

# Linear Regulator - 300 mA, Market Leading Transient Response Time and Ultra-Low Dropout

## Preliminary Document T30LMPSR165, T30LAPSR165

The T30LxPSR165 is an ultra-fast linear regulator capable of supplying 300 mA output current from 1.4 V input voltage. The device provides a best-in-class transient response time (1  $\mu$ s, typ.) suitable for applications with fast sampling rate. The device features an ultra-low dropout voltage (26 mV at 300 mA) enabling higher efficiency while offering wide output voltage range (1.0 V up to 3.2 V), very low noise and high PSRR for noise sensitive applications. Due to its low quiescent current, the T30LxPSR165 is suitable for battery powered devices such as smartphones and tablets. The device is designed to work with a 1  $\mu$ F input and 1  $\mu$ F output ceramic capacitor. It is available in ultra-small 0.35P, 0.64 mm x 0.64 mm Chip Scale Package (CSP).

### Features

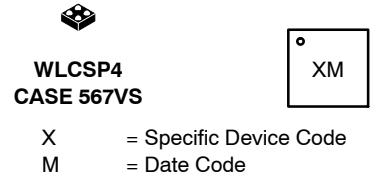
- Market Leading Load Transient Response: 0 to 300 mA in 100 ns
  - ♦ Voltage Undershoot: 37 mV
  - ♦ Settling Time: 1  $\mu$ s
- $\pm 1\%$  Accuracy Over Load/Temperature
- Very Low Dropout: 26 mV for 2.85 V @ 300 mA
- High PSRR: Typ. 45 dB at 20 mA,  $f = 100$  kHz
- Operating Input Voltage Range: 1.4 V to 3.3 V
- Available in Fixed Voltage Option: 1.0 V to 3.2 V
- Ultra Low Noise: 16  $\mu$ V<sub>RMS</sub>
- Stable with a 1  $\mu$ F eff. Output Capacitance
- Available in WLCSP4 0.64 mm x 0.64 mm x 0.33 mm Package
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant

### Typical Applications

- Battery-powered Equipment
- Wireless LAN Devices
- Smartphone, Tablets
- Cameras, DVRs, STB and Camcorders

This Preliminary document is for informational purposes only. onsemi may update or withdraw it without notice. Content and referenced products are under development and subject to change.

### MARKING DIAGRAM



### PIN CONNECTIONS

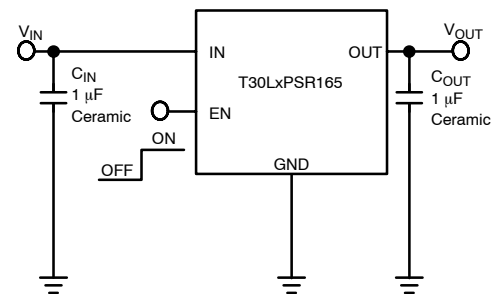
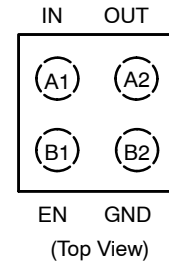


Figure 1. Typical Application Schematic

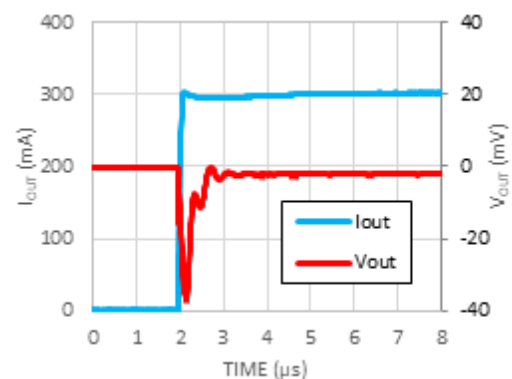


Figure 2. Load Transient Response for  
C<sub>OUT</sub> 1  $\mu$ F and Load Step 0 to 300 mA with  
Rise Time 100 ns

### ORDERING INFORMATION

See detailed ordering, marking and shipping information on page 4 of this data sheet.

