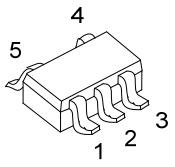
500mA SYNCHRONOUS STEP-DOWN DC/DC CONVERTERS



SOT-25

■ DESCRIPTION

The UTC **UC3655** is a synchronous-rectification type DC/DC converters with a built-in 0.6Ω P-channel driver transistor and 0.7Ω N-channel switching transistor, which designed to allow the use of ceramic capacitors. Using only a coil and two capacitors connected externally, the **UC3655** enable a high efficiency, stable power supply with an output current of 500mA to be configured. Its operating voltage is 2.0V and the output voltage is programmable in a range from 0.9V to 4.0V in increments of 0.1V (accuracy: ±2.0%) internally. The oscillation frequency is 1.2MHz.

For operation mode, it is PWM control in the UTC **UC3655**, the UTC **UC3655** series is automatic PWM/PFM switching control, allowing fast response, low ripple and high efficiency over the full range of load.

Internal soft start and current control functions are built in it. All circuits are shutdown to reduce current consumption to as low as 1.0μA or less during standby mode. With the built-in Under Voltage Lock Out (U.V.L.O.) function, when input voltage becomes 1.4V or lower the internal P channel driver transistor is forced OFF.

■ FEATURES

* Very High Efficiency 92%
* Low Ripple Rejection Voltage 10mV
* Output Current 500mA @V_{IN}=3.0V, V_{OUT}=1.8V
* Oscillation Frequency is 1.2MHz
* With PWM / PFM Automatic Switching Control
* Maximum Duty Ratio is 100%
* Ceramic Capacitor Available

■ ORDERING INFORMATION

Ordering Number	Package	Packing
UC3655G-xx-AF5-R	SOT-25	Tape Reel

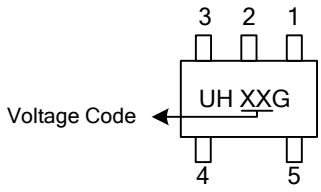
UC3655G-xx-AF5-R

(1)Packing Type
(2)Package Type
(3)Output Voltage Code
(4)Halogen Free

(1) R: Tape Reel
(2) AF5: SOT-25
(3) xx: refer to Marking Information
(4) G: Halogen Free

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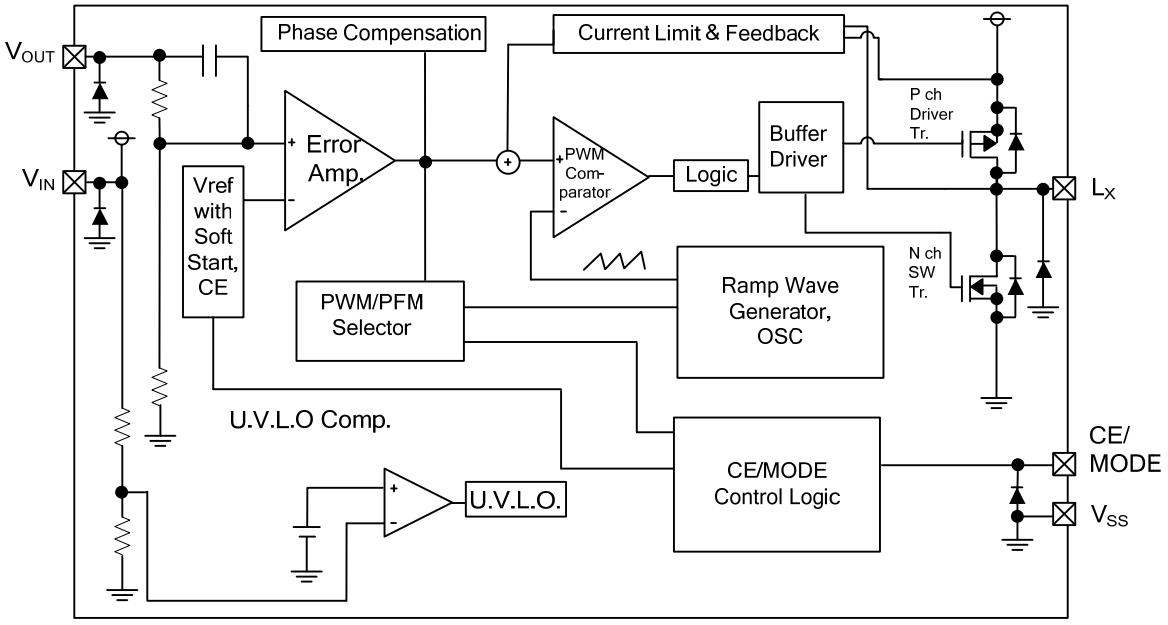
■ MARKING

