UNISONIC TECHNOLOGIES CO., LTD

UCL2300

Preliminary

LINEAR INTEGRATED CIRCUIT

PSR SINGLE-STAGE APFC OFFLINE LED DRIVER

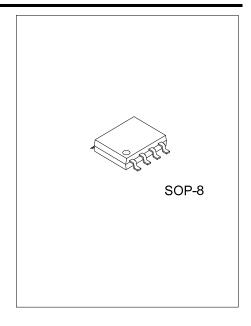
DESCRIPTION

The UTC UCL2300 is a high precision primary-side regulation controller with single stage Active PFC, specially designed for universal input offline flyback or buck-boost constant current LED lighting. The controller with on-chip PFC circuit achieves high power factor and low THD. Operating in critical conduction mode, the power MOSFET switching loss is reduced and the inductor is fully utilized.

The UTC UCL2300 adopts proprietary primary side current sensing scheme. It can precisely control the LED current without secondary side sense and feedback circuits. The system size and cost are optimized, as well as the system reliability.

The UTC UCL2300 utilizes patented line and load voltage compensation method to achieve excellent line and load regulation. And the line compensation factor can also be tuned externally for flexibility.

The UTC UCL2300 offers rich protection functions to improve the system reliability, including LED open circuit protection, LED short circuit protection, V_{CC} over voltage protection, V_{CC} under voltage protection, CS resistor open protection and cycle by cycle current limit. All the protection functions are auto-recovery.



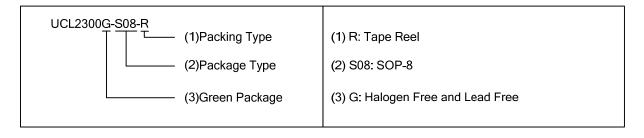
FEATURES

- * Single-stage active PFC for high power factor and low THD
- * Primary side control constant current operation, No opto-coupler required
- * Ultrafast LED start (<200ms @85V)
- * ±3% LED current accuracy
- * Excellent line and load regulation
- * Critical conduction mode operation
- * Source driving method
- * Ultra-low (20µA) startup current

- * Ultra-low (300µA) Operating current
- * High resistance feedback resistor for improved efficiency
- * LED open and short circuit protection
- * CS resistor open and short circuit protection
- * Transformer saturation protection
- * Cycle-by-cycle current limit
- * V_{CC} over-voltage and under-voltage protection
- * Auto fault recovery

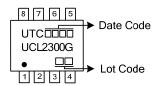
ORDERING INFORMATION

Ordering Number	Package	Packing
UCL2300G-S08-R	SOP-8	Tape Reel

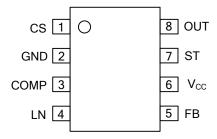


1 of 5 www.unisonic.com.tw

MARKING



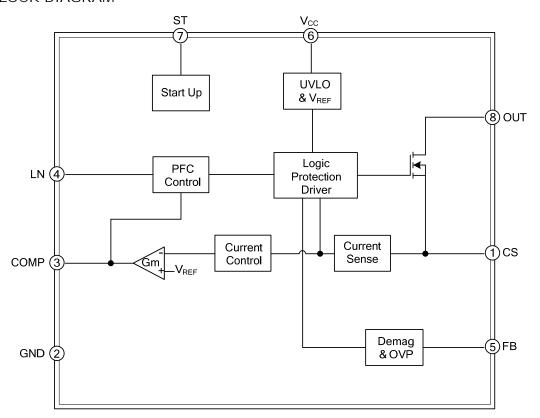
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	CS	Current sense pin. Connect a resistor to GND to sense the power MOSFET current.
2	GND	Ground.
3	COMP	Loop compensation node.
4	LN	Line voltage sample input.
5	FB	Feedback voltage input Pin.
6	V _{CC}	Power supply pin.
7	ST	Chip enable pin.
8	OUT	Pulse out pin. Connected to the 'Source' of external power MOSFET.

■ BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	RATINGS	UNIT
V _{CC} Pin Input Voltage	V _{cc}	-0.3~22	V
Current Sense Pin Input Voltage	CS	-0.3~6	V
Compensation Pin Voltage	COMP	-0.3~6	V
Line Voltage Sample Input	LN	-0.3~6	V
Feedback Pin Input Voltage	FB	-0.3~6	V
ST Pin Maximum Supply Current	I _{ST MAX}	5	mA
External Power MOSFET Drive Voltage	OUT	-0.3~18	V
Maximum Work Current of Internal Power MOSFET	I _{OUT}	3	Α
Power Dissipation (Note 1)	P _{DMAX}	0.45	W
Junction to Ambient	θ_{JA}	145	°C/W
Junction Temperature	T_J	-40~+150	°C
Storage Temperature	T _{STG}	-55~+150	°C

- Notes: 1. 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.
 - 2. The maximum power dissipation decrease if temperature rise, it is decided by T_{JMAX} , θ_{JA} , and environment temperature (T_A) . The maximum power dissipation is the lower one between $P_{DMAX}=(T_{JMAX}-T_A)/\theta_{JA}$ and the number listed in the maximum table.

■ RECOMMENDED OPERATION CONDITIONS

PARAMETER	SYMBOL	RATINGS	UNIT
Power Supply Voltage	V_{CC}	11.5~17.5	V

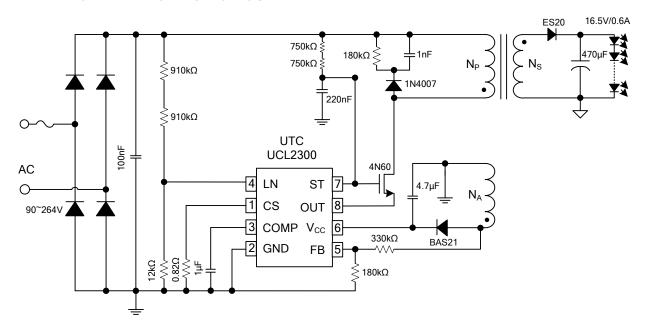
■ ELECTRICAL CHARACTERISTICS (Notes 1, 2) (Unless otherwise specified, V_{CC}=14V and T_A=25°C)

