**Unitrode Products
from Texas Instruments**

application
INFO
available

**UC1846/7
UC2846/7
UC3846/7**

Current Mode PWM Controller

FEATURES

- Automatic Feed Forward Compensation

- Programmable Pulse-by-Pulse Current Limiting

- Automatic Symmetry Correction in Push-pull Configuration

- Enhanced Load Response Characteristics

- Parallel Operation Capability for Modular Power Systems

- Differential Current Sense Amplifier with Wide Common Mode Range

- Double Pulse Suppression

- 500mA (Peak) Totem-pole Outputs

- ±1% Bandgap Reference

- Under-voltage Lockout

- Soft Start Capability

- Shutdown Terminal

- 500kHZ Operation

DESCRIPTION

The UC1846/7 family of control ICs provides all of the necessary features to implement fixed frequency, current mode control schemes while maintaining a minimum external parts count. The superior performance of this technique can be measured in improved line regulation, enhanced load response characteristics, and a simpler, easier-to-design control loop. Topological advantages include inherent pulse-by-pulse current limiting capability, automatic symmetry correction for push-pull converters, and the ability to parallel "power modules" while maintaining equal current sharing.

Protection circuitry includes built-in under-voltage lockout and programmable current limit in addition to soft start capability. A shutdown function is also available which can initiate either a complete shutdown with automatic restart or latch the supply off.

Other features include fully latched operation, double pulse suppression, deadline adjust capability, and a ±1% trimmed bandgap reference.

The UC1846 features low outputs in the OFF state, while the UC1847 features high outputs in the OFF state.
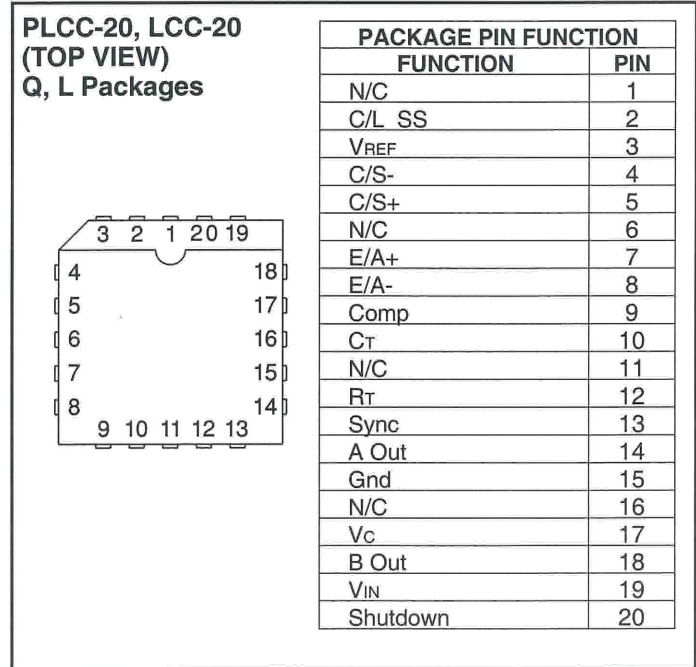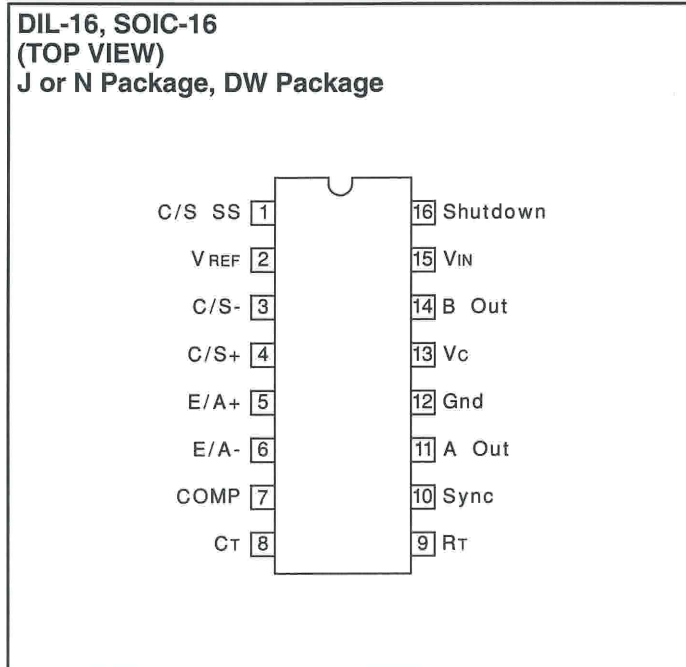
BLOCK DIAGRAM
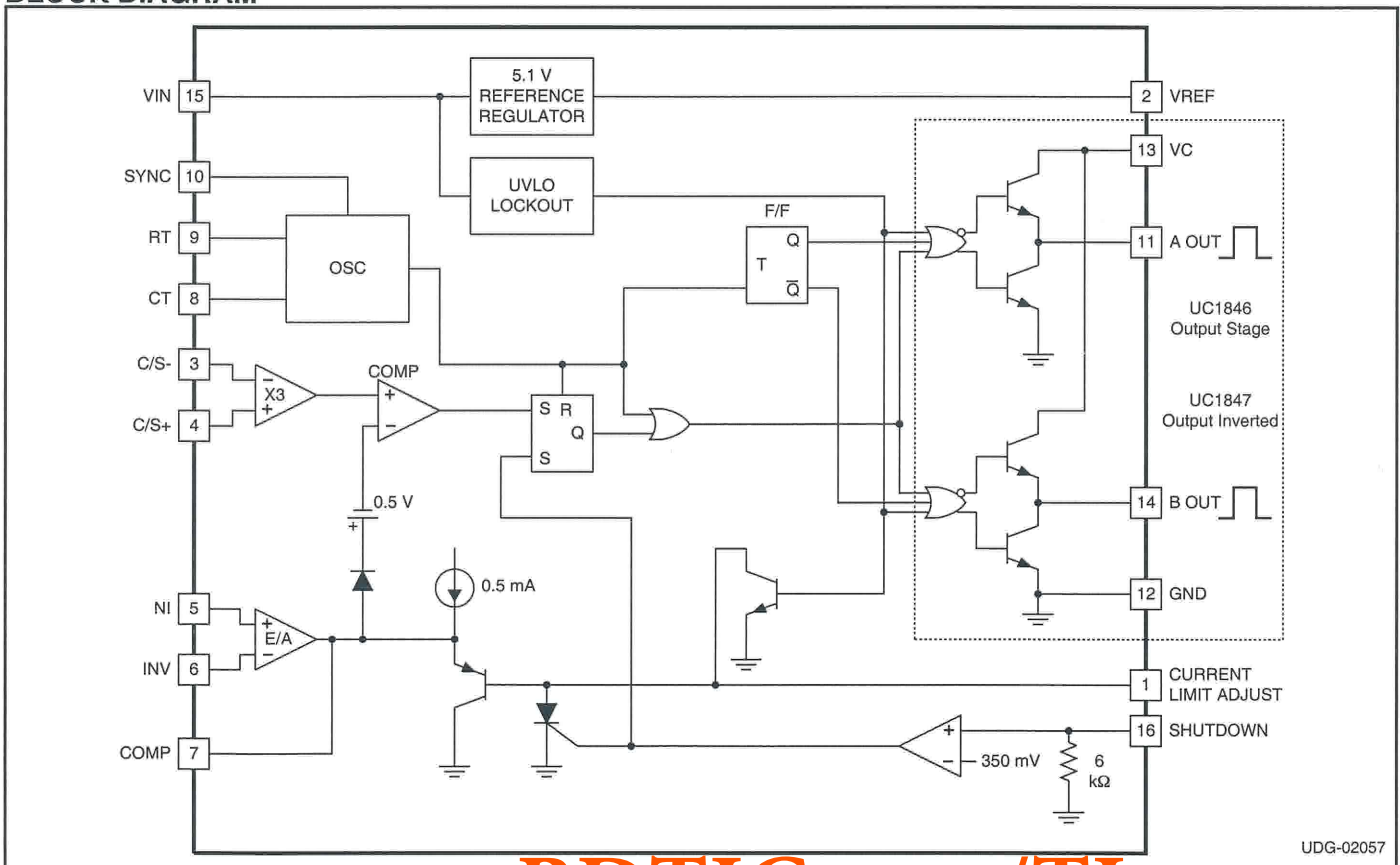
UDG-02057

