2.5A, 18V Synchronous Rectified Step-Down Converter

UM5483S *SOT23-6*
UM5483SB *SOT23-6*

General Description

The UM5483 is a monolithic synchronous buck regulator. The device integrates two 100mΩ MOSFETs, and provides 2.5A of continuous load current over a wide input voltage of 4.75V to 18V. Current mode control provides fast transient response and cycle-by-cycle current limit.

The device, available in SOT23-6 package, provides a very compact solution with minimal external components.

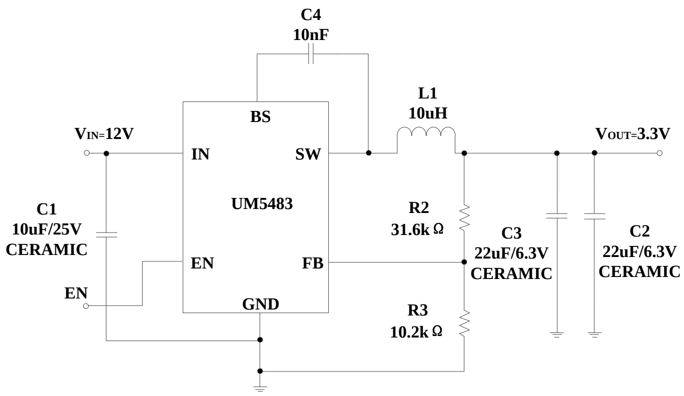
Applications

- Distributed Power Systems
- Networking Systems
- FPGA, DSP, ASIC Power Supplies
- Green Electronics/ Appliances
- Notebook Computers

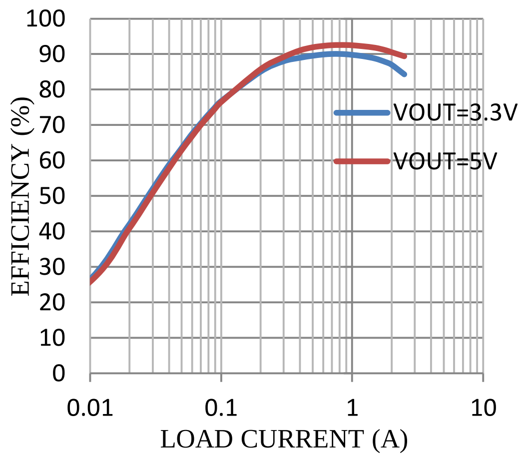
Features

- 1% Feedback Voltage Accuracy
- Fast Soft-Start
- Wide 4.75V to 18V Operating Input Range
- Integrated 100mΩ Power MOSFET Switches
- Output Adjustable from 0.8V to 15V
- Up to 92.5% Efficiency
- Stable with Low ESR Ceramic Output Capacitors
- Fixed 340kHz Frequency
- Cycle-by-Cycle Over Current Protection
- Input Under Voltage Lockout
- SOT23-6 package

Typical Application Circuit



Efficiency vs Load Current

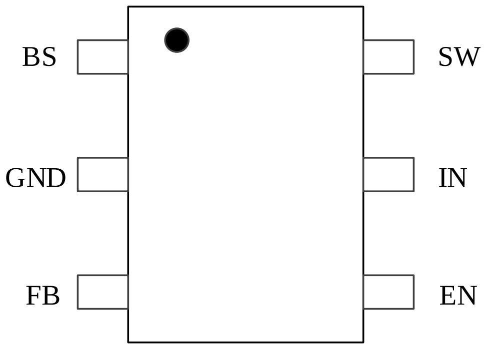


Ordering Information

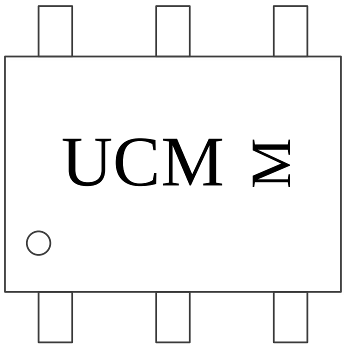
Part Number	Temp. Range	Mark Code	Package Type	Shipping Qty
UM5483S	-40 ℃ to +85 ℃	UCM	SOT23-6	3000pcs/7 Inch Tape & Reel
UM5483SB	-40 ℃ to +85 ℃	UCL	SOT23-6	3000pcs/7 Inch Tape & Reel