Startup Voltage	PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT		
V _{ST} Startup Voltage V _{ST ON} 1mA, V _{CC} =10V 16 17 18 V V _{ST} Hysteresis Voltage V _{ST HYS} V _{CC} =14V 2 V ST Startup Current I _{ST ON} V _{CC} =10V 20 35 µA ST Operating Current I _{ST OP} V _{CC} =14V 35 60 µA Supply Voltage Section V _{CC} Startup Voltage V _{CC} ON V _{CC} Rising 10 11 12 V V _{CC} UvLo V _{CC} Falling 5.2 5.8 6.5 V V _{CC} UvLo V _{CC} Falling 5.2 5.8 6.5 V V _{CC} HoLD V _{CC} Falling 5.2 5.8 6.5 V V _{CC} UvLo V _{CC} Falling 5.2 5.8 6.5 V V _{CC} HOLD V _{CC} Falling 7.7 5 8 V V _{CC} Turn Off Current I _{CC} More Turn I _{CC} More Turn 30 M 7 7.5 8									
V _{ST} Hysteresis Voltage V _{ST HYS} V _{Cc} =14V 2 V ST Startup Current I _{ST ON} V _{Cc} =10V 20 35 μA ST Operating Current I _{ST OP} V _{Cc} =14V 35 60 μA Supply Voltage Section V _{CC} Startup Voltage V _{CC ON} V _{Cc} Rising 10 11 12 V V _{CC} Undervoltage Protection Threshold V _{CC Undervoltage} V _{CC Hold} V _{Cc} Falling 5.2 5.8 6.5 V V _{CC} Hold Voltage V _{CC Hold} V _{CC} Falling 7.7.5 8 V V _{CC} Turn Off Current I _{CC UVLO} V _{CC} Rising, V _{CC} =10V 40 70 μA V _{CC} Quiescent Current I _{CC UVLO} V _{CC} Rising, V _{CC} =10V 40 70 μA V _{CC} Quiescent Current I _{CC UVLO} V _{CC} Rising, V _{CC} =10V 40 70 μA V _{CC} Quiescent Current I _{CC UVLO} V _{CC} Rising, V _{CC} =10V 30 600 μA V _{CC} Quiescent Current I _{CC UVLO} V _{CC MP} =60KHz 3		V _{ST ON}	1mA, V _{CC} =10V	16	17	18	V		
ST Startup Current I _{ST ON} V _{CC} =10V 20 35 μA ST Operating Current I _{ST OP} V _{CC} =14V 35 60 μA Supply Voltage Section V _{CC} Startup Voltage Protection Threshold V _{CC ON} V _{CC} Rising 10 11 12 V V _{CC} Undervoltage Protection Threshold V _{CC UVLO} V _{CC} Falling 5.2 5.8 6.5 V V _{CC} Hold Voltage V _{CC HOLD} V _{CC} Falling 7 7.5 8 V V _{CC} Turn Off Current I _{CC UVLO} V _{CC} Rising, V _{CC} =10V 40 70 μA V _{CC} Quiescent Current I _Q No Switch, V _{CC} =14V 320 600 μA V _{CC} Quiescent Current I _Q No Switch, V _{CC} =14V 320 600 μA V _{CC} Quiescent Current I _Q No Switch, V _{CC} =14V 320 600 μA V _{CC} Quiescent Current I _Q No Switch, V _{CC} =14V 320 600 μA V _{CC} Quiescent Current I _Q No Switch, V _{CC} =14V 320 600 μA V _{CC} Quiescent Current Sende V _{CC} Ne	V _{ST} Hysteresis Voltage				2		V		
ST Operating Current I _{ST OP} V _{CC} =14V 35 60 μA Supply Voltage Section V _{CC} Startup Voltage V _{CC ON} V _{CC Rising} 10 11 12 V V _{CC} Undervoltage Protection Threshold V _{CC HOLD} V _{CC} Falling 5.2 5.8 6.5 V V _{CC} Hold Voltage V _{CC HOLD} V _{CC} Falling 7 7.5 8 V V _{CC} Turn Off Current I _{CC} UVLO V _{CC} Rising, V _{CC} =10V 40 70 μA V _{CC} Quiescent Current I _C No Switch, V _{CC} =14V 320 600 μA V _{CC} Operating Current I _C F _{OP} =60kHz 300 μA V _{CC} Operating Current I _C F _{OP} =60kHz 300 μA V _{CC} Operating Current I _C F _{OP} =60kHz 300 μA V _{CC} Operating Current I _C F _{OP} =60kHz 300 μA V _{CC} Operating Current I _C F _{OP} =60kHz 300 μA V _C F B Falling 0.4 V V FB Falling Edge Threshold Voltage V _{FB}	ST Startup Current		V _{CC} =10V		20	35	μA		
