ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

Input Voltage V_{IN} ..... -0.3V to 6.0V
EN, V_{FB} Voltages ..... -0.3V to V_{IN}
SW Voltage..... -0.3V to (V_{IN} + 0.3V)
Storage Temperature..... -65°C to 150°C
Lead Temperature (Soldering, 10 sec) ..... 260°C
ESD Rating (HBM - Human Body Model)..... 2kV
ESD Rating (CDM – Charged Device Model) 500V
Junction Temperature (Notes 1, 3) ..... 150°C

OPERATING RATINGS

Input Voltage Range V_{IN}.....2.5V to 5.5V
Ambient Temperature Range T_A ..... -40°C to 85°C
Junction Temperature Range T_J.....-40°C to 125°C
Thermal Resistance .....
θ_{JA} (5 Pin SOT23) .....134.5°C/W
θ_{JC} (5 Pin SOT23) ..... 81°C/W

ELECTRICAL SPECIFICATIONS

Specifications are for an Ambient Temperature of T_A = 25°C only; limits applying over the full Operating Temperature range are denoted by a "•". Minimum and Maximum limits are guaranteed through test, design, or statistical correlation. Typical values represent the most likely parametric norm at T_A = 25°C, and are provided for reference purposes only. Unless otherwise indicated, V_{IN} = 3.6V, T_A= 25°C.

Parameter	Min.	Typ.	Max.	Units		Conditions
Input Voltage Range	2.5		5.5	V		
Feedback Current		±100		nA		
Regulated Feedback Voltage	0.588	0.600	0.612	V		
Output Voltage Accuracy	-3		3	%		I_{OUT} = 100mA, V_{IN} < 3.0V
Output Voltage Accuracy	-3		3	%	•	I_{OUT} = 100mA, V_{IN} = 3.0V to 5.5V
Reference Voltage Line Regulation			0.4	%/V		V_{IN} = 2.5V to 3.0V
Reference Voltage Line Regulation			0.4	%/V	•	V_{IN} = 3.0V to 5.5V
Output Voltage Line Regulation			0.4	%/V		V_{IN} = 2.5V to 3.0V
Output Voltage Line Regulation			0.4	%/V	•	V_{IN} = 3.0V to 5.5V
Peak Inductor Current	1.5	2.3		A		V_{FB} = 0.5V or V_{OUT} = 90%
PFM Quiescent Current		30		µA		V_{FB} = 0.65V or V_{OUT} = 108%
Shutdown		0.1	1	µA		V_{RUN} = 0V, V_{IN} = 4.2V
Oscillator Frequency	1.2	1.5	1.8	MHz	•	V_{FB} = 0.6V or V_{OUT} = 100%
Short-Circuit Oscillator Frequency		f_{OSC}/2		kHz	•	V_{FB} = 0V or V_{OUT} = 0V
$R_{DS(ON)}$ of PMOS		0.22		Ω		I_{SW} = 100mA
$R_{DS(ON)}$ of NMOS		0.17		Ω		I_{SW} = –100mA
Under Voltage Lock Out		2		V		
SW Leakage			±1	µA		V_{RUN} = 0V, V_{SW} = 0V or 5V, V_{IN} = 5V
Enable Threshold			1.2	V	•	
Shutdown Threshold	0.4			V	•	
EN Leakage Current			±1	µA	•	

Note 1: T_J is a function of the ambient temperature T_A and power dissipation P_D: ($T_J = T_A + (P_D * \theta_{JA})$)
Note 2: Dynamic quiescent current is higher due to the gate charge being delivered at the switching frequency.
Note 3: This IC is built-in over-temperature protection to avoid damage from overload conditions.
Note 4: θ_{JA} is measured in the natural convection at T_A=25℃ on a high effective thermal conductivity test board (2 layers, 2S0P) of JEDEC 51-5 thermal measurement standard.
Note 5: θ_{JC} represents the resistance to the heat flows the chip to package top case.

