

## Current-Mode PWM Multiple Output Flyback Converter

### Introduction

The Supertex HV9606DB1 evaluation board demonstrates the features of HV9606 IC by presenting a DC/DC converter employing flyback technique to achieve multiple outputs:

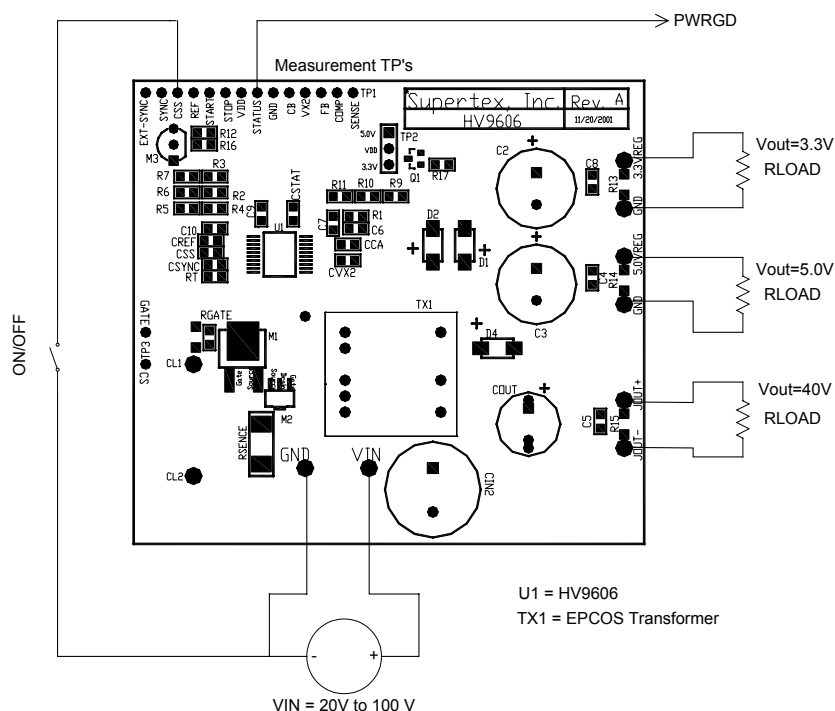
- 3.3V non-isolated output with  $\pm 1\%$  accuracy. The output power is 350mW.
- 5V isolated output with  $\pm 5\%$  accuracy. The output power is 150mW.
- 40V nominal isolated output. The output power is 500mW.

The HV9606 current-mode PWM controller features a built-in start-up regulator that can be used to operate the IC from inputs of 15V to 250V. Other features include built-in soft start, programmable input under voltage lockout and hysteresis, and standby current of  $6\mu\text{A}$  (below UVLO).

### Specifications

Total Output Power	1 Watt		
Efficiency	$\geq 70$	$V_{in} = 48\text{V}$	all outputs at 50% Load
Input Voltage Range	20V to 100V		
Input Voltage Lockout	Start when $V_{in} \geq 21\text{V}$	Stop when $V_{in} \leq 19\text{V}$	
Switching Frequency	25kHz		
3.3V Output	$3.3\text{V} \pm 1\%$	$I_{\text{Outmax}} = 106\text{mA}$	350mW Output Power
5V Output	$5.0\text{V} \pm 5\%$	$I_{\text{Outmax}} = 30\text{mA}$	150mW Output Power
40V Isolated Output	40.0V (nominal)	$I_{\text{Outmax}} = 12.5\text{mA}$	500mW Output Power
Remote On/Off	Yes		
Remote Power Good Indicator	Yes		

### Board Layout and Connections



## Instructions

### Vin , GND

Connect 21 to 100V power source to these terminals: positive to Vin , negative to GND.

### 3.3VREG, GND

Connect your load to these terminals. This is a regulated 3.3V output. This output can typically deliver a current up to 106mA.

### 5.0VREG, GND

Connect your load to these terminals. This is a 5.0V output. This output can typically deliver a current up to 30mA.

### JOUT+, JOUT-

Connect your load to these terminals. This is an isolated 40.0V output. This output can typically deliver a current up to 12.5mA.

### ON/OFF

This is a remote inhibit pin. Connecting this pin to GND will disable the converter. The converter will resume operation beginning with soft start as the ON/OFF pin is released.