Pin Configurations

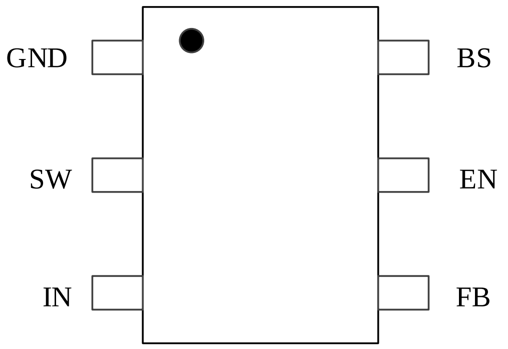
Top View



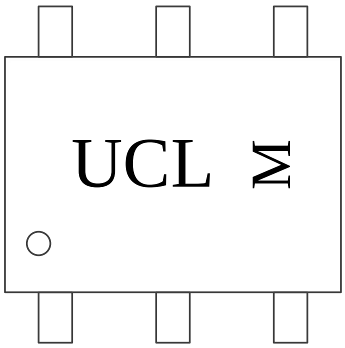
UM5483S



M:Month Code
UM5483S
SOT23-6



UM5483SB



M:Month Code
UM5483SB
SOT23-6

Pin Description

Pin No.		Pin Name	Function
UM5483S	UM5483SB		
1	6	BS	Boot-strap pin. Supply high side gate driver. Connect a 10nF ceramic capacitor between BS and SW pin.
2	1	GND	Power ground pin.
3	4	FB	Output feedback pin. Connect this pin to the center point of the output resistor divider to program the output voltage.
4	5	EN	Enable control. Pull high to turn on. Do not leave this pin floating. Connect a 100k pull-up resistance between EN and IN when EN is connected to IN.
5	3	IN	Input pin. Decouple this pin to GND pin with at least a 10μF ceramic capacitor.
6	2	SW	Inductor pin. Connect this pin to the switching node of inductor.

Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Value	Unit
V_{IN}	Supply Voltage on V_{IN}	-0.3 to +19	V
V_{SW}	Voltage on SW pin	-0.3 to +20	V
V_{BS}	Voltage on BS pin	V_{SW} -0.3 to V_{SW} +5.5	V
V_{EN}	Voltage on EN pin	-0.3 to +18	V
V_{FB}	Voltage on FB pin	-0.3 to +5.5	V
T_J	Junction Temperature Range	-40 to +150	℃
T_{STG}	Storage Temperature Range	-65 to +150	℃
T_L	Maximum Lead Temperature for Soldering 10 Seconds	+260	℃

Note 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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Symbol	Parameter	Value	Unit
V_{IN}	Input Voltage	4.75 to 18	V
V_{EN}	EN Voltage	2 to V_{IN}	V
V_{OUT}	Output Voltage	0.8 to 15	V
T_A	Operating Temperature Range	-40 to +85	℃

Thermal Information

Symbol	Parameter		Value	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance	SOT23-6	173	℃/W

Electrical Characteristics

(V_{IN} = 12V, T_A = +25 ℃, unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Shutdown Supply Current		V_{EN}=0V		1	3.0	μA
Supply Current		V_{EN}=2.0V; V_{FB}=1.2V		0.5	1.5	mA
Feedback Voltage	V_{FB}	4.75V ≤ V_{IN} ≤ 18V	0.792	0.8	0.808	V
Feedback Overvotage Threshold				1.1		V
High-Side Switch On Resistance (1)	$R_{DS(ON)1}$			100		mΩ
Low-Side Switch On Resistance (1)	$R_{DS(ON)2}$			100		mΩ
High-Side Switch Leakage Current		V_{EN}=0V; V_{SW}=0V			10	μA
Upper Switch Current Limit		Minimum Duty Cycle	2.4	3.4		A
Lower Switch Current Limit		From Drain to Source		1.1		A
Oscillation Frequency	F_{OSC1}		305	340	375	KHz
Short Circuit Oscillation Frequency	F_{OSC2}	V_{FB}=0V		34		KHz
Maximum Duty Cycle	D_{MAX}	V_{FB}=0.72V		90		%
Minimum On Time (1)				138		ns
EN Shutdown Threshold Voltage		V_{EN} Rising	1	1.2	1.4	V
EN Shutdown Threshold Voltage Hysteresis				140		mV
EN Lockout Threshold Voltage			1.6	1.8	2	V
EN Lockout Threshold Voltage Hysteresis				210		mV
Input Under Voltage Lockout Threshold		V_{IN} Rising	3.80	4.10	4.40	V
Input Under Voltage Lockout Threshold Hysteresis				210		mV
Soft-Start Period				1.5		ms
Thermal Shutdown (1)				160		℃

Note 1:
Guaranteed by design, not tested

Typical Performance Characteristics

(V_{IN} = 12V, V_O = 3.3V, L = 10μH, C1 = 10μF, C2 = 22μF, C3 = 22μF, T_A = +25℃, unless otherwise noted.)

