

340kHz, 2A Synchronous DC-DC Buck Converter**AP3502****General Description**

The AP3502 is a 340kHz fixed frequency, current mode, PWM synchronous buck (step-down) DC-DC converter, capable of driving a 2A load with high efficiency, excellent line and load regulation. The device integrates N-channel power MOSFET switches with low on-resistance. Current mode control provides fast transient response and cycle-by-cycle current limit.

The over output voltage protection is equipped in AP3502, which protects the IC under open load condition. The AP3502 includes UVLO, programmable soft-start and OTP to protect the circuit.

This IC is available in SOIC-8 package.

Features

- Input Voltage Range: 4.75V to 18V
- Fixed 340kHz Frequency
- High Efficiency: up to 93%
- Output Current: 2A
- Current Mode Control
- Built-in Over Current Protection
- Built-in Thermal Shutdown Function
- Built-in UVLO Function
- Built-in Over Voltage Protection
- Programmable Soft-start

Applications

- LCD TV
- Set Top Box
- Portable DVD
- Digital Photo Frame



Figure 1. Package Type of AP3502

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Pin Configuration

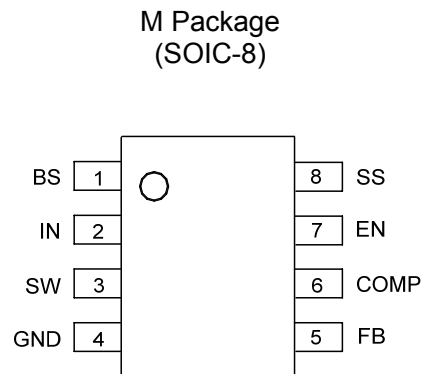


Figure 2. Pin Configuration of AP3502 (Top View)

Pin Description

Pin Number	Pin Name	Function
1	BS	Bootstrap pin. A bootstrap capacitor is connected between the BS pin and SW pin. The voltage across the bootstrap capacitor drives the internal high-side power MOSFET
2	IN	Supply input pin. A capacitor should be connected between the IN pin and GND pin to keep the input voltage constant
3	SW	Power switch output pin. This pin is connected to the inductor and bootstrap capacitor
4	GND	Ground pin
5	FB	Feedback pin. This pin is connected to an external resistor divider to program the system output voltage. When the FB pin voltage exceeds 1.1V, the over voltage protection is triggered. When the FB pin voltage is below 0.3V, the oscillator frequency is lowered to realize short circuit protection
6	COMP	Compensation pin. This pin is the output of the transconductance error amplifier and the input to the current comparator. It is used to compensate the control loop. Connect a series RC network from this pin to GND. In some cases, an additional capacitor from this pin to GND pin is required
7	EN	Control input pin. Forcing this pin above 1.5V enables the IC. Forcing this pin below 0.5V shuts down the IC. When the IC is in shutdown mode, all functions are disabled to decrease the supply current below 1μA
8	SS	Soft-start control input pin. SS controls the soft start period. Connect a capacitor from SS to GND to set the soft-start period. A 0.1μF capacitor sets the soft-start period to 10ms. To disable the soft-start feature, leave SS unconnected