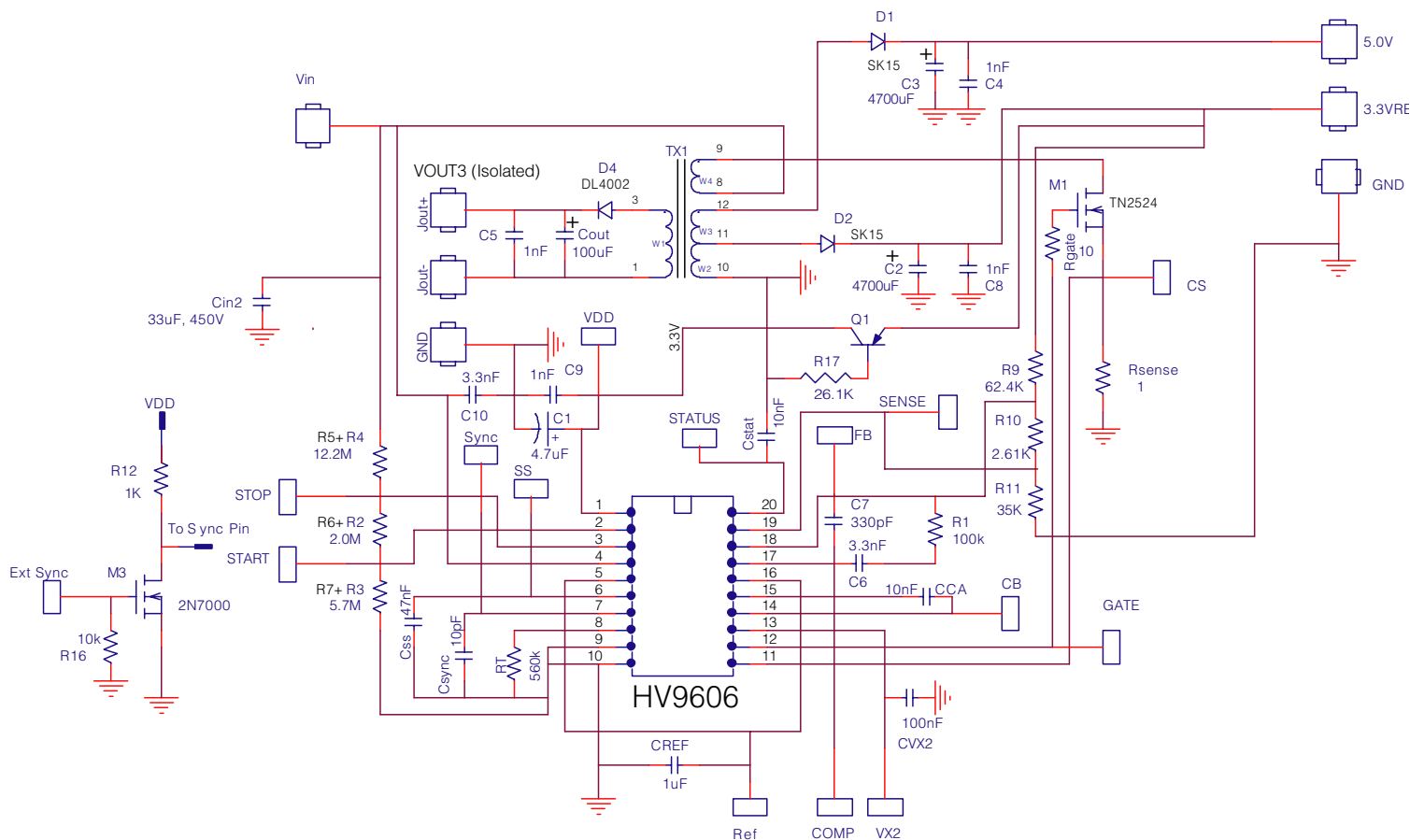
### PWRGD

This is an active "High", remote power-good indicator. This pin is utilized with CMOS coupled logic of 3.3V for "High" and 0V for "Low".

