1.5-A High Efficiency Step-Down Converter in SOT23-5 Package

Check for Samples: TLV62565, TLV62566

FEATURES

- **2.7-V to 5.5-V Input Voltage Range**
- **1.5-MHz Typical Switching Frequency**
- **Output Current up to 1.5 A (Max)**
- **Adaptive On-Time Current Control**
- **Power Save Mode for Light Load Efficiency**
- **50-µA Operating Quiescent Current**
- **Up to 95% Efficiency**
- **Over Current Protection**
- **95% Maximum Duty Cycle**
- **Excellent AC and Transient Load Response**
- **Power Good Output, TLV62566**
- **Internal Soft Startup of 250 µs (Typ)**
- **Adjustable Output Voltage**
- **Thermal Shutdown Protection**
- **Available in SOT23-5 Package**

APPLICATIONS

- **Portable Devices**
- **DSL Modems**
- **Hard Disk Drivers**
- **Set Top Box**
- **Tablet**

DESCRIPTION

The TLV62565/6 devices are synchronous step-down converters optimized for small solution size and high efficiency. The devices integrate switches capable of delivering an output current up to 1.5 A.

The devices are based on an adaptive on time with valley current mode control scheme. Typical operating frequency is 1.5 MHz at medium to heavy loads. The devices are optimized to achieve very low output voltage ripple even with small external components and feature an excellent load transient response.

During a light load, the TLV62565/6 automatically enter into Power Save Mode at the lowest quiescent current (50 µA typ) to maintain high efficiency over the entire load current range. In shutdown, the current consumption is reduced to less than 1 µA.

The TLV62565/6 provide an adjustable output voltage via an external resistor divider. The output voltage start-up ramp is controlled by an internal soft start, typically 250 µs. Power sequencing is possible by configuring the Enable (TLV62565) and Power Good (TLV62566) pins. Other features like over current protection and over temperature protection are built-in. The TLV62565/6 devices are available in a SOT23-5 package.

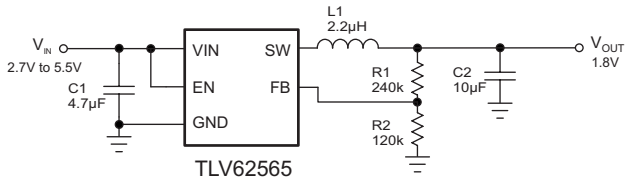

Figure 1. TLV62565 Typical Application

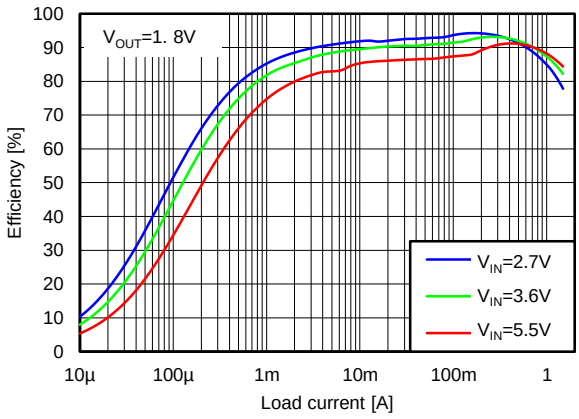

Figure 2. TLV62565 Efficiency, 1.8 V_{OUT}

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.

Table 1. ORDERING INFORMATION

T_A	EN or PG FUNCTION	PACKAGE MARKING	PACKAGE	PART NUMBER(1)
–40°C to 85°C	EN	SIK	DBV	TLV62565DBV
	PG	SIL	DBV	TLV62566DBV

(1) For detailed ordering information please check the PACKAGE OPTION ADDENDUM section at the end of this datasheet.

ABSOLUTE MAXIMUM RATINGS

Over operating free-air temperature range (unless otherwise noted)(1)

		VALUE		UNIT
		MIN	MAX	
Voltage range(2)	VIN, EN,PG	–0.3	7	V
	SW	–0.3	V_{IN}+0.3	V
	FB	–0.3	3.6	V
Sink current, I_{PG}	PG		660	uA
ESD rating	Human Body Model		2	kV
	Charged Device Model		500	V
Continuous total power dissipation		See Thermal Information table		
Temperature range	Operating junction, T_J	–40	150	°C
	Storage, T_{stg}	–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.
(2) All voltage values are with respect to network ground terminal.

THERMAL INFORMATION

THERMAL METRIC(1)		TLV62565, TLV62566	UNITS
		DBV (5 PINS)	
θ_{JA}	Junction-to-ambient thermal resistance	208.3	°C/W
θ_{JCtop}	Junction-to-case (top) thermal resistance	73.7	
θ_{JB}	Junction-to-board thermal resistance	36.1	
ψ_{JT}	Junction-to-top characterization parameter	2.3	
ψ_{JB}	Junction-to-board characterization parameter	35.3	
θ_{JCbot}	Junction-to-case (bottom) thermal resistance	N/A	

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

RECOMMENDED OPERATING CONDITIONS(1)

		MIN	TYP	MAX	UNIT
V_{IN}	Input voltage range, VIN	2.7		5.5	V
T_A	Operating ambient temperature	–40		85	°C

(1) Refer to the APPLICATION INFORMATION section for further information.

ELECTRICAL CHARACTERISTICS

Over recommended free-air temperature range, V_{IN} = 3.6 V, T_A = -40°C to 85°C, typical values are at T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SUPPLY						
V_{IN}	Input voltage range		2.7		5.5	V
I_Q	Quiescent current into VIN pin	I_{OUT} = 0 mA, Not switching		50		uA
V_{UVLO}	Under voltage lock out	V_{IN} falling		2.2	2.3	V
	Under voltage lock out hysteresis			200		mV
T_{JSD}	Thermal shutdown	Junction temperature rising		150		°C
	Thermal shutdown hysteresis	Junction temperature falling below T_{JSD}		20		
LOGIC INTERFACE, TLV62565						
V_{IH}	High-level input voltage	2.7 V ≤ V_{IN} ≤ 5.5 V	1.2			V
V_{IL}	Low-level input voltage	2.7 V ≤ V_{IN} ≤ 5.5 V			0.4	V
I_{SD}	Shutdown current into VIN pin	EN = LOW		0.1	1	µA
$I_{EN,LKG}$	EN leakage current			0.01	0.16	µA
POWER GOOD, TLV62566						
V_{PG}	Power Good low threshold	V_{FB} falling referenced to V_{FB} nominal		90%		
	Power Good high threshold	V_{FB} risng referenced to V_{FB} nominal		95%		
V_L	Low level voltage	I_{sink} = 500 µA			0.4	V
$I_{PG,LKG}$	PG Leakage current	V_{PG} = 5.0 V		0.01	0.17	µA
OUTPUT						
V_{OUT}	Output voltage range		0.6		D_{MAX}· V_{IN}	V
V_{FB}	Feedback regulation voltage	PWM operation	0.588	0.6	0.612	V
		PFM comparator threshold		+0.9%		
I_{FB}	Feedback input bias current	V_{FB} = 0.6 V		10	100	nA
$R_{DS(on)}$	High-side FET on resistance	I_{SW} = 500 mA, V_{IN} = 3.6 V		173		mΩ
	Low-side FET on resistance	I_{SW} = 500 mA, V_{IN} = 3.6 V		105		
$I_{LIM,LS}$	Low-side FET valley current limit		1.5			A
$I_{LIM,HS}$	High-side FET peak current limit		1.8			A
f_{SW}	Switching frequency			1.5		MHz
D_{MAX}	Maximum duty cycle			95%		
$t_{OFF,MIN}$	Minimum off time			40		ns

