μs
Enable high (enabled)	V <sub>EN(HI)</sub>		-55°C to +125°C	All	1.7	V <sub>IN</sub>	V
Enable low (shutdown)	V <sub>EN(LO)</sub>		-55°C to +125°C	All	0	0.5	V
Enable pin current (enabled)	I <sub>EN(HI)</sub>	V <sub>EN</sub> = 5.5 V	-55°C to +125°C	All		0.1	μA
Thermal shutdown temperature	T <sub>SD</sub>	Shutdown, temperature increasing	+25°C	All	160 typical		°C
		Reset, temperature decreasing			140 typical		
Operating ambient temperature	T <sub>A</sub>			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<sub>IN</sub> = V<sub>OUT(nom)</sub> + 0.5 V, I<sub>OUT</sub> = 10 mA, V<sub>EN</sub> = 1.7 V, and C<sub>OUT</sub> = 0.1 μF.

3/ Minimum V<sub>IN</sub> = V<sub>OUT</sub> + V<sub>DO</sub> or 1.7 V, whichever is greater.

4/ Device type 01 is tested at V<sub>OUT</sub> = 2.5 V.

5/ V<sub>DO</sub> is not measured for device type 02 or device type 03, since minimum V<sub>IN</sub> = 1.7 V.

6/ Fixed voltage versions only; see the vendor's datasheet applications section for more information.

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Case X

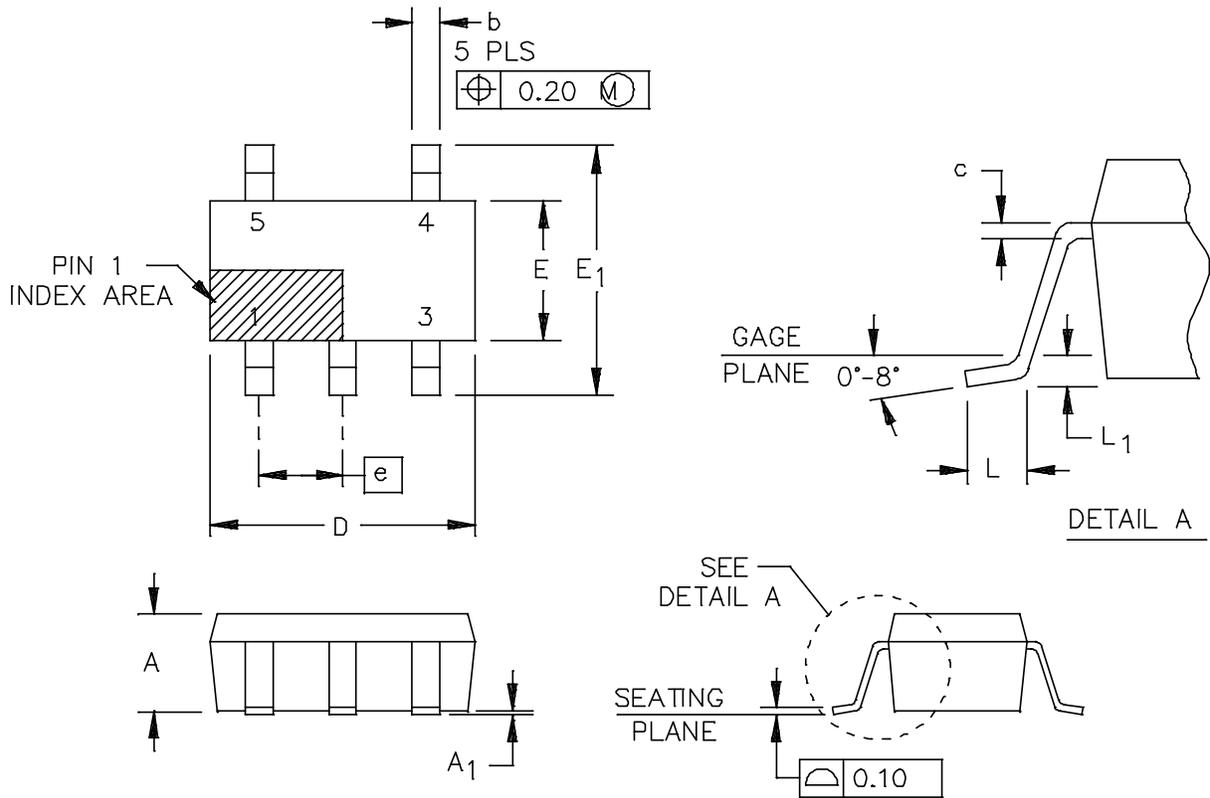


FIGURE 1. Case outline.