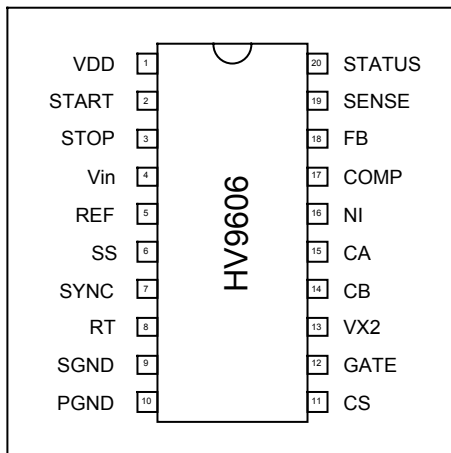
### EXT SYNC

Apply external clock, a 3.3 volt logic signal to Ext Sync. Clock frequency has to exceed 25kHz to sync, but not exceed 50kHz.

## Schematic Diagram



## Pinout / Measurement TP's



## Pin Descriptions

**V<sub>DD</sub>** – This is the supply pin for the PWM Logic and Analog circuits. When the input voltage to the V<sub>IN</sub> pin exceeds the start voltage the input regulator seeks to regulate the voltage on the capacitor connected to this pin to a nominal 2.9V. After the PWM has started, the bootstrap supply will regulate this voltage to a nominal 3.3V or 5V. With V<sub>IN</sub> connected to PGND the circuit can be powered via this pin in the voltage range of 2.9V to 5.5V with a nominal 2.8V UVLO.

**START** – The resistive divider from V<sub>IN</sub> sets the start-up regulator start voltage.

**STOP** – The resistive divider from V<sub>IN</sub> sets the start-up regulator stop voltage. A low power sleep mode function may be implemented by pulling this pin to SGND.

**V<sub>IN</sub>** – This is the startup linear regulator input. It can accept DC input voltages in the range of 15V to 250V. With START and STOP programmed to more than 20V, the leakage current on this pin is less than 6 $\mu$ A at V<sub>IN</sub> = 20V.

**VREF** – This pin provides a !1% tolerance reference voltage.

**SS** – A capacitor connected to this pin determines the soft start time. Soft start may be initiated by a low VX2 voltage or an over current condition when supervisor circuit STATUS output is low. During short duration input interruptions when the output voltage does not decay below programmed limits, the supervisor circuit inhibits soft start to permit rapid recovery of the system.

**SYNC** – This I/O pin may be connected to the SYNC pin of other HV9606 circuits and will cause the oscillators to lock to the highest frequency oscillator. Synchronization to a master clock is possible by means of an open collector or open drain logic gate or optocoupler, provided the low duty cycle does not exceed 50%. If synchronization is utilized then a pull up resistor to V<sub>DD</sub> is required to overcome the effects of parasitic capacitance on the circuit board. The value of the resistor required will depend on the operating frequency and master clock duty cycle.

**RT** – The resistor connected from this pin to SGND sets the frequency of the internal oscillator by setting the charging current for the internal timing capacitor. The PWM output frequency is one half the oscillator frequency.

**SGND** – Common connection for all Logic and Analog circuits.

**PGND** – Common connection for Gate Driver circuit.

**CS** – This is the current sense input. Under normal operation the over current limit is triggered when the voltage on this pin exceeds 0.5V<sub>REF</sub>, however, current sensing is blanked during the first 85ns on time of the MOSFET to prevent false triggering during the turn on switching transition. The loop control operating peak current sense may be set to any level below 0.5V<sub>REF</sub>.

**GATE** – This push-pull CMOS output is designed to drive the gate of an N-Channel power MOSFET.

**VX2** – This is the supply pin for the Gate Driver circuit and is generated by the Charge Pump V<sub>DD</sub> voltage doubler circuit. It should be bypassed to PGND with a capacitor, typically 0.1 $\mu$ F.

**CA and CB** – The charge pump circuit uses a capacitor (typically 0.01 $\mu$ F) connected between these pins to generate the VX2 voltage.

**NI** – High impedance non-inverting input of the error amplifier.

**COMP** – The output of the error amplifier.

**FB** – High impedance inverting input of the error amplifier.

**SENSE** – This is the input pin to the supervisory circuit. On a rising input voltage the circuit changes state at a nominal 0.85V<sub>REF</sub> + 0.075V. When the input voltage is decaying the circuit changes state a nominal 0.85V<sub>REF</sub> – 0.075V.

**STATUS** – This is the output of the supervisory circuit. When the sense-input voltage is high, this output is pulled up to V<sub>DD</sub> by a 10 $\mu$ A current source and the Soft Start function is disabled. When the sense-input is low, this output is pulled low and it may be used to directly control the reset of a microprocessor or it may be used to drive an optocoupler or LED indicator.