V _{CC} Startup Voltage V _{CC} on V _{CC} Rising 10 11 12 V V _{CC} Undervoltage Protection Threshold V _{CC UVLO} V _{CC} Falling 5.2 5.8 6.5 V V _{CC} Hold Voltage V _{CC HolD} V _{CC} Falling 7 7.5 8 V V _{CC} Turn Off Current I _{CC UVLO} V _{CC} Rising, V _{CC} =10V 40 70 µA V _{CC} Quiescent Current I _Q No Switch, V _{CC} =14V 320 600 µA V _{CC} Operating Current I _Q No Switch, V _{CC} =14V 320 600 µA V _{CC} Over Voltage Protection Threshold V _{CC} Over 21 V V P	ST Operating Current		V _{CC} =14V		35	60	μA		
V _{CC} Undervoltage Protection Threshold V _{CC HoLD} V _{CC Falling} 5.2 5.8 6.5 V V _{CC} Hold Voltage V _{CC HoLD} V _{CC Falling} 7 7.5 8 V V _{CC} Turn Off Current I _{CC UVLO} V _{CC} Rising, V _{CC} =10V 40 70 µA V _{CC} Quiescent Current I _Q No Switch, V _{CC} =14V 320 600 µA V _{CC} Operating Current I _{CC} F _{OP} =60kHz 300 µA V _{CC} Over Voltage Protection Threshold V _{CC OVP} 21 V FB Falling Edge Threshold Voltage V _{FB FALL} FB Falling 0.4 V FB Hysteresis Voltage V _{FB HYS} FB Rising 0.6 V FB Over Voltage Protection Threshold V _{FB OVP} 5.5 V Minimum Off Time T _{OFF MIN} 4.0 µs Maximum Off Time T _{OFF MIN} 90 µs Current Sense Section Leading Edge Blanking Time for Current Sense T _{LEB CS} 350 ns Switch off Delay Time T _{OELAY}	Supply Voltage Section								
V _{CC} Undervoltage Protection Threshold V _{CC HOLD} V _{CC Falling} 5.2 5.8 6.5 V V _{CC} Hold Voltage V _{CC HOLD} V _{CC Falling} 7 7.5 8 V V _{CC} Turn Off Current I _{CC UVLO} V _{CC} Rising, V _{CC} =10V 40 70 µA V _{CC} Quiescent Current I _Q No Switch, V _{CC} =14V 320 600 µA V _{CC} Operating Current I _{CC} F _{OP} =60kHz 300 µA V _{CC} Over Voltage Protection Threshold V _{CC OVP} 21 V FB Falling Edge Threshold Voltage V _{FB FALL} FB Falling 0.4 V FB Hysteresis Voltage V _{FB HYS} FB Rising 0.6 V FB Over Voltage Protection Threshold V _{FB OVP} 5.5 V Minimum Off Time T _{OFF MIN} 4.0 µs Maximum Off Time T _{OFF MIN} 90 µs Current Sense Section Leading Edge Blanking Time for Current Sense T _{LEB CS} 350 ns Switch off Delay Time T _{OELAY}	V _{CC} Startup Voltage	$V_{CC\ ON}$	V _{CC} Rising	10	11	12	V		
$V_{\text{CC}} \text{Turn Off Current} \qquad \qquad I_{\text{CC}} \text{UvLo} \qquad V_{\text{CC}} \text{Rising, V}_{\text{CC}} = 10V \qquad \qquad 40 \qquad 70 \qquad \mu A \\ V_{\text{CC}} \text{Quiescent Current} \qquad \qquad I_{\text{Q}} \qquad \text{No Switch, V}_{\text{CC}} = 14V \qquad 320 \qquad 600 \qquad \mu A \\ V_{\text{CC}} \text{Operating Current} \qquad \qquad I_{\text{CC}} \qquad F_{\text{OP}} = 60\text{kHz} \qquad 300 \qquad \qquad \mu A \\ V_{\text{CC}} \text{Over Voltage Protection Threshold} \qquad V_{\text{CC}} \text{Over} \qquad \qquad 21 \qquad V \\ \textit{FB Feedback} \qquad \qquad$	V _{CC} Undervoltage Protection Threshold		V _{CC} Falling	5.2	5.8	6.5	V		
V _{CC} Quiescent Current I _Q No Switch, V _{CC} =14V 320 600 μA V _{CC} Operating Current I _{CC} F _{OP} =60kHz 300 μA V _{CC} Over Voltage Protection Threshold V _{CC OVP} 21 V FB Feedback FB Falling Edge Threshold Voltage V _{FB FALL} FB Falling 0.4 V FB Hysteresis Voltage V _{FB HYS} FB Rising 0.6 V FB Over Voltage Protection Threshold V _{FB HYS} FB Rising 0.6 V FB Over Voltage Protection Threshold V _{FB HYS} FB Rising 0.6 V FB Over Voltage Protection Threshold V _{FB HYS} FB Rising 0.6 V FB Over Voltage Protection Threshold V _{FB HYS} FB Rising 0.6 V Maximum Off Time T _{OFF,MIN} 4.0 μρε Current Sense Section Leading Edge Blanking Time for Current Sense T _{LEB CS} 350 ns Switch off Delay Time T _{DELAY} 180 ns Loop Compensation Internal Reference Voltage V _{COMP LO} 1.5 3.5 <td rows<="" td=""><td>V_{CC} Hold Voltage</td><td>$V_{CC\ HOLD}$</td><td>V_{CC} Falling</td><td>7</td><td>7.5</td><td>8</td><td>V</td></td>	<td>V_{CC} Hold Voltage</td> <td>$V_{CC\ HOLD}$</td> <td>V_{CC} Falling</td> <td>7</td> <td>7.5</td> <td>8</td> <td>V</td>	V _{CC} Hold Voltage	$V_{CC\ HOLD}$	V _{CC} Falling	7	7.5	8	V	
