

High Speed PWM Controller

FEATURES

- Compatible with Voltage or Current Mode Topologies
- Practical Operation Switching Frequencies to 1MHz
- 50ns Propagation Delay to Output
- High Current Dual Totem Pole Outputs (1.5A Peak)
- Wide Bandwidth Error Amplifier
- Fully Latched Logic with Double Pulse Suppression
- Pulse-by-Pulse Current Limiting
- Soft Start / Max. Duty Cycle Control
- Under-Voltage Lockout with Hysteresis
- Low Start Up Current (1.1mA)

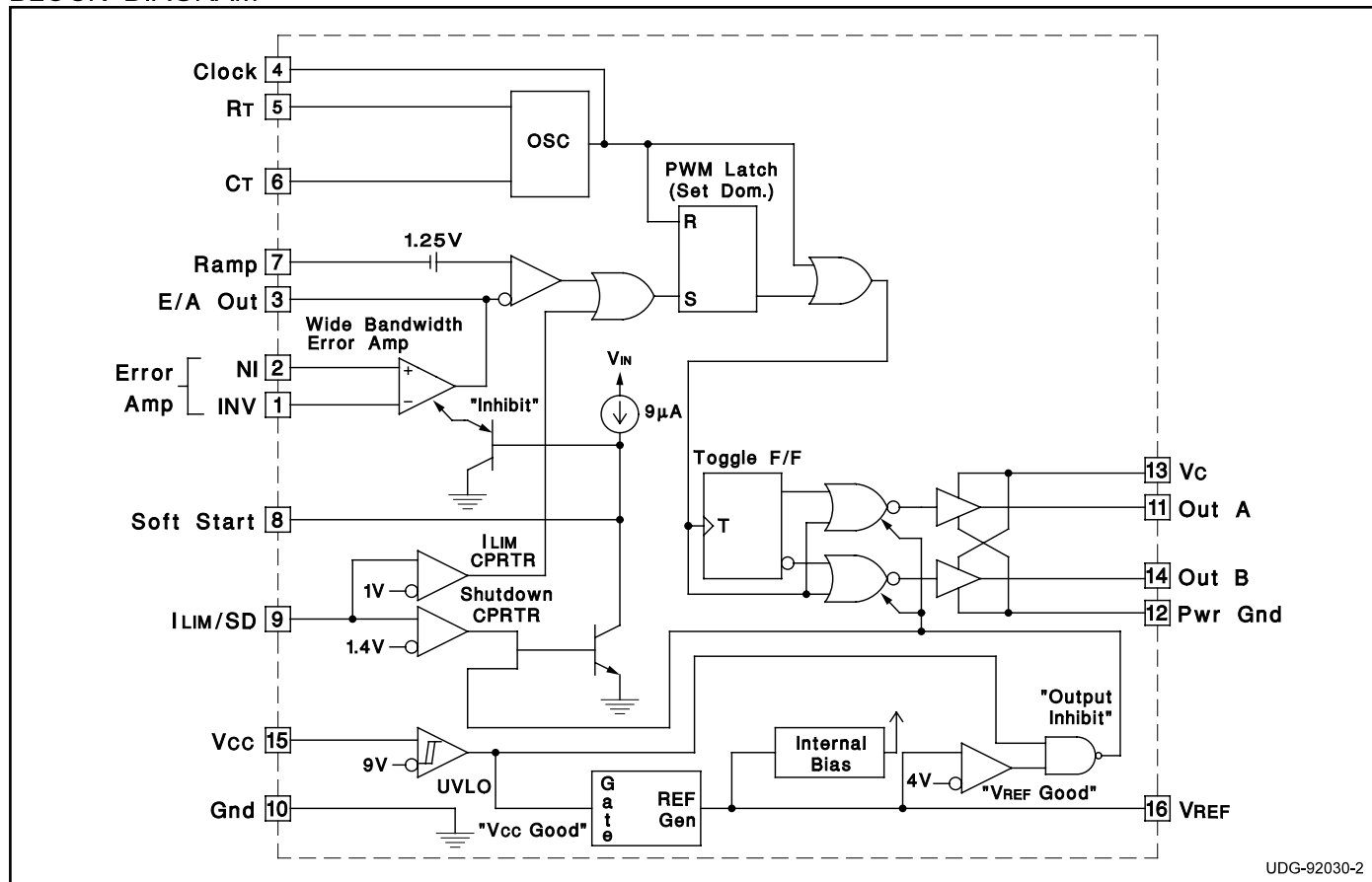
DESCRIPTION

The UC1825 family of PWM control ICs is optimized for high frequency switched mode power supply applications. Particular care was given to minimizing propagation delays through the comparators and logic circuitry while maximizing bandwidth and slew rate of the error amplifier. This controller is designed for use in either current-mode or voltage mode systems with the capability for input voltage feed-forward.

