CURRENT MODE PWM CONTROLLER

General Description

The IT3842A/3A/4A/5A are high performance fixed frequency current-mode PWM controller series. They are improved versions of IT3842A/3A/4A/5A.

These integrated circuits are optimized for off-line and DC-DC converter applications with minimum external components. They feature under-voltage lockout (UVLO) circuit with low start-up current, trimmed oscillator for precise duty cycle control, current sense comparator providing maximum current limiting and a totem pole output stage for increasing output current. In addition, these ICs also feature accurate protection against over-temperature, over-current and maximal output power.

The IT3842A and IT3844A have UVLO thresholds of 16V(on) and 10V(off); The corresponding thresholds for IT3843A and IT3845A are 8.4 V(on) and 7.6V(off).

The IT3842A and IT3843A can operate approaching 100% duty cycle; IT3844A and IT3845A can operate from zero to 50% duty cycle.

These ICs are available in 3 packages: SOIC-8, DIP-8 and SOIC-14.

Features

- Low Start-up Current: 0.15mA
- Robust V_{REF} Line/Load Regulation
  Low Line Regulation : 4mV
  Low Load Regulation : 4mV
- High Stability of Reference Voltage over a Full Temperature Range: 0.2mV/ ^{o}C
- Operating Frequency up to 500KHz
- High PWM Frequency Stability over a Full Temperature Range: 2.5%
- High PWM Frequency Stability under a Full Supply Voltage Range: 0.2%
- Accurate Over-temperature Protection with Hysteresis
- UVLO with Hysteresis

Applications

- Off-line Converter
- DC-DC Converter
- Voltage Adapter
- CRT Monitor Power Supply
- Desktop Power Supply
- DVD/STB Power Supply