<p><b>DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO</b></p>	<p><b>SIZE A</b></p>	<p><b>CODE IDENT NO. 16236</b></p>	<p><b>DWG NO. V62/06644</b></p>
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Case X

Symbol	Dimensions			
	Inch		Millimeters	
	Min	Max	Min	Max
A	---	.057	---	1.45
A1	.000	.006	0.00	0.15
b	.011	.019	0.30	0.50
c	.003	.008	0.08	0.22
D	.108	.120	2.75	3.05
E	.057	.068	1.45	1.75
E1	.102	.118	2.60	3.00
e	.037 BSC		0.95 BSC	
L	.011	.021	0.30	0.55
L1	.009 BSC		0.25 BSC	
n	5 leads		5 leads	

NOTES:

1. Controlling dimensions are millimeter, inch dimensions are given for reference only.
2. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 mm (0.006 inch) per side.
3. Falls with JEDEC MO-178-AA.

FIGURE 1. Case outline – 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's datasheet shutdown section under application 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 very 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.

FIGURE 2. Terminal connections.

<b>DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO</b>	<b>SIZE A</b>	<b>CODE IDENT NO. 16236</b>	<b>DWG NO. V62/06644</b>
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Fixed voltage

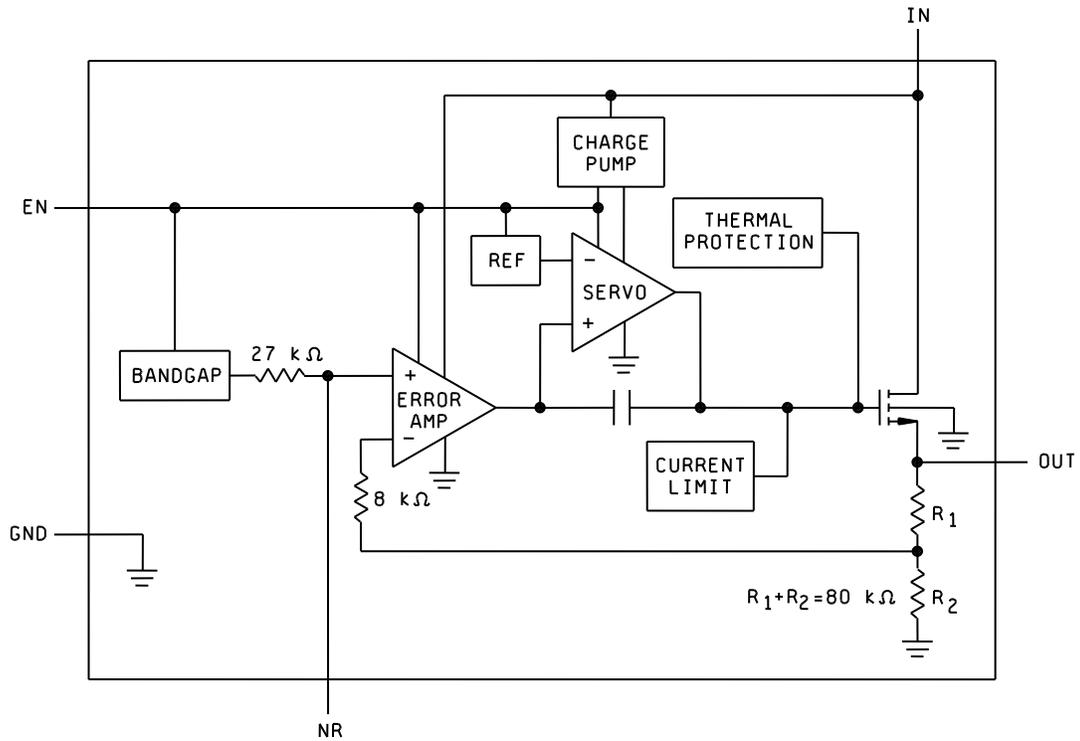
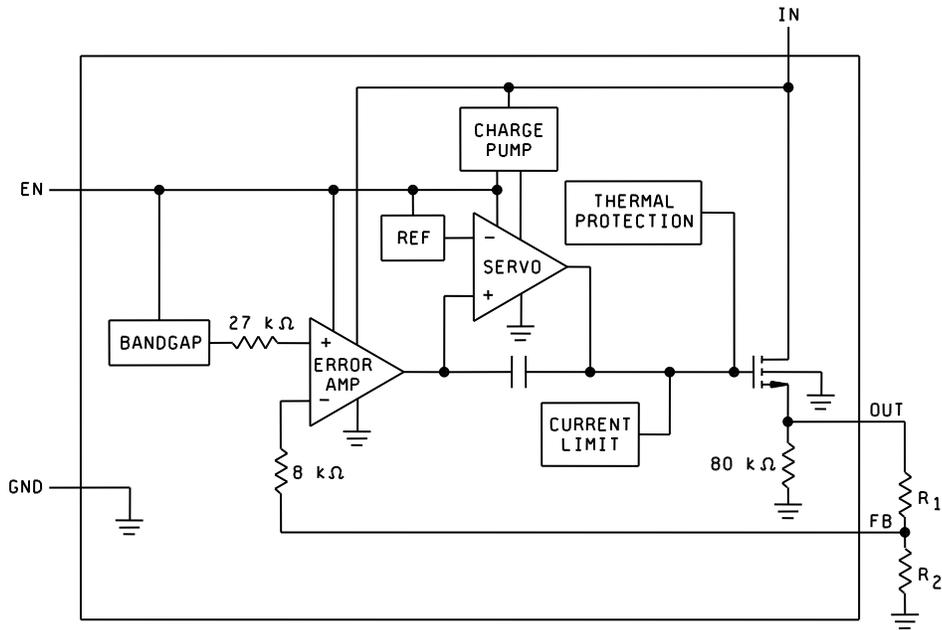