Protection circuitry includes a current limit comparator with a 1V threshold, a TTL compatible shutdown port, and a soft start pin which will double as a maximum duty cycle clamp. The logic is fully latched to provide jitter free operation and prohibit multiple pulses at an output. An under-voltage lockout section with 800mV of hysteresis assures low start up current. During under-voltage lockout, the outputs are high impedance.

These devices feature totem pole outputs designed to source and sink high peak currents from capacitive loads, such as the gate of a power MOSFET. The on state is designed as a high level.

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (Note 1)

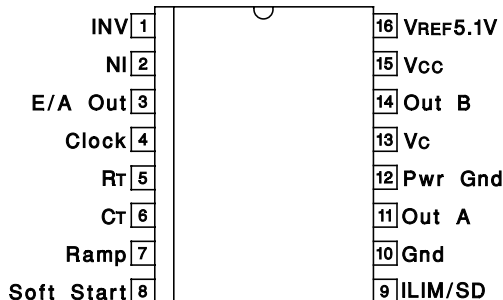
Supply Voltage (Pins 13, 15)	30V
Output Current, Source or Sink (Pins 11, 14)	
DC	0.5A
Pulse (0.5μs)	2.0A
Analog Inputs	
(Pins 1, 2, 7)	-0.3V to 7V
(Pin 8, 9)	-0.3V to 6V
Clock Output Current (Pin 4)	-5mA
Error Amplifier Output Current (Pin 3)	5mA
Soft Start Sink Current (Pin 8)	20mA
Oscillator Charging Current (Pin 5)	-5mA
Power Dissipation	1W
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C

Note 1: All voltages are with respect to GND (Pin 10); all currents are positive into, negative out of part; pin numbers refer to DIL-16 package.

Note 3: Consult Unitrode Integrated Circuit Databook for thermal limitations and considerations of package.

SOIC-16 (Top View)

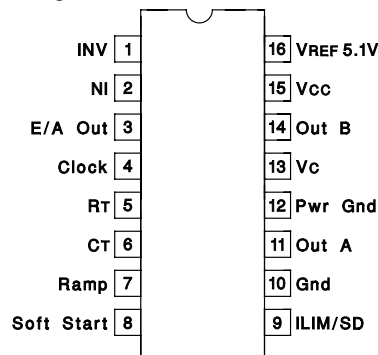
DW Package



CONNECTION DIAGRAMS

DIL-16 (Top View)

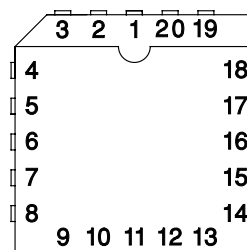
J, N or W Package



PLCC-20 & LCC-20

(Top View)

Q & L Packages



PACKAGE PIN FUNCTION

FUNCTION	PIN
N/C	1
INV	2
NI	3
E/A Out	4
Clock	5
N/C	6
RT	7
CT	8
Ramp	9
Soft Start	10
N/C	11
ILIM/SD	12
Gnd	13
Out A	14
Pwr Gnd	15
N/C	16
Vc	17
Out B	18
Vcc	19
VREF 5.1V	20

ELECTRICAL CHARACTERISTICS: Unless otherwise stated, these specifications apply for, $R_T = 3.65k$, $C_T = 1nF$, $V_{CC} = 15V$, $-55^\circ C < T_A < 125^\circ C$ for the UC1825, $-40^\circ C < T_A < 85^\circ C$ for the UC2825, and $0^\circ C < T_A < 70^\circ C$ for the UC3825, $T_A = T_J$.

PARAMETERS	TEST CONDITIONS	UC1825 UC2825			UC3825			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Reference Section								
Output Voltage	TJ = 25°C, Io = 1mA	5.05	5.10	5.15	5.00	5.10	5.20	V
Line Regulation	10V < Vcc < 30V		2	20		2	20	mV
Load Regulation	1mA < Io < 10mA		5	20		5	20	mV
Temperature Stability*	TMIN < TA < TMAX		0.2	0.4		0.2	0.4	mV/°C
Total Output Variation*	Line, Load, Temperature	5.00		5.20	4.95		5.25	V
Output Noise Voltage*	10Hz < f < 10kHz		50			50		μV
Long Term Stability*	TJ = 125°C, 1000hrs.		5	25		5	25	mV
Short Circuit Current	VREF = 0V	-15	-50	-100	-15	-50	-100	mA
Oscillator Section								
Initial Accuracy*	TJ = 2°C	360	400	440	360	400	440	kHz
Voltage Stability*	10V < Vcc < 30V		0.2	2		0.2	2	%
Temperature Stability*	TMIN < TA < TMAX		5			5		%
Total Variation*	Line, Temperature	340		460	340		460	kHz

ELECTRICAL CHARACTERISTICS: Unless otherwise stated, these specifications apply for , $R_T = 3.65k$, $C_T = 1nF$, $V_{CC} = 15V$, $-55^{\circ}C < T_A < 125^{\circ}C$ for the UC1825, $-40^{\circ}C < T_A < 85^{\circ}C$ for the UC2825, and $0^{\circ}C < T_A < 70^{\circ}C$ for the UC3825, $T_A = T_J$.