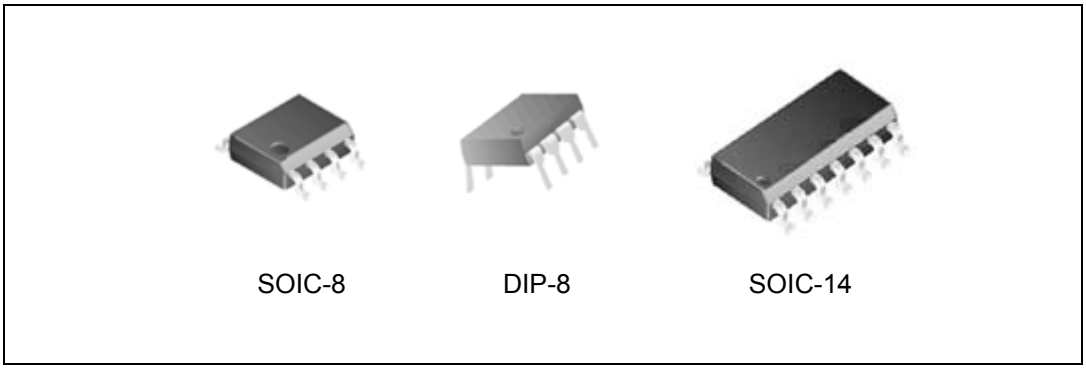


Figure 1. Package Types of IT3842A/3A/4A/5A

Pin Configuration

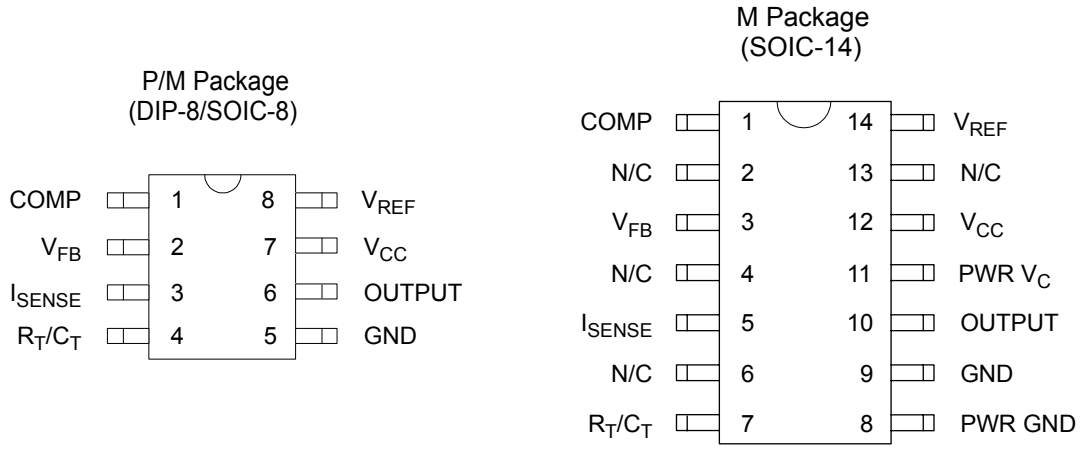


Figure 2. Pin Configuration of IT3842A/3A/4A/5A(Top View)

Pin Description

Pin Number		Pin Name	Function
8-pin	14-pin		
1	1	COMP	This pin is the Error Amplifier output and is made available for loop compensation.
2	3	V_{FB}	The inverting input of the Error Amplifier. It is normally connected to the switching power supply output through a resistor divider.
3	5	I_{SENSE}	A voltage proportional to inductor current is connected to this input. The PWM uses this information to terminate the output switch conduction.
4	7	R_T/C_T	The Oscillator frequency and maximum Output duty cycle are programmed by connecting resistor R_T to V_{REF} and capacitor C_T to ground. Operation to 500 kHz is possible.
5		GND	The combined control circuitry and power ground.
6	10	OUTPUT	This output directly drives the gate of a power MOSFET. Peak currents up to 1.0 A are sourced and sunk by this pin.
7	12	V_{CC}	The positive supply of the control IC.
8	14	V_{REF}	This is the reference output. It provides charging current for capacitor C_T through resistor R_T.
	8	PWR GND	This pin is a separate power ground return that is connected back to the power source. It is used to reduce the effects of switching transient noise on the control circuitry.
	11	PWR V_C	The Output high state (V_{OH}) is set by the voltage applied to this pin. With a separate power source connection, it can reduce the effects of switching transient noise on the control circuitry.
	9	GND	This pin is the control circuitry ground return and is connected back to the power source ground.
	2,4,6,13	N/C	No connection. These pins are not internally connected.