V _{CC} Operating Current I _{CC} F _{OP} =60kHz 300 μA V _{CC} Over Voltage Protection Threshold V _{CC OVP} 21 V FB Feedback FB Falling Edge Threshold Voltage V _{FB FALL} FB Falling 0.4 V FB Hysteresis Voltage V _{FB HYS} FB Rising 0.6 V FB Over Voltage Protection Threshold V _{FB OVP} 5.5 V Minimum Off Time T _{OFF MIN} 4.0 μs Maximum Off Time T _{OFF MAX} 90 μs Current Sense Section Leading Edge Blanking Time for Current Sense T _{LEB CS} 350 ns Switch off Delay Time T _{DELAY} 180 ns Loop Compensation Internal Reference Voltage V _{REF} 0.294 0.300 0.306 V COMP Low Clamp Voltage V _{COMP LO} 1.5 3.5 V COMP Protection Threshold V _{COMP OVP} 4.5 V Linear Voltage Sampling V _{LN} 0 2.5 <t< td=""><td>V_{CC} Turn Off Current</td><td>I_{CC_UVLO}</td><td>V_{CC} Rising, V_{CC}=10V</td><td></td><td>40</td><td>70</td><td>μΑ</td></t<>	V _{CC} Turn Off Current	I _{CC_UVLO}	V _{CC} Rising, V _{CC} =10V		40	70	μΑ		
V _{CC} Over Voltage Protection Threshold V _{CC} OVP 21 V FB Feedback FB Feedback FB Falling Edge Threshold Voltage V _{FB FALL} FB Falling 0.4 V FB Hysteresis Voltage V _{FB HYS} FB Rising 0.6 V FB Over Voltage Protection Threshold V _{FB OVP} 5.5 V Minimum Off Time T _{OFF MIN} 4.0 μs Maximum Off Time T _{OFF MAX} 90 μs Current Sense Section Leading Edge Blanking Time for Current Sense T _{LEB CS} 350 ns Switch off Delay Time T _{DELAY} 180 ns Loop Compensation Internal Reference Voltage V _{REF} 0.294 0.300 0.306 V COMP Low Clamp Voltage V _{COMP LO} 1.5 3.5 V COMP Protection Threshold V _{COMP OVP} 4.5 V Linear Voltage Sampling V _{LN} 0 2.5 V Driver Stage V _{LN} 0 2.5	V _{CC} Quiescent Current	I_Q	No Switch, V _{CC} =14V		320	600	μΑ		
FB Feedback FB Falling Edge Threshold Voltage V _{FB FALL} FB Falling 0.4 V	V _{CC} Operating Current	I_{CC}	F _{OP} =60kHz		300		μΑ		
FB Falling Edge Threshold Voltage V _{FB FALL} FB Falling 0.4 V	V _{CC} Over Voltage Protection Threshold	$V_{\sf CC\ OVP}$			21		V		
FB Hysteresis Voltage	FB Feedback								
FB Over Voltage Protection Threshold V _{FB_OVP} 5.5 V	FB Falling Edge Threshold Voltage	V_{FB} FALL	FB Falling		0.4		V		
Minimum Off Time T _{OFF MIN} 4.0 μs Maximum Off Time T _{OFF MAX} 90 μs Current Sense Section Leading Edge Blanking Time for Current Sense T _{LEB CS} 350 ns Switch off Delay Time T _{DELAY} 180 ns Loop Compensation Internal Reference Voltage V _{REF} 0.294 0.300 0.306 V COMP Low Clamp Voltage V _{COMP LO} 1.5 V COMP Linear Operating Voltage Range V _{COMP} 1.5 3.5 V COMP Protection Threshold V _{COMP OVP} 4.5 V Linear Voltage Sampling V _{LN} 0 2.5 V Driver Stage V _{LN} 0 2.5 V	FB Hysteresis Voltage	V_{FB_HYS}	FB Rising		0.6		V		
Maximum Off Time T _{OFF_MAX} 90 μs Current Sense Section Leading Edge Blanking Time for Current Sense T _{LEB CS} 350 ns Switch off Delay Time T _{DELAY} 180 ns Loop Compensation Internal Reference Voltage V _{REF} 0.294 0.300 0.306 V COMP Low Clamp Voltage V _{COMP_LO} 1.5 V COMP Linear Operating Voltage Range V _{COMP_OVP} 1.5 3.5 V COMP Protection Threshold V _{COMP_OVP} 4.5 V Linear Voltage Sampling V _{LN} 0 2.5 V Driver Stage V _{LN} 0 2.5 V	FB Over Voltage Protection Threshold	V_{FB_OVP}			5.5		V		