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Functional Block Diagram

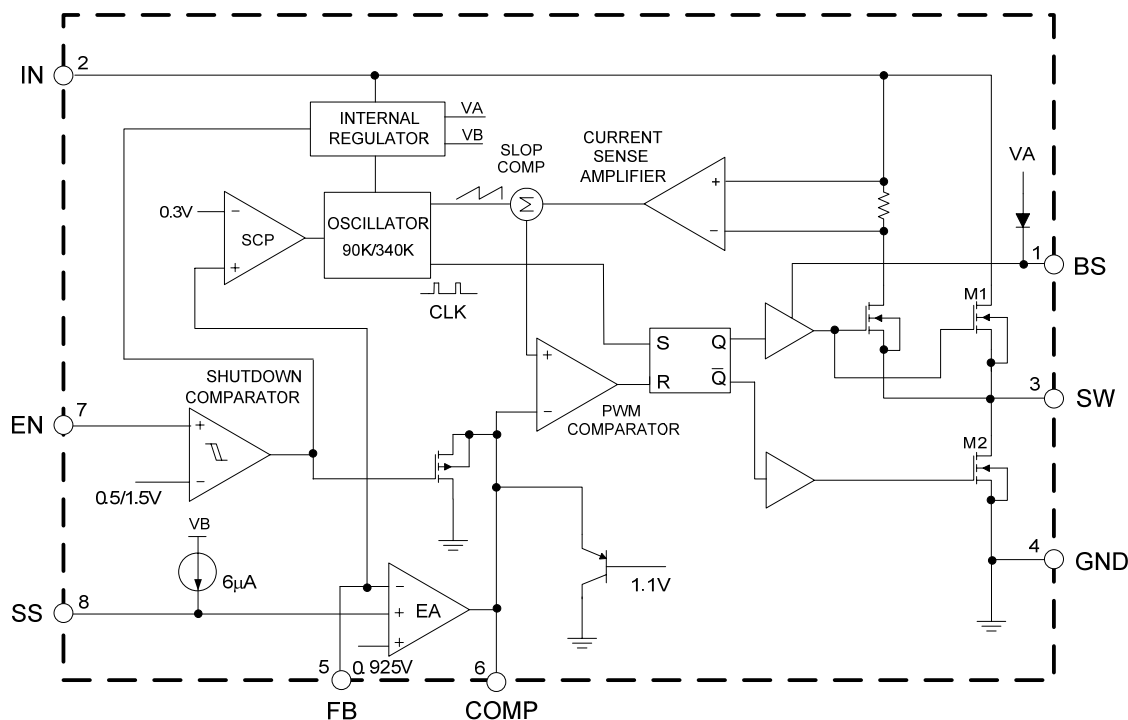
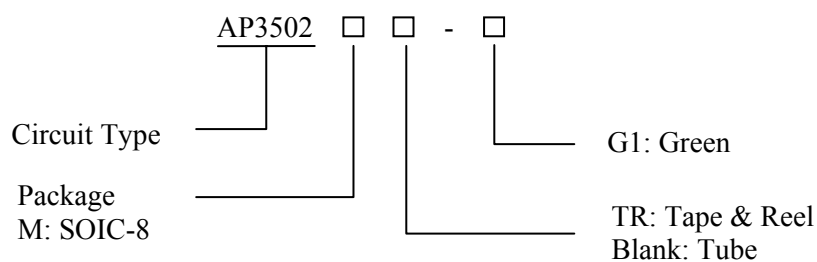


Figure 3. Functional Block Diagram of AP3502

Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing Type
SOIC-8	-40 to 85°C	AP3502M-G1	3502M-G1	Tube
		AP3502MTR-G1	3502M-G1	Tape & Reel

BCD Semiconductor's Pb-free products, as designated with "G1" suffix in the part number, are RoHS compliant and green.

**340kHz, 2A Synchronous DC-DC Buck Converter****AP3502****Absolute Maximum Ratings (Note 1)**

Parameter	Symbol	Value	Unit
IN Pin Voltage	V_{IN}	-0.3 to 20	V
EN Pin Voltage	V_{EN}	-0.3 to V_{IN}	V
SW Pin Voltage	V_{SW}	21	V
BS Pin Voltage	V_{BS}	-0.3 to $V_{SW}+6$	V
FB Pin Voltage	V_{FB}	-0.3 to 6	V
COMP Pin Voltage	V_{COMP}	-0.3 to 6	V
SS Pin Voltage	V_{SS}	-0.3 to 6	V
Thermal Resistance	θ_{JA}	105	°C/W
Operating Junction Temperature	T_J	150	°C
Storage Temperature	T_{STG}	-65 to 150	°C
Lead Temperature (Soldering, 10sec)	T_{LEAD}	260	°C
ESD (Machine Model)		200	V
ESD (Human Body Model)		2000	V

Note 1: Stresses greater than 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 Ratings” for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Input Voltage	V_{IN}	4.75	18	V
Maximum Output Current	$I_{OUT(Max)}$	2		A
Operating Ambient Temperature	T_A	-40	85	°C