PARAMETERS	TEST CONDITIONS	UC1825 UC2825			UC3825			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Oscillator Section (cont.)								
Clock Out High		3.9	4.5		3.9	4.5		V
Clock Out Low			2.3	2.9		2.3	2.9	V
Ramp Peak*		2.6	2.8	3.0	2.6	2.8	3.0	V
Ramp Valley*		0.7	1.0	1.25	0.7	1.0	1.25	V
Ramp Valley to Peak*		1.6	1.8	2.0	1.6	1.8	2.0	V
Error Amplifier Section								
Input Offset Voltage				10			15	mV
Input Bias Current			0.6	3		0.6	3	μA
Input Offset Current			0.1	1		0.1	1	μA
Open Loop Gain	1V < V _O < 4V	60	95		60	95		dB
CMRR	1.5V < V _{CM} < 5.5V	75	95		75	95		dB
PSRR	10V < V _{CC} < 30V	85	110		85	110		dB
Output Sink Current	V _{PIN 3} = 1V	1	2.5		1	2.5		mA
Output Source Current	V _{PIN 3} = 4V	-0.5	-1.3		-0.5	-1.3		mA
Output High Voltage	I _{PIN 3} = -0.5mA	4.0	4.7	5.0	4.0	4.7	5.0	V
Output Low Voltage	I _{PIN 3} = 1mA	0	0.5	1.0	0	0.5	1.0	V
Unity Gain Bandwidth*		3	5.5		3	5.5		MHz
Slew Rate*		6	12		6	12		V/μs
PWM Comparator Section								
Pin 7 Bias Current	V _{PIN 7} = 0V		-1	-5		-1	-5	μA
Duty Cycle Range		0		80	0		85	%
Pin 3 Zero DC Threshold	V _{PIN 7} = 0V	1.1	1.25		1.1	1.25		V
Delay to Output*			50	80		50	80	ns
Soft-Start Section								
Charge Current	V _{PIN 8} = 0.5V	3	9	20	3	9	20	μA
Discharge Current	V _{PIN 8} = 1V	1			1			mA
Current Limit / Shutdown Section								
Pin 9 Bias Current	0 < V _{PIN 9} < 4V			15			10	μA
Current Limit Threshold		0.9	1.0	1.1	0.9	1.0	1.1	V
Shutdown Threshold		1.25	1.40	1.55	1.25	1.40	1.55	V
Delay to Output			50	80		50	80	ns
Output Section								
Output Low Level	I _{OUT} = 20mA		0.25	0.40		0.25	0.40	V
	I _{OUT} = 200mA		1.2	2.2		1.2	2.2	V
Output High Level	I _{OUT} = -20mA	13.0	13.5		13.0	13.5		V
	I _{OUT} = -200mA	12.0	13.0		12.0	13.0		V
Collector Leakage	V _C = 30V		100	500		10	500	μA
Rise/Fall Time*	CL = 1nF		30	60		30	60	ns
Under-Voltage Lockout Section								
Start Threshold		8.8	9.2	9.6	8.8	9.2	9.6	V
UVLO Hysteresis		0.4	0.8	1.2	0.4	0.8	1.2	V
Supply Current Section								
Start Up Current	V _{CC} = 8V		1.1	2.5		1.1	2.5	mA
ICC	V _{PIN 1} , V _{PIN 7} , V _{PIN 9} = 0V: V _{PIN 2} = 1V		22	33		22	33	mA