Functional Block Diagram

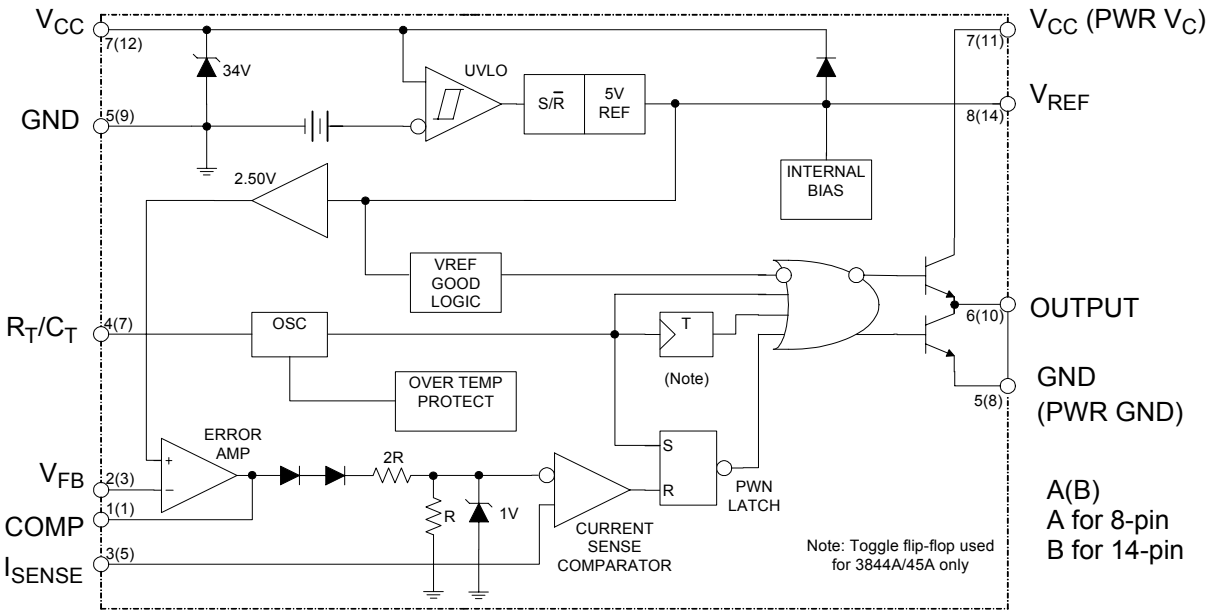


Figure 3. Functional Block Diagram of I T3842A/3A/4A/5A

Ordering Information

Package	Temperature Range	Part Number	Marking ID	Packing Type
SOIC-8	-40 to 85°C	IT3842A/3A/4A/5AM	3842A/3A/4A/5AM	Tape/Reel/Tube
DIP-8		IT3842A/3A/4A/5AP	IT3842A/3A/4A/5AP	Tube
SOIC-14		IT3842A/3A/4A/5AM14	IT3842A/3A/4A/5AM14	Tape/Reel

Some of our products are available in Lead Free packages; If buyers need Lead Free product, please add -E1 after the part number in your order. For example, IT358M is a standard tin-lead product, IT358M-E1 means a Lead Free product.

Absolute Maximum Ratings (Note 1, 2)

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	30	V
Output Current	I_O	± 1	A
Analog Inputs (8-pin: pin2,3, 14-pin: pin3,5)	V(ANA)	-0.3 to 6.3	V
Error Amp Output Sink Current	I_{SINK}(E.A)	10	mA
Power Dissipation at T_A< 25 °C (DIP-8)	P_D (Note 3)	1000	mW
Power Dissipation at T_A<25 °C (SOIC-8)	P_D (Note 3)	460	mW
Power Dissipation at T_A<25 °C (SOIC-14)	P_D (Note 3)	725	mW
Storage Temperature Range	T_{STG}	-65 to 150	°C
Lead Temperature (Soldering, 10sec)	T_{LEAD}	+300	°C
ESD (Machine Mode)		250	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.

Note 2: All voltages are with respect to pin 5 and all currents are positive into specified terminal.

Note 3: Board thickness 1.6mm, board dimension 90mm X 90mm.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Oscillation Frequency	f		500	KHz
Ambient Temperature	T_A	-40	85	°C

Electrical Characteristics

(V_{CC}=15V, R_T=10kΩ C_T=3.3nF, T_A= -40 to 85°C, unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
REFERENCE SECTION						
Reference Output Voltage	V_{REF}	T_J=25°C, I_{REF}=1mA	4.95	5.00	5.05	V
Total Output Variation		Line, Load, Temp.	4.9		5.10	V
Line Regulation	ΔV_{REF}	12V ≤ V_{CC} ≤25V		4	15	mV
Load Regulation	ΔV_{REF}	1mA ≤ I_{REF} ≤20mA		4	15	mV
Short Circuit Output Current	I_{SC}	T_A=25°C		-100	-180	mA
Temperature Stability				0.2	0.4	mV/°C
OSCILLATOR SECTION						
Oscillation Frequency	f	T_J=25°C	47	52	57	KHz
Oscillator Amplitude	V_{OSC}	Pin 4, peak to peak (Note 6)		1.7		V
Temperature Stability		(Note 6)		2.5		%
Voltage Stability		12V ⩽ VCC ⩽ 25V		0.2	1	%
Discharge Current		Vpin 4 =2V(Note 7)	8.5		10.5	mA
ERROR AMPLIFIER SECTION						
Input Voltage	V_I	Vpin 1=2.5V	2.45	2.50	2.55	V
Output Sink Current	I_{SINK}	Vpin1=1.1V	2	6		mA
Output Source Current	I_{SOURCE}	Vpin1=5V	-0.5	-0.8		mA
High Output Voltage	V_{OH}	RL=15kΩ to GND	5	6		V
Low Output Voltage	V_{OL}	RL=15kΩ to pin 8		0.7	1.1	V
Voltage Gain		2V ≤ V_O ≤ 4V	65	90		dB
Power Supply Rejection Ratio	PSRR	12V ≤ V_{CC} ≤ 25V	60	70		dB
CURRENT SENSE SECTION						
Maximum Input Signal	V_I(MAX)	Vpin1=5V(Note 4)	0.9	1	1.1	V
Gain	GV	(Note 4, 5)	2.85	3	3.15	V/V
Power Supply Rejection Ratio	PSRR	12V ≤ V_{CC} ≤ 25V (Note 4, 6)		70		dB
Delay to Output		Vpin3 = 0 to 2V (Note 6)		150	300	ns
Input Bias Current	I_{BIAS}			-3	-10	µA
OUTPUT SECTION						
Low Output Voltage	V_{OL}	I_{SINK} = 20mA		0.1	0.4	V
		I_{SINK} = 200mA		1.4	2.2	V
High Output Voltage	V_{OH}	I_{SOURCE} = 20mA	13	14		V
		I_{SOURCE} = 200mA	12	13		V
Rise Time	t_R	T_J=25°C, C_L=1nF (Note 6)		50	150	ns
Fall Time	t_F	T_J=25°C, C_L=1nF (Note 6)		50	150	ns