**340kHz, 2A Synchronous DC-DC Buck Converter****AP3502****Electrical Characteristics**

$V_{IN}=V_{EN}=12V$, $V_{OUT}=3.3V$, unless otherwise specified. Specification with standard typeface are for $T_A=25^{\circ}C$, and those in **boldface type** apply over the full operating temperature range ($T_A=-40^{\circ}C$ to $85^{\circ}C$)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Voltage	V_{IN}		4.75		18	V
Quiescent Current	I_Q	$V_{FB}=1V$, $V_{EN}=2V$		1.0	1.2	mA
Shutdown Supply Current	I_{SHDN}	$V_{EN}=0V$		0.1	10	μA
Feedback Voltage	V_{FB}		0.900	0.925	0.95	V
Feedback Over Voltage Threshold	V_{FBOV}			1.1		V
Feedback Bias Current	I_{FB}	$V_{FB}=1V$	-0.1		0.1	μA
High-side Switch On-resistance (Note 2)	$R_{DS(ON)H}$	$I_{SW}=0.2A\&0.7A$		0.12		Ω
Low-side Switch On-resistance (Note 2)	$R_{DS(ON)L}$	$I_{SW}=-0.2A\&-0.7A$		0.11		Ω
High-side Switch Leakage Current	I_{LEAKH}	$V_{IN}=18V$, $V_{EN}=0V$ $V_{SW}=0V$		0.1	10	μA
High-side Switch Current Limit	I_{LIMH}		2.7	3.5	4.3	A
Low-side Switch Current Limit	I_{LIML}	From drain to source		1.4		A
EN Pin Threshold	V_{ENH}		1.5			V
	V_{ENL}				0.5	
Input UVLO Threshold	V_{UVLO}	V_{IN} Rising	3.65	4.0	4.45	V
Input UVLO Hysteresis	V_{HYS}			0.3		V
Oscillator Frequency	F_{OSC1}		300	340	380	kHz
Short Circuit Oscillator Frequency	F_{OSC2}			90		kHz
Maximum Duty Cycle	D_{MAX}	$V_{FB}=0.85V$		90		%
Minimum Duty Cycle	D_{MIN}	$V_{FB}=1V$			0	%
Error Amplifier Voltage Gain (Note 3)	A_{EA}			400		V/V
Error Amplifier Transconductance	G_{EA}			800		$\mu A/V$
COMP to Current Sense Transconductance	G_{CS}			3.5		A/V
Thermal Shutdown (Note 3)	T_{OTSD}			160		$^{\circ}C$
Thermal Shutdown Hysteresis (Note 3)	T_{HYS}			30		$^{\circ}C$
Soft-start Time (Note 3)	t_{SS}	$C4=0.1\mu F$, $I_{OUT}=500mA$		10		ms
Soft-start Current				6		μA

Note 2: $R_{DS(ON)} = \frac{V_{SW1} - V_{SW2}}{I_{SW1} - I_{SW2}}$

Note 3: Not tested, guaranteed by design.

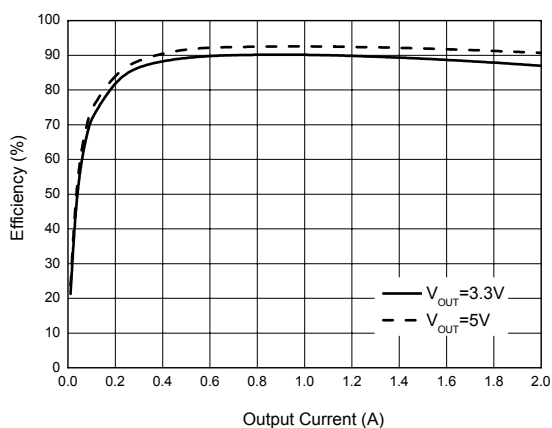
**340kHz, 2A Synchronous DC-DC Buck Converter****AP3502****Typical Performance Characteristics** $T_A=25^{\circ}\text{C}$, $V_{IN}=12\text{V}$, $V_{OUT}=3.3\text{V}$, unless otherwise noted.