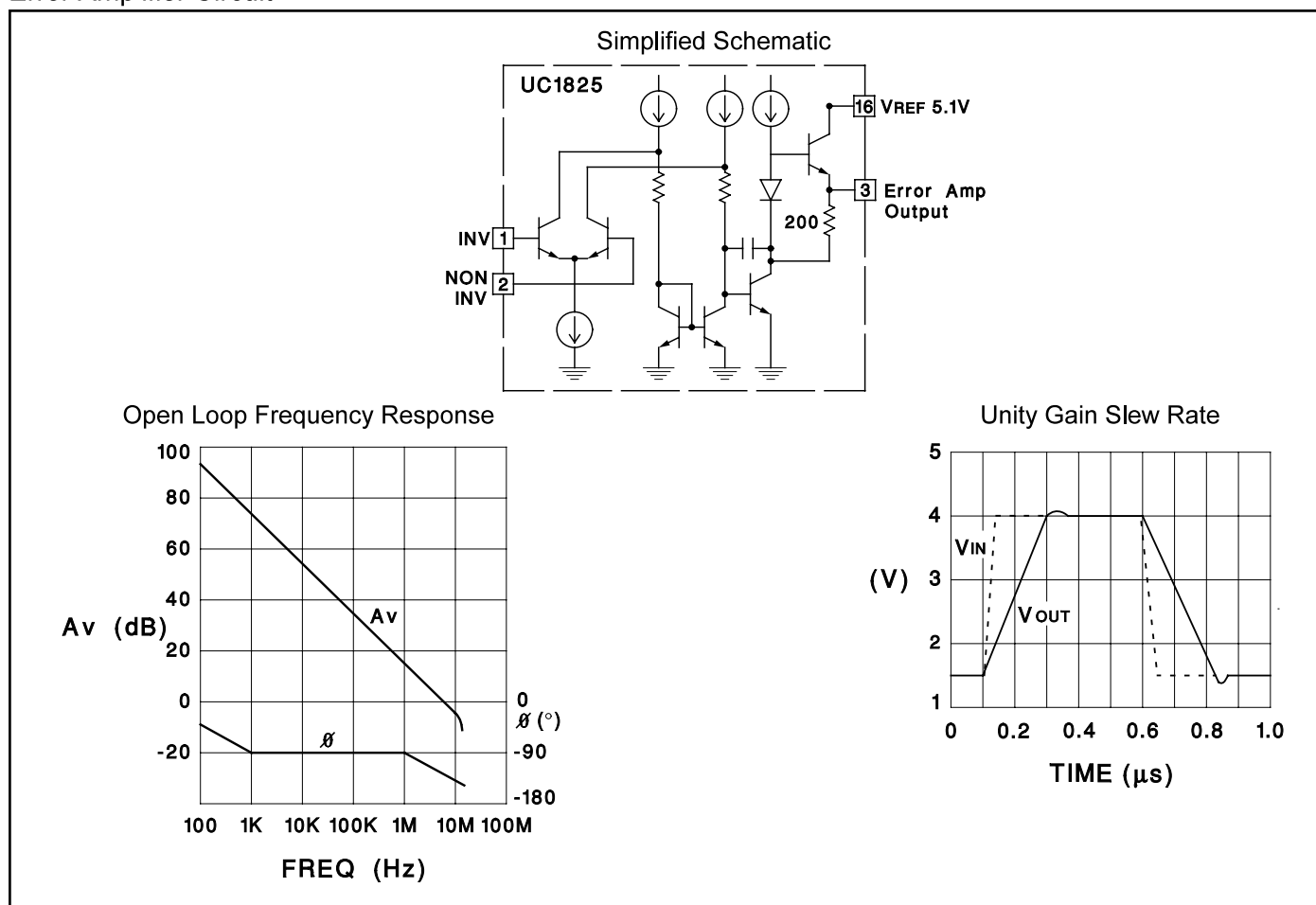
* This parameter not 100% tested in production but guaranteed by design.

Printed Circuit Board Layout Considerations

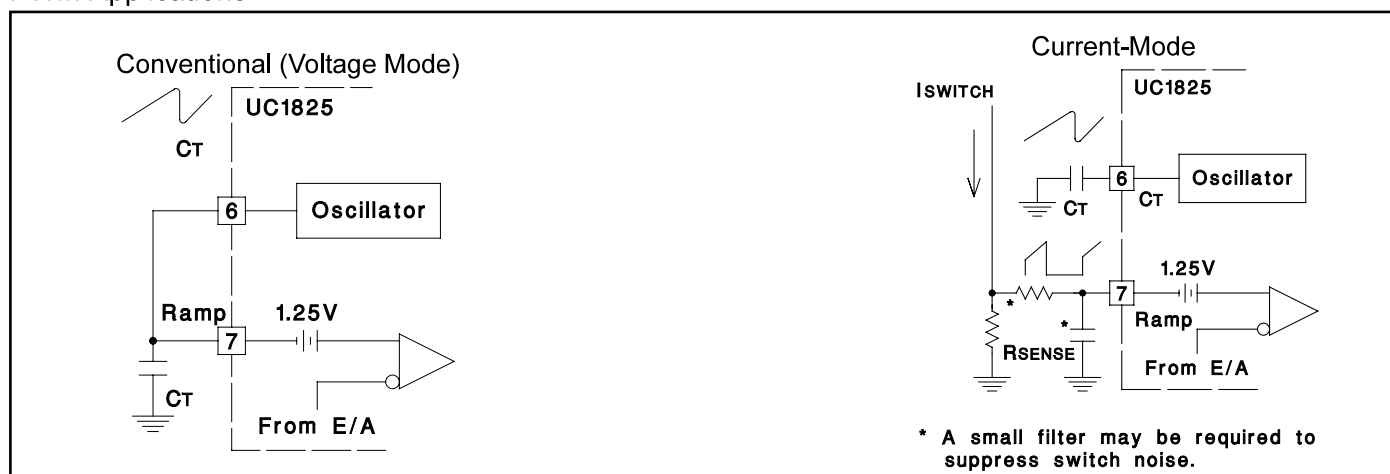
High speed circuits demand careful attention to layout and component placement. To assure proper performance of the UC1825 follow these rules: 1) Use a ground plane. 2) Damp or clamp parasitic inductive kick energy from the gate of driven MOSFETs. Do not allow the output pins to ring below ground. A series gate resistor or a shunt 1 Amp Schottky diode at the output pin will serve