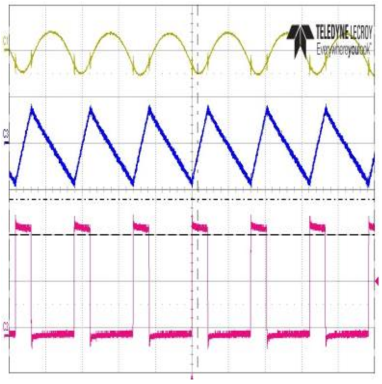
Steady State Test

V_{IN}=12V, V_{OUT}=3.3V , I_{IN}=8.1mA

V_{OUT} 20mV/div

I_L 0.5A/div

V_{SW} 5V/div



2μs/div

Startup through Enable

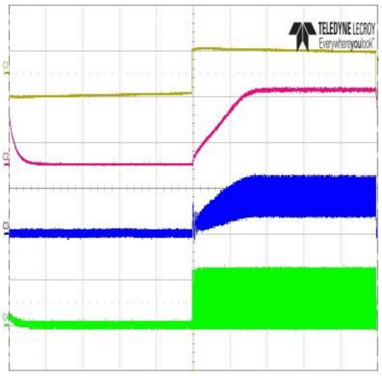
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=1A(Resistance Load)

V_{EN} 2V/div

V_{OUT} 2V/div

I_L 1A/div

V_{SW} 10V/div



1ms/div

Startup through Enable

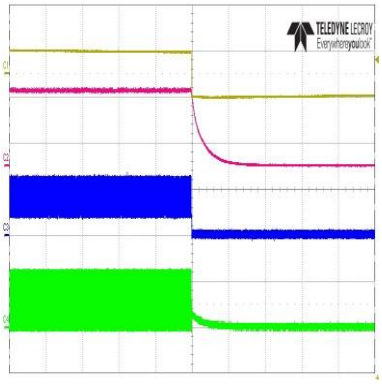
V_{IN}=12V, V_{OUT}=3. 3V, I_{OUT}=1A(Resistance Load)

V_{EN} 2V/div

V_{OUT} 2V/div

I_L 1A/div

V_{SW} 10V/div



0.5ms/div

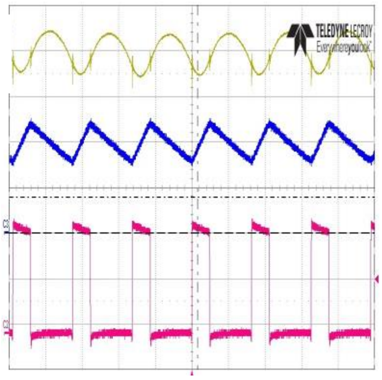
Heavy Load Operation

2A Load

V_{OUT} 20mV/div

I_L 1A/div

V_{SW} 5V/div



2μs/div

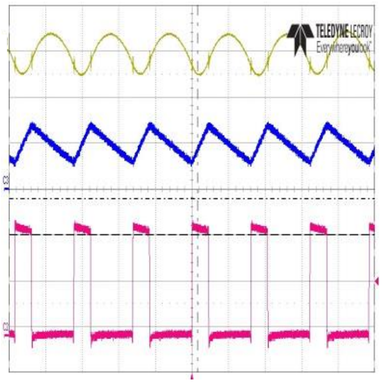
Medium Load Operation

1A Load

V_{OUT} 20mV/div

I_L 1A/div

V_{SW} 5V/div



2μs/div

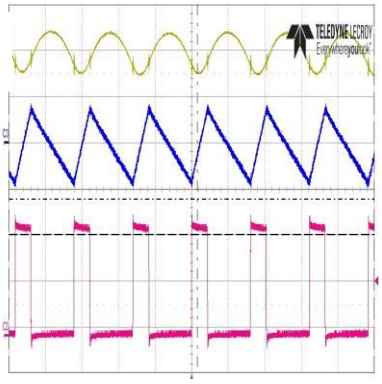
Light Load Operation

No Load

V_{OUT} 20mV/div

I_L 0.5A/div

V_{SW} 5V/div

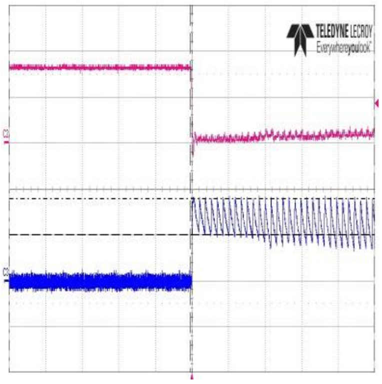


2μs/div

Short Circuit Protection

V$_{OUT}$ 2V/div

I$_{L}$ 2A/div

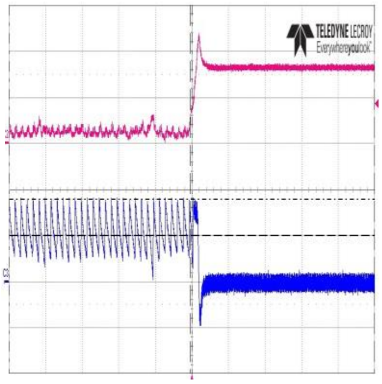


200µs/div

Short Circuit Recovery

V$_{OUT}$ 2V/div

I$_{L}$ 2A/div

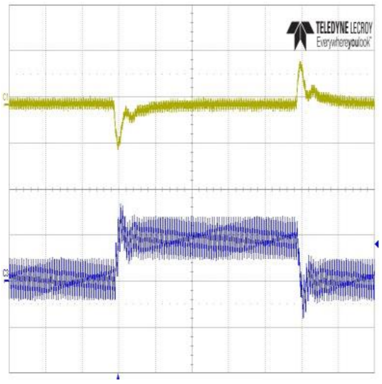


200µs/div

Load Transient

V$_{OUT}$ 200mV/div

I$_{L}$ 1A/div

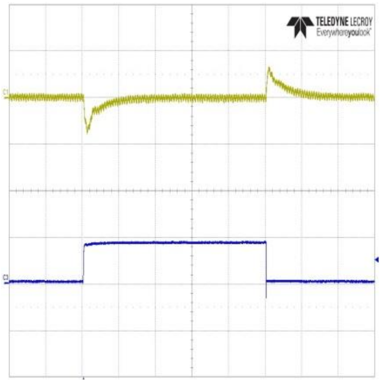


50µs/div

Load Transient

V$_{OUT}$ 200mV/div

I$_{LOAD}$ 1A/div



50µs/div

Operation Functional Description

The UM5483 is a synchronous rectified, current-mode, step-down regulator. It regulates input voltages from 4.75V to 18V down to an output voltage as low as 0.8V, and supplies up to 2.5A of load current.

The UM5483 uses current-mode control to regulate the output voltage. The output voltage is measured at FB through a resistive voltage divider and amplified through the internal transconductance error amplifier.

The converter uses internal N-Channel MOSFET switches to step-down the input voltage to the regulated output voltage. Since the high side MOSFET requires a gate voltage greater than the input voltage, a boost capacitor connected between SW and BS is needed to drive the high side gate. The boost capacitor is charged from the internal 5V rail when SW is low.