Figure 4. Efficiency vs. Output Current

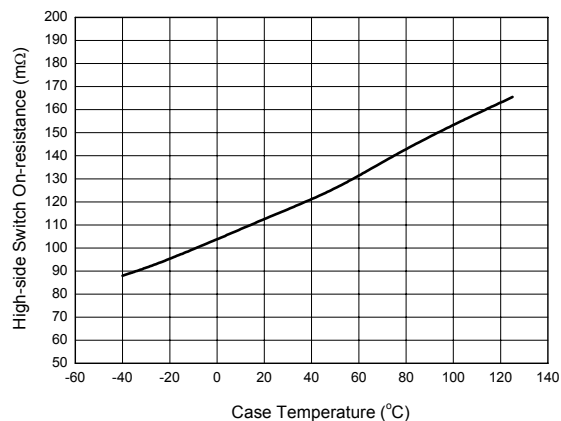
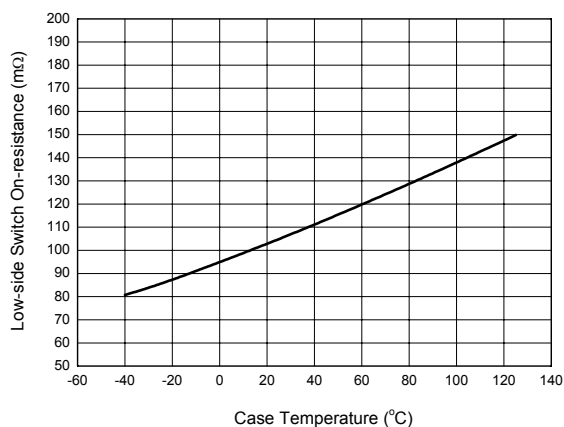
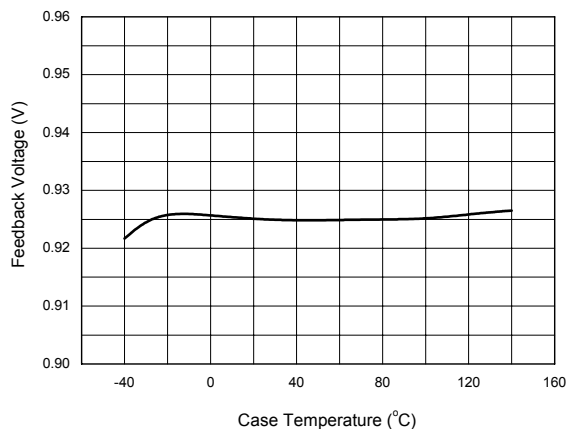
Figure 5. $R_{DS(on)}$ vs. Case TemperatureFigure 6. $R_{DS(on)}$ vs. Case Temperature

Figure 7. Feedback Voltage vs. Case Temperature

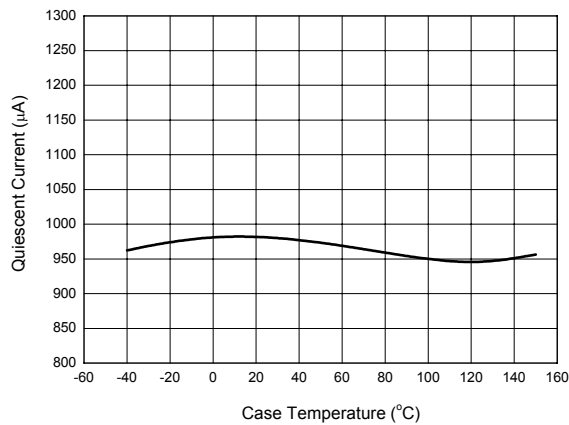
**340kHz, 2A Synchronous DC-DC Buck Converter****AP3502****Typical Performance Characteristics (Continued)** $T_A=25^{\circ}\text{C}$, $V_{\text{IN}}=12\text{V}$, $V_{\text{OUT}}=3.3\text{V}$, unless otherwise noted.