this purpose. 3) Bypass V_{CC} , V_C , and V_{REF} . Use $0.1\mu\text{F}$ monolithic ceramic capacitors with low equivalent series inductance. Allow less than 1 cm of total lead length for each capacitor between the bypassed pin and the ground plane. 4) Treat the timing capacitor, C_T , like a bypass capacitor.

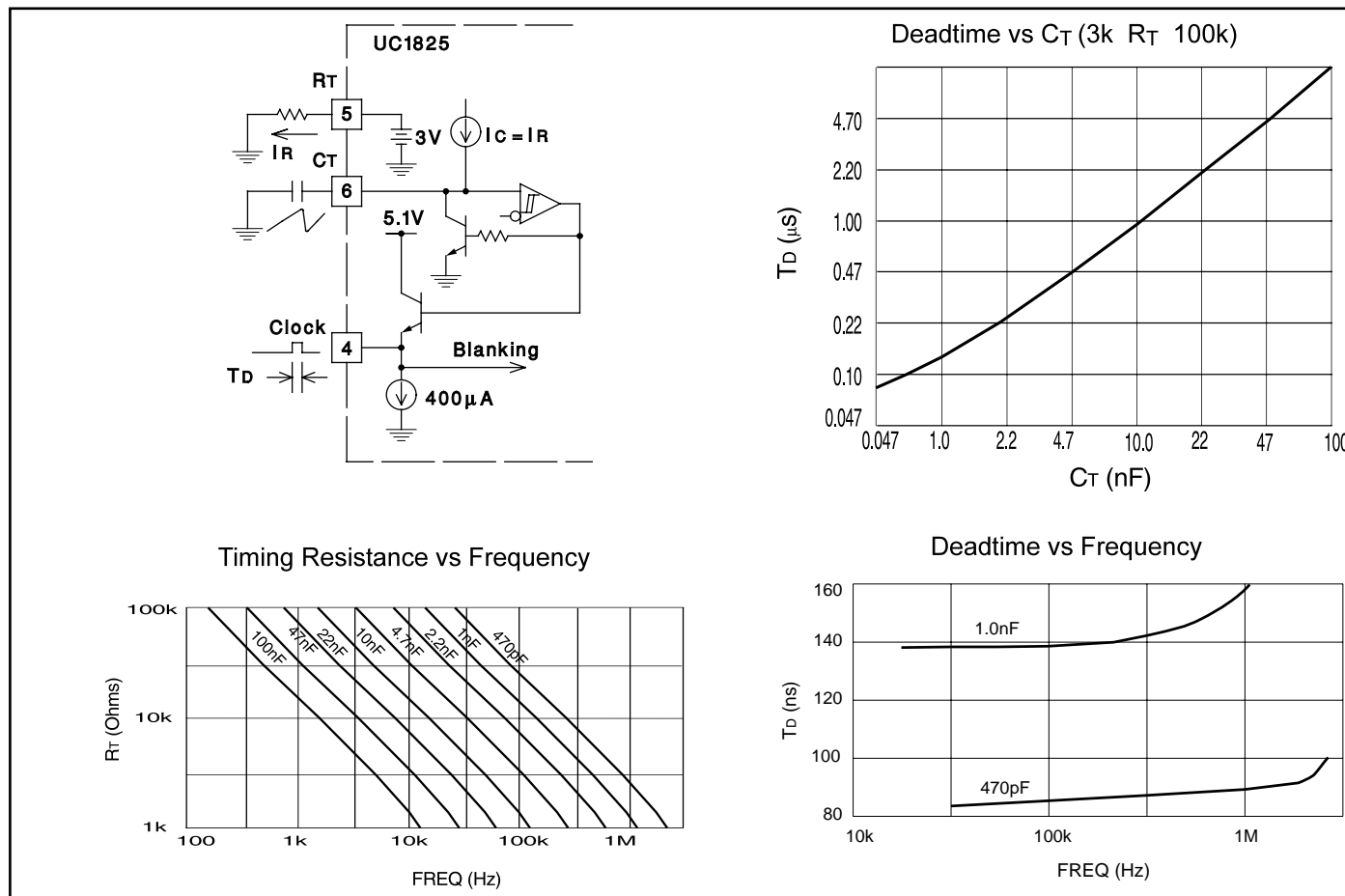
Error Amplifier Circuit



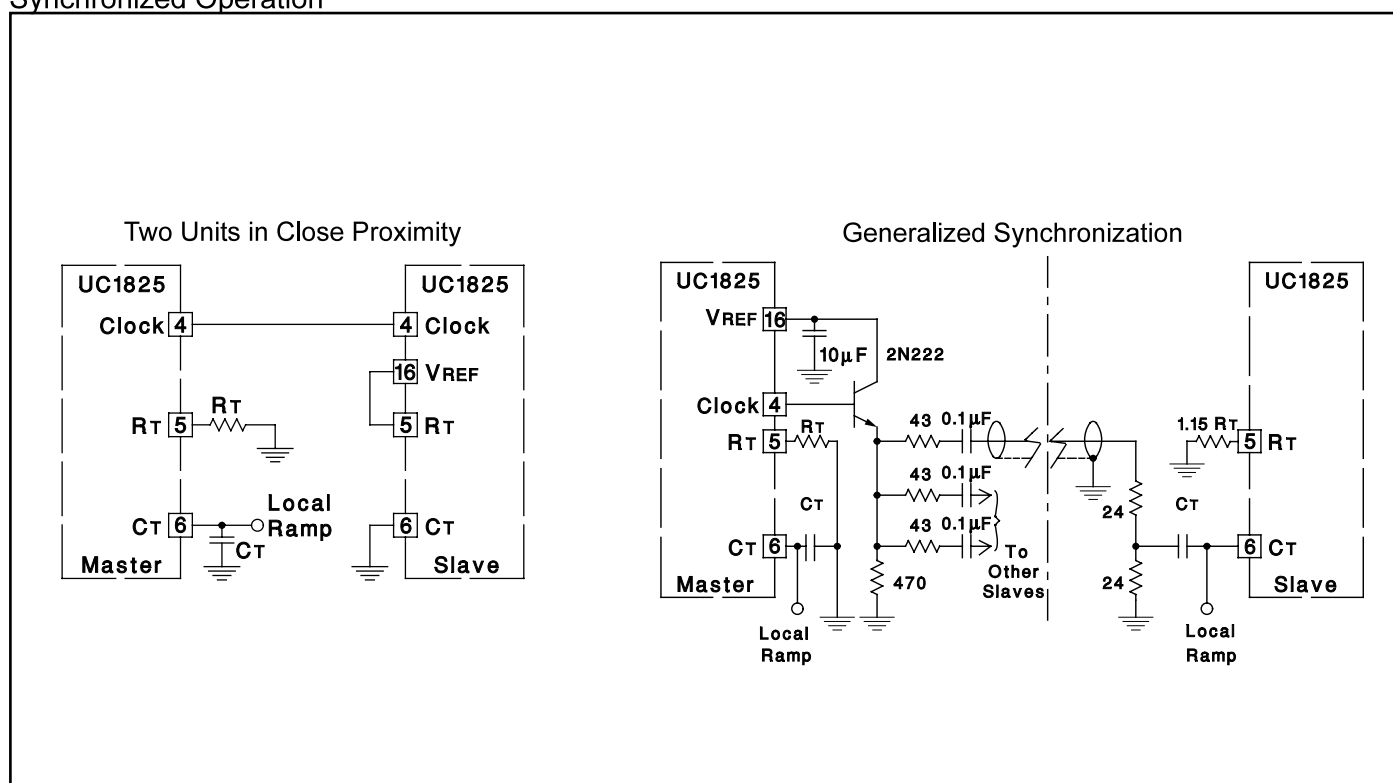
PWM Applications