PACKAGE	VOLTAGE CODE	MARKING
SOT-25	12:1.2V 28:2.8V 33:3.3V 38:3.8V	

■ PIN DESCRIPTION

PIN NO	PIN NAME	DESCRIPTION
1	V_{IN}	Power Input Voltage
2	V_{SS}	Ground
3	CE / MODE	Switch Pin For Chip Enable Mode
4	V_{OUT}	Output Voltage Sense Pin
5	Lx	Output Of Switching

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING (T_a=25°C)

PARAMETER		SYMBOL	RATINGS	UNIT
V_{IN} Pin Voltage		V_{IN}	- 0.3 ~ 6.5	V
Input/Output Pins	LX	V_{Lx}	- 0.3 ~ V_{IN} + 0.3	V
	V_{OUT}	V_{OUT}	-0.3 ~ 6.5	
	CE/MODE	V_{CE}	- 0.3 ~ V_{IN} + 0.3	
Lx Pin Current		I_{Lx}	±1000	mA
Power Dissipation		P_D	250	mW
Operating Temperature		T_{OPR}	- 40 ~ 85	°C
Storage Temperature Range		T_{STG}	- 55 ~ 125	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ ELECTRICAL CHARACTERISTICS (f_{OSC}=1.2MHz, Ta=25°C)

UC3655-12 (V_{IN}=3.6V, V_{OUT}=1.2V)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Operating Voltage Range	V_{IN}		2.0		6.0	V
Output Voltage	V_{OUT}	CE=V_{IN}, I_{OUT}=30mA	1.176	1.200	1.224	V
U.V.L.O. Voltage	V_{UVLO}	CE=V_{IN}, V_{OUT}=0V, LX=L	1.0	1.40	1.78	V
Output Voltage Temperature Characteristics	$\frac{\Delta V_{OUT}}{V_{OUT}*\Delta T_{OPR}}$	I_{OUT}=30mA, -40°C ≤T_{OPR}≤85°C		±100		ppm/°C
Maximum Output Current	$I_{OUT(MAX)}$	V_{IN}=4.5V	500			mA
Supply Current	I_{DD}	V_{IN}=CE=5.0V, V_{OUT}=V_{OUT}*1.1		70	115	μA
Stand-by Current	I_{STN-BY}	V_{IN}=5.0V, CE=0V, V_{OUT}=V_{OUT}*1.1		0	1.0	μA
PFM Switch Current	I_{PFM}	CE=V_{IN}, I_{OUT}=1mA	100	140	180	mA
Current Limit	I_{LIM}	V_{IN}=CE=5.0V, V_{OUT}=0V	600	700		mA
Efficiency (Note 1)	η	CE=V_{IN}=4.5V, I_{OUT}=100mA		90		%
OSCILLATOR						
Oscillation Frequency	f_{OSC}	I_{OUT}=100mA	1020	1200	1380	kHz
Maximum Duty Ratio	D_{MAX}	CE=V_{IN}, V_{OUT}=0V	100			%
Minimum Duty Ratio	D_{MIN}	CE=V_{OUT}=V_{IN}			0	%
Soft-Start Time	T_{SS}	I_{OUT}=1mA	0.5	1.0	3.0	ms
Latch Time	T_{lat}	V_{IN}=CE=5.0V (Note 3)	1		20	ms
CE (PIN 3)						
CE "H" Voltage	V_{CEH}		0.9		V_{IN}	V
CE "L" Voltage	V_{CEL}		V_{SS}		0.3	V
CE "H" Current	I_{CEH}	V_{IN}=CE=5.5V, V_{OUT}=0V	-0.1		0.1	μA
CE "L" Current	I_{CEL}	V_{IN}=5.5V, CE=0V, V_{OUT}=0V	-0.1		0.1	μA
LX (PIN 5)						
LX SW "H" ON Resistance	R_{LXH}	CE=0.5V_{IN}, V_{OUT}=0V, I_{LX}=100mA		0.6		Ω
LX SW "L" ON Resistance	R_{LXL}	CE=0.5V_{IN}, I_{LX}=100mA		0.7		Ω
LX SW "H" Leak Current	I_{LEAKH}	V_{IN}=V_{OUT}=5.0V, CE=0V, LX=0V (Note 2)		0.01	1.0	μA
LX SW "L" Leak Current	I_{LEAKL}	V_{IN}=V_{OUT}=5.0V, CE=0V, LX=5.0V		0.01	1.0	μA