BLOCK DIAGRAM

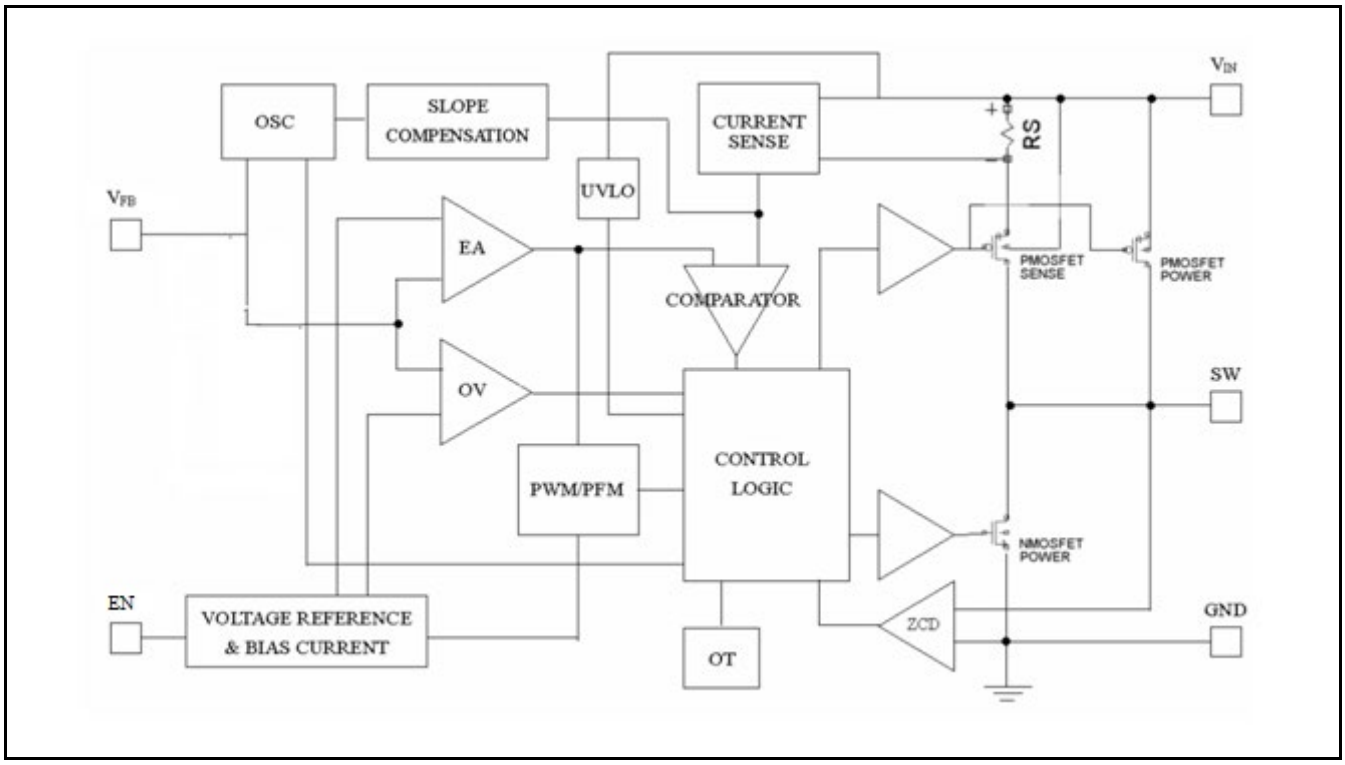


Fig. 2: XRP6658 Block Diagram

PIN ASSIGNMENT

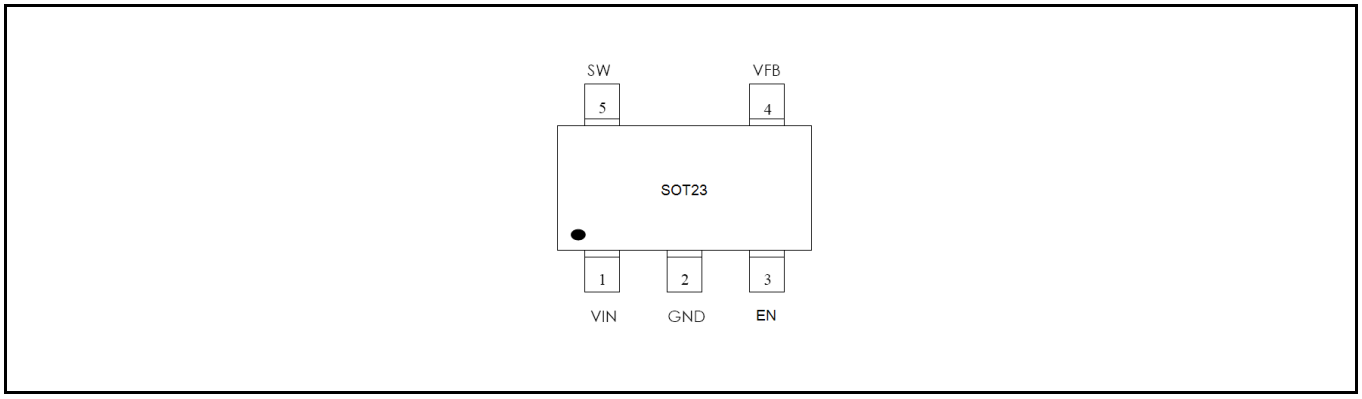


Fig. 3: XRP6658 Pin Assignment

PIN DESCRIPTION

Name	Pin Number	Description
VIN	1	Power Input Pin. Must be closely decoupled to GND pin with a 4.7µF or greater ceramic capacitor.
GND	2	Ground Signal
EN	3	Enable Pin. Minimum 1.2V to enable the device. Maximum 0.4V to shutdown the device.
VFB	4	Feedback Pin. Receives the feedback voltage from an external resistive divider across the output.
SW	5	Switch Pin. Must be connected to Inductor. This pin connects to the drains of the internal main and synchronous power MOSFET switches.

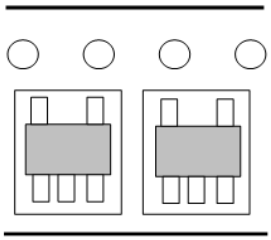
ORDERING INFORMATION(1)

Part Number	Temperature Range	Package	Packing Method	Lead Free(2)
XRP6658ISTR-F	-40°C ≤ T_J ≤ +125°C	5-Pin SOT23	Tape & Reel	Yes
XRP6658EVB	XRP6658 Evaluation Board			

Notes:

1. Refer to www.maxlinear.com/XRP6658 for most up-to-date Ordering Information.
2. Visit www.maxlinear.com for additional information on Environmental Rating.

Note that the XRP6658 series is packaged in Tape and Reel with a reverse part orientation as per the following diagram:



TYPICAL PERFORMANCE CHARACTERISTICS

All data taken at V_{IN} = 3.6V, T_J = T_A = 25°C, unless otherwise specified - Schematic and BOM from Application Information section of this datasheet.