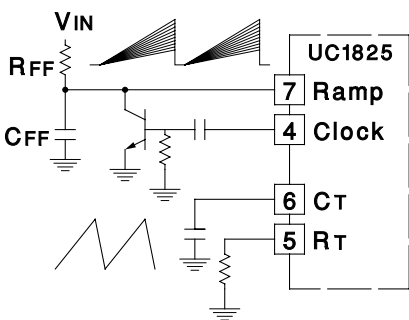
Oscillator Circuit



Synchronized Operation

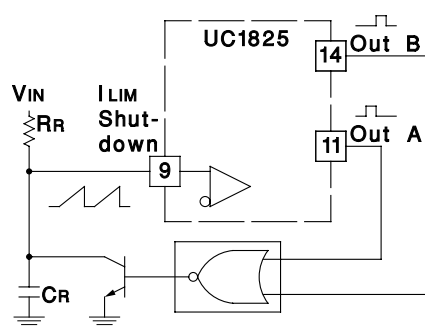


Forward Technique for Off-Line Voltage Mode Application

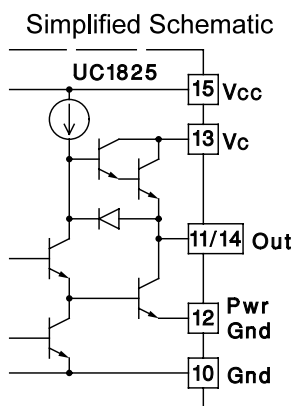


Constant Volt-Second Clamp Circuit

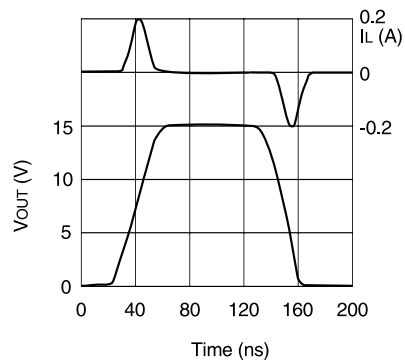
The circuit shown here will achieve a constant volt-second product clamp over varying input voltages. The ramp generator components, R_T and C_R are chosen so that the ramp