UC3655-28 (V_{IN}=3.6V, V_{OUT}=2.8V)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Operating Voltage Range	V_{IN}		2.0		6.0	V
Output Voltage	V_{OUT}	CE=V_{IN}, I_{OUT}=30mA	2.744	2.8	2.856	V
U.V.L.O. Voltage	V_{UVLO}	CE=V_{IN}, V_{OUT}=0V, LX=L	1.0	1.40	1.78	V
Output Voltage Temperature Characteristics	$\frac{\Delta V_{OUT}}{V_{OUT}*\Delta T_{OPR}}$	I_{OUT}=30mA, -40°C ≤T_{OPR}≤85°C		±100		ppm/°C
Maximum Output Current	$I_{OUT(MAX)}$	V_{IN}=4.5V	500			mA
Supply Current	I_{DD}	V_{IN}=CE=5.0V, V_{OUT}=V_{OUT}*1.1		75	120	μA

■ ELECTRICAL CHARACTERISTICS(Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Stand-by Current	I_{STN-BY}	V_{IN}=5.0V, CE=0V, V_{OUT}=V_{OUT}*1.1		0	1.0	μA
PFM Switch Current	I_{PFM}	CE=V_{IN}, I_{OUT}=1mA	100	140	180	mA
Current Limit	I_{LIM}	V_{IN}=CE=5.0V, V_{OUT}=0V	600	700		mA
Efficiency (Note 1)	η	CE=V_{IN}=4.5V, I_{OUT}=100mA		92		%
OSCILLATOR						
Oscillation Frequency	f_{OSC}	I_{OUT}=100mA	1020	1200	1380	kHz
Maximum Duty Ratio	D_{MAX}	CE=V_{IN}, V_{OUT}=0V	100			%
Minimum Duty Ratio	D_{MIN}	CE=V_{OUT}=V_{IN}			0	%
Soft-Start Time	T_{SS}	I_{OUT}=1mA	0.5	1.0	3.0	ms
Latch Time	T_{lat}	V_{IN}=CE=5.0V (Note 3)	1		20	ms
CE (PIN 3)						
CE "H" Voltage	V_{CEH}		0.9		V_{IN}	V
CE "L" Voltage	V_{CEL}		V_{SS}		0.3	V
CE "H" Current	I_{CEH}	V_{IN}=CE=5.5V, V_{OUT}=0V	-0.1		0.1	μA
CE "L" Current	I_{CEL}	V_{IN}=5.5V, CE=0V, V_{OUT}=0V	-0.1		0.1	μA
LX (PIN 5)						
LX SW "H" ON Resistance	R_{LXH}	CE=0.5V_{IN}, V_{OUT}=0V, I_{LX}=100mA		0.5		Ω
LX SW "L" ON Resistance	R_{LXL}	CE=0.5V_{IN}, I_{LX}=100mA		0.6		Ω
LX SW "H" Leak Current	I_{LEAKH}	V_{IN}=V_{OUT}=5.0V, CE=0V, LX=0V (Note 2)		0.01	1.0	μA
LX SW "L" Leak Current	I_{LEAKL}	V_{IN}=V_{OUT}=5.0V, CE=0V, LX=5.0V		0.01	1.0	μA