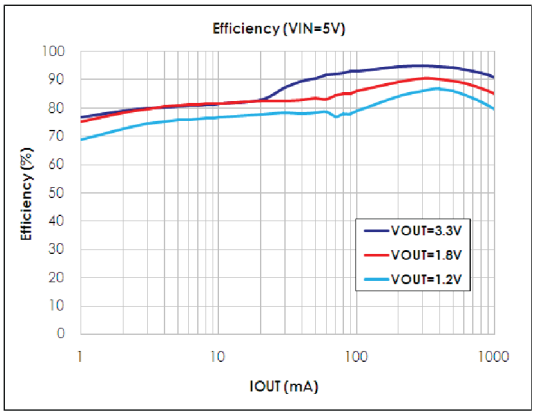


Fig. 4: Efficiency vs. Output Current, V_{IN} = 5V

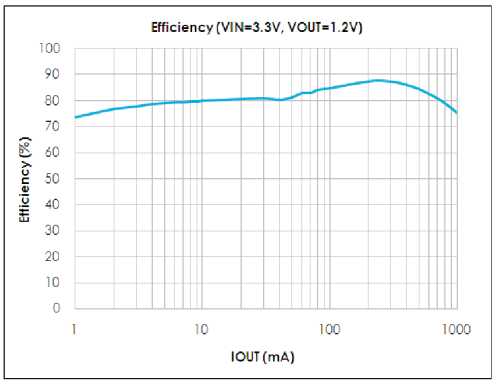


Fig. 5: Efficiency vs. Output Current, V_{IN} = 3.3V

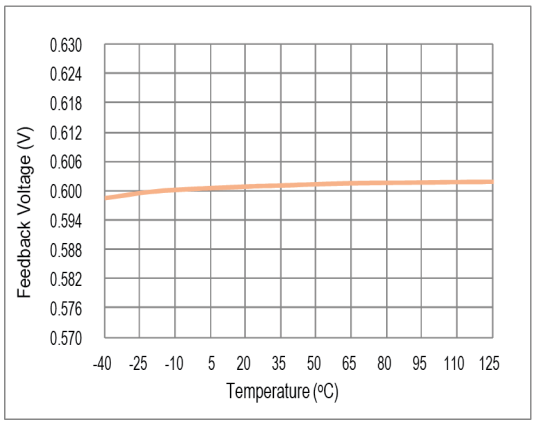


Fig. 6: Feedback Voltage vs. Temperature

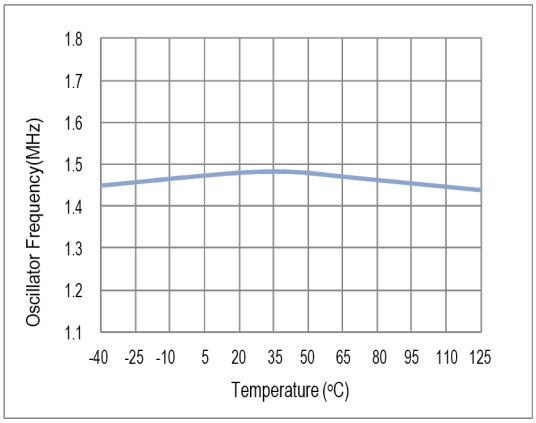


Fig. 7: Oscillator Frequency vs Temperature

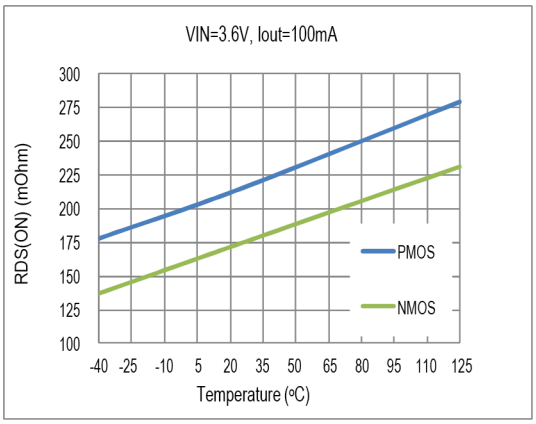


Fig. 8: $R_{DS(ON)}$ vs Temperature