at Pin 9 crosses the 1V threshold at the same time the desired maximum volt-second product is reached. The delay through the functional nor block must be such that the ramp capacitor can be completely discharged during the minimum deadtime.



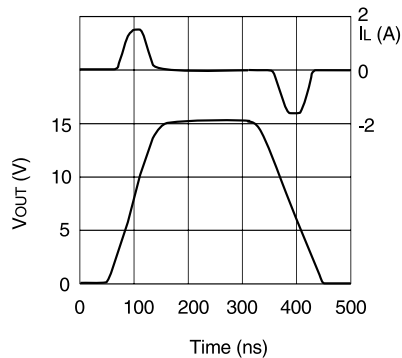
Output Section



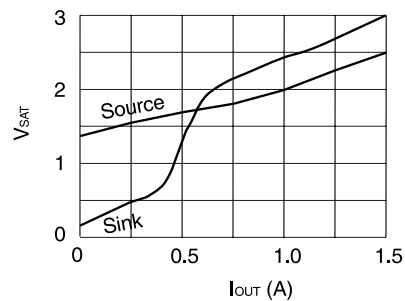
Rise/Fall Time ($C_L=1\text{nF}$)



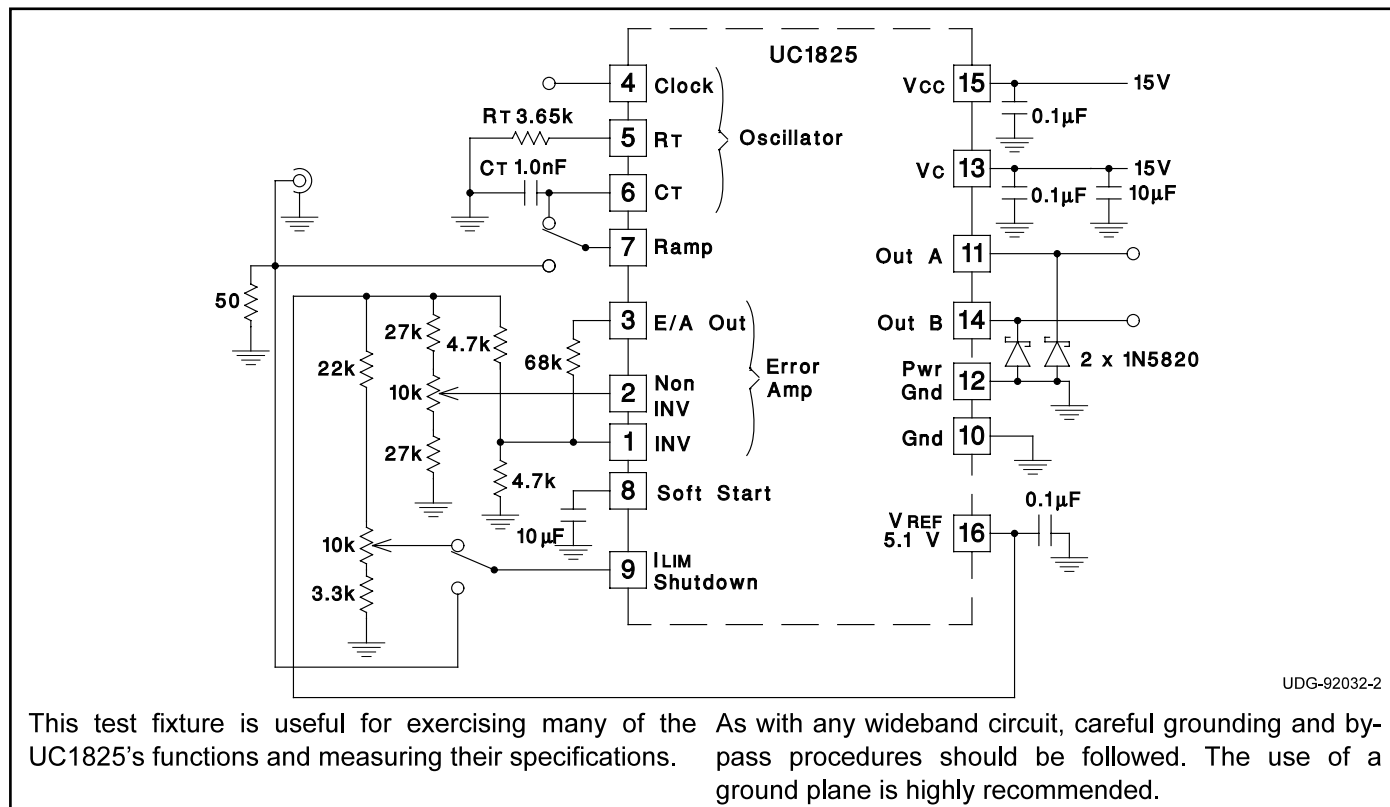
Rise/Fall Time ($C_L=10\text{nF}$)



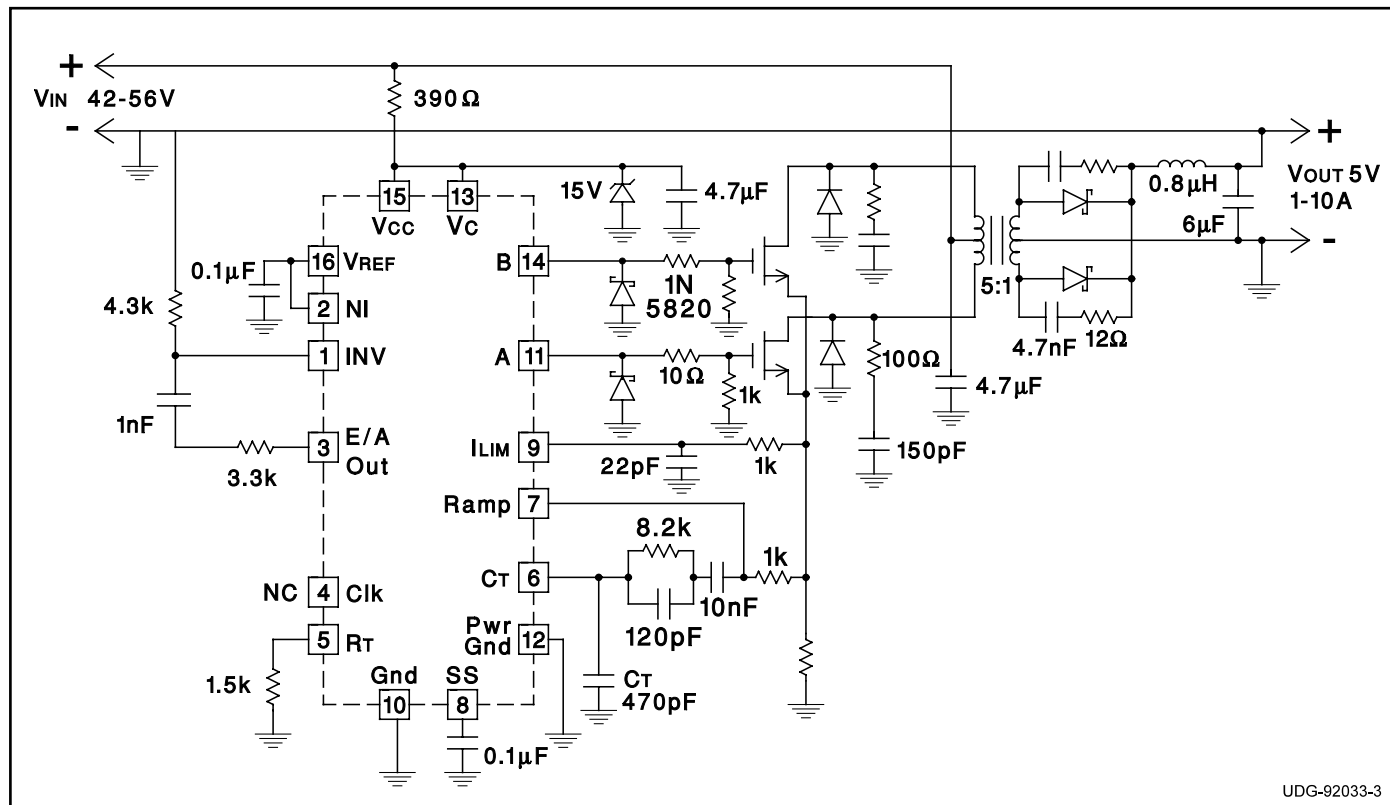
Saturation Curves



Open Loop Laboratory Test Fixture



Design Example: 50W, 48V to 5V DC to DC Converter - 1.5MHz Clock Frequency



IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

This datasheet has been download from:

www.datasheetcatalog.com

Datasheets for electronics components.