UC3655-33 (V_{IN}=5.0V, V_{OUT}=3.3V)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Operating Voltage Range	V_{IN}		2.0		6.0	V
Output Voltage	V_{OUT}	CE=V_{IN}, I_{OUT}=30mA	3.234	3.300	3.366	V
U.V.L.O. Voltage	V_{UVLO}	CE=V_{IN}, V_{OUT}=0V, LX=L	1.0	1.40	1.78	V
Output Voltage Temperature Characteristics	$\frac{\Delta V_{OUT}}{V_{OUT}*\Delta T_{OPR}}$	I_{OUT}=30mA, -40℃≤T_{OPR}≤85℃		±100		ppm/°C
Maximum Output Current	$I_{OUT(MAX)}$	V_{IN}=4.5V	500			mA
Supply Current	I_{DD}	V_{IN}=CE=5.0V, V_{OUT}=V_{OUT}*1.1		75	120	μA
Stand-by Current	I_{STN-BY}	V_{IN}=5.0V, CE=0V, V_{OUT}=V_{OUT}*1.1		0	1.0	μA
PFM Switch Current	I_{PFM}	CE=V_{IN}, I_{OUT}=1mA	100	140	180	mA
Current Limit	I_{LIM}	V_{IN}=CE=5.0V, V_{OUT}=0V	600	700		mA
Efficiency (Note 1)	η	CE=V_{IN}=4.5V, I_{OUT}=100mA		92		%
OSCILLATOR						
Oscillation Frequency	f_{OSC}	I_{OUT}=100mA	1020	1200	1380	kHz
Maximum Duty Ratio	D_{MAX}	CE=V_{IN}, V_{OUT}=0V	100			%
Minimum Duty Ratio	D_{MIN}	CE=V_{OUT}=V_{IN}			0	%
Soft-Start Time	T_{SS}	I_{OUT}=1mA	0.5	1.0	3.0	ms
Latch Time	T_{lat}	V_{IN}=CE=5.0V (Note 3)	1		20	ms
CE (PIN 3)						
CE "H" Voltage	V_{CEH}		0.9		V_{IN}	V
CE "L" Voltage	V_{CEL}		V_{SS}		0.3	V
CE "H" Current	I_{CEH}	V_{IN}=CE=5.5V, V_{OUT}=0V	-0.1		0.1	μA
CE "L" Current	I_{CEL}	V_{IN}=5.5V, CE=0V, V_{OUT}=0V	-0.1		0.1	μA
LX (PIN 5)						
LX SW "H" ON Resistance	R_{LXH}	CE=0.50V_{IN}, V_{OUT}=0V, I_{LX}=100mA		0.5		Ω
LX SW "L" ON Resistance	R_{LXL}	CE=0.5V_{IN}, I_{LX}=100mA		0.6		Ω
LX SW "H" Leak Current	I_{LEAKH}	V_{IN}=V_{OUT}=5.0V, CE=0V, LX=0V (Note 2)		0.01	1.0	μA
LX SW "L" Leak Current	I_{LEAKL}	V_{IN}=V_{OUT}=5.0V, CE=0V, LX=5.0V		0.01	1.0	μA

■ ELECTRICAL CHARACTERISTICS(Cont.)

UC3655-38 (V_{IN}=5.0V, V_{OUT}=3.8V)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Operating Voltage Range	V_{IN}		2.0		6.0	V
Output Voltage	V_{OUT}	CE=V_{IN}, I_{OUT}=30mA	3.724	3.800	3.876	V
U.V.L.O. Voltage	V_{UVLO}	CE=V_{IN}, V_{OUT}=0V, LX=L	1.0	1.40	1.78	V
Output Voltage Temperature Characteristics	$\frac{\Delta V_{OUT}}{V_{OUT}*\Delta T_{OPR}}$	I_{OUT}=30mA, -40℃≤T_{OPR}≤85℃		±100		ppm/°C
Maximum Output Current	$I_{OUT(MAX)}$	V_{IN}=4.5V	500			mA
Supply Current	I_{DD}	V_{IN}=CE=5.0V, V_{OUT}=V_{OUT}*1.1		75	120	μA
Stand-by Current	I_{STN-BY}	V_{IN}=5.0V, CE=0V, V_{OUT}=V_{OUT}*1.1		0	1.0	μA
PFM Switch Current	I_{PFM}	CE=V_{IN}, I_{OUT}=1mA	100	140	180	mA
Current Limit	I_{LIM}	V_{IN}=CE=5.0V, V_{OUT}=0V	600	700		mA
Efficiency (Note 1)	η	CE=V_{IN}=4.5V, I_{OUT}=100mA		92		%
OSCILLATOR						
Oscillation Frequency	f_{OSC}	I_{OUT}=100mA	1020	1200	1380	kHz
Maximum Duty Ratio	D_{MAX}	CE=V_{IN}, V_{OUT}=0V	100			%
Minimum Duty Ratio	D_{MIN}	CE=V_{OUT}=V_{IN}			0	%
Soft-Start Time	T_{SS}	I_{OUT}=1mA	0.5	1.0	3.0	ms
Latch Time	T_{lat}	V_{IN}=CE=5.0V (Note 3)	1		20	ms
CE (PIN 3)						
CE "H" Voltage	V_{CEH}		0.9		V_{IN}	V
CE "L" Voltage	V_{CEL}		V_{SS}		0.3	V
CE "H" Current	I_{CEH}	V_{IN}=CE=5.5V, V_{OUT}=0V	-0.1		0.1	μA
CE "L" Current	I_{CEL}	V_{IN}=5.5V, CE=0V, V_{OUT}=0V	-0.1		0.1	μA
LX (PIN 5)						
LX SW "H" ON Resistance	R_{LXH}	CE=0.5V_{IN}, V_{OUT}=0V, I_{LX}=100mA		0.5		Ω
LX SW "L" ON Resistance	R_{LXL}	CE=0.5V_{IN}, I_{LX}=100mA		0.6		Ω
LX SW "H" Leak Current	I_{LEAKH}	V_{IN}=V_{OUT}=5.0V, CE=0V, LX=0V (Note 2)		0.01	1.0	μA
LX SW "L" Leak Current	I_{LEAKL}	V_{IN}=V_{OUT}=5.0V, CE=0V, LX=5.0V		0.01	1.0	μA