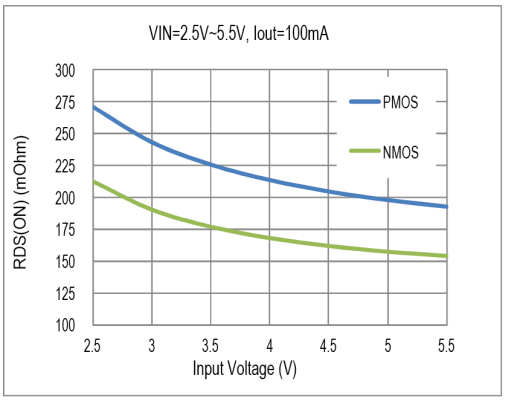


Fig. 9: $R_{DS(ON)}$ vs Input Voltage

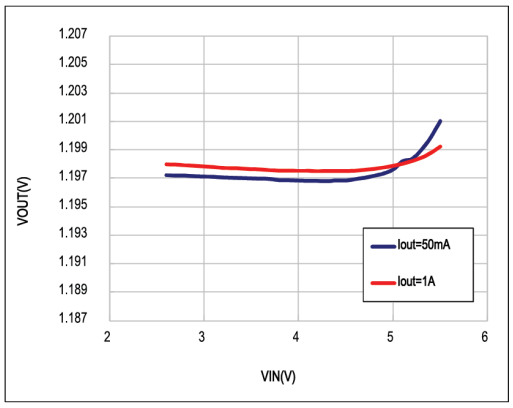


Fig. 10: Line Regulation

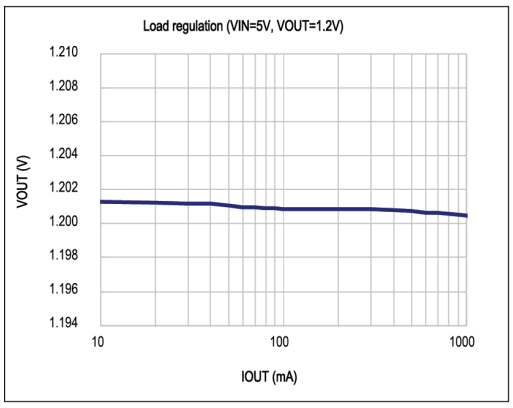


Fig. 11: Load Regulation

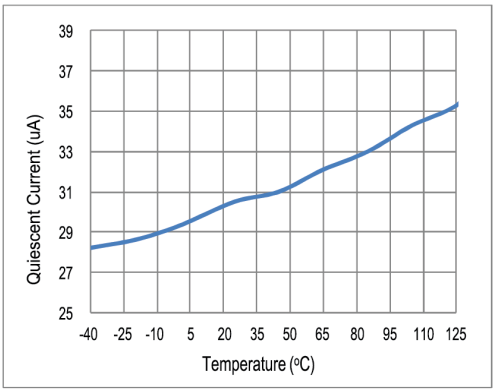


Fig. 12: Quiescent Current vs Temperature

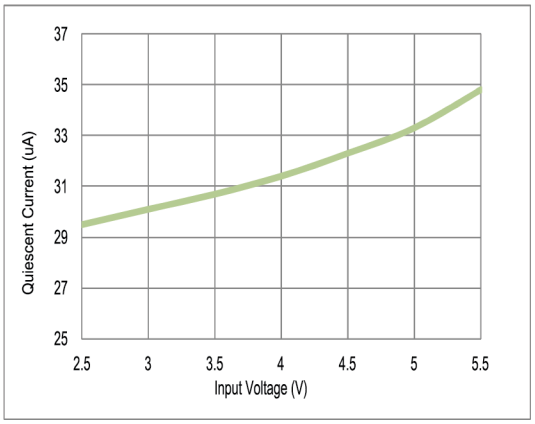


Fig. 13: Quiescent Current vs Input Voltage

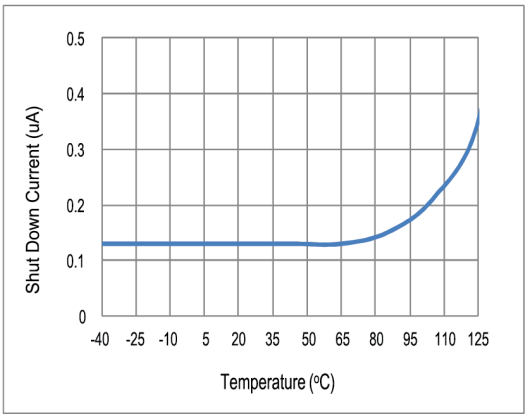