FIGURE 3. Block diagrams.

<p><b>DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO</b></p>	<p>SIZE <b>A</b></p>	<p>CODE IDENT NO. <b>16236</b></p>	<p>DWG NO. <b>V62/06644</b></p>
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Adjustable voltage



Standard 1 % resistor values for common output voltages

V <sub>OUT</sub>	R <sub>1</sub>	R <sub>2</sub>
1.2 V	Short	Open
1.5 V	23.2 kΩ	95.3 kΩ
1.8 V	28.0 kΩ	56.2 kΩ
2.5 V	39.2 kΩ	36.5 kΩ
2.8 V	44.2 kΩ	33.2 kΩ
3.0 V	46.4 kΩ	30.9 kΩ
3.3 V	52.3 kΩ	30.1 kΩ
5.0 V	78.7 kΩ	24.9 kΩ

NOTE:  $V_{OUT} = (R_1 + R_2) / R_2 \times 1.204$ ;  $R_1 \parallel R_2 \cong 19 \text{ k}\Omega$  for best accuracy.

FIGURE 3. Block diagrams - Continued.

<b>DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OHIO</b>	SIZE <b>A</b>	CODE IDENT NO. <b>16236</b>	DWG NO. <b>V62/06644</b>
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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>
V62/06644-01XE	01295	TPS73201MDBVREP
V62/06644-02XE	01295	TPS73215MDBVREP
V62/06644-03XE	01295	TPS73216MDBVREP
V62/06644-04XE	01295	TPS73218MDBVREP
V62/06644-05XE	01295	TPS73225MDBVREP
V62/06644-06XE	01295	TPS73230MDBVREP
V62/06644-07XE	01295	TPS73233MDBVREP
V62/06644-08XE	01295	TPS73250MDBVREP

1/ The vendor item drawing establishes an administrative control number for identifying the item on the engineering documentation.

2/ Output voltages from 1.2 V to 4.5 V in 50 mV increments are available through the use of innovative factory EEPROM programming; minimum order quantities may apply. Contact factory for details and availability, [www.ti.com](http://www.ti.com).

CAGE code

01295

Source of supply

Texas Instruments, Inc.  
 Semiconductor Group  
 8505 Forest Lane  
 P.O. 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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