ABSOLUTE MAXIMUM RATINGS (Note 1)

Supply Voltage (Pin 15) . . . . +40V
Collector Supply Voltage (Pin 13) . . . . +40V
Output Current, Source or Sink (Pins 11, 14) 500mA
Analog Inputs (Pins 3, 4, 5, 6, 16). . . . . -0.3V to +V_{IN}
Reference Output Current (Pin 2) . . . . -30mA
Sync Output Current (Pin 10). . . . . -5mA
Error Amplifier Output Current (Pin 7) . . . . -5mA
Soft Start Sink Current (Pin 1) 50mA
Oscillator Charging Current (Pin 9) 5mA
Power Dissipation at T_A=25°C 1000mW
Power Dissipation at T_C=25°C 2000mW
Storage Temperature Range . . . . -65°C to +150°C
Lead Temperature (soldering, 10 seconds) . . . . +300°C

Note 1. All voltages are with respect to Ground, Pin 13. Currents are positive into, negative out of the speficied terminal. Consult Packaging Section of Databook for thermal limitations and considerations of packages. Pin numbers refer to DIL and SOIC packages only.

CONNECTION DIAGRAMS

DIL-16, SOIC-16 (TOP VIEW) J or N Package, DW Package

Left pins		Right pins
C/S SS	1	16 Shutdown
V_{REF}	2	15 V_{IN}
C/S-	3	14 B Out
C/S+	4	13 Vc
E/A+	5	12 Gnd
E/A-	6	11 A Out
COMP	7	10 Sync
C_T	8	9 R_T

PLCC-20, LCC-20 (TOP VIEW) Q, L Packages

PACKAGE PIN FUNCTION	
FUNCTION	PIN
N/C	1
C/L SS	2
V_{REF}	3
C/S-	4
C/S+	5
N/C	6
E/A+	7
E/A-	8
Comp	9
C_T	10
N/C	11
R_T	12
Sync	13
A Out	14
Gnd	15
N/C	16
Vc	17
B Out	18
V_{IN}	19
Shutdown	20

ELECTRICAL CHARACTERISTICS

(Unless otherwise stated, these specifications apply for T_A=-55°C to +125°C for UC1846/7; -40°C to +85°C for the UC2846/7; and 0°C to +70°C for the UC3846/7; V_{IN}=15V, R_T=10k, C_T=4.7nF, T_A=T_J.)

PARAMETER	TEST CONDITIONS	UC1846/UC1847 UC2846/UC2847			UC3846/UC3847			UNITS
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Reference Section								
Output Voltage	T_J=25°C, I_O=1mA	5.05	5.10	5.15	5.00	5.10	5.20	V
Line Regulation	V_{IN}=8V to 40V		5	20		5	20	mV
Load Regulation	I_L=1mA to 10mA		3	15		3	15	mV
Temperature Stability	Over Operating Range, (Note 2)		0.4			0.4		mV/°C
Total Output Variation	Line, Load, and Temperature (Note 2)	5.00		5.20	4.95		5.25	V
Output Noise Voltage	10Hz ≤ f ≤10kHz, T_J=25°C (Note 2)		100			100		μV
Long Term Stability	T_J=125°C, 1000 Hrs. (Note 2)		5			5		mV
Short Circuit Output Current	V_{REF}=0V	-10	-45			-45		mA

ELECTRICAL CHARACTERISTICS (cont.) (Unless otherwise stated, these specifications apply for TA=-55°C to +125°C for UC1846/7; -40°C to +85°C for the UC2846/7; and 0°C to +70°C for the UC3846/7; VIN=15V, RT=10k, CT=4.7nF, TA=TJ.)

PARAMETER	TEST CONDITIONS	UC1846/UC1847 UC2846/UC2847			UC3846/UC3847			UNITS
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Oscillator Section								
Initial Accuracy	TJ=25°C	39	43	47	39	43	47	kHz
Voltage Stability	VIN=8V to 40V		-1	2		-1	2	%
Temperature Stability	Over Operating Range (Note 2)		-1			-1		%
Sync Output High Level		3.9	4.35		3.9	4.35		V
Sync Output Low Level			2.3	2.5		2.3	2.5	V
Sync Input High Level	Pin 8=0V	3.9			3.9			V
Sync Input Low Level	Pin 8=0V			2.5			2.5	V
Sync Input Current	Sync Voltage=3.9V, Pin 8=0V		1.3	1.5		1.3	1.5	mA
Error Amp Section								
Input Offset Voltage			0.5	5		0.5	10	mV
Input Bias Current			-0.6	-1		-0.6	-2	μA
Input Offset Current			40	250		40	250	nA
Common Mode Range	VIN=8V to 40V	0		VIN-2V	0		VIN-2V	V
Open Loop Voltage Gain	ΔVO=1.2 to 3V, VCM=2V	80	105		80	105		dB
Unity Gain Bandwidth	TJ=25°C (Note 2)	0.7	1.0		0.7	1.0		MHz
CMRR	VCM=0V to 38V, VIN=40V	75	100		75	100		dB
PSRR	VIN=8V to 40V	80	105		80	105		dB
Output Sink Current	VID=-15mV to -5V, VPIN 7=1.2V	2	6		2	6		mA
Output Source Current	VID=15mV to 5V, VPIN 7=2.5V	-0.4	-0.5		-0.4	-0.5		mA
High Level Output Voltage	RL=(Pin 7) 15kΩ	4.3	4.6		4.3	4.6		V
Low Level Output Voltage			0.7	1		0.7	1	V
Current Sense Amplifier Section								
Amplifier Gain	VPIN 3=0V, Pin 1 Open (Notes 3 & 4)	2.5	2.75	3.0	2.5	2.75	3.0	V
Maximum Differential Input Signal (VPIN 4-VPIN 3)	Pin 1 Open (Note 3) RL (Pin 7)=15kW	1.1	1.2		1.1	1.2		V
Input Offset Voltage	VPIN 1=0.5V, Pin 7 Open (Note 3)		5	25		5	25	mV
CMRR	VCM=1V to 12V	60	83		60	83		dB
PSRR	VIN=8V to 40V	60	84		60	84		dB
Input Bias Current	VPIN 1=0.5V, Pin 7 Open (Note 3)		-2.5	-10		-2.5	-10	μA
Input Offset Current	VPIN 1=0.5V, Pin 7 Open (Note 3)		0.08	1		0.08	1	μA
Input Common Mode Range		0		VIN-3	0		VIN-3	V
Delay to Outputs	TJ=25°C, (Note 2)		200	500		200	500	ns
Current Limit Adjust Section								
Current Limit Offset	VPIN 3=0V, VPIN 4=0V, Pin 7 Open (Note 3)	0.45	0.5	0.55	0.45	0.5	0.55	V
Input Bias Current	VPIN 5=VREF, VPIN 6=0V		-10	-30		-10	-30	μA
Shutdown Terminal Section								
Threshold Voltage		250	350	400	250	350	400	mV
Input Voltage Range		0		VIN	0		VIN	V
Minimum Latching Current (IPIN 1)	(Note 6)	3.0	1.5		3.0	1.5		mA

ELECTRICAL CHARACTERISTICS (cont.) (Unless otherwise stated, these specifications apply for TA=-55°C to +125°C for UC1846/7; -40°C to +85°C for the UC2846/7; and 0°C to +70°C for the UC3846/7; VIN=15V, RT=10k, CT=4.7nF, TA=TJ.)

PARAMETER	TEST CONDITIONS	UC1846/UC1847 UC2846/UC2847			UC3846/UC3847			UNITS
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Shutdown Terminal Section (cont.)								
Maximum Non-Latching Current (IPIN 1)	(Note 7)		1.5	0.8		1.5	0.8	mA
Delay to Outputs	TJ=25°C (Note 2)		300	600		300	600	ns
Output Section								
Collector-Emitter Voltage		40			40			V
Collector Leakage Current	VC=40V (Note 5)			200			200	µA
Output Low Level	ISINK=20mA		0.1	0.4		0.1	0.4	V
	ISINK=100mA		0.4	2.1		0.4	2.1	V
Output High Level	ISOURCE=20mA	13	13.5		13	13.5		V
	ISOURCE=100mA	12	13.5		12	13.5		V
Rise Time	CL=1nF, TJ=25°C (Note 2)		50	300		50	300	ns
Fall Time	CL=1nF, TJ=25°C (Note 2)		50	300		50	300	ns
Under-Voltage Lockout Section								
Start-Up Threshold			7.7	8.0		7.7	8.0	V
Threshold Hysteresis			0.75			0.75		V
Total Standby Current								
Supply Current			17	21		17	21	mA

Note 2. These parameters, although ensured over the recommended operating conditions, are not 100% tested in production.

Note 3. Parameter measured at trip point of latch with VPIN 5 = VREF, VPIN 6 = 0V.

Note 4. Amplifier gain defined as: $G = \dfrac{\Delta V_{PIN7}}{\Delta V_{PIN4}}$; $V_{PIN4} = 0$ to $1.0V$
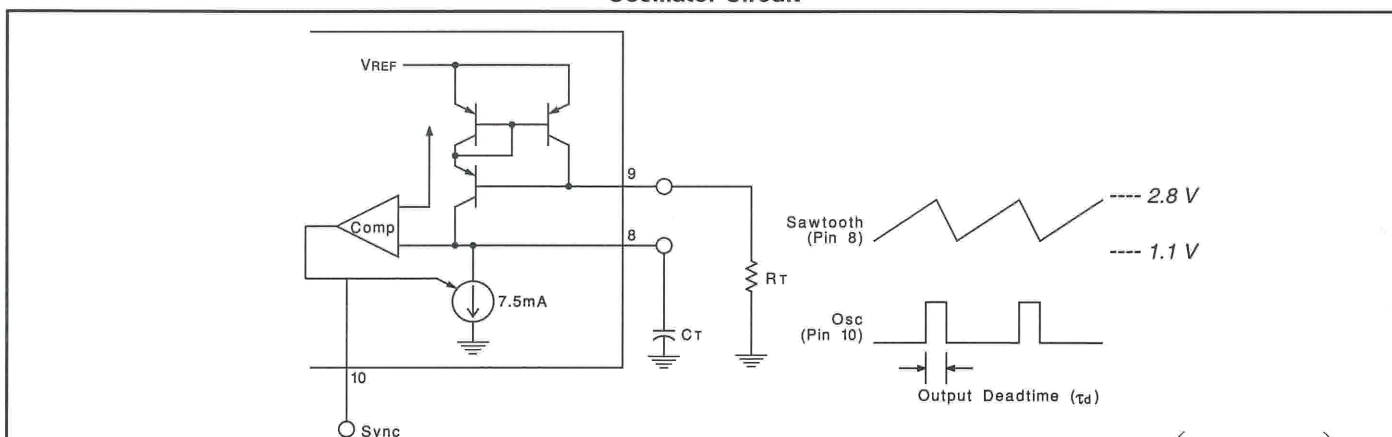
Note 5. Applies to UC1846/UC2846/UC3846 only due to polarity of outputs.

Note 6. Current into Pin 1 ensured to latch circuit in shutdown state.

Note 7. Current into Pin 1 ensured not to latch circuit in shutdown state.

APPLICATIONS DATA

Oscillator Circuit

Output deadtime is determined by the external capacitor, CT, according to the formula: $\tau d\ (\mu s) = 145 CT\ (\mu f) \left(\dfrac{ID}{ID - \dfrac{3.6}{RT\ (k\Omega)}} \right)$.
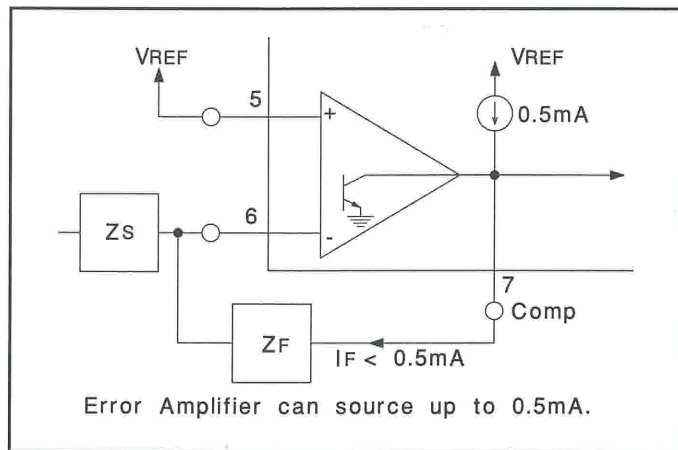
ID = Oscillator discharge current at 25°C is typically 7.5.

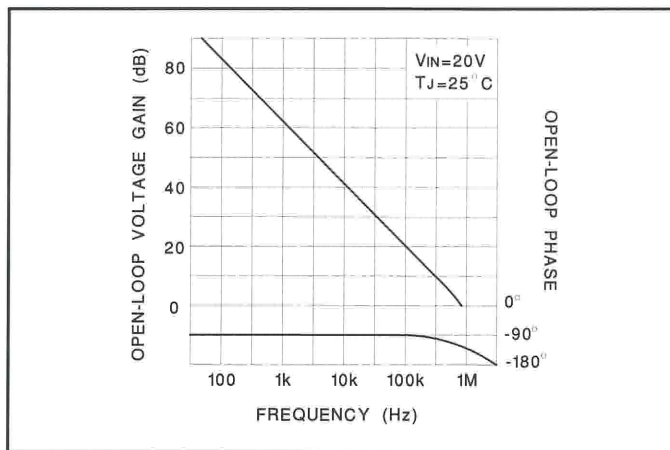For large values of RT: $\tau d\ (\mu s) \approx 145 CT\ (\mu f)$.

Oscillator frequency is approximated by the formula: $fT\ (kHz) \approx \dfrac{2.2}{RT\ (k\Omega) \cdot CT\ (\mu f)}$.
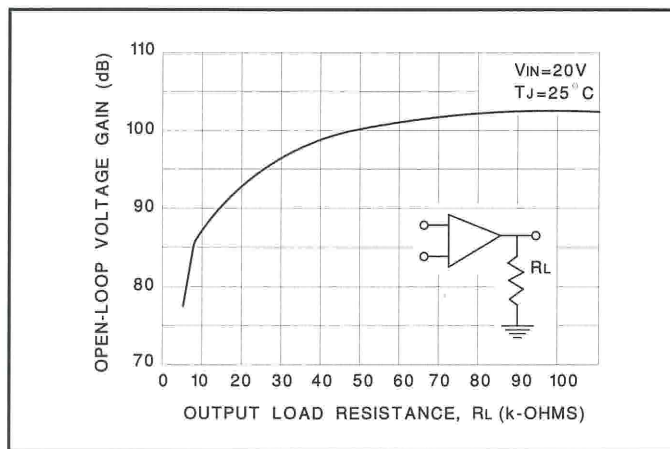
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APPLICATIONS DATA (cont.)
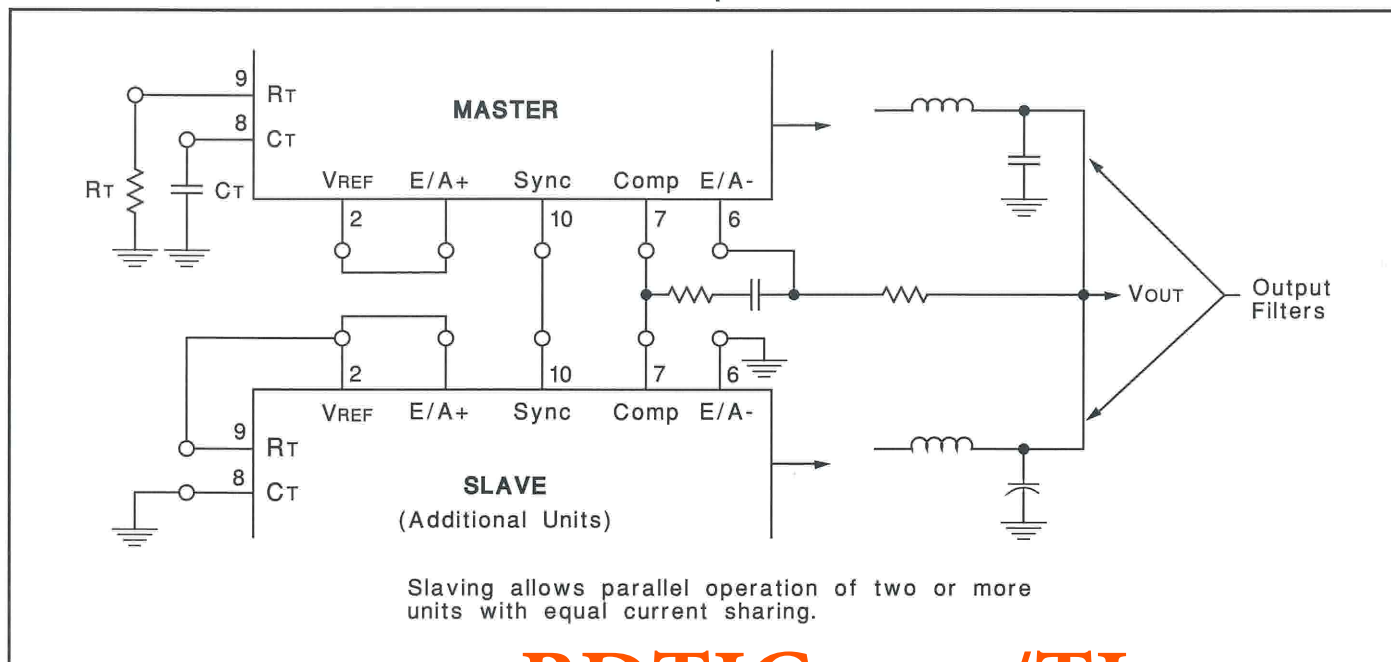
Error Amp Output Configuration

Error Amplifier can source up to 0.5mA.

Error Amp Gain and Phase vs Frequency

Error Amp Open-Logic D.C. Gain vs Load Resistance

Parallel Operation

Slaving allows parallel operation of two or more units with equal current sharing.

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APPLICATIONS DATA (cont.)

Pulse by Pulse Current Limiting

Peak Current (Is) is determined by the formula: $IS = \dfrac{\dfrac{R2\,VREF}{R1+R2} - 0.5}{3RS}$
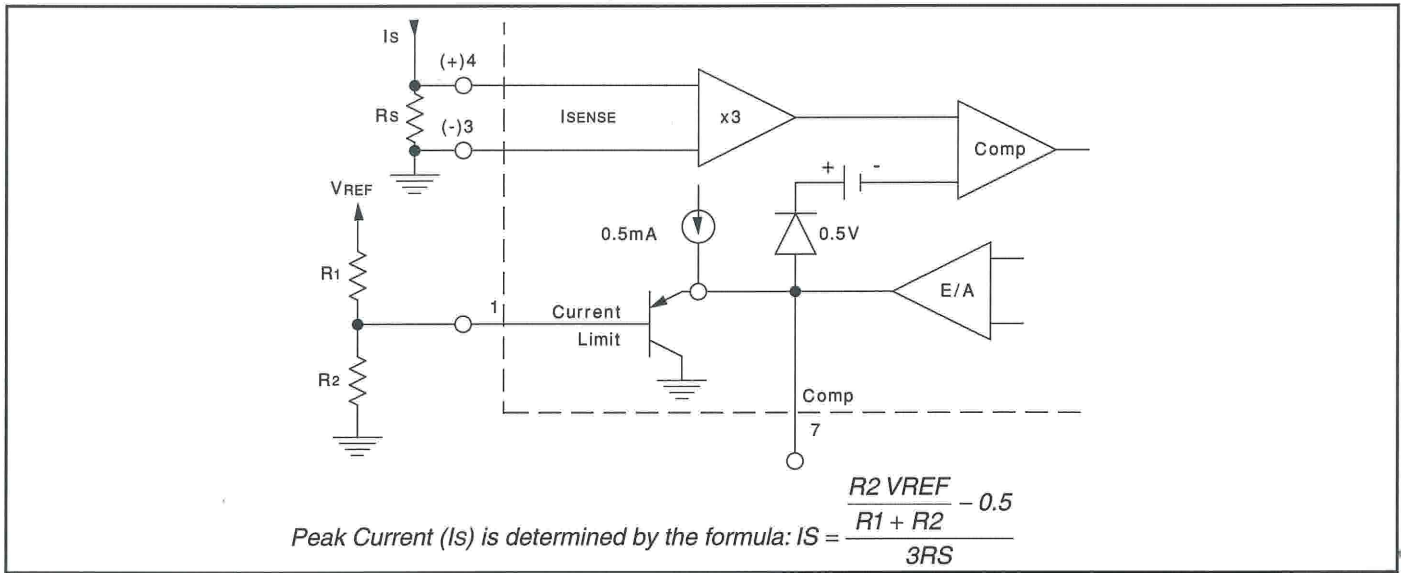
Soft Start and Shutdown /Restart Functions

Shutdown With Auto-Restart

Shutdown Without Auto-Restart (Latched)

$\dfrac{VREF}{R1} < 0.8mA$

$\dfrac{VREF}{R1} > 3mA$ (Latched Off)

If $\dfrac{VREF}{R1} < 0.8mA$, the shutdown latch will commutate when Iss = 0.8mA and a restart cycle will be initiated.

If $\dfrac{VREF}{R1} > 3mA$, the device will latch off until power is recycled.
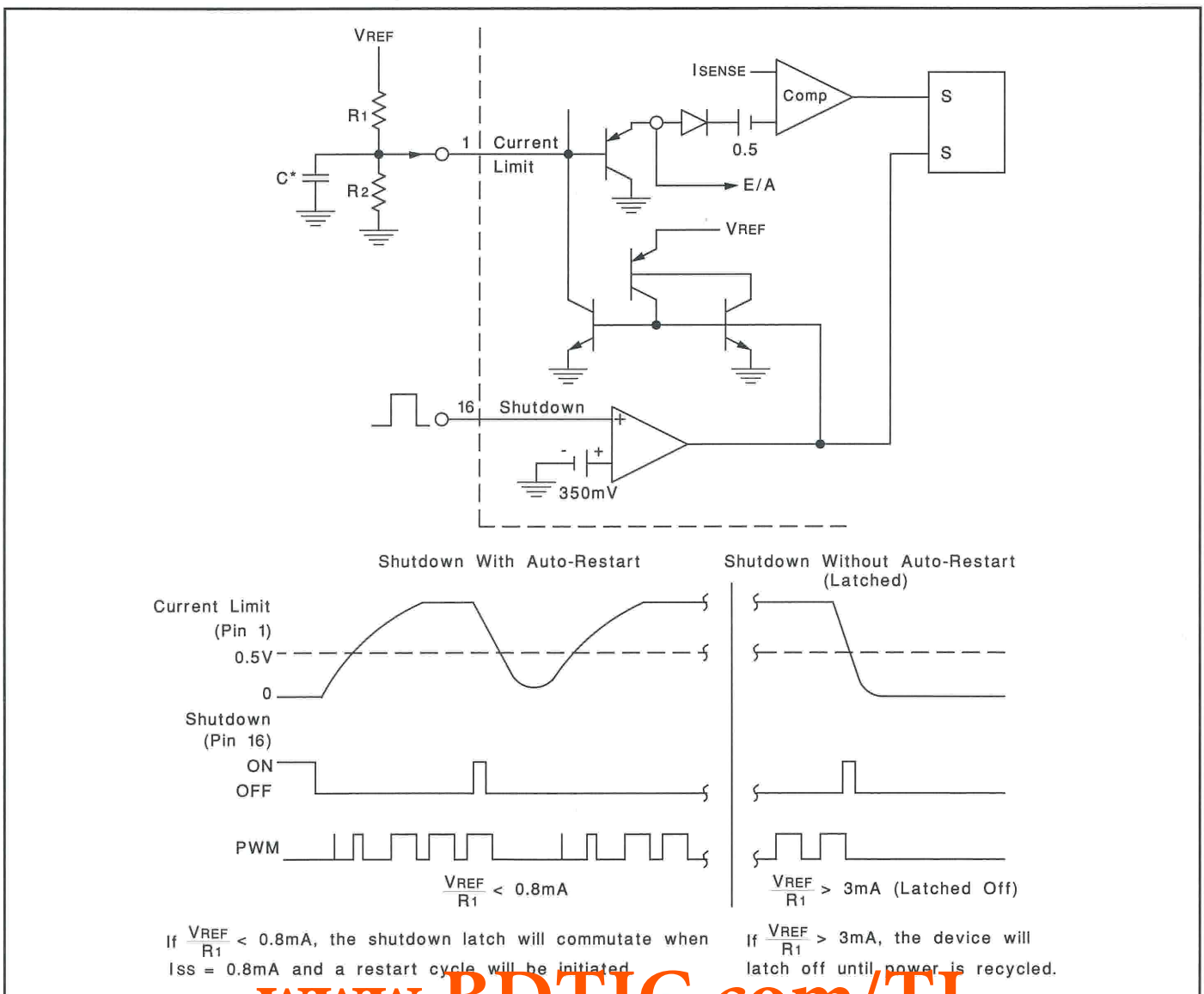
APPLICATIONS DATA (cont.)

Current Sense Amp Connection

*A small RC filter may be required in some applications to reduce switch transients.
Differential input allows remote, noise free sensing.*
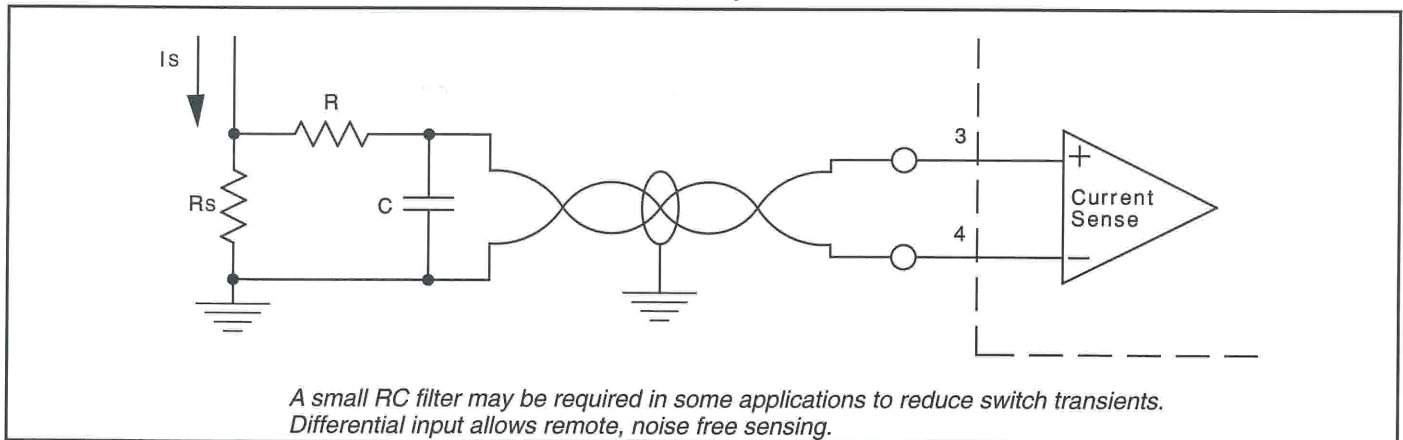
UC1846 Open Loop Test Circuit

-Bypass Caps Should Be Low ESR & ESL Type
-Short Pins 6 & 7 for Unity Gain Testing

7
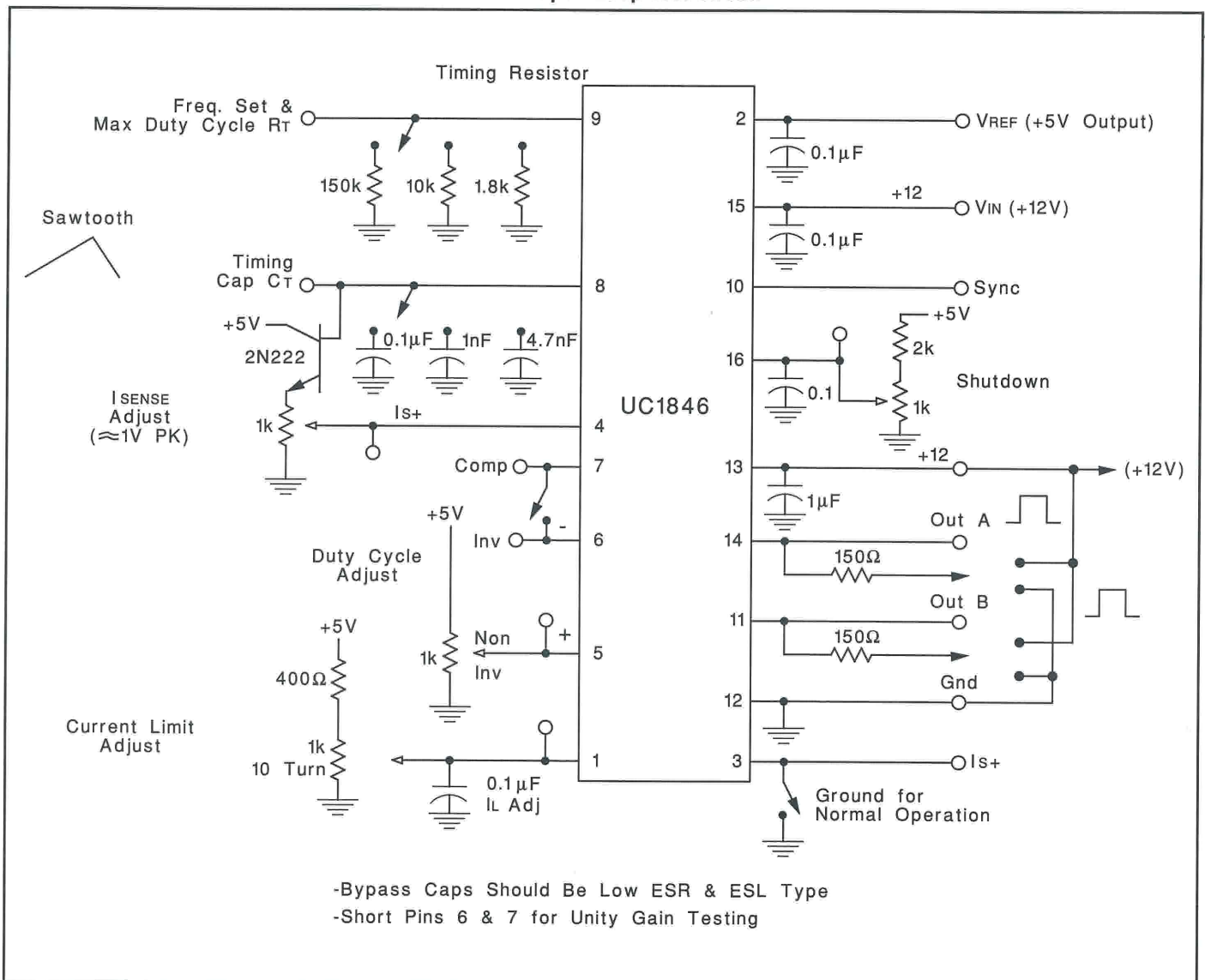
REVISION HISTORY

SLUS352A to SLUS352B July 2010:

1) Updated block diagram, page 1.

2) Added peak and vally voltages to the Oscillator Circuit, page 4.

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/ Ball Finish	MSL Peak Temp [3]	Samples (Requires Login)
5962-86806012A	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Call TI	
5962-8680601EA	ACTIVE	CDIP	J	16	1	TBD	Call TI	Call TI	
UC1846J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	
UC1846J/80257	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI	
UC1846J/80364	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI	
UC1846J/80619	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI	
UC1846J883B	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	
UC1846L883B	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	
UC1847J	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI	
UC1847J883B	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI	
UC1847L	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI	
UC1847L883B	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI	
UC2846DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC2846DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC2846DWTR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC2846DWTR/81265	OBSOLETE	SOIC	DW	16		TBD	Call TI	Call TI	
UC2846DWTR/81265G4	OBSOLETE	SOIC	DW	16		TBD	Call TI	Call TI	
UC2846DWTRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC2846J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	
UC2846N	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
UC2846NG4	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
UC2846QTR	ACTIVE	PLCC	FN	20	1000	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	
UC2846QTRG3	ACTIVE	PLCC	FN	20	1000	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/ Ball Finish	MSL Peak Temp [3]	Samples (Requires Login)
UC2847DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC2847DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC2847N	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
UC2847NG4	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
UC3846DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC3846DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC3846DWTR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC3846DWTRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC3846J	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	
UC3846N	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
UC3846NG4	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	
UC3846Q	ACTIVE	PLCC	FN	20	46	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	
UC3846QG3	ACTIVE	PLCC	FN	20	46	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	
UC3846QTR	ACTIVE	PLCC	FN	20	1000	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	
UC3846QTRG3	ACTIVE	PLCC	FN	20	1000	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR	
UC3847DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC3847DWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
UC3847J	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI	
UC3847N	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/ Ball Finish	MSL Peak Temp [3]	Samples (Requires Login)
UC3847NG4	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	

[1] The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

[2] Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

[3] MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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OTHER QUALIFIED VERSIONS OF UC1846, UC1847, UC2846, UC2846M, UC3846, UC3846M, UC3847 :

- Catalog: UC3846, UC3847, UC2846, UC3846M, UC3846

- Enhanced Product: UC1846-EP, UC1846-EP

- Military: UC2846M, UC1846, UC1847

- Space: UC1846-SP, UC1846-SP

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

- Enhanced Product - Supports Defense, Aerospace and Medical Applications

- Military - QML certified for Military and Defense Applications

- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

![Texas Instruments logo]

PACKAGE MATERIALS INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSIONS

A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
UC2846DWTR	SOIC	DW	16	2000	330.0	16.4	10.85	10.8	2.7	12.0	16.0	Q1
UC2846QTR	PLCC	FN	20	1000	330.0	16.4	10.3	10.3	4.9	12.0	16.0	Q1
UC3846DWTR	SOIC	DW	16	2000	330.0	16.4	10.85	10.8	2.7	12.0	16.0	Q1
UC3846QTR	PLCC	FN	20	1000	330.0	16.4	10.3	10.3	4.9	12.0	16.0	Q1

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TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
UC2846DWTR	SOIC	DW	16	2000	346.0	346.0	33.0
UC2846QTR	PLCC	FN	20	1000	346.0	346.0	33.0
UC3846DWTR	SOIC	DW	16	2000	346.0	346.0	33.0
UC3846QTR	PLCC	FN	20	1000	346.0	346.0	33.0

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