Fig. 14: Shutdown Current vs Temperature

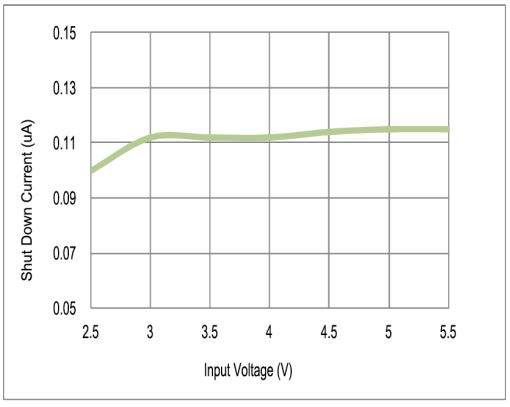


Fig. 15: Shutdown Current vs Input Voltage

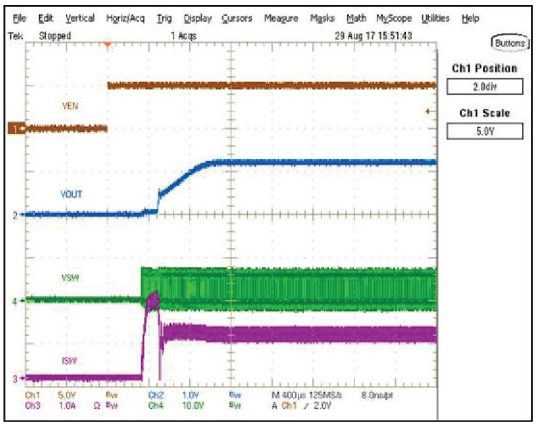


Fig. 16: Enable From EN Pin (V_{IN}=5V, I_{OUT}=1A)

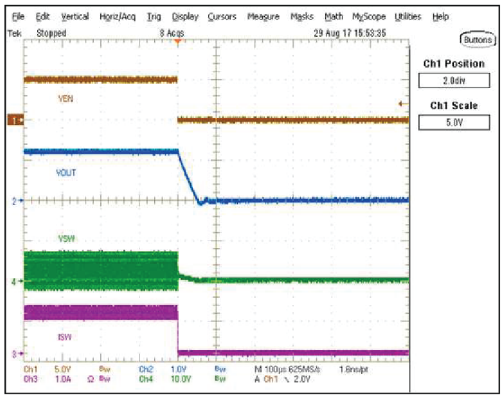


Fig. 17: Disable From EN Pin (V_{IN}=5V, I_{OUT}=1A)

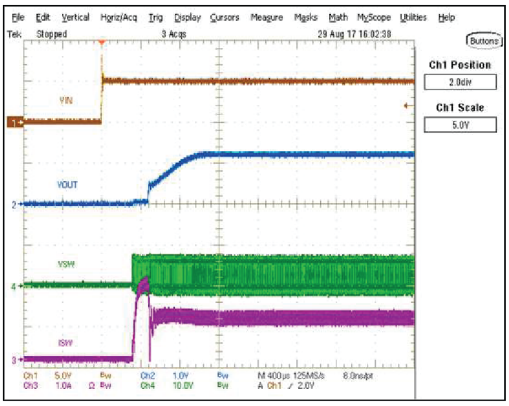


Fig. 18: Power-On From V_{IN} Pin (V_{IN}=5V, I_{OUT}=1A)