Electrical Characteristics (Continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
UNDER -VOLTAGE LOCKOUT SECTION						
Start Threshold	$V_{TH}(ST)$	IT3842A/IT3844A	14.5	16	17.5	V
		IT3843A/IT3845A	7.8	8.4	9.0	V
Min. Operation Voltage (After Turn On)	V_{OPR} (Min.)	IT3842A/IT3844A	8.5	10.0	11.5	V
		IT3843A/IT3845A	7.0	7.6	8.2	V
PWM SECTION						
Max. Duty Cycle	D(Max.)	IT3842A/IT3843A	95	97	100	%
	D(Max.)	IT3844a/IT3845A	46	48	50	%
Min. Duty Cycle	D(Min.)				0	%
TOTAL STANDBY CURRENT SECTION						
Start-Up Current	I_{ST}			0.15	0.3	mA
Operating Supply Current	I_{CC}(OPR)	Vpin3=Vpin2=0V		10	14	mA
Zener Voltage	V_Z	I_{CC}=25mA	30	34		V
OVER-TEMPERATURE PROTECT SECTION						
Shutdown Temperature	T_{SHUT}	(Note 6)		155		°C
Temperature Hysteresis	T_{HYS}	(Note 6)		25		°C

Note 4: Parameters are tested at trip point of latch with Vpin2 = 0.
Note 5: Here gain is defined as:

$$A=\frac{\Delta VPin\ 1}{\Delta VPin\ 3},\ 0 \le Vpin3 \le 0.8V$$

Note 6: These parameters, although guaranteed, are not 100% tested in production.
Note 7: This parameter is measured with RT=10kΩ to V_{REF}, it contributes 0.3mA of current to the measured value. So the total current flowing into the CT pin will be 0.3mA higher than the measured value approximately.

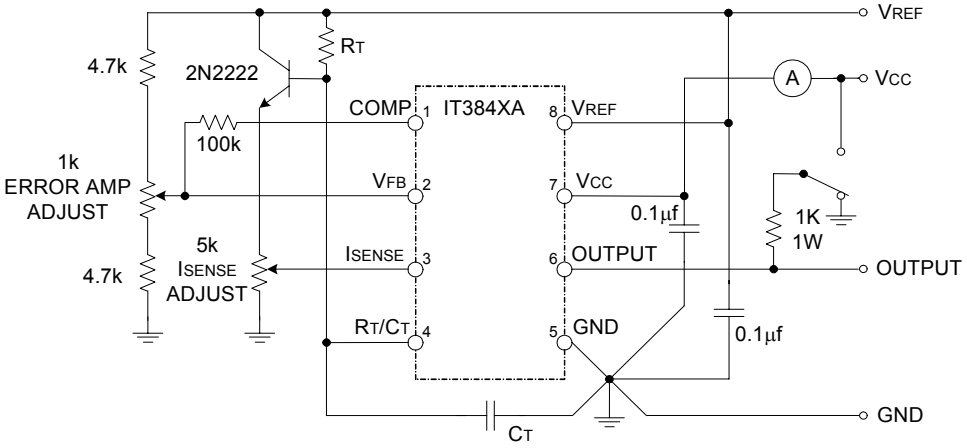


Figure 4. Basic Test Circuit

Electrical Characteristics (Continued)

Figure 4 is the basic test circuit for IT384x. In testing, the high peak currents associated with capacitive loads necessitate careful grounding techniques. Timing and bypass capacitors should be connected close to pin 5 in a single point ground. The transistor and 5k potentiometer are used to sample the oscillator waveform and apply an adjustable ramp to pin 3.