DEVICE INFORMATION

SOT23-5 PACKAGE
5 PINS
TOP VIEW

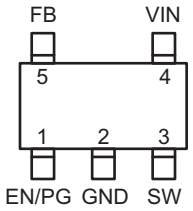

Table 2. PIN FUNCTIONS

PIN			I/O/PWR	DESCRIPTION
NAME	NO.			
	TLV62565	TLV62566		
EN	1	—	I	Device enable logic input. Logic HIGH enables the device, logic low disables the device and turns it into shutdown.
PG	—	1	O	Power Good open drain output. This pin is high impedance if the output voltage is within regulation. It is pulled low if the output is below its nominal value. It is also in logic low when V_{IN} below UVLO or thermal shutdown triggers.
GND	2	2	PWR	Ground pin.
SW	3	3	PWR	Switch pin connected to the internal MOSFET switches and inductor terminal. Connect the inductor of the output filter to this pin.
VIN	4	4	PWR	Power supply voltage input.
FB	5	5	I	Feedback pin for the internal control loop. Connect this pin to the external feedback divider.

FUNCTIONAL BLOCK DIAGRAMS

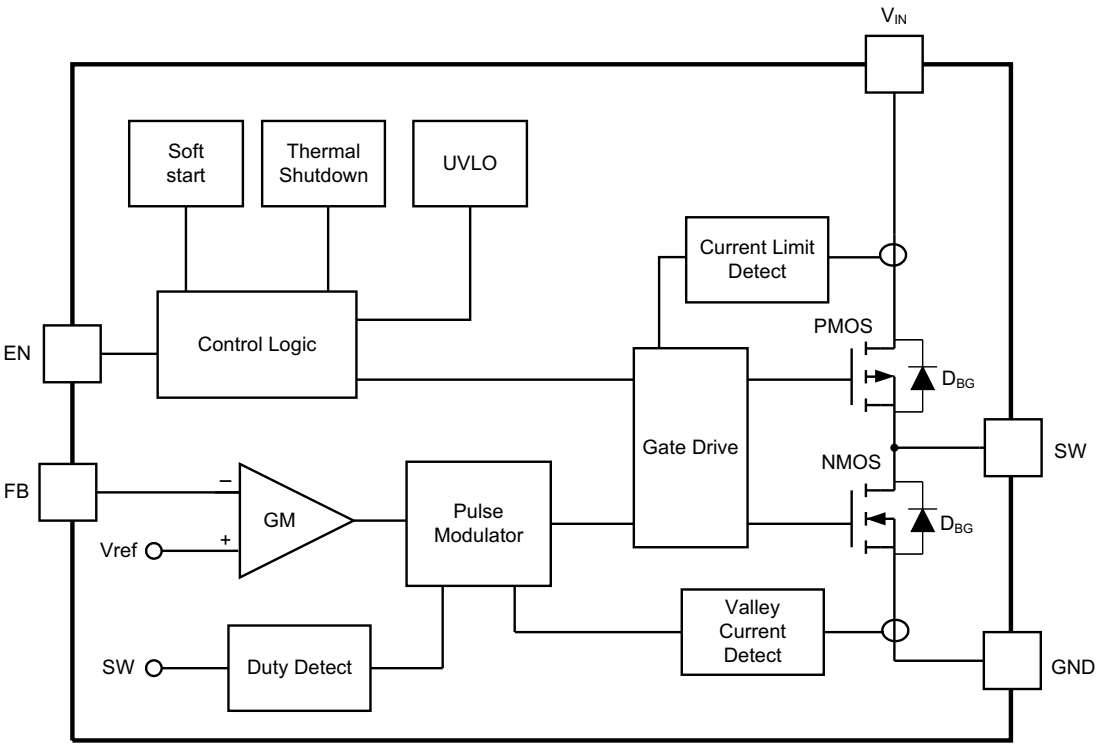

Figure 3. TLV62565 Functional Block Diagram

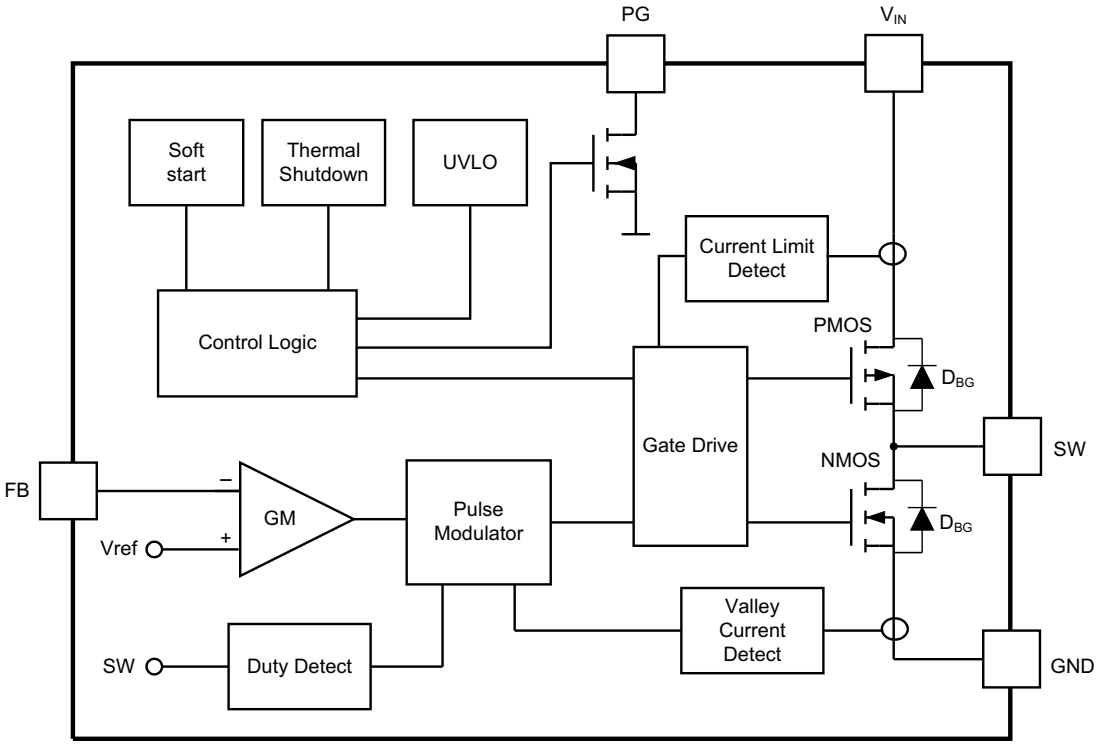

Figure 4. TLV62566 Functional Block Diagram

PARAMETER MEASUREMENT INFORMATION

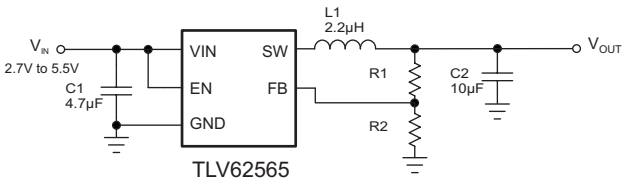

Table 3. List of Components

REFERENCE	DESCRIPTION	MANUFACTURER
C1	4.7 µF, Ceramic Capacitor, 6.3 V, X5R, size 0603, GRM188R60J475ME84	Murata
C2	10 µF, Ceramic Capacitor, 6.3 V, X5R, size 0603, GRM188R60J106ME84	Murata
L1	2.2 µH, Power Inductor, 2.5 A, size 4mmx4mm, LQH44PN2R2MP0	Murata
R1,R2	Chip resistor,1%,size 0603	Std.