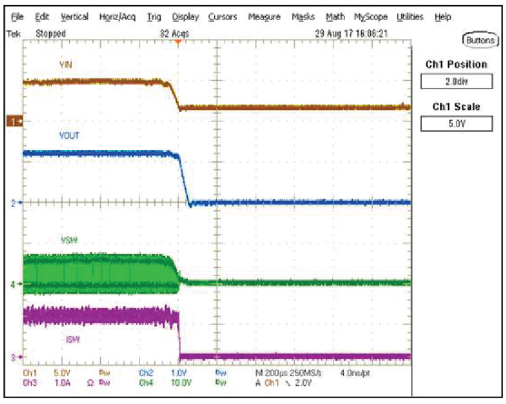


Fig. 19: Power-Off From V_{IN} Pin (V_{IN}=5V, I_{OUT}=1A)

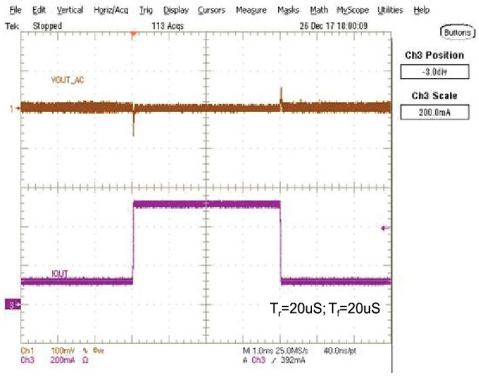


Fig. 20: Load Step Response
V_{OUT}=1.2V, I_{OUT} From 100mA to 500mA

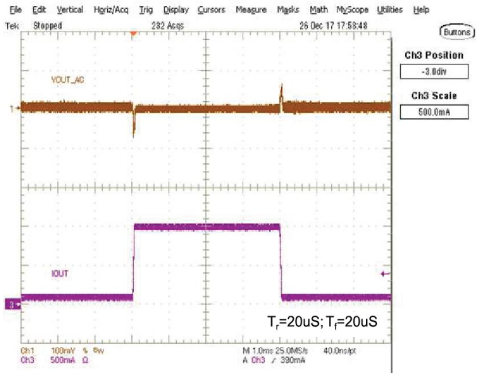


Fig. 21: Load Step Response
V_{OUT}=1.2V, I_{OUT} From 100mA to 1A

THEORY OF OPERATION

The typical application circuit of adjustable version is shown in figure 22.

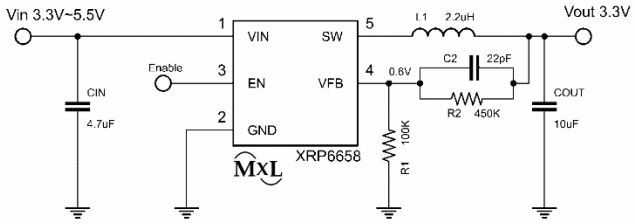


Fig. 22: Typical Application

INDUCTOR SELECTION

Inductor ripple current and saturation current rating are two factors to be considered when selecting the inductor value. A low DCR inductor is preferred.

The inductor value L can be calculated from the following equation:

$$L = (V_{IN} - V_{OUT}) \times \left(\frac{V_{OUT}}{V_{IN}}\right) x \left(\frac{1}{f}\right) x \left(\frac{1}{\Delta IL}\right)$$

C_{IN} AND C_{OUT} SELECTION

A low ESR input capacitor can minimize the input voltage ripple. Voltage rating of the capacitor should be at least 50% higher than the input voltage. The RMS current of the input capacitor is required to be larger than the I_{RMS} calculated by:

$$I_{RMS} \cong I_{OMAX} \frac{\sqrt{V_{OUT}(V_{IN} - V_{OUT})}}{V_{IN}}$$

The ESR value is an important parameter to consider when selecting an output capacitor C_{OUT}. The output ripple V_{OUT} is determined by:

$$\Delta V_{OUT} \cong \Delta I_L \left(ESR + \frac{1}{8 \times f \times C_{OUT}}\right)$$

The output capacitor's value can be optimized for very low output voltage ripple and small circuit size. Voltage rating of the capacitor should be at least 50% higher than the output voltage. Higher values, lower cost ceramic capacitors are now available in smaller sizes. These ceramic capacitors have high ripple currents, high voltage ratings and low ESR that make them ideal for switching regulator applications.