## T30LMPSR165, T30LAPSR165

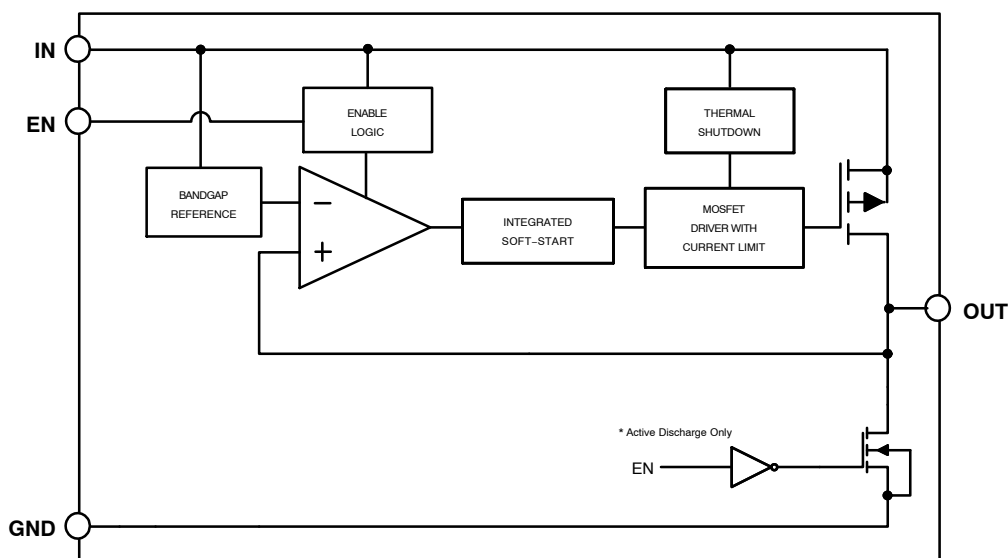


Figure 3. Simplified Schematic Block Diagram

### PIN FUNCTION DESCRIPTION

| Pin No.<br>WLCSP4 | Pin Name | Description                                                                                                |
|-------------------|----------|------------------------------------------------------------------------------------------------------------|
| A1                | IN       | Input voltage supply pin                                                                                   |
| A2                | OUT      | Regulated output voltage. The output should be bypassed with small 1 $\mu$ F ceramic capacitor.            |
| B1                | EN       | Chip enable: Applying $V_{EN} < 0.3$ V disables the regulator, Pulling $V_{EN} > 0.825$ V enables the LDO. |
| B2                | GND      | Common ground connection                                                                                   |

### ABSOLUTE MAXIMUM RATINGS

| Rating                                        | Symbol             | Value                             | Unit         |
|-----------------------------------------------|--------------------|-----------------------------------|--------------|
| Input Voltage (Notes 1, 3)                    | $V_{IN}$           | -0.3 to 3.6                       | V            |
| Output Voltage                                | $V_{OUT}$          | -0.3 to $V_{IN} + 0.3$ , max. 3.6 | V            |
| Enable Voltage (Notes 1, 3)                   | $V_{CE}$           | -0.3 to 3.6                       | V            |
| Output Short Circuit Duration                 | $t_{SC}$           | unlimited                         | s            |
| Maximum Junction Temperature                  | $T_J$              | 150                               | $^{\circ}$ C |
| Storage Temperature Range                     | $T_{STG}$          | -55 to 150                        | $^{\circ}$ C |
| ESD Capability, Human Body Model (Note 2)     | ESD <sub>HBM</sub> | 2000                              | V            |
| ESD Capability, Charged Device Model (Note 2) | ESD <sub>CDM</sub> | 1000                              | V            |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- Refer to ELECTRICAL CHARACTERISTICS and APPLICATION INFORMATION for Safe Operating Area.
- This device series incorporates ESD protection and is tested by the following methods:  
 ESD Human Body Model tested per EIA/JESD22-A114ESD  
 Charged Device Model tested per JS-002-2018  
 Latchup Current Maximum Rating tested per JEDEC standard: JESD78
- The common grey zones (Device working in grey zone is functional but parameters from ELECTRICAL CHARACTERISTICS table are not guaranteed):  
 The range between max operating temperature and max thermal shutdown trigger temperature,  
 The range between min operating supply and min POR level,  
 The range between max operating supply and abs\_max.