TABLE OF GRAPHS

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	vs Load current (V_{OUT} = 3.3 V, V_{IN} = 4.2 V, 5.5 V)	Figure 7
Output voltage	vs Input voltage (Line regulation, V_{OUT} = 1.8 V, Load = 0.5 A,1 A,1.5 A)	Figure 8
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PFM mode	V_{IN} = 3.6 V, V_{OUT} = 1.8 V, Load current = 10 mA	Figure 16
Load transient	V_{IN} = 3.6 V, V_{OUT} = 1.8 V, Load current = 0.3 A to 1.3 A, L = 2.2 µH, C_{OUT} = 10 µF	Figure 17
Load transient	V_{IN} = 3. 6 V, V_{OUT} = 1.8 V, Load current = 1.3 A to 0.3 A, L = 2.2 µH, C_{OUT} = 10 µF	Figure 18
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TYPICAL CHARACTERISTICS

EFFICIENCY
vs
LOAD CURRENT

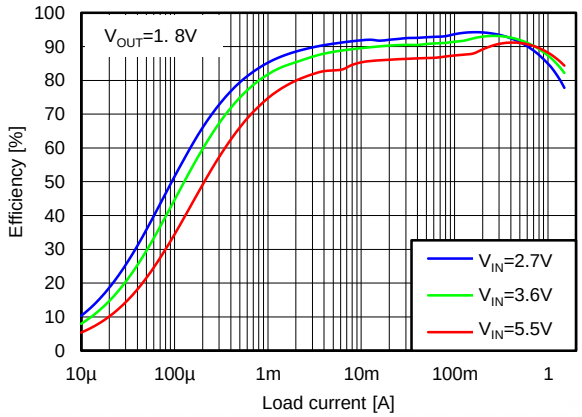


Figure 5.

EFFICIENCY
vs
LOAD CURRENT

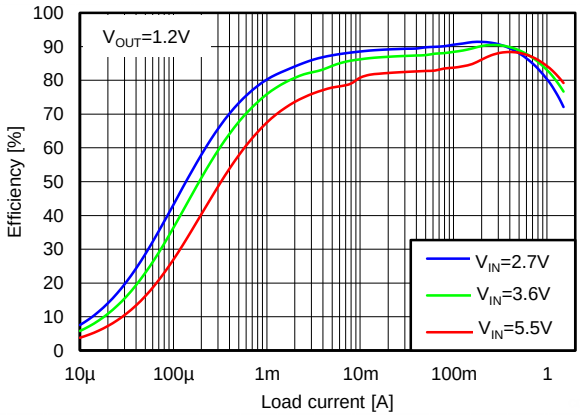


Figure 6.

EFFICIENCY
vs
LOAD CURRENT

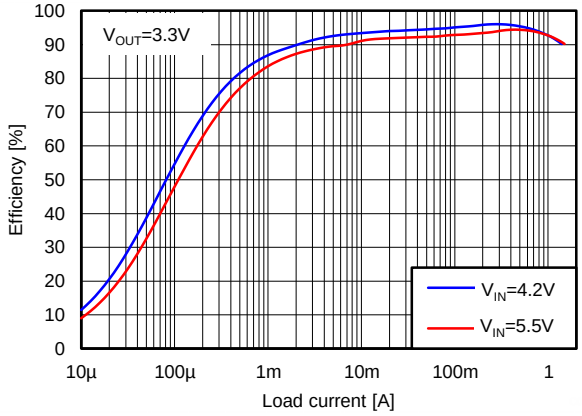


Figure 7.

OUTPUT VOLTAGE
vs
INPUT VOLTAGE

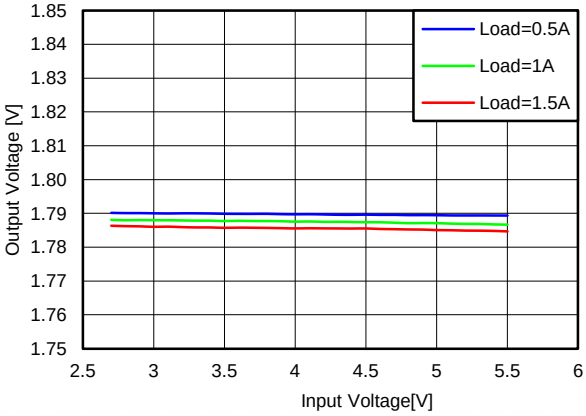


Figure 8.

OUTPUT VOLTAGE
vs
LOAD CURRENT

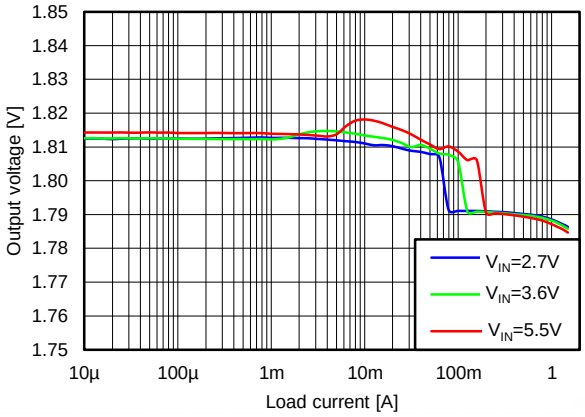


Figure 9.

QUIESCENT CURRENT
vs
INPUT VOLTAGE

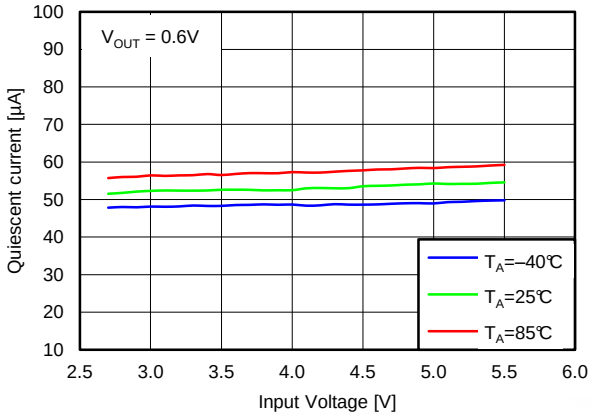


Figure 10.