Typical Performance Characteristics

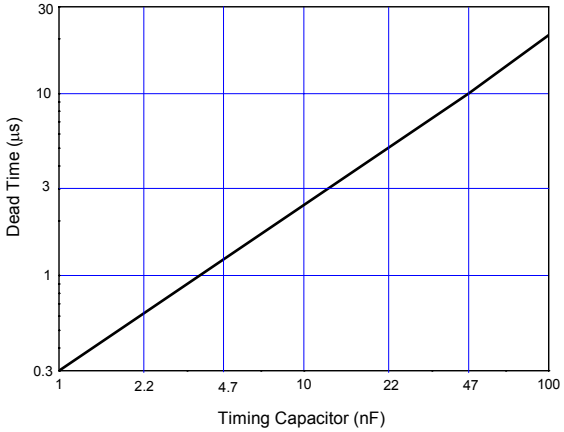


Figure 5. Oscillator Dead Time vs. Timing Capacitor

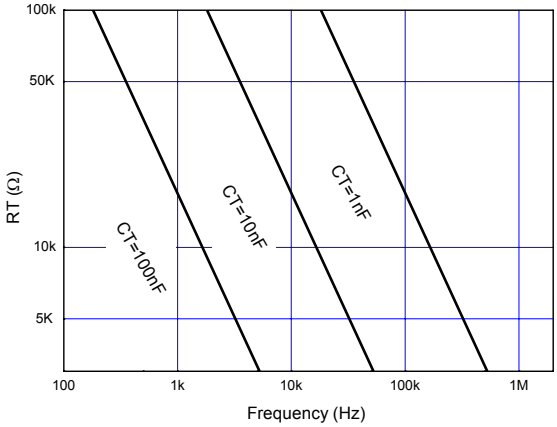


Figure 6. Timing Resistor vs. Frequency

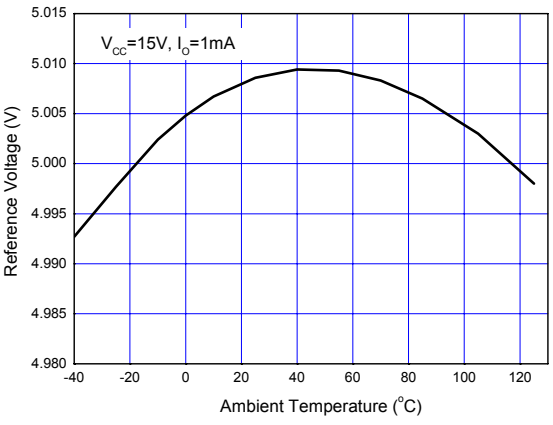


Figure 7. Reference Voltage vs. Ambient Temperature

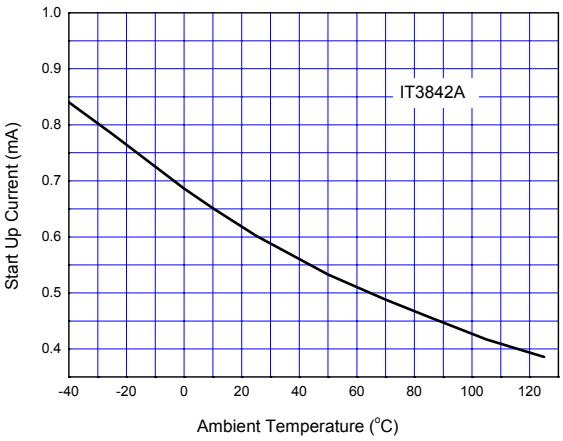


Figure 8. Start-up Current vs. Ambient Temperature

Typical Performance Characteristics (Continued)