Current Sense Section Leading Edge Blanking Time for Current Sense T _{LEB_CS} 350 ns Switch off Delay Time T _{DELAY} 180 ns Loop Compensation Internal Reference Voltage V _{REF} 0.294 0.300 0.306 V COMP Low Clamp Voltage V _{COMP_LO} 1.5 V COMP Linear Operating Voltage Range V _{COMP} 1.5 3.5 V COMP Protection Threshold V _{COMP_OVP} 4.5 V Linear Voltage Sampling LN Linear Working Range V _{LN} 0 2.5 V Driver Stage	Minimum Off Time	T _{OFF_MIN}			4.0		μs		
Leading Edge Blanking Time for Current Sense T _{LEB_CS} 350 ns Switch off Delay Time T _{DELAY} 180 ns Loop Compensation Internal Reference Voltage V _{REF} 0.294 0.300 0.306 V COMP Low Clamp Voltage V _{COMP_LO} 1.5 V COMP Linear Operating Voltage Range V _{COMP_OVP} 1.5 3.5 V COMP Protection Threshold V _{COMP_OVP} 4.5 V Linear Voltage Sampling LN Linear Working Range V _{LN} 0 2.5 V Driver Stage	Maximum Off Time	T _{OFF_MAX}			90		μs		
Switch off Delay Time T _{DELAY} 180 ns Loop Compensation Internal Reference Voltage V _{REF} 0.294 0.300 0.306 V COMP Low Clamp Voltage V _{COMP_LO} 1.5 V COMP Linear Operating Voltage Range V _{COMP} 1.5 3.5 V COMP Protection Threshold V _{COMP_OVP} 4.5 V Linear Voltage Sampling V _{LN} 0 2.5 V Driver Stage V _{LN} 0 2.5 V	Current Sense Section								
Loop Compensation VREF 0.294 0.300 0.306 V COMP Low Clamp Voltage VCOMP_LO 1.5 V COMP Linear Operating Voltage Range VCOMP 1.5 3.5 V COMP Protection Threshold VCOMP_OVP 4.5 V Linear Voltage Sampling LN Linear Working Range VLN 0 2.5 V Driver Stage V </td <td>Leading Edge Blanking Time for Current Sense</td> <td>T_{LEB_CS}</td> <td></td> <td></td> <td>350</td> <td></td> <td>ns</td>	Leading Edge Blanking Time for Current Sense	T _{LEB_CS}			350		ns		
Internal Reference Voltage	Switch off Delay Time	T_{DELAY}			180		ns		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Loop Compensation								
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Internal Reference Voltage	V_{REF}		0.294	0.300	0.306	V		
COMP Protection Threshold V _{COMP_OVP} 4.5 V Linear Voltage Sampling V _{LN} 0 2.5 V LN Linear Working Range V _{LN} 0 2.5 V Driver Stage	COMP Low Clamp Voltage	V_{COMP_LO}			1.5		V		
Linear Voltage Sampling LN Linear Working Range V _{LN} 0 2.5 V Driver Stage V _{LN} 0 0	COMP Linear Operating Voltage Range	V_{COMP}		1.5		3.5	V		
LN Linear Working Range V _{LN} 0 2.5 V Driver Stage	COMP Protection Threshold	V_{COMP_OVP}			4.5		V		
Driver Stage									
	LN Linear Working Range	V_{LN}		0		2.5	V		
Internal Tube Driven MOS Resistance $R_{DS ON}$ V_{CC} =14V 1200 $m\Omega$	Driver Stage								
	Internal Tube Driven MOS Resistance	R _{DS_ON}	V _{CC} =14V		1200		mΩ		

Notes: 1. Production testing of the chip is performed at 25°C.

^{2.} The maximum and minimum parameters specified are guaranteed by test, the typical value are guaranteed by design, characterization and statistical analysis

TYPICAL APPLICATION CIRCUIT



UTC assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all UTC products described or contained herein. UTC products are not designed for use in life support appliances, devices or systems where malfunction of these products can be reasonably expected to result in personal injury. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner. The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice.