International
IOR Rectifier

Data Sheet PD No.60226

IR2086S

HIGH SPEED, 100V, SELF OSCILLATING 50% DUTY CYCLE, FULL-BRIDGE DRIVER

Features

- Simple primary side control solution to enable full-bridge DC-Bus Converters for 48V distributed systems with reduced component count and board space.
- Frequency and dead time set by two external components
- Maximum 500KHz per channel output with 50% duty cycle
- Adjustable dead time 50nsec ~ 200nsec
- Floating channel designed for bootstrap operation up to +100Vdc
- High and low side pulse width matching to +/- 25nsec
- Overcurrent protection with adjustable hiccup period.
- Undervoltage lockout and internal soft start

Product Summary

$V_{CC\ (max)}$	25V
$V_{offset(max)}$	100Vdc
High/low side output freq (f_{osc})	500kHz
Output Current (I_O)	+/-1.2A
High/low side pulse edge matching	+/- 25ns

Description

The IR2086S is a self oscillating full-bridge controller and driver IC with 50% duty cycle ideally suited for 36V-75V full-bridge DC Bus Converters.

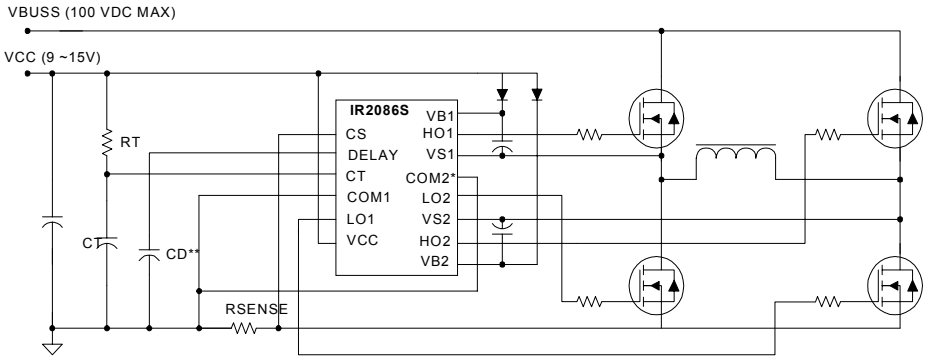
Dead time can be controlled through proper selection of C_T and can range from 50 to 200nsec. Internal soft start increases pulse width on power up and maintains equal pulse widths for the high and low outputs throughout the start up cycle. Undervoltage lockout prevents operation if Vcc is less than 7.5 Vdc. Over current shutdown occurs when the voltage on the Cs pin exceeds 200mV. Restart after overcurrent trip can be delayed by adjusting the external capacitor. The delay time ranges from 10µs to 1s.

Package

16-Lead SOIC

Typical Connection

(Refer to Lead Assignments for correct pin configuration). This/These diagram(s) show electrical connections only. Please refer to our Application Notes and DesignTips for proper circuit board layout.



*COM2 must be shorted to COM1 for proper operation
**CD is optional

Absolute Maximum Ratings

V_{BIAS} (V_{CC}, V_{BS}) = 12V, C_L = 1000 pF, and T_A = 25°C unless otherwise specified.
Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute voltages referenced to COM. All currents are defined positive into any lead. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions.

Symbol	Definition	Min.	Max.	Units
V_{CC}	Low side supply voltage	-0.3	25	Vdc
$V_{B1,2}$	High side floating supply voltage	-0.3	150	
$V_{S1,2}$	High side floating supply offset voltage	$V_{B1,2}$ - 25	$V_{B1,2}$ + 0.3	
$V_{HO1,2}$	High side floating output voltage	$V_{B1,2}$ - 0.3	$V_{B1,2}$ + 0.3	
$V_{LO1,2}$	Low side output voltage	-0.3	V_{CC} + 0.3	
V_{CT}	CT pin voltage	-0.3	V_{CC} + 0.3	
V_{CS}	Cs pin voltage	-0.3	V_{CC} + 0.3	
V_{DELAY}	Delay pin voltage	-0.3	V_{CC} + 0.3	
dV_S/dt	Allowable offset voltage slew rate	-50	+50	V/ns
I_{CC}	Supply current	—	40	mA
P_D	Package power dissipation (16-lead SOIC)	—	1.0	W
Rth_{JA}	Thermal resistance, junction to ambient (16-lead SOIC)	—	200	°C/W
T_J	Junction temperature	-55	150	°C
T_S	Storage temperature	-55	150	
T_L	Lead temperature (soldering, 10 seconds)	—	300	

Recommended Operating Conditions

For proper operation the device should be used within the recommended conditions.

Symbol	Definition	Min.	Max.	Units
$V_{B1,2}$	High side floating supply voltage	9.5	15	Vdc
$V_{S1,2}$	Steady state high side floating supply offset voltage	-5	100	
V_{CC}	Supply voltage	9.5	15	
I_{CC}	Supply current	—	1	mA
R_T	Timing resistor	10	100	Kohms
C_T	Timing capacitor	47	1000	pF
fmax	Operating frequency (per channel)	—	500	KHz
T_j	Junction temperature	-40	125	°C

Note1: Care should be taken to avoid output switching conditions where the Vs node flies inductively below ground by more than 5V.

Dynamic Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}) = 12V, C_L = 1000 pF, and T_A = 25°C unless otherwise specified.

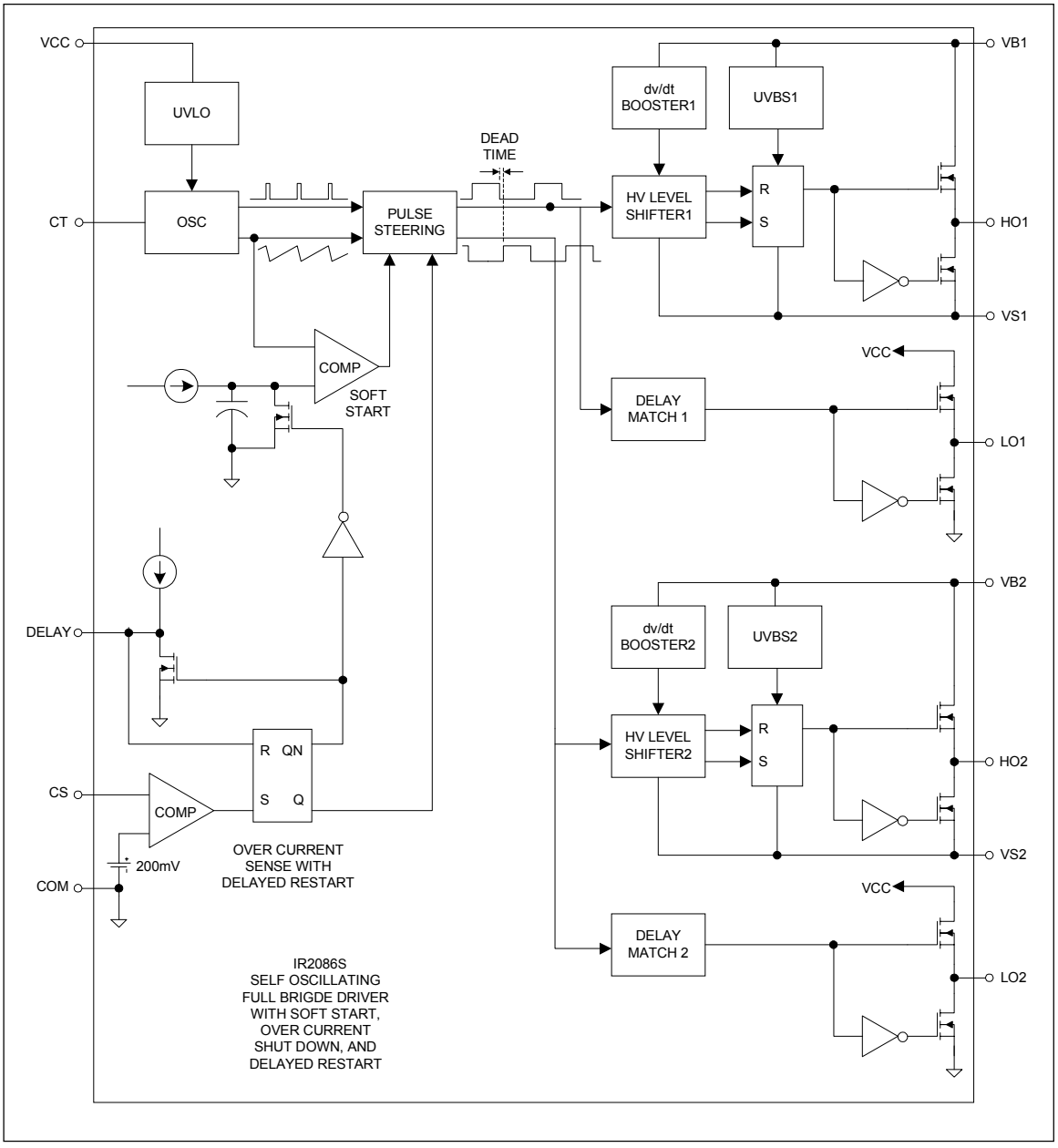
Symbol	Definition	Min.	Typ.	Max.	Units	Test Conditions
t_r	Turn-on rise time	—	40	60	nsec	V_S = 0V
t_f	Turn-off fall time	—	20	30		
fout	Per channel output frequency	450	500	550	KHz	Ct=100pF, Rt=10Kohm
tdt	High/low output dead time	50	—	—	nsec	
PM	High/low pulse width matching	—	25	—		V_S = 0V ~ 100V
t_{dcs}	Overcurrent shut down delay	—	200	—		
$t_{restart}$	Overcurrent restart delay	—	0.5	—	sec	Vcc =15V, Cd=100nF