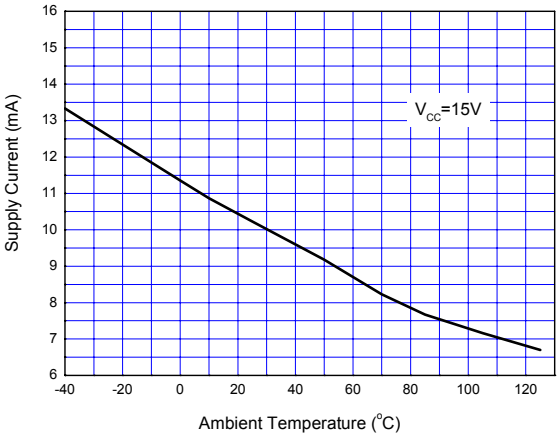


Figure 9. Supply Current vs. Ambient Temperature

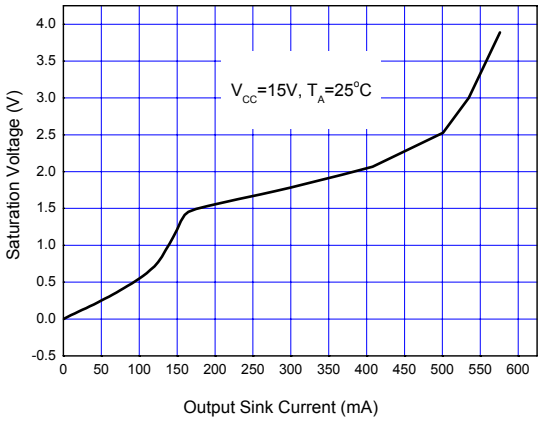


Figure 10. Output Saturation Characteristics