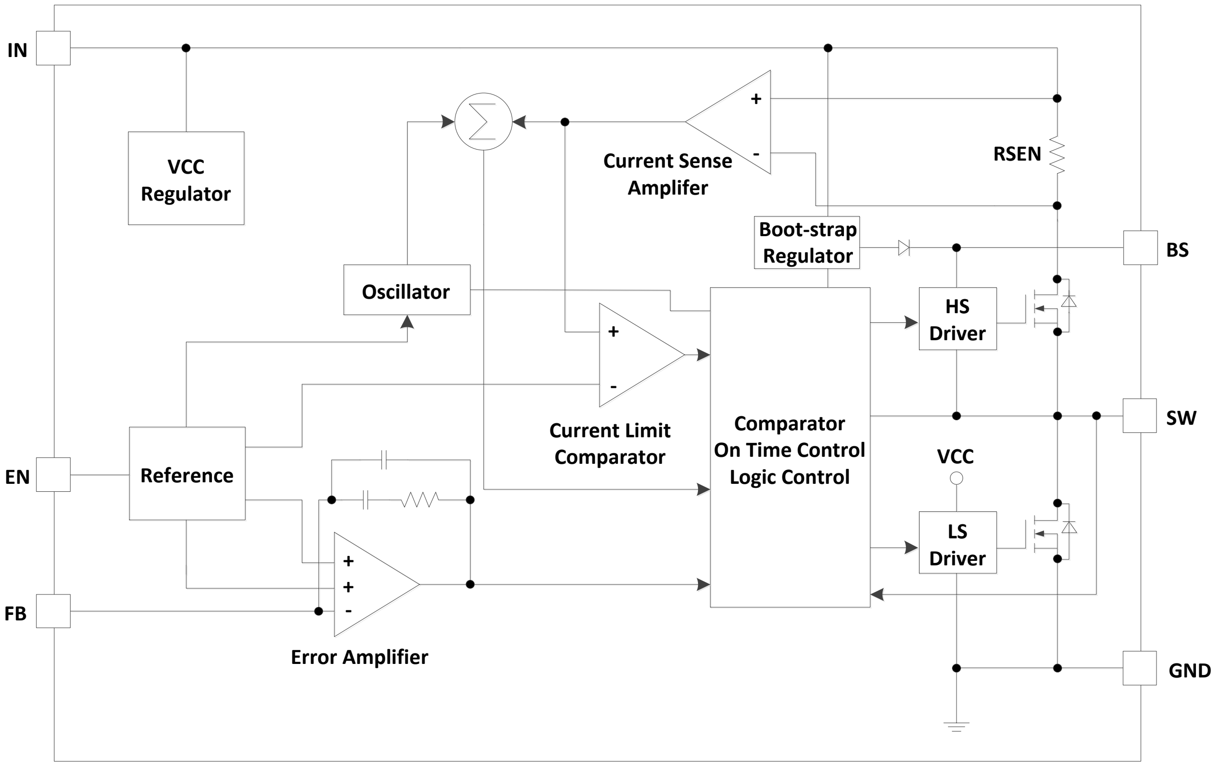


Figure 1.Functional Block Diagram

Application Information

Component Selection

Setting the Output Voltage

The output voltage is set using a resistive voltage divider from the output voltage to FB pin. The voltage divider divides the output voltage down to the feedback voltage by the ratio:

$$V_{FB} = V_{OUT}\ \frac{R2}{R1+R2}$$

Where V_{FB} is the feedback voltage and V_{OUT} is the output voltage. Thus the output voltage is:

$$V_{OUT} = 0.8 \times \frac{R1+R2}{R2}$$

Inductor

The inductor is required to supply constant current to the output load while being driven by the switched input voltage. A larger value inductor will result in less ripple current that will result in lower output ripple voltage. However, the larger value inductor will have a larger physical size, higher series resistance, and/or lower saturation current. A good rule for determining the inductance to use is to allow the peak-to-peak ripple current in the inductor to be approximately 30% of the maximum switch current limit. Also, make sure that the peak inductor current is below the maximum switch current limit.

The inductance value can be calculated by:

$$L = \frac{V_{OUT}}{f_S \times \Delta I_L} \times (1 - \frac{V_{OUT}}{V_{IN}})$$

Where V_{OUT} is the output voltage, V_{IN} is the input voltage, f_S is the switching frequency, and ΔI_L is the peak-to-peak inductor ripple current.

Choose an inductor that will not saturate under the maximum inductor peak current. The peak inductor current can be calculated by:

$$I_{LP} = I_{LOAD} + \frac{V_{OUT}}{2 \times f_S \times L} \times (1 - \frac{V_{OUT}}{V_{IN}})$$

Where I_{LOAD} is the load current.

The choice of which style inductor to use mainly depends on the price vs. size requirements and any EMI requirements.

Input Capacitor

The input current to the step-down converter is discontinuous, therefore a capacitor is required to supply the AC current to the step-down converter while maintaining the DC input voltage. Use low ESR capacitors for the best performance. Ceramic capacitors are preferred, but tantalum or low-ESR electrolytic capacitors may also suffice. Choose X5R or X7R dielectrics when using ceramic capacitors.

Since the input capacitor (C1) absorbs the input switching current it requires an adequate ripple current rating. The RMS current in the input capacitor can be estimated by:

$$I_{C1} = I_{LOAD} \times \sqrt{\frac{V_{OUT}}{V_{IN}} \times (1 - \frac{V_{OUT}}{V_{IN}})}$$

The worst-case condition occurs at $V_{IN} = 2V_{OUT}$, where $I_{C1} = I_{LOAD}/2$. For simplification, choose the input capacitor whose RMS current rating greater than half of the maximum load current.