TYPICAL CHARACTERISTICS (continued)

HIGH-SIDE FET $R_{DS(on)}$ VS INPUT VOLTAGE

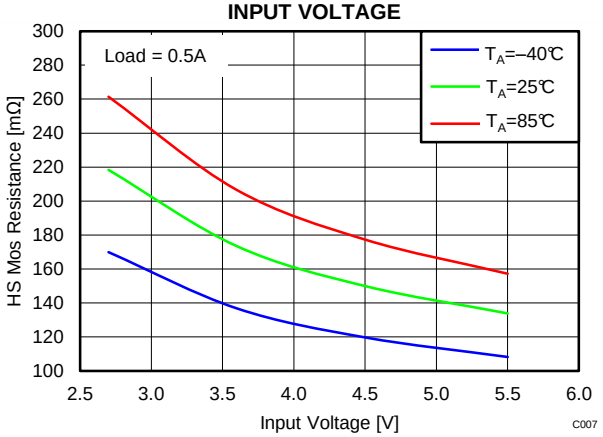


Figure 11.

LOW-SIDE FET $R_{DS(on)}$ VS INPUT VOLTAGE

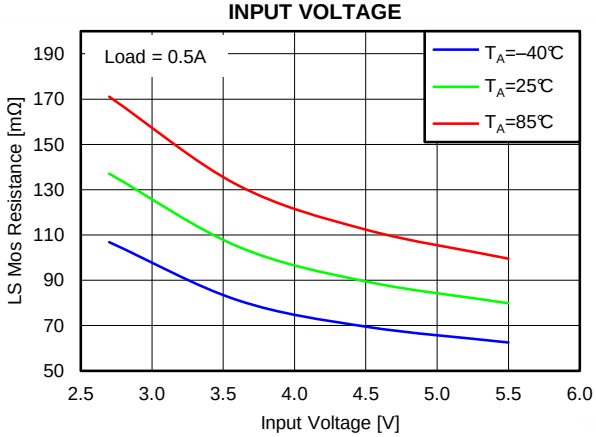


Figure 12.

SWITCHING FREQUENCY VS LOAD CURRENT

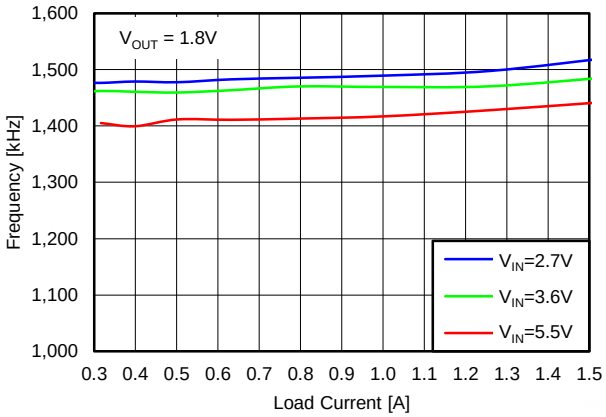


Figure 13.

TYPICAL APPLICATION (PWM MODE)

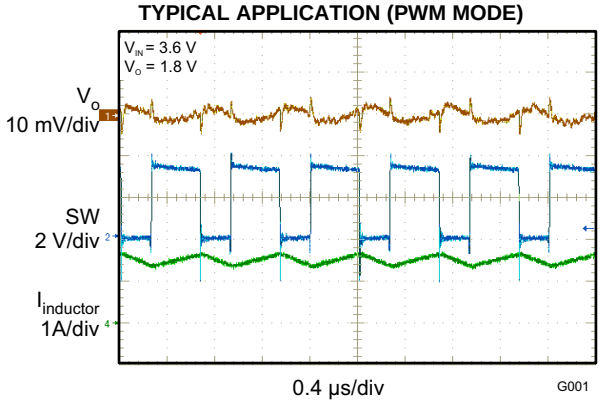


Figure 14.

TYPICAL APPLICATION (PFM MODE)

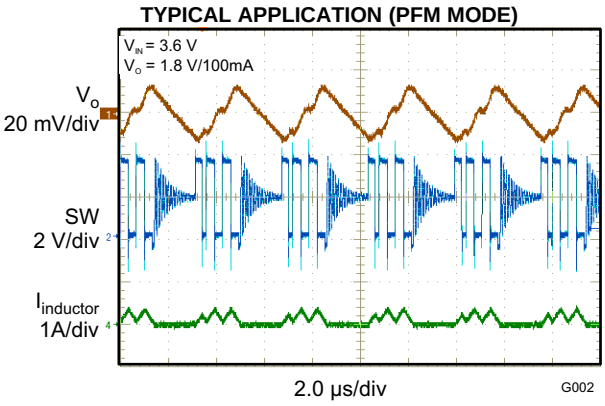


Figure 15.

TYPICAL APPLICATION (PFM MODE)

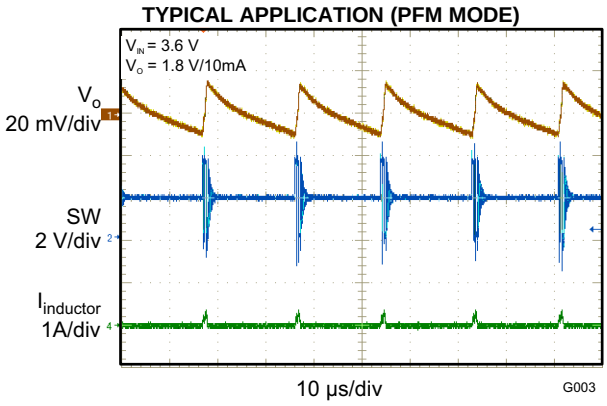


Figure 16.

TYPICAL CHARACTERISTICS (continued)

LOAD TRANSIENT

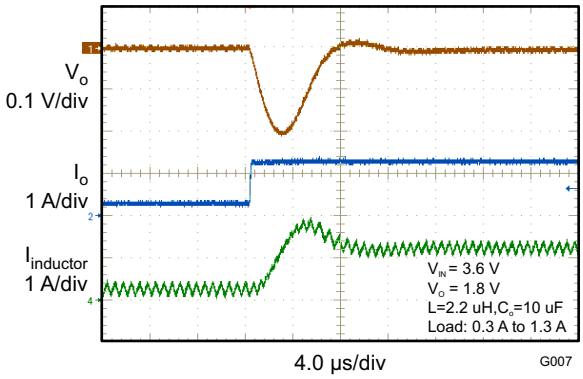


Figure 17.

LOAD TRANSIENT

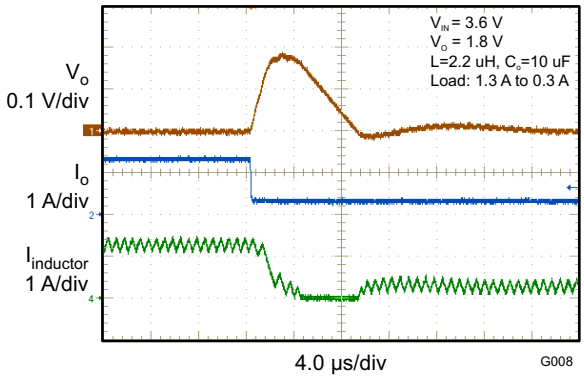


Figure 18.

START UP

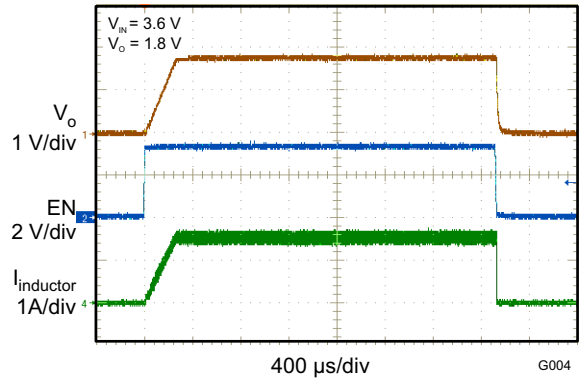


Figure 19.