Note: 1. η= [(V_{OUT}*I_{OUT})/(V_{IN}*I_{IN})]*100

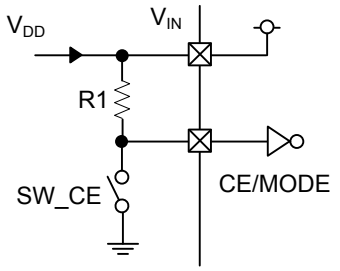
2. When temperature is high, a current of approximately 20μA (maximum) may leak.
3. Time until it short-circuits DCOUT with GND through 1Ω of resistance from a state of operation and is set to DCOUT=0V from current limit pulse generating.

■ OPERATIONAL EXPLANATION

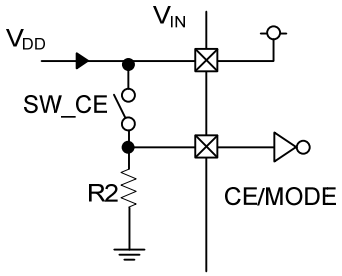
CE / MODE Pin Function

When a low level signal is input to the CE/MODE pin the operation of the **UC3655** series will enter into the shut down mode. In this mode, the current consumption occurs only in the detector and is 0 μA (TYP.), with a state of high impedance at the Lx pin and VOUT pin. By inputting a high level signal to the CE/MODE pin the IC starts its operation. The input of the CE/MODE pin is a CMOS input and its sink current is 0 μA (TYP.).