### THERMAL CHARACTERISTICS

| Rating                                                                        | Symbol          | Value | Unit           |
|-------------------------------------------------------------------------------|-----------------|-------|----------------|
| Thermal Characteristics, WLCSP4 (Note 4), Thermal Resistance, Junction-to-Air | $R_{\theta JA}$ | 101   | $^{\circ}$ C/W |

- Measured according to JEDEC board specification. Detailed description of the board can be found in JESD51-7

## T30LMPSR165, T30LAPSR165

### ELECTRICAL CHARACTERISTICS

( $-40^{\circ}\text{C} \leq T_J \leq 125^{\circ}\text{C}$ ;  $V_{IN} = V_{OUT(NOM)} + 0.1\text{ V}$  or **1.4 V**, whichever is greater;  $I_{OUT} = 1\text{ mA}$ ;  $C_{IN} = C_{OUT} = 1\text{ }\mu\text{F}$  eff., unless otherwise noted.  $V_{EN} = 1\text{ V}$ . Typical values are at  $T_J = +25^{\circ}\text{C}$  (Note 5))

| Parameter                          | Test Conditions                                                                              |                                  | Symbol     | Min  | Typ   | Max   | Unit                |
|------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------|------------|------|-------|-------|---------------------|
| Operating Input Voltage            |                                                                                              |                                  | $V_{IN}$   | 1.4  | –     | 3.3   | V                   |
| Output Voltage Accuracy            | $I_{OUT} = 1\text{ mA to }300\text{ mA}$                                                     | $V_{OUT(NOM)} \leq 1.4\text{ V}$ | $V_{OUT}$  | –15  | –     | +15   | mV                  |
|                                    |                                                                                              | $V_{OUT(NOM)} > 1.4\text{ V}$    |            | –1   | –     | +1    | %                   |
| Line Regulation                    | $V_{OUT(NOM)} + 0.5\text{ V} \leq V_{IN} \leq 3.3\text{ V}$ , ( $V_{IN} \geq 1.4\text{ V}$ ) |                                  | LineReg    | –    | 0.02  | –     | %/V                 |
| Load Regulation                    | $I_{OUT} = 1\text{ mA to }300\text{ mA}$                                                     |                                  | LoadReg    | –    | 0.001 | –     | %/mA                |
| Dropout Voltage (Note 6)           | $V_{OUT(NOM)} = 2.85\text{ V}$                                                               | $I_{OUT} = 300\text{ mA}$        | $V_{DO}$   | –    | 26    | 70    | mV                  |
| Current Limit                      | $V_{OUT} = 90\% \times V_{OUT(NOM)}$                                                         |                                  | $I_{CL}$   | 325  | 570   | –     | mA                  |
| Quiescent Current                  | $I_{OUT} = 0\text{ mA}$                                                                      |                                  | $I_Q$      | –    | 240   | 300   | $\mu\text{A}$       |
| Shutdown Current                   | $V_{EN} \leq 0.285\text{ V}$                                                                 | $T_J \leq 85^{\circ}\text{C}$    | $I_{SHUT}$ | –    | 0.01  | 1     | $\mu\text{A}$       |
|                                    |                                                                                              | $T_J \leq 125^{\circ}\text{C}$   |            | –    | –     | 3.5   |                     |
| EN Pin Threshold Voltage           | EN Input Voltage “H”                                                                         |                                  | $V_{ENH}$  | 0.77 | –     | –     | V                   |
|                                    | EN Input Voltage “L”                                                                         | $T_J \leq 85^{\circ}\text{C}$    | $V_{ENL}$  | –    | –     | 0.325 |                     |
|                                    |                                                                                              | $T_J \leq 125^{\circ}\text{C}$   |            | –    | –     | 0.285 |                     |
| EN Pull Down Current               | $V_{EN} = 3.3\text{ V}$                                                                      |                                  | $I_{EN}$   | –    | 0.1   | 0.5   | $\mu\text{A}$       |
| Power Supply Rejection Ratio       | $I_{OUT} = 20\text{ mA}$                                                                     | $f = 100\text{ Hz}$              | PSRR       | –    | 70    | –     | dB                  |
|                                    |                                                                                              | $f = 1\text{ kHz}$               |            | –    | 70    | –     |                     |
|                                    |                                                                                              | $f = 10\text{ kHz}$              |            | –    | 65    | –     |                     |
|                                    |                                                                                              | $f = 100\text{ kHz}$             |            | –    | 50    | –     |                     |
| Output Voltage Noise               | $f = 10\text{ Hz to }100\text{ kHz}$                                                         |                                  | $V_N$      | –    | 16    | –     | $\mu\text{V}_{RMS}$ |
| Thermal Shutdown Threshold         | Temperature rising                                                                           |                                  | $T_{SDH}$  | –    | 160   | –     | $^{\circ}\text{C}$  |
|                                    | Temperature falling                                                                          |                                  | $T_{SDL}$  | –    | 140   | –     | $^{\circ}\text{C}$  |
| Active Output Discharge Resistance | $V_{EN} < 0.285\text{ V}$                                                                    |                                  | $R_{DIS}$  | –    | 280   | –     | $\Omega$            |

## T30LMPSR165, T30LAPSR165

### T30LxPSR165CFCT120T2G CHARACTERISTICS

–40°C ≤ T<sub>J</sub> ≤ 125°C; V<sub>IN</sub> = 1.4 V, V<sub>OUT(NOM)</sub> = 1.2 V, whichever is greater; I<sub>OUT</sub> = 1 mA; C<sub>IN</sub> = C<sub>OUT</sub> = 1 μF eff., unless otherwise noted. V<sub>EN</sub> = 1 V. Typical values are at T<sub>J</sub> = +25°C (Note 5)

| Parameter    | Test Conditions                                                                   | Symbol             | Min | Typ | Max | Unit |
|--------------|-----------------------------------------------------------------------------------|--------------------|-----|-----|-----|------|
| Delay Time   | From assertion of V <sub>EN</sub> to output voltage increase                      | t <sub>DELAY</sub> | –   | 120 | –   | μs   |
| Rise Time    | V <sub>OUT</sub> rise from 5% to 95% V <sub>OUT(NOM)</sub>                        | t <sub>RISE</sub>  | –   | 340 | –   |      |
| Turn-on Time | From assertion of V <sub>EN</sub> to V <sub>OUT</sub> = 95% V <sub>OUT(NOM)</sub> | t <sub>ON</sub>    | –   | 500 | –   |      |

### T30LxPSR165CFCT200T2G CHARACTERISTICS

–40°C ≤ T<sub>J</sub> ≤ 125°C; V<sub>IN</sub> = 2.1 V, V<sub>OUT(NOM)</sub> = 2.0 V, whichever is greater; I<sub>OUT</sub> = 1 mA; C<sub>IN</sub> = C<sub>OUT</sub> = 1 μF eff., unless otherwise noted. V<sub>EN</sub> = 1 V. Typical values are at T<sub>J</sub> = +25°C (Note 5)

| Parameter    | Test Conditions                                                                   | Symbol             | Min | Typ | Max | Unit |
|--------------|-----------------------------------------------------------------------------------|--------------------|-----|-----|-----|------|
| Delay Time   | From assertion of V <sub>EN</sub> to output voltage increase                      | t <sub>DELAY</sub> | –   | 120 | –   | μs   |
| Rise Time    | V <sub>OUT</sub> rise from 5% to 95% V <sub>OUT(NOM)</sub>                        | t <sub>RISE</sub>  | –   | 610 | –   |      |
| Turn-on Time | From assertion of V <sub>EN</sub> to V <sub>OUT</sub> = 95% V <sub>OUT(NOM)</sub> | t <sub>ON</sub>    | –   | 790 | –   |      |

### T30LxPSR165CFCT285T2G CHARACTERISTICS

–40°C ≤ T<sub>J</sub> ≤ 125°C; V<sub>IN</sub> = 2.95 V, V<sub>OUT(NOM)</sub> = 2.85 V, whichever is greater; I<sub>OUT</sub> = 1 mA; C<sub>IN</sub> = C<sub>OUT</sub> = 1 μF eff., unless otherwise noted. V<sub>EN</sub> = 1 V. Typical values are at T<sub>J</sub> = +25°C (Note 5)

| Parameter    | Test Conditions                                                                   | Symbol             | Min | Typ  | Max | Unit |
|--------------|-----------------------------------------------------------------------------------|--------------------|-----|------|-----|------|
| Delay Time   | From assertion of V <sub>EN</sub> to output voltage increase                      | t <sub>DELAY</sub> | –   | 120  | –   | μs   |
| Rise Time    | V <sub>OUT</sub> rise from 5% to 95% V <sub>OUT(NOM)</sub>                        | t <sub>RISE</sub>  | –   | 820  | –   |      |
| Turn-on Time | From assertion of V <sub>EN</sub> to V <sub>OUT</sub> = 95% V <sub>OUT(NOM)</sub> | t <sub>ON</sub>    | –   | 1000 | –   |      |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

- Performance guaranteed over the indicated operating temperature range by design and/or characterization. Production tested at T<sub>A</sub> = 25°C. Low duty cycle pulse techniques are used during the testing to maintain the junction temperature as close to ambient as possible.
- Dropout voltage is characterized when V<sub>OUT</sub> falls about 3% below V<sub>OUT(NOM)</sub>.

### ORDERING INFORMATION

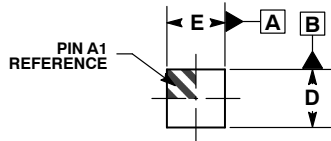
| Device                                                 | Nominal Output Voltage | Marking | Rotation | Description                                     | Package                                                                 | Shipping <sup>†</sup>  |
|--------------------------------------------------------|------------------------|---------|----------|-------------------------------------------------|-------------------------------------------------------------------------|------------------------|
| T30LMPSR165CFCT110T2G<br>(Consult <b>onsemi</b> sales) | 1.10 V                 | TBD     | TBD      | 300 mA LDO, with<br>Active Discharge<br>Feature | WLCSP4<br>CASE 567VS<br>(Pb-Free)<br>UBM: 200 μm<br>Bump type: Sn Plate | 10000 / Tape &<br>Reel |
| T30LMPSR165CFCT120T2G<br>(Consult <b>onsemi</b> sales) | 1.20 V                 | U       | 0°       |                                                 |                                                                         |                        |
| T30LMPSR165CFCT180T2G<br>(Consult <b>onsemi</b> sales) | 1.80 V                 | TBD     | TBD      |                                                 |                                                                         |                        |
| T30LMPSR165CFCT200T2G<br>(Consult <b>onsemi</b> sales) | 2.00 V                 | L       | 0°       |                                                 |                                                                         |                        |
| T30LMPSR165CFCT280T2G<br>(Consult <b>onsemi</b> sales) | 2.80 V                 | TBD     | TBD      |                                                 |                                                                         |                        |
| T30LMPSR165CFCT285T2G<br>(Consult <b>onsemi</b> sales) | 2.85 V                 | Y       | 0°       |                                                 |                                                                         |                        |



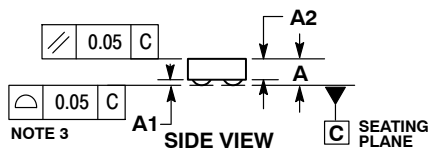
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WLCSP4, 0.64x0.64x0.33  
CASE 567VS  
ISSUE O

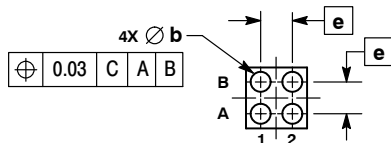
DATE 25 JAN 2018



TOP VIEW

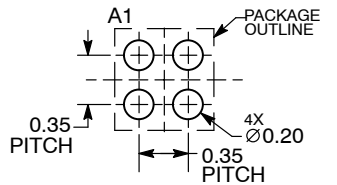


SIDE VIEW



BOTTOM VIEW

RECOMMENDED  
SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. COPLANARITY APPLIES TO SPHERICAL CROWNS OF SOLDER BALLS.

| DIM | MILLIMETERS |       |       |
|-----|-------------|-------|-------|
|     | MIN         | NOM   | MAX   |
| A   | ---         | ---   | 0.33  |
| A1  | 0.04        | 0.06  | 0.08  |
| A2  | 0.23 REF    |       |       |
| b   | 0.180       | 0.200 | 0.220 |
| D   | 0.610       | 0.640 | 0.670 |
| E   | 0.610       | 0.640 | 0.670 |
| e   | 0.35 BSC    |       |       |

GENERIC  
MARKING DIAGRAM\*



X = Specific Device Code  
M = Month

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

\*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

|                  |                        |                                                                                                                                                                                  |
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