Static Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}) = 12V, C_L = 1000 pF and T_A = 25°C unless otherwise specified.

Symbol	Definition	Min.	Typ.	Max.	Units	Test Conditions
$V_{OH1,2}$	High level output voltage, (V_{BIAS} - V_O)	—	—	1.5	V	
$V_{OL1,2}$	Low level output voltage	—	—	0.1		
I_{leak}	Offset supply leakage current	—	—	50	µA	
I_{QBS}	Quiescent V_{BS} supply current	—	—	150		
I_{QCC}	Quiescent V_{CC} supply current	—	—	1.75	mA	
V_{CS+}	Overcurrent shutdown threshold	—	300	—	mV	
U_{VCC+}	Undervoltage positive going threshold	6.5	7.25	8.0	V	
U_{VCC-}	Undervoltage negative going threshold	6.0	6.8	7.7		
I_{O+}	Output high short circuit current	—	1.2	—	A	
I_{O-}	Output low short circuit current	—	1.2	—		

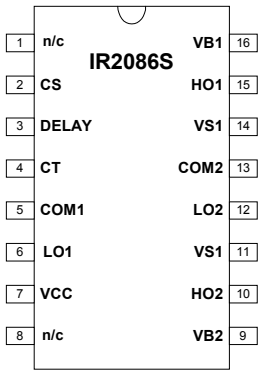
Functional Block Diagrams



Lead Definitions

Symbol	Description
VCC	Supply
COM1,2	Supply return
VB1,2	High side floating supply
VS1,2	Floating supply return
HO1,2	High side output
LO1,2	Low side output
CT	Oscillator Input
CS	Current sense input
DELAY	Over current restart delay

Lead Assignments



Detailed Pin Description

Cs: The input pin to the overcurrent comparator. Exceeding the overcurrent threshold value specified in "Static Electrical Parameters" Section will terminate output pulses. A new soft start cycle will commence after the expiration of the programmed delay time at DELAY pin.