It is recommended to use X5R or X7R ceramic capacitors as they have the best temperature and voltage characteristics.

OUTPUT VOLTAGE SELECTION

The output voltage is adjustable via the external resistor network R1 and R2 as per the following formula:

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R2}{R1}\right)$$

where, V_{REF} is the reference voltage at 0.6V.

The feedback resistors must be chosen such that power dissipation of the network is minimal. R1 must be selected within the range of 80kΩ≤ R1 ≤120kΩ. R2 is selected based on the above equation.

THERMAL CONSIDERATIONS

Although thermal shutdown is built-in in XRP6658 to protect the device from thermal damage, the total power dissipation that XRP6658 can sustain is based on the package thermal capability. The formula to ensure safe operation is shown in Note 1. To avoid XRP6658 from exceeding the maximum junction temperature, some thermal analysis is required.

GUIDELINES FOR PCB LAYOUT

To ensure proper operation of the XRP6658, please note the following PCB layout guidelines:

1. The GND, SW and VIN traces should be kept short, direct and wide.

2. VFB pin must be connected directly to the feedback resistors. Resistive divider R1/R2 must be connected in parallel to the output capacitor C_{OUT}.

3. The input capacitor C_{IN} must be as close as possible to pin VIN.

4. Keep SW node away from the sensitive VFB node since SW signal experiences high frequency voltage swings.

TYPICAL APPLICATIONS

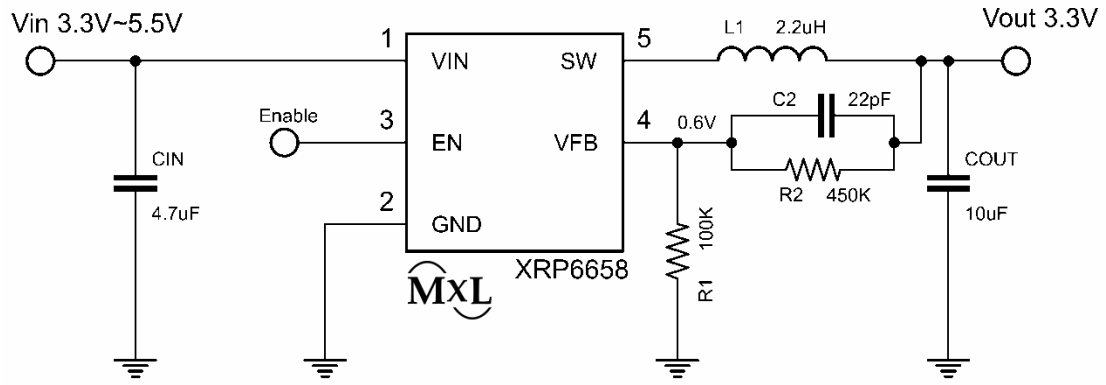


Fig. 23: 3.3V/5.5V to 3.3V Conversion

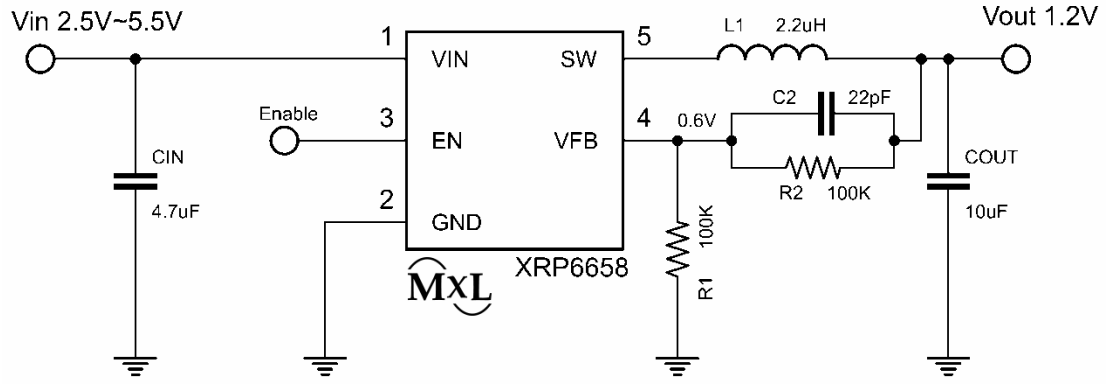
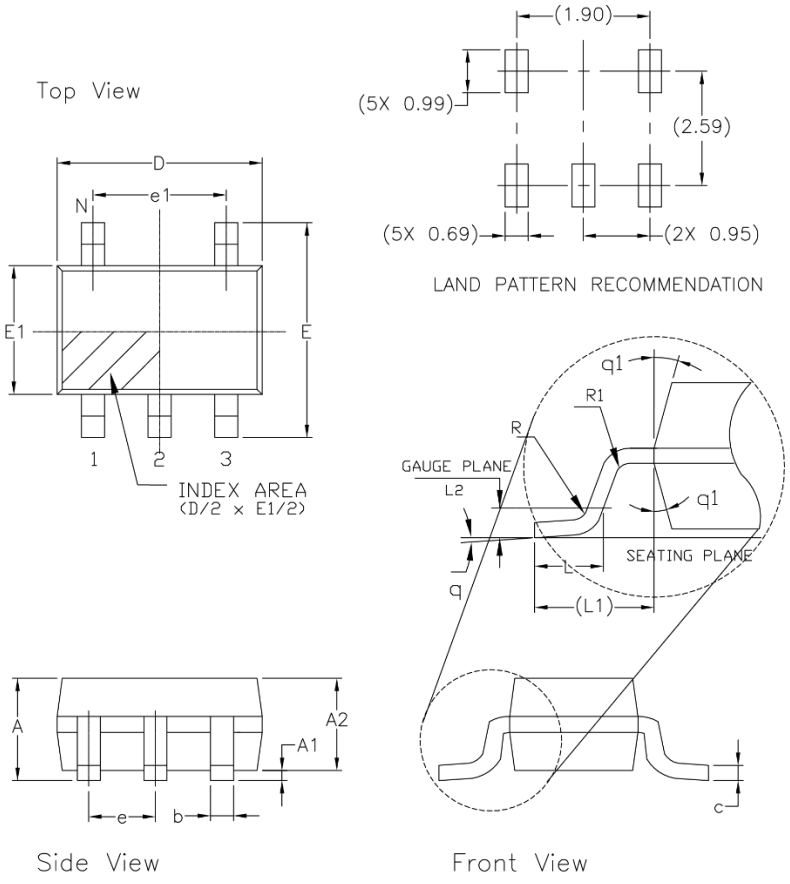


Fig. 24: 2.5V/5.5V to 1.2V Conversion

PACKAGE SPECIFICATION

5-PIN SOT23