UC3655 series - Examples of how to use CE/MODE pin



SW_CE	STATUS
ON	Stand-by
OFF	Operation



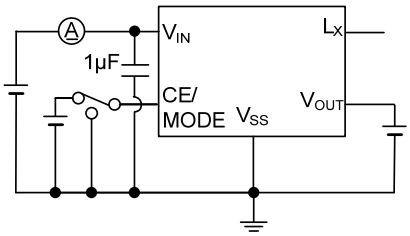
SW_CE	STATUS
ON	Stand-by
OFF	Operation

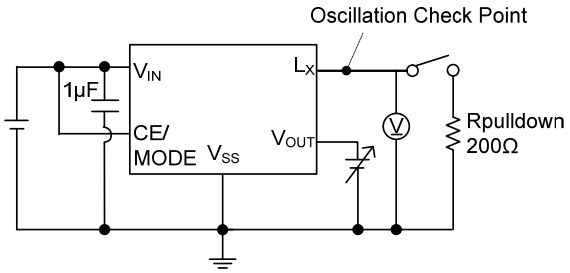
■ FUNCTIONS

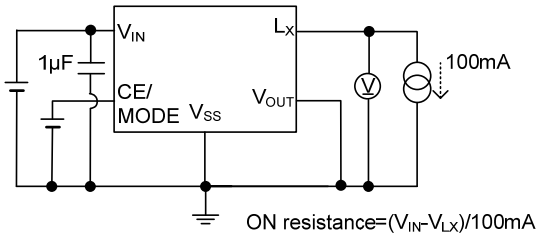
CE/MODE

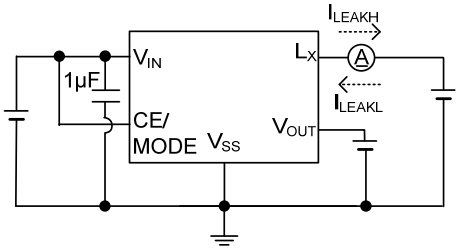
VOLTAGE LEVEL		OPERATION
H Level	V_{IN}-0.3V≦H level≦V_{IN}	Synchronous PWM/PFM Automatic Switching Control
M Level	0.9V≦M Level≦V_{IN}-1.0V	
L Level	0V≦L Level≦0.3V	Stand-by

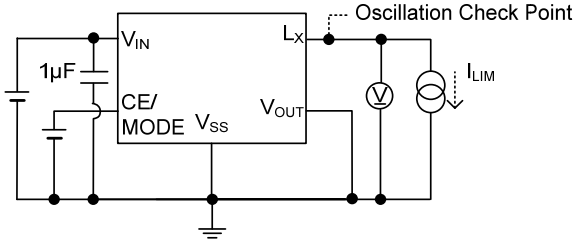
■ TEST CIRCUIT

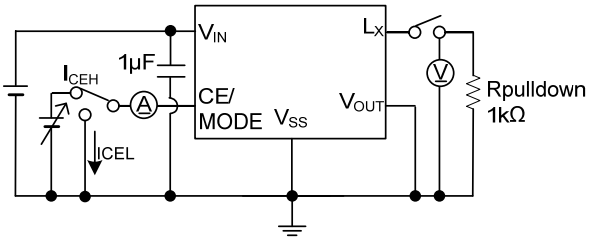


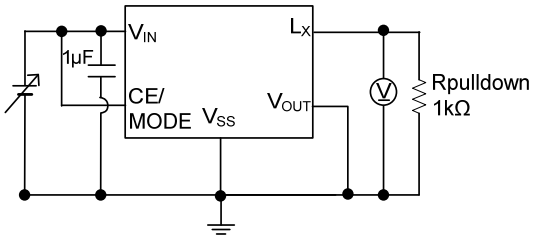


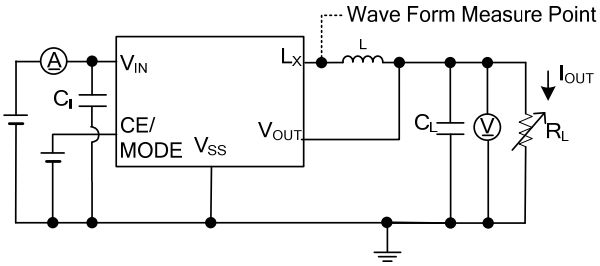


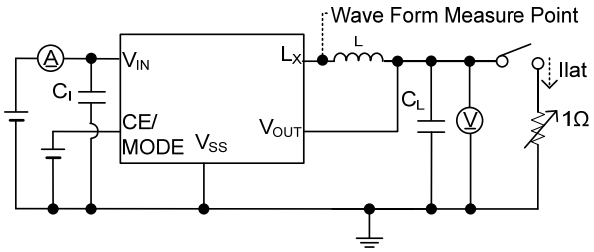






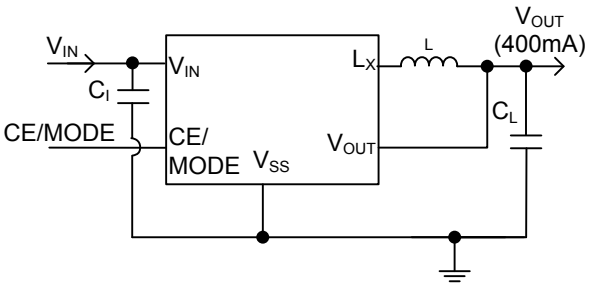






C_I	4.7μF (Ceramic)
C_L	10μF (Ceramic)
L	3.3μH

■ TYPICAL APPLICATION CIRCUIT



C_I	4.7μF (Ceramic)
C_L	10μF (Ceramic)
L	3.3μH

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