The input capacitor can be electrolytic, tantalum or ceramic. When using electrolytic or tantalum capacitors, a small, high quality ceramic capacitor, i.e. 0.1μF, should be placed as close to the IC as possible. When using ceramic capacitors, make sure that they have enough capacitance to provide sufficient charge to prevent excessive voltage ripple at input. The input voltage ripple for low ESR capacitors can be estimated by:

$$\Delta V_{IN} = \frac{I_{LOAD}}{C1 \times f_S} \times \frac{V_{OUT}}{V_{IN}} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

Where C1 is the input capacitance value.

Output Capacitor

The output capacitor is required to maintain the DC output voltage. Ceramic, tantalum, or low ESR electrolytic capacitors are recommended. Low ESR capacitors are preferred to keep the output voltage ripple low. The output voltage ripple can be estimated by:

$$\Delta V_{OUT} = \frac{V_{OUT}}{f_S \times L} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right) \times \left(R_{ESR} + \frac{1}{8 \times f_S \times C2}\right)$$

Where C2 is the output capacitance value and R_{ESR} is the equivalent series resistance (ESR) value of the output capacitor.

In the case of ceramic capacitors, the impedance at the switching frequency is dominated by the capacitance. The output voltage ripple is mainly caused by the capacitance. For simplification, the output voltage ripple can be estimated by:

$$\Delta V_{OUT} = \frac{V_{OUT}}{8 \times f_S^2 \times L \times C2} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

In the case of tantalum or electrolytic capacitors, the ESR dominates the impedance at the switching frequency. For simplification, the output ripple can be approximated to:

$$\Delta V_{OUT} = \frac{V_{OUT}}{f_S \times L} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right) \times R_{ESR}$$

The characteristics of the output capacitor also affect the stability of the regulation system. The UM5483 can be optimized for a wide range of capacitance and ESR values.

Typical Application Circuit

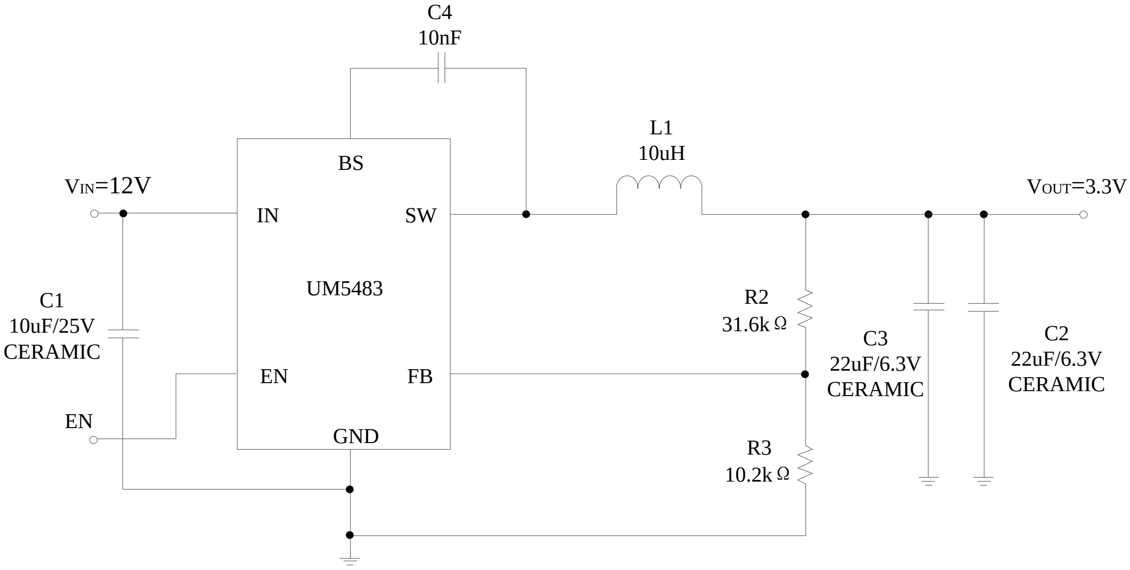
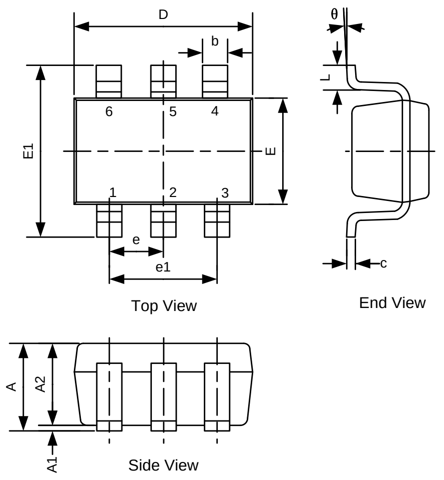