Figure 8. Quiescent Current vs. Case Temperature

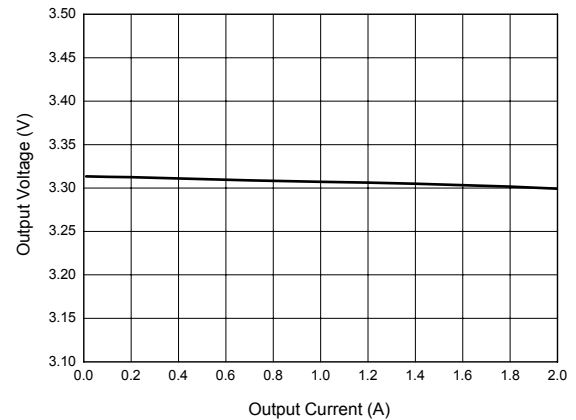
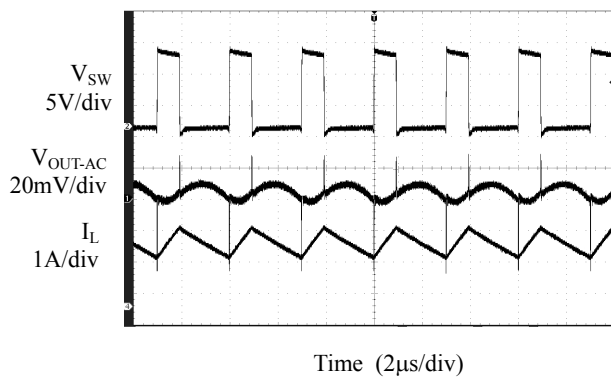
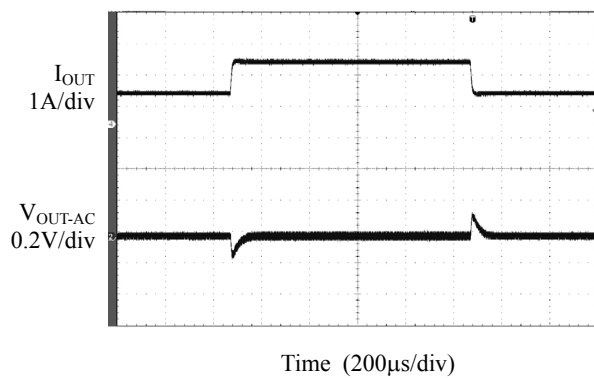


Figure 9. Output Voltage vs. Output Current

Figure 10. Output Ripple ($I_{\text{OUT}}=2\text{A}$)Figure 11. Load Transient ($I_{\text{OUT}}=1\text{A}$ to 2A)

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Typical Performance Characteristics (Continued)

$T_A=25^{\circ}\text{C}$, $V_{IN}=12\text{V}$, $V_{OUT}=3.3\text{V}$, unless otherwise noted.

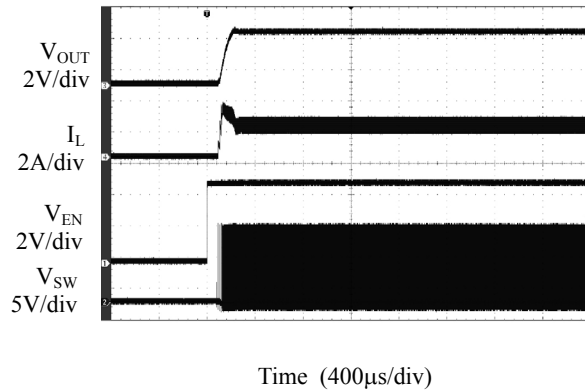


Figure 12. Enable Turn on Characteristic
(Resistance Load, $R_{LOAD}=1.6\Omega$)