START UP (Power Good)

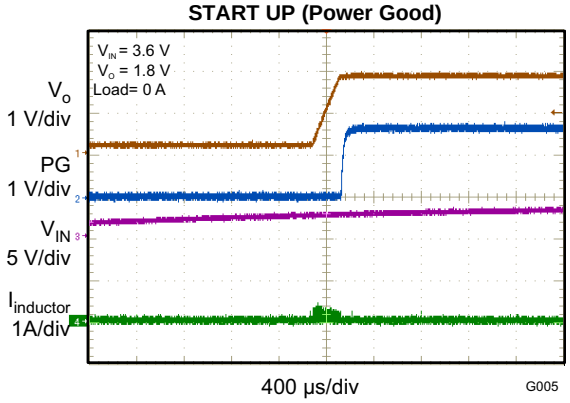


Figure 20.

SHORT CIRCUIT PROTECTION

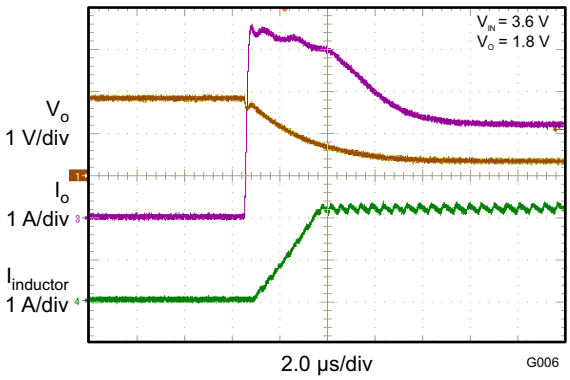


Figure 21.

DETAILED DESCRIPTION

DEVICE OPERATION

The TLV62565/6 device family includes two high-efficiency synchronous step-down converters. Each device operates with an adaptive on-time control scheme, which is able to dynamically adjust the on-time duration based on the input voltage and output voltage so that it can achieve relative constant frequency operation. The device operates at typically 1.5-MHz frequency pulse width modulation (PWM) at moderate to heavy load currents. Based on the V_{IN}/V_{OUT} ratio, a simple circuit sets the required on time for the high-side MOSFET. It makes the switching frequency relatively constant regardless of the variation of input voltage, output voltage, and load current. At the beginning of each switching cycle, the high-side switch is turned on and the inductor current ramps up to a peak current that is defined by on time and inductance. In the second phase, once the on time expires, the high-side switch is turned off while the low-side switch is being turned on. The current through the inductor then decays until triggering the valley current limit determined by the output of the error amplifier. Once this occurs, the on timer is set to turn the high-side switch back on again and the cycle is repeated.

The TLV62565/6 device family offers excellent load transient response with a unique fast response constant on-time valley current mode. The switching frequency changes during load transition so that the output voltage comes back in regulation faster than a traditional fixed PWM control scheme. Figure 22 shows the operation principles of the load transient response of the TLV62565/6. Internal loop compensation is integrated which simplifies the design process while minimizing the number of external components. At light load currents the device automatically operates in Power Save Mode with pulse frequency modulation (PFM).

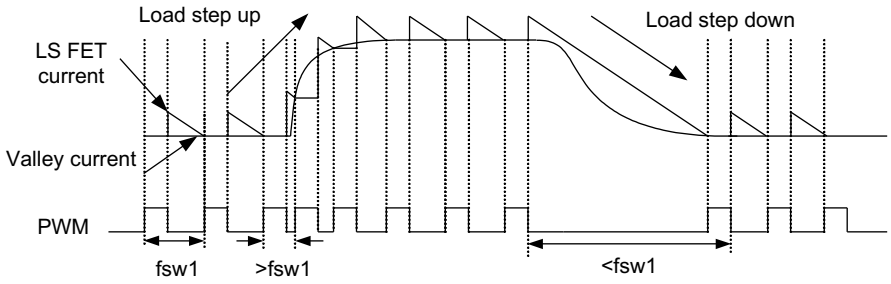


Figure 22. Operation in Load Transient

POWER SAVE MODE

The device integrates a Power Save Mode with PFM to improve efficiency at light load. In Power Save Mode, the device only switches when the output voltage trips below a set threshold voltage. It ramps up the output voltage with several pulses and stops switching when the output voltage is higher than the set threshold voltage. PFM is exited and PWM mode entered in case the output current can no longer be supported in Power Save Mode. The threshold of the PFM comparator is typically 0.9% higher than the normal reference voltage. Figure 23 shows the details of PFM/PWM mode transition.

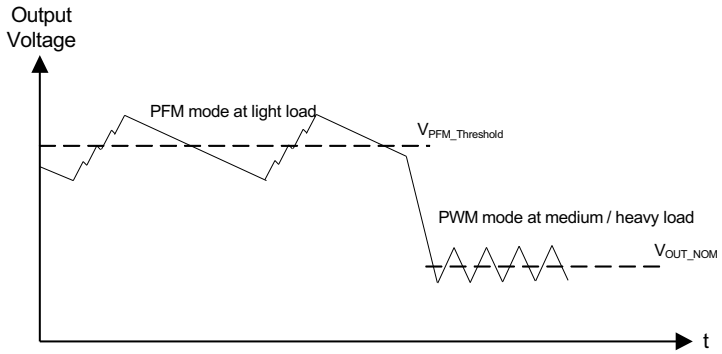


Figure 23. Output Voltage in PFM/PWM Mode

ENABLING/DISABLING THE DEVICE

The device is enabled by setting the EN input to a logic HIGH. Accordingly, a logic LOW disables the device. If the device is enabled, the internal power stage starts switching and regulates the output voltage to the set point voltage. The EN input must be terminated and should not be left floating.

SOFT START

After enabling the device, internal soft-start circuitry monotonically ramps up the output voltage which reaches nominal output voltage during a soft-start time of 250 µs (typical). This avoids excessive inrush current and creates a smooth output voltage rise slope. It also prevents excessive voltage drops of primary cells and rechargeable batteries with high internal impedance.

If the output voltage is not reached within the soft-start time, such as in the case of a heavy load, the converter enters regular operation. The TLV62565/6 are able to start into a pre-biased output capacitor. The converter starts with the applied bias voltage and ramps the output voltage to its nominal value.

SWITCH CURRENT LIMIT

The switch current limit prevents the device from high inductor current and drawing excessive current from a battery or input voltage rail. Excessive current might occur with a heavy load or shorted output circuit condition.

The TLV62565/6 adopt valley current control by sensing the current of the low-side MOSFET. Once the low-side valley switch current limit is tripped, the low-side MOSFET is turned off and limits the inductor's valley current. The high-side current is also limited which is determined by the on time of the high-side MOSFET and inductor value calculated by Equation 1. For example, with 3.6 V_{IN} to 1.8 V_{OUT} and 2.2-µH specification, the peak current limit is approximately 1.97 A with a typical valley current limit of 1.7 A.