Figure 2.UM5483 with 3.3V Output, 22µF/6.3V Ceramic Output Capacitor

Package Information

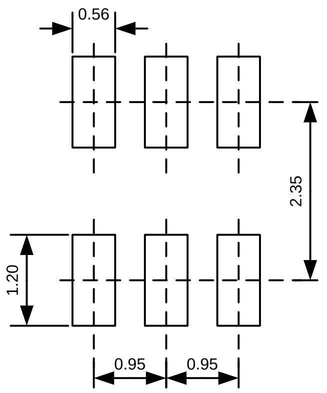
UM5483S SOT23-6

Outline Drawing



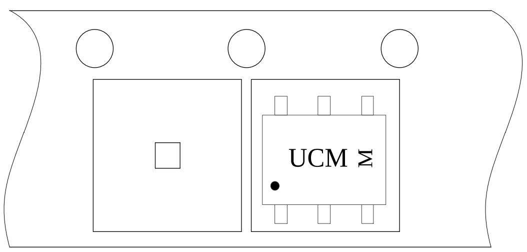
Symbol	DIMENSIONS MILLIMETERS Min	Typ	Max	INCHES Min	Typ	Max
A	1.013	1.15	1.40	0.040	0.045	0.055
A1	0.00	0.05	0.10	0.000	0.002	0.004
A2	1.00	1.10	1.30	0.039	0.043	0.051
b	0.30	-	0.50	0.012	-	0.020
c	0.10	0.15	0.20	0.004	0.006	0.008
D	2.82	-	3.10	0.111	-	0.122
E	1.50	1.60	1.70	0.059	0.063	0.067
E1	2.60	2.80	3.00	0.102	0.110	0.118
e	0.95REF			0.037REF		
e1	1.90REF			0.075REF		
L	0.30	-	0.60	0.012	-	0.024
θ	0 °	-	8 °	0 °	-	8 °

Land Pattern



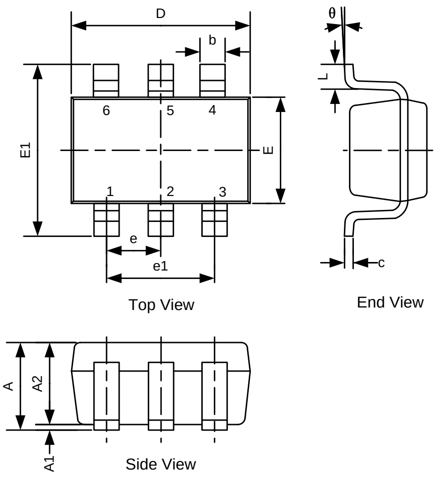
NOTES:
1. Compound dimension: 2.92×1.60.
2. Unit: mm.
3. General tolerance ±0.05mm unless otherwise specified.
4. The layout is just for reference.

Tape and Reel Orientation



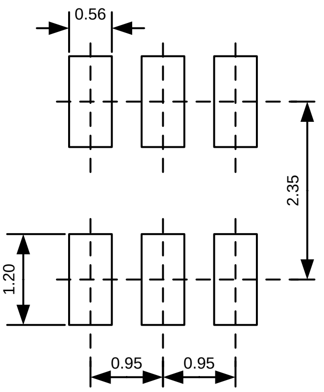
UM5483SB SOT23-6

Outline Drawing



Symbol	DIMENSIONS					
	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	1.013	1.15	1.40	0.040	0.045	0.055
A1	0.00	0.05	0.10	0.000	0.002	0.004
A2	1.00	1.10	1.30	0.039	0.043	0.051
b	0.30	-	0.50	0.012	-	0.020
c	0.10	0.15	0.20	0.004	0.006	0.008
D	2.82	-	3.10	0.111	-	0.122
E	1.50	1.60	1.70	0.059	0.063	0.067
E1	2.60	2.80	3.00	0.102	0.110	0.118
e	0.95REF			0.037REF		
e1	1.90REF			0.075REF		
L	0.30	-	0.60	0.012	-	0.024
θ	0°	-	8°	0°	-	8°