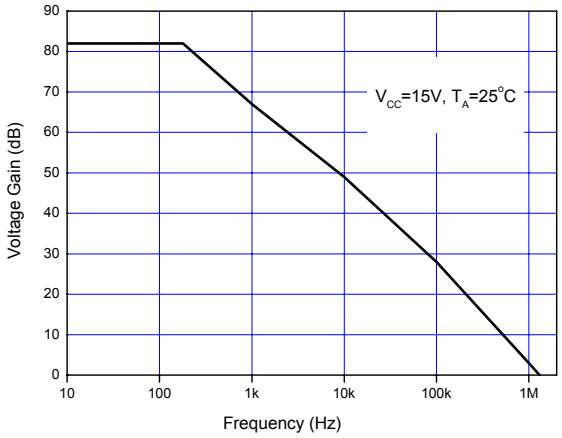


Figure 11. Error Amplifier Open-loop Frequency Response

Typical Application

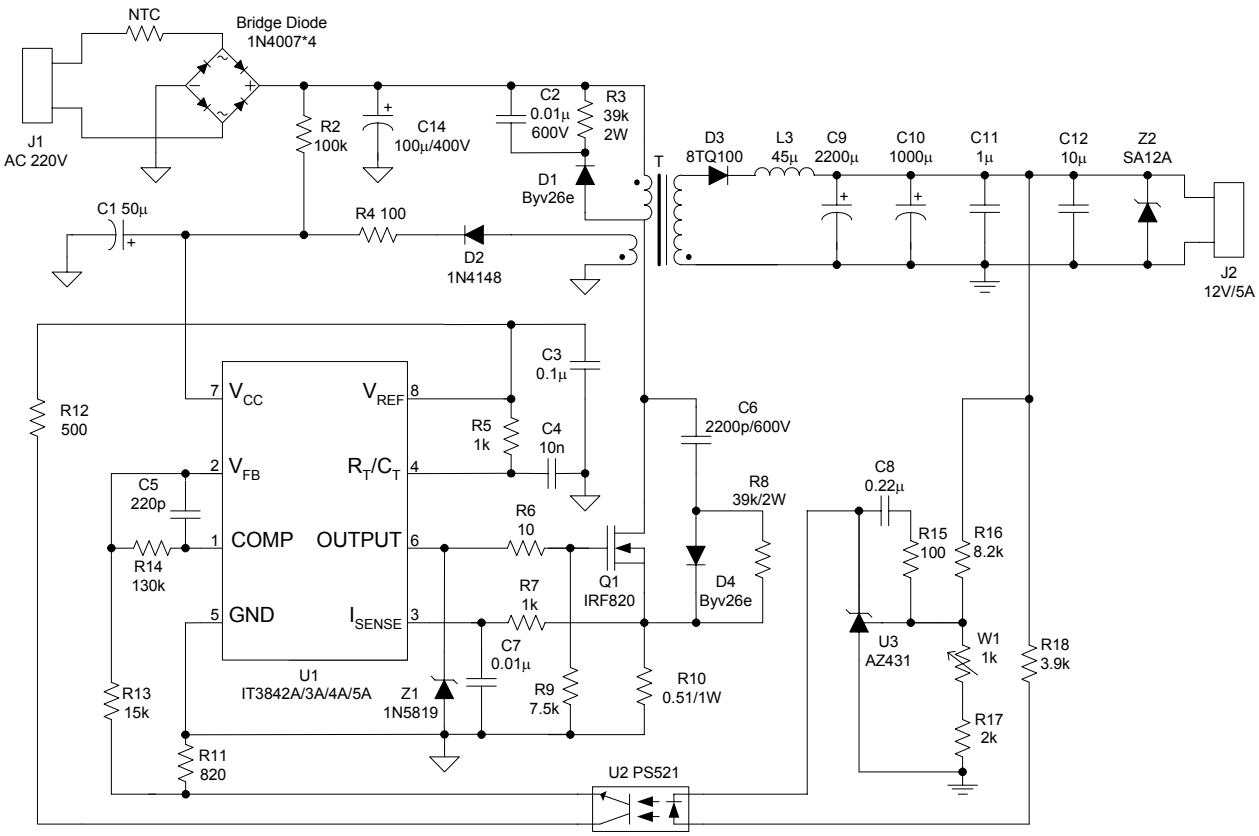
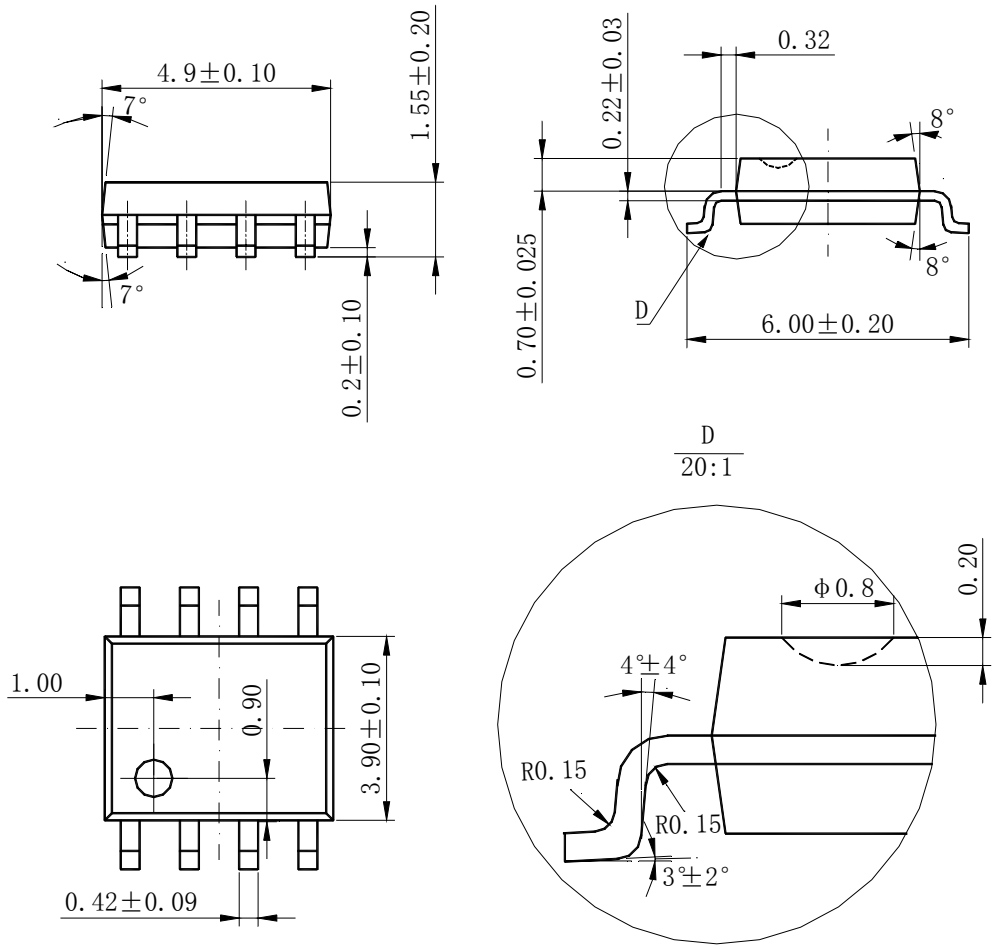