Additionally, there is a secondary high-side current limit (typical 2 A) to prevent the current from going too high, which is shown in Figure 24. Due to the internal propagation delay, the real current limit value might be higher than the static current limit in the electrical characteristics table.

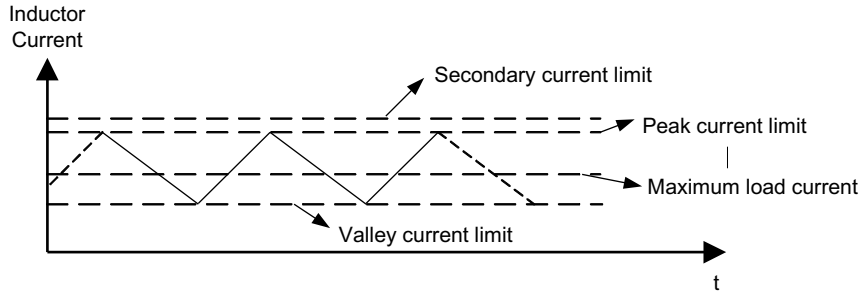


Figure 24. Switch Current Limit

$$I_{PEAK,LIMIT} = I_{VALLEY,LIMIT} + \Delta I_L$$

$$\Delta I_L = \frac{V_{OUT}}{L} \times \frac{(1-D)}{f_{SW}} \quad (1)$$

where:

- $I_{PEAK,LIMIT}$ is the high-side peak current limit
- $I_{VALLEY,LIMIT}$ is the low-side valley current limit

POWER GOOD

The TLV62566 integrates a Power Good output going low when the output voltage is below its nominal value. The Power Good output stays high impedance once the output is above 95% of the regulated voltage and is low once the output voltage falls below typically 90% of the regulated voltage. The PG pin is an open drain output and is specified to sink typically up to 0.5 mA. The Power Good output requires a pull-up resistor connected to any voltage lower than 5.5 V. When the device is off due to UVLO or thermal shutdown, the PG pin is pulled to logic low.

UNDER VOLTAGE LOCKOUT

To avoid mis-operation of the device at low input voltages, under voltage lockout is implemented that shuts down the device at voltages lower than V_{UVLO} with V_{HYS_UVLO} hysteresis.

THERMAL SHUTDOWN

The device enters thermal shutdown once the junction temperature exceeds typically T_{JSD}. Once the device temperature falls below the threshold with hysteresis, the device returns to normal operation automatically. Power Good is pulled low when thermal protection is triggered.

APPLICATION INFORMATION

OUTPUT FILTER DESIGN

The inductor and output capacitor together provide a low-pass frequency filter. To simplify this process, Table 4 outlines possible inductor and capacitor value combinations.

Table 4. Matrix of Output Capacitor and Inductor Combinations

L [µH](1)	C_{OUT} [µF](2) (3)				
	4.7	10	22	47	100
1					
2.2		+(4)	+(4)	+(4)	
4.7					

(1) Inductor tolerance and current de-rating is anticipated. The effective inductance can vary by +20% and -30%.
(2) Capacitance tolerance and bias voltage de-rating is anticipated. The effective capacitance can vary by +20% and -50%.
(3) For low output voltage applications (≤ 1.2 V), more output capacitance is recommended (usually ≥ 22 µF) for smaller ripple.
(4) Typical application configuration. '+' indicates recommended filter combinations.

INDUCTOR SELECTION

The main parameters for inductor selection is inductor value and then saturation current of the inductor. To calculate the maximum inductor current under static load conditions, Equation 2 is given:

$$I_{L,MAX} = I_{OUT,MAX} + \frac{\Delta I_L}{2}$$

$$\Delta I_L = V_{OUT} \times \frac{1 - \frac{V_{OUT}}{V_{IN}}}{L \times f_{SW}} \quad (2)$$

where:

- $I_{OUT,MAX}$ is the maximum output current
- ΔI_L is the inductor current ripple
- f_{SW} is the switching frequency
- L is the inductor value

It is recommended to choose a saturation current for the inductor that is approximately 20% to 30% higher than $I_{L,MAX}$. In addition, DC resistance and size should also be taken into account when selecting an appropriate inductor. The recommended inductors are listed in Table 5.

Table 5. List of Recommended Inductors

INDUCTANCE [µH]	CURRENT RATING [mA]	DIMENSIONS L x W x H [mm^3]	DC RESISTANCE [mΩ typ]	TYPE	MANUFACTURER
2.2	2500	4 x 3.7 x 1.65	49	LQH44PN2R2MP0	Murata
2.2	3000	4 x 4 x 1.8	50	NRS4018T2R2MDGJ	Taiyo Yuden

INPUT AND OUTPUT CAPACITOR SELECTION

The input capacitor is the low impedance energy source for the converter that helps provide stable operation. The closer the input capacitor is placed to the V_{IN} and GND pins, the lower the switch ring. A low ESR multilayer ceramic capacitor is recommended for best filtering. For most applications, 4.7-µF input capacitance is sufficient; a larger value reduces input voltage ripple.

The architecture of the TLV62565/6 allow use of tiny ceramic-type output capacitors with low equivalent series resistance (ESR). These capacitors provide low output voltage ripple and are thus recommended. To keep its resistance up to high frequencies and to achieve narrow capacitance variation with temperature, it is recommended to use X7R or X5R dielectric. The TLV62565/6 are designed to operate with an output capacitance of 10 µF to 47 µF, as outlined in Table 4.

SETTING THE OUTPUT VOLTAGE

An external resistor divider is used to set output voltage. By selecting R1 and R2, the output voltage is programmed to the desired value. When the output voltage is regulated, the typical voltage at the FB pin is V_{FB}. Equation 3, Equation 4, and Equation 5 can be used to calculate R1 and R2.

When sizing R2, in order to achieve low quiescent current and acceptable noise sensitivity, use a minimum of 5 µA for the feedback current I_{FB}. Larger currents through R2 improve noise sensitivity and output voltage accuracy but increase current consumption.

$$V_{OUT} = V_{FB} \times \left(1 + \frac{R1}{R2}\right) = 0.6V \times \left(1 + \frac{R1}{R2}\right) \quad (3)$$

$$R2 = \frac{V_{FB}}{I_{FB}} = \frac{0.6V}{5\mu A} = 120k\Omega \quad (4)$$

$$R1 = R2 \times \left(\frac{V_{OUT}}{V_{FB}} - 1\right) = R2 \times \left(\frac{V_{OUT}}{0.6V} - 1\right) \quad (5)$$

LOOP STABILITY

The first step of circuit and stability evaluation is to look from a steady-state perspective at the following signals:

- Switching node, SW
- Inductor current, I_L
- Output ripple voltage, $V_{OUT(AC)}$

These are the basic signals that need to be measured when evaluating a switching converter. When the switching waveform shows large duty cycle jitter or the output voltage or inductor current shows oscillations, the regulation loop may be unstable. This is often a result of board layout and/or L-C combination. Applications with the recommended L-C combinations in Table 4 are designed for good loop stability as well as fast load transient response.

As a next step in the evaluation of the regulation loop, the load transient response is illustrated. The TLV62565/6 use a constant on time with valley current mode control, so the on time of the high-side MOSFET is relatively consistent from cycle to cycle when a load transient occurs. Whereas the off time adjusts dynamically in accordance with the instantaneous load change and brings V_{OUT} back to the regulated value.