DELAY: Delay programming pin for restart after overcurrent condition. A capacitor connected to this pin will determine the delay form the over current trip to the beginning of a new soft start cycle. The delay time ranges from 10us to 1s, and is set according to:

$$t_d \approx \frac{C_d \, V_{cc}}{2uA} + 10us$$

CT: The oscillator-programming pin. Only two components are required to program the internal oscillator frequency: a resistor connected between the Vcc pin and the CT pin, and a capacitor connected from the CT pin to GND. The approximate oscillator frequency is determined by the following simple formula:

$$f_{osc} = 1 / (2 \cdot R_T \cdot C_T)$$

Where frequency is in Hertz (Hz), R_T resistance in Ohms (Ω) and C_T capacitance in Farads (F). The recommended range of timing resistors is between 10kΩ and 100kΩ and range of time capacitances is between 47pF and 470pF. The timing resistors less than 10kΩ should be avoided.
The value of the timing capacitor determines the amount of dead time between the two output drivers: lower the CT, shorter the dead time and vice versa. It is not recommended to use a timing capacitor below 47pF.
For best performance, keep the time components as close as possible to the IR2086S. Separated ground and Vdd traces to the timing components are encouraged.

Detailed Pin Description continued

COM1, COM2: Signal ground and power ground for all functions. Due to high current and high frequency operation, a low impedance circuit board ground plane is highly recommended.

HO1, HO2, LO1, LO2: High side and low side gate drive pins. The high and low side drivers can directly drive the gate of a power MOSFET. The drivers are capable of 1A peak source and sink currents. It is recommended that the high and low drive pins be very close to the gates of the high side and low side MOSFETs to prevent any delay and distortion of the drive signals.

Vb1, Vb2: High side power input connection. The high side supplies are derived from bootstrap circuits using low-leakage Schottky diodes and ceramic capacitors. To prevent noise, the Schottky diodes and bypass capacitors should be very close to the IR2086S.

Vs1, Vs2: The high side power return connection. Vs should be connected directly to the source terminal of high side MOSFET with a trace as short as possible.

Vcc: The IC bias input connection for the device. Although the quiescent Vcc current is very low, total supply current will be higher, depending on the gate charge of the MOSFETs connected to the HO and LO pins, and the programmed oscillator frequency, Total Vcc current is the sum of quiescent Vcc current and the average current at HO and LO. Knowing the operating frequency and the MOSFET gate charge (Qg) at selected Vcc voltage, the average current to drive four power MOSFETs in full-bridge configuration can be calculated from:

Iave = 2 x Qg X fosc

(Note that fosc is equal to the output frequency - twice the frequency of each individual bridge leg on the primary.)

To prevent noise problem, a bypass ceramic capacitor connected to Vcc and COM1 / COM2 should be placed as close as possible to the IR2086S.

IR2086S has an under voltage lookout feature for the IC bias supply, Vcc. The minimum voltage required on Vcc to make sure that IC will work within specifications must be higher than 8.5V (9.5V minimum Vcc is recommended to prevent asymmetrical gates signals on HO and LO pins that are expected when Vcc is between 7.5V and 8.5V).

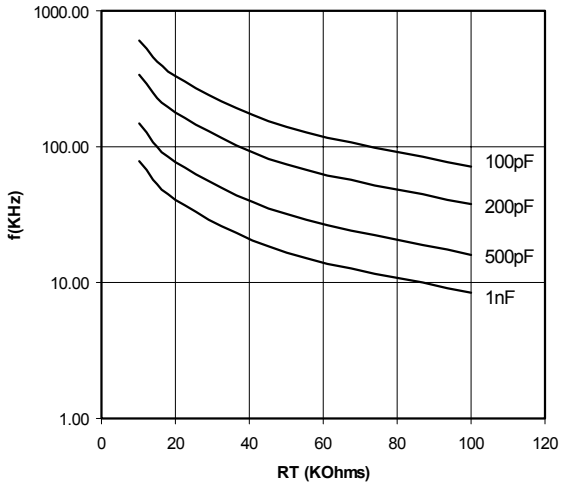


Fig. 1 Output Frequency (-25°C to 125°C)

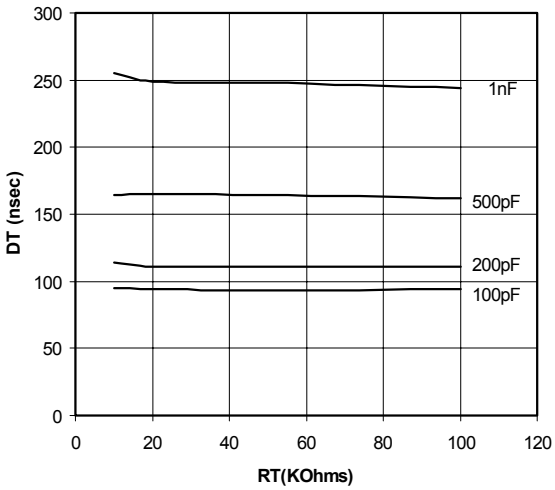


Fig. 2 Dead Time (@27°C)

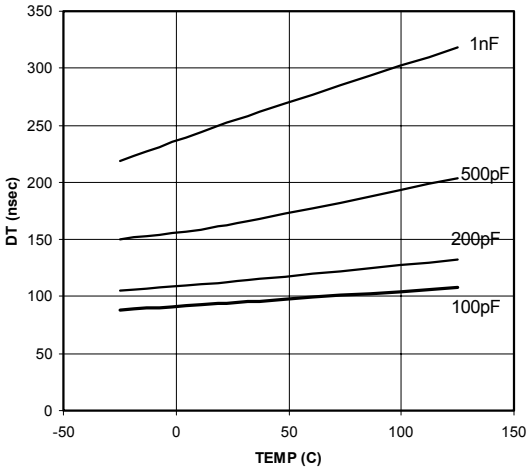


Fig. 3 Dead Time vs Temp

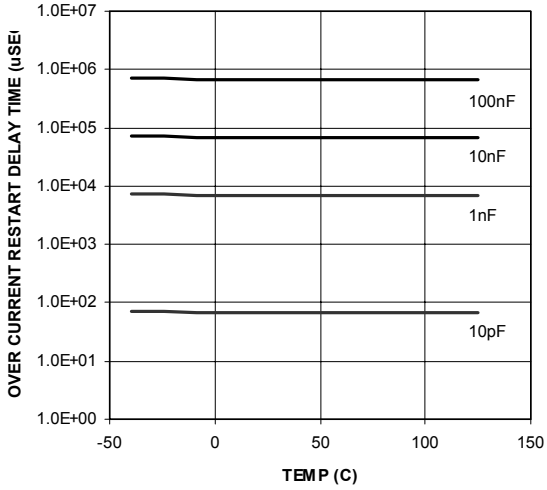
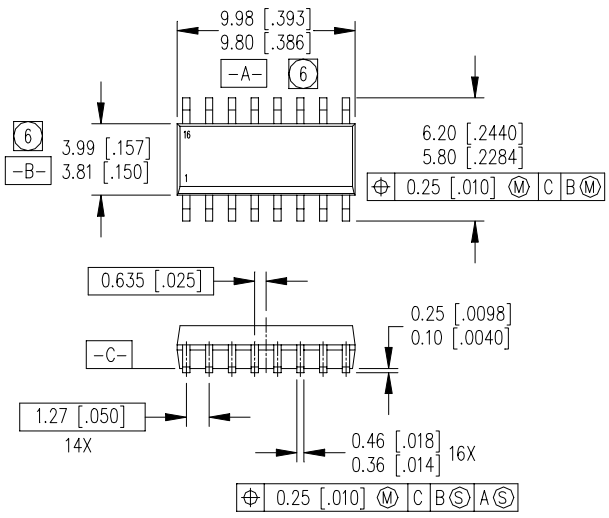
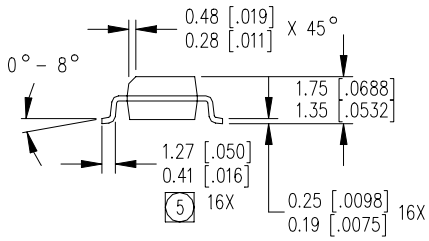


Fig. 4 Over Current Restart Delay Time vs Temp (Vcc = 15V)

Case outlines



NOTES:
1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982.
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AC.
5. DIMENSION IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE.
6. DIMENSION DOES NOT INCLUDE MOLD PROTUSIONS. MOLD PROTUSIONS SHALL NOT EXCEED 0.15 [.006].



16-Lead SOIC (narrow body)

01-6018
01-3064 00 (MS-012AC)

WORLD HEADQUARTERS: 233 Kansas Street, El Segundo, California 90245 Tel: (310) 252-7105