FOR REFERENCE ONLY



5 Pin SOT-23 JEDEC MO-178 Variation AA						
SYMBOLS	DIMENSIONS IN MM (Control Unit)			DIMENSIONS IN INCH (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	—	—	1.45	—	—	0.057
A1	0.00	—	0.15	0.000	—	0.006
A2	0.90	1.15	1.30	0.036	0.045	0.051
b	0.30	—	0.50	0.012	—	0.020
c	0.08	—	0.22	0.003	—	0.009
D	2.90 BSC			0.115 BSC		
E	2.80 BSC			0.111 BSC		
E1	1.60 BSC			0.063 BSC		
e	0.95 BSC			0.038 BSC		
e1	1.90 BSC			0.075 BSC		
L	0.30	0.45	0.60	0.012	0.018	0.024
L1	0.60 REF			0.024 REF		
L2	0.25 BSC			0.010 BSC		
R	0.10	—	—	0.004	—	—
R1	0.10	—	0.25	0.004	—	0.010
q	0°	4°	8°	0°	4°	8°
q1	5°	10°	15°	5°	10°	15°
N	5			5		

Drawing No: POD-00000025
Revision: B

REVISION HISTORY

Revision	Date	Description
1.0.0	09/16/2010	Initial release of datasheet
1.1.0	09/30/2010	Corrected pin-out on schematics Figures 1, 23 and 24.
1.2.0	11/15/2010	Corrected ΔV_{OUT} equation: changed V_{OUT} to C_{OUT}. Updated 'Output Voltage selection' section.
1.3.0	01/14/2011	Added specific test conditions and data in Electrical Specification Table for output voltage accuracy, reference voltage Line regulation and output voltage line regulation for operations below 3V.
1.4.0	07/19/2011	Corrected typographical errors on package specification table parameters "b" and "e".
1.5.0	0/15/2011	Added a range for the selection of lower feedback resistor.
1.6.0	1/13/2014	Added "Junction Temperature Range T_J……-40°C to 125°C" to operating ratings; In "Ordering Information" changed the temperature range to "-40°C≤T_J≤+125°C".
2.0.0	01/07/2020	Updated to MaxLinear logo. Updated Ordering Information. Updated I_Q, $R_{DS(ON)}$, feedback current and UVLO. Updated graphs. Updated ESD rating.

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