During recovery time, V_{OUT} can be monitored for settling time, overshoot, or ringing which helps judge the stability of the converter. Without any ringing, the loop usually has more than 45° of phase margin.

THERMAL INFORMATION

Implementation of integrated circuits in low-profile and fine-pitch surface-mount packages typically requires special attention to power dissipation. Many system-dependent issues such as thermal coupling, airflow, convection surfaces, and the presence of other heat-generating components affect the power dissipation limits of a given component.

Two basic approaches for enhancing thermal performance are listed below:

- Improving the power dissipation capability of the PCB design
- Introducing airflow in the system

For more details on how to use the thermal parameters, see the application notes: Thermal Characteristics Application Notes SZZA017 and SPRA953.

APPLICATION EXAMPLES

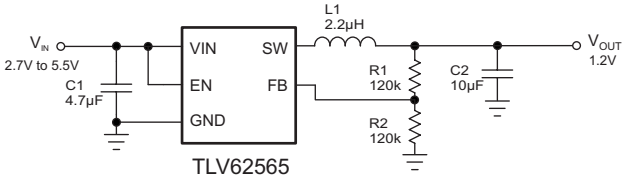


Figure 25. TLV62565 1.2-V Output Application

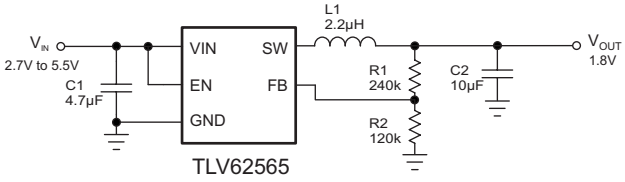


Figure 26. TLV62565 1.8-V Output Application

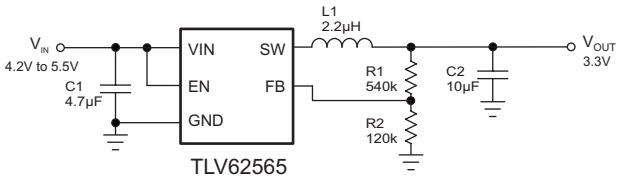


Figure 27. TLV62565 3.3-V Output Application

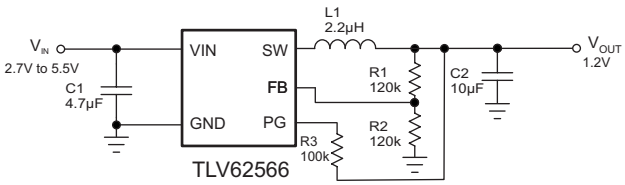


Figure 28. TLV62566 1.2-V Output Application

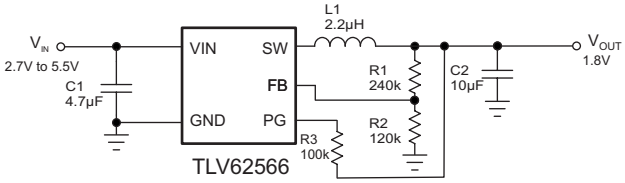


Figure 29. TLV62566 1.8-V Output Application

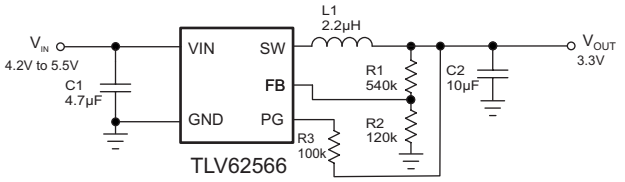


Figure 30. TLV62566 3.3-V Output Application

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
TLV62565DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	SIK	Samples
TLV62565DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	SIK	Samples
TLV62566DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	SIL	Samples
TLV62566DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	SIL	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.

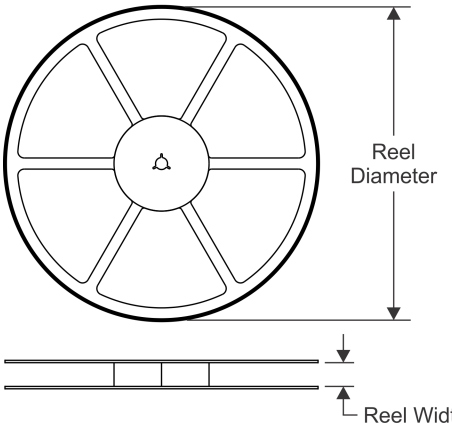
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

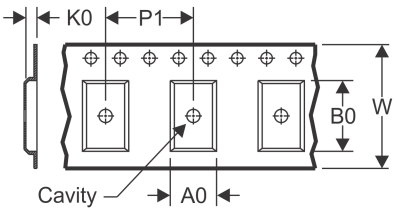
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

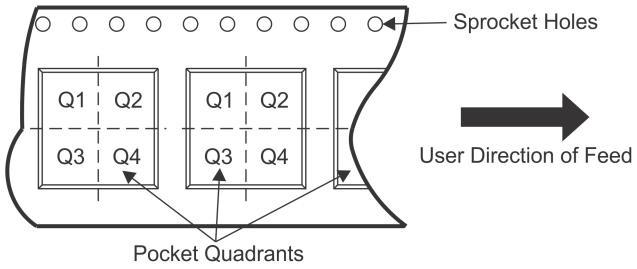


TAPE DIMENSIONS



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

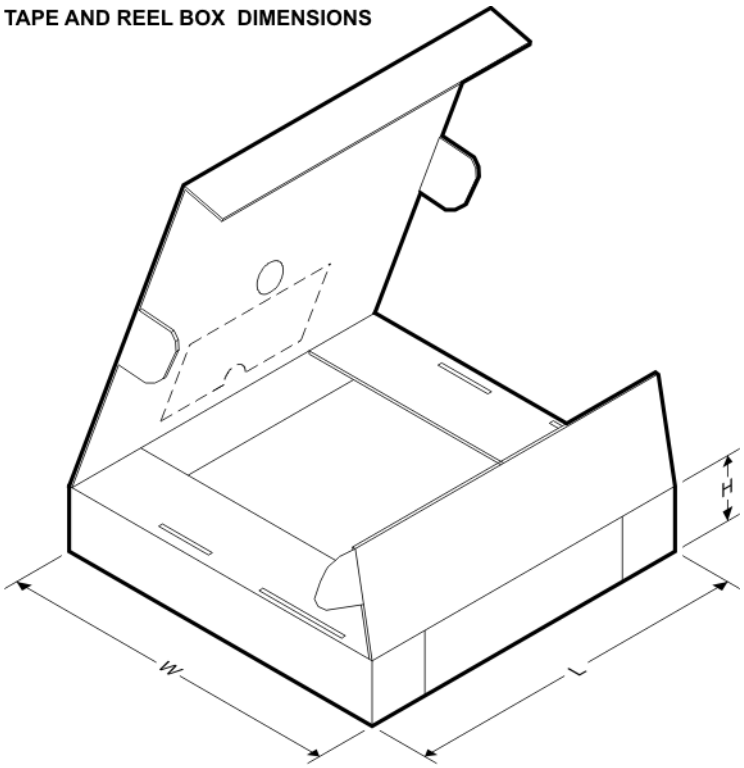
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TLV62565DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TLV62565DBVT	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TLV62566DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TLV62566DBVT	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3