Figure 12. Typical Application of IT3842A/3A/4A/5A

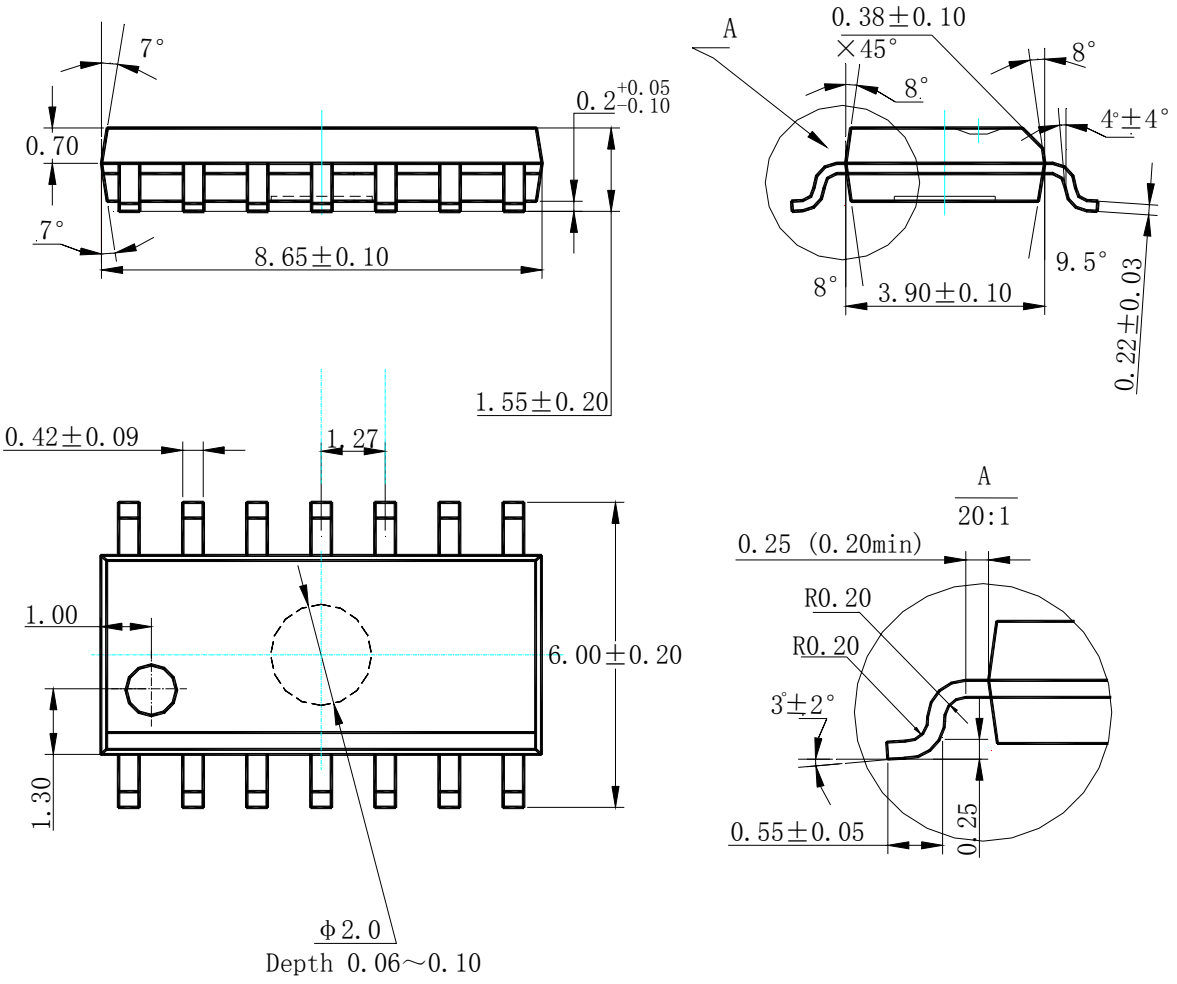
Mechanical Dimensions

SOIC-8 **Unit: mm**



Mechanical Dimensions (Continued)

SOIC-14 **Unit: mm**



Mechanical Dimensions (Continued)

DIP-8 **Unit: mm**