Land Pattern



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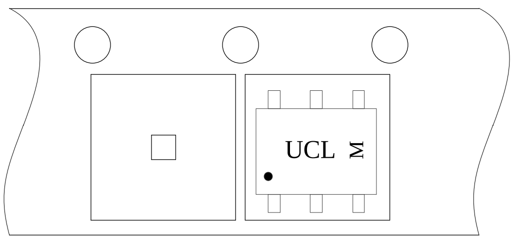
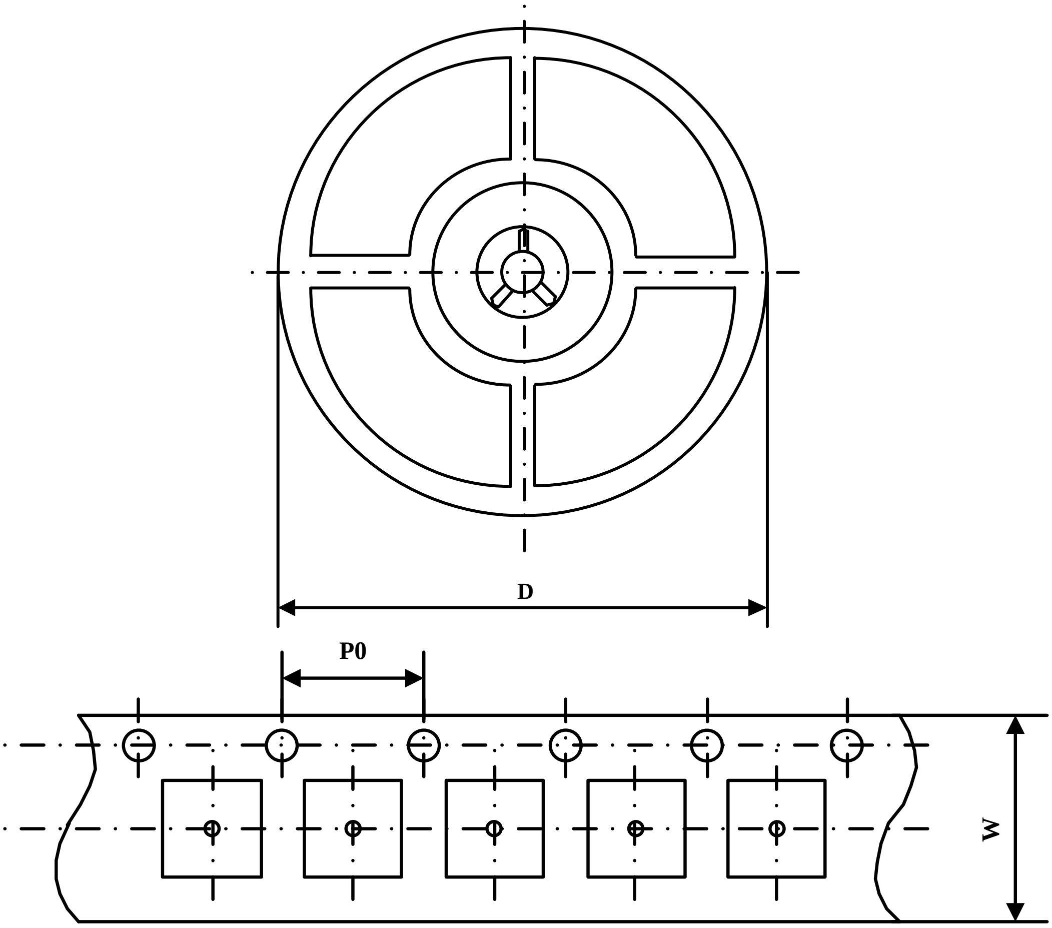
Tape and Reel Orientation



Packing Information



Part Number	Package Type	Carrier Width(W)	Pitch(P0)	Reel Size(D)
UM5483S	SOT23-6	8 mm	4 mm	180 mm
UM5483SB	SOT23-6	8 mm	4 mm	180 mm

GREEN COMPLIANCE

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http://www.union-ic.com/index.aspx?cat_code=RoHSDeclaration

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