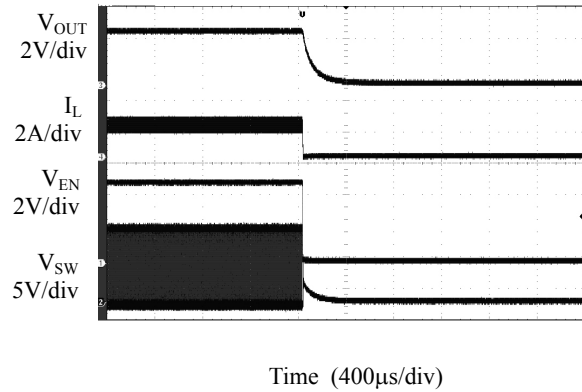


Figure 13. Enable Turn off Characteristic
(Resistance Load, $R_{LOAD}=1.6\Omega$)

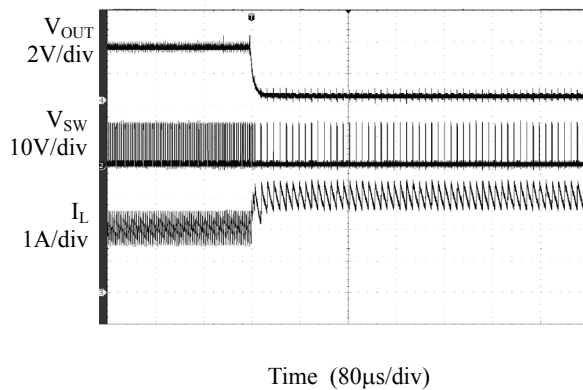


Figure 14. Short Circuit Protection
($I_{OUT}=2\text{A}$)

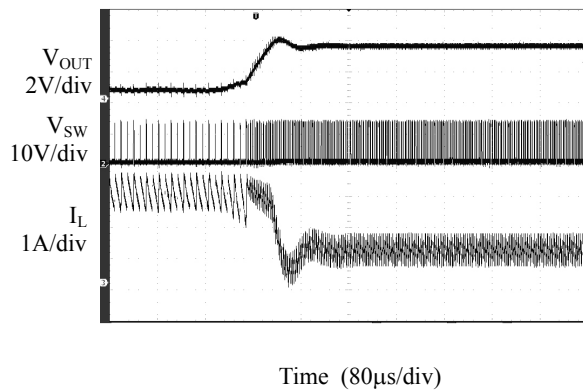


Figure 15. Short Circuit Recovery
($I_{OUT}=2\text{A}$)