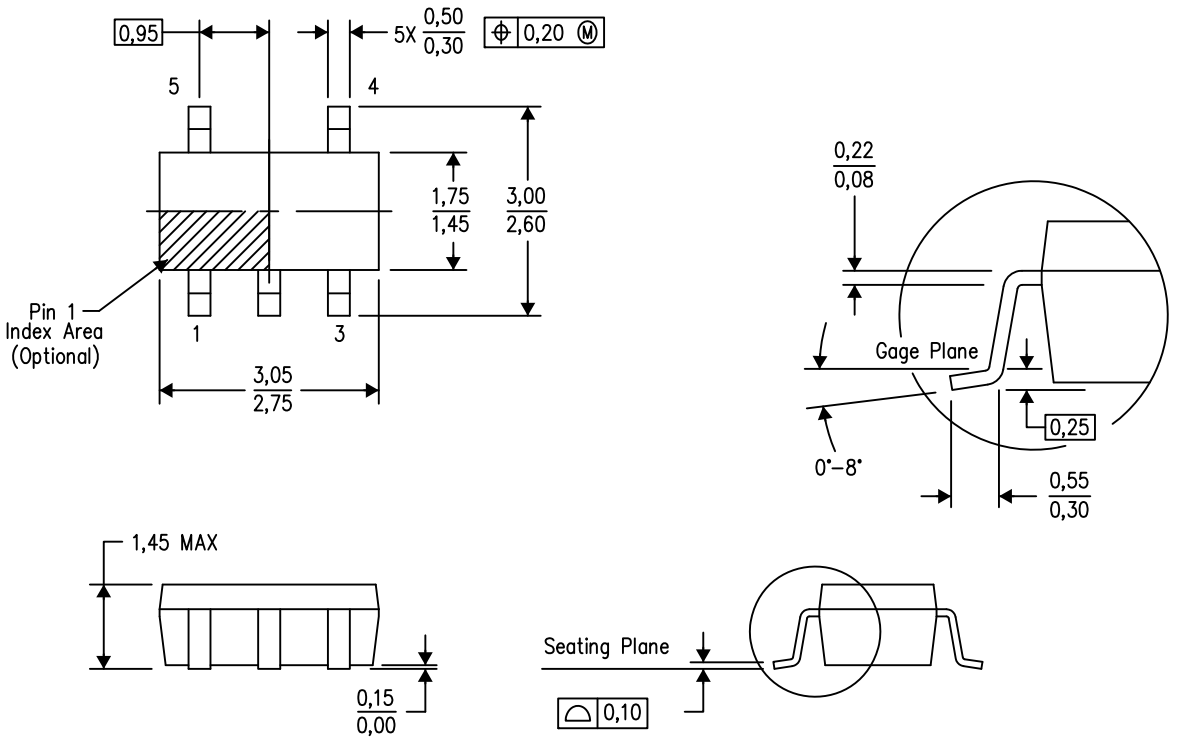
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV62565DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TLV62565DBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TLV62566DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TLV62566DBVT	SOT-23	DBV	5	250	180.0	180.0	18.0

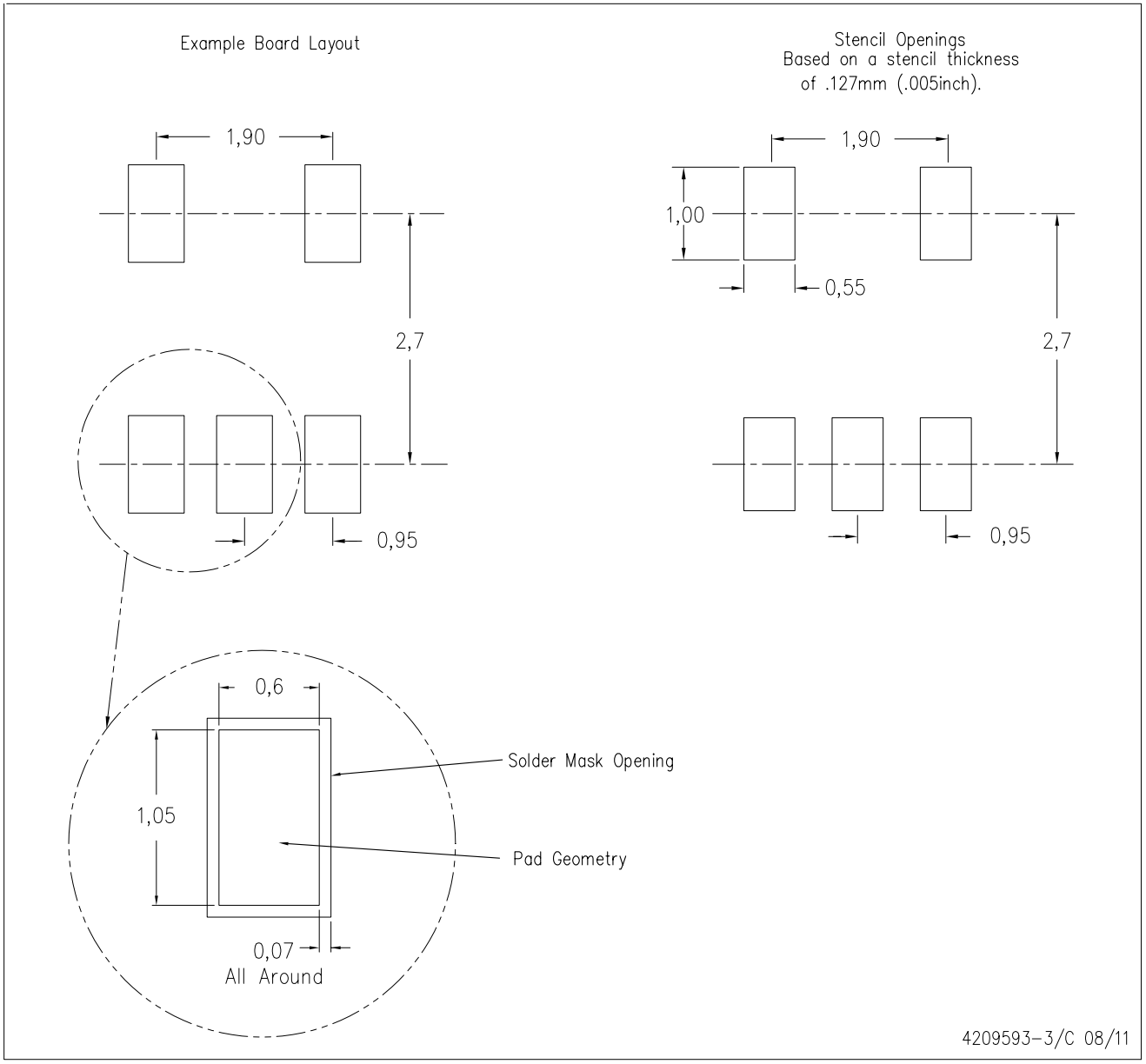
DBV (R–PDSO–G5) PLASTIC SMALL–OUTLINE PACKAGE



4073253–4/L 08/2013

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO–178 Variation AA.

DBV (R–PDSO–G5) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
D. Publication IPC–7351 is recommended for alternate designs.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC–7525 for other stencil recommendations.

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