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Typical Application

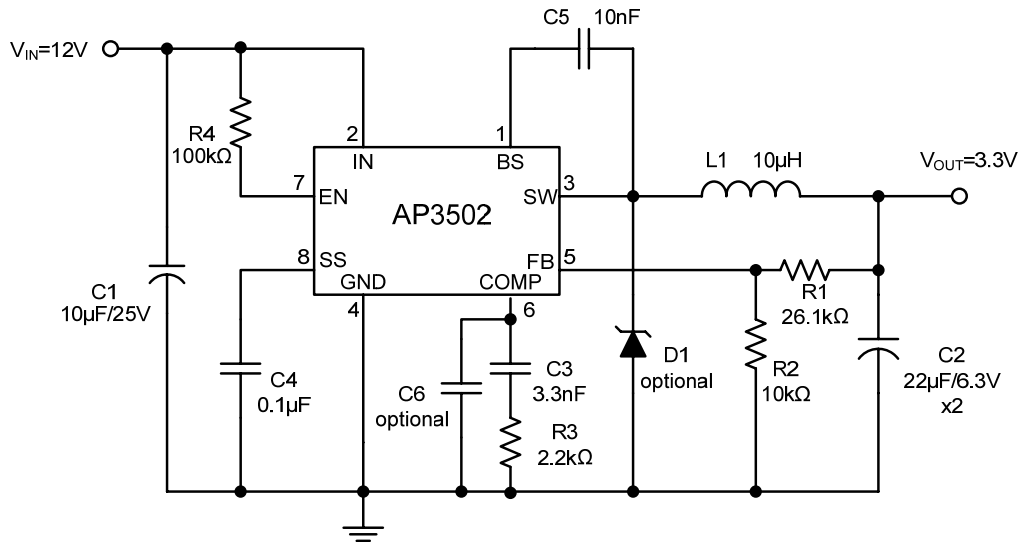
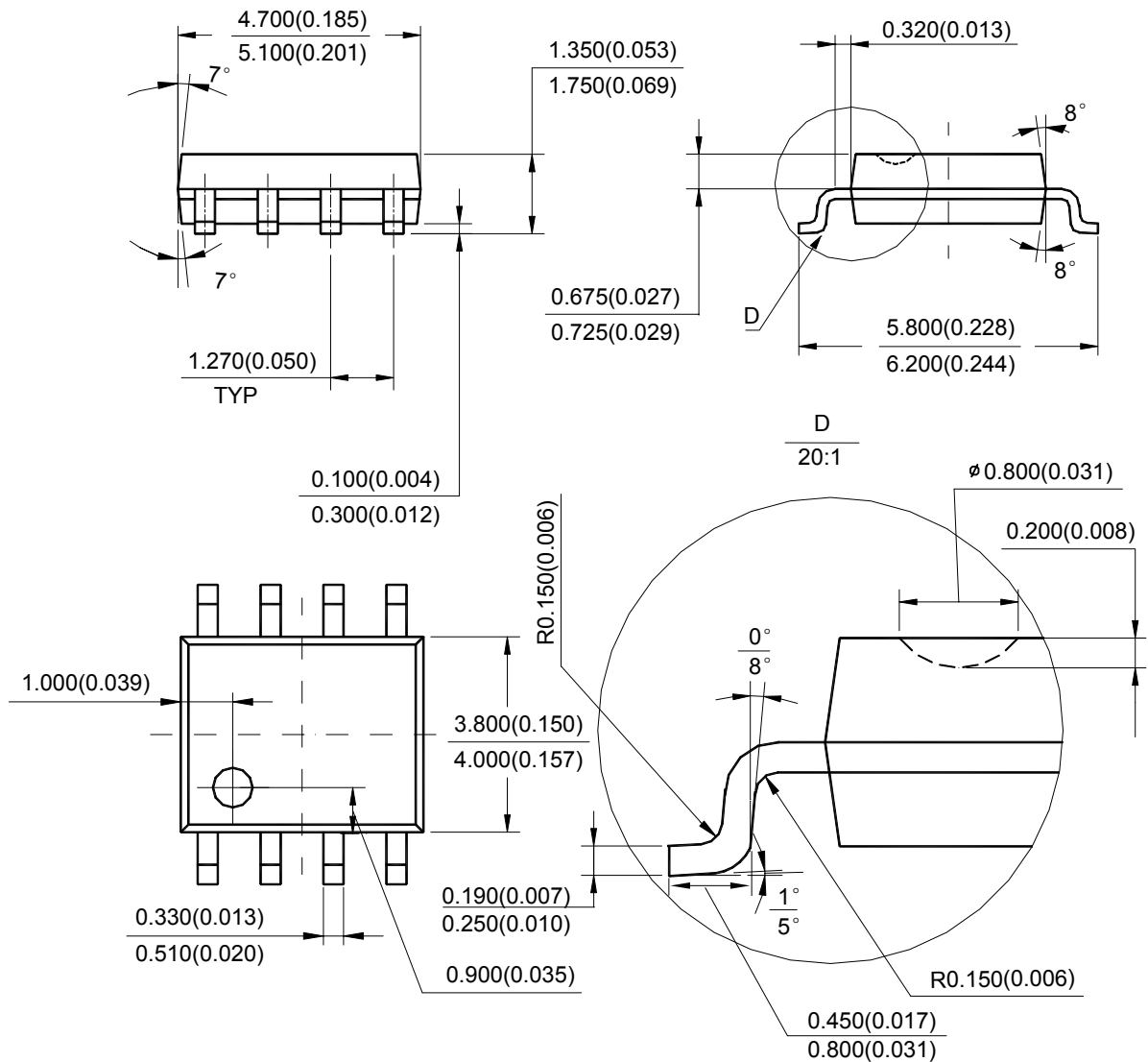


Figure 16. Typical Application of AP3502

Mechanical Dimensions

SOIC-8
Unit: mm(inch)


Note: Eject hole, oriented hole and mold mark is optional.



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