## Parts List

Item	Reference	Part	Value	Footprint	Part No.
1	C1	Capacitor	4.7uF, 10 Volts	SMD-1206	Panasonic or equivalent
2	C2	Capacitor	4700uF, 6.3 Volts	Radial	Panasonic or equivalent
3	C3	Capacitor	4700uF, 6.3 Volts	Radial	Panasonic or equivalent
4	C4	Capacitor	.001uF, 50 Volts	SMD-0805	Panasonic or equivalent
5	C5	Capacitor	.001uF, 50 Volts	SMD-0805	Panasonic or equivalent
6	C6	Capacitor	3.3nF, 50 Volts	SMD-0805	Panasonic or equivalent
7	C7	Capacitor	330pF, 50 Volts	SMD-0805	Panasonic or equivalent
8	C8	Capacitor	.001uF, 50 Volts	SMD-0805	Panasonic or equivalent
9	C9	Capacitor	.001uF, 50 Volts	SMD-0805	Panasonic or equivalent
10	C10	Capacitor	.0033uF, 200 Volts	SMD-0805	Panasonic or equivalent
11	CCA	Capacitor	10nF, 50 Volts	SMD-0805	Panasonic or equivalent
12	CIN2	Capacitor	33uF, 450 Volts	Radial	Panasonic or equivalent
13	COUT	Capacitor	100uF, 100 Volts	Radial	Panasonic or equivalent
14	CREF	Capacitor	1uF, 16 Volts	SMD-0805	Panasonic or equivalent
15	CSS	Capacitor	47nF, 50 Volts	SMD-0805	Panasonic or equivalent
16	CSTAT	Capacitor	10nF, 50 Volts	SMD-0805	Panasonic or equivalent
17	CSYNC	Capacitor	10pF, 50 Volts	SMD-0805	Panasonic or equivalent
18	CVX2	Capacitor	100nF, 50 Volts	SMD-0805	Panasonic or equivalent
19	D1	Diode	1 Amp, 50 Volt	SMD-SMB	Diodes, Inc. #B150B or equivalent
20	D2	Diode	1 Amp, 50 Volt	SMD-SMB	Diodes, Inc. #B150B or equivalent
21	D4	Diode	1 Amp, 100 Volt	MELF	Diodes, Inc. #DL4002 or equivalent
22	M1	MOSFET	TN2524N8	SOT-223	Supertex, Inc.
23	M3	MOSFET	2N7000	TO-92	Supertex, Inc.
24	Q1	Bipolar Transistor	MMBTA56	SMD-SOT23	Fairchild Semiconductor or equivalent
25	R1	Resistor	100K $\Omega$ , 1%	SMD-0805	Panasonic or equivalent
26	R2	Resistor	2M $\Omega$ , 1%	SMD-0805	Panasonic or equivalent
27	R3	Resistor	3M $\Omega$ , 1%	SMD-0805	Panasonic or equivalent
28	R4	Resistor	10M $\Omega$ , 1%	SMD-0805	Panasonic or equivalent
29	R5	Resistor	2.2M $\Omega$ , 1%	SMD-0805	Panasonic or equivalent
30	R6	Resistor	0 $\Omega$ , 1%	SMD-0805	Panasonic or equivalent
31	R7	Resistor	2.7M $\Omega$ , 1%	SMD-0805	Panasonic or equivalent
32	R9	Resistor	62K $\Omega$ , 1%	SMD-0805	Panasonic or equivalent
33	R10	Resistor	2.61K $\Omega$ , 1%	SMD-0805	Panasonic or equivalent
34	R11	Resistor	34.8K $\Omega$ , 1%	SMD-0805	Panasonic or equivalent
35	R12	Resistor	1K $\Omega$ , 5%	SMD-0805	Panasonic or equivalent
36	R16	Resistor	10K $\Omega$ , 5%	SMD-0805	Panasonic or equivalent
37	R17	Resistor	26K $\Omega$ , 5%	SMD-0805	Panasonic or equivalent
38	RGATE	Resistor	10 $\Omega$ , 5%	SMD-0805	Panasonic or equivalent
39	RSENSE	Resistor	1 $\Omega$ , 1 Watt, 5%	SMD-RW1SOBa	Panasonic or equivalent
40	RT	Resistor	560K $\Omega$ , 1%	SMD-0805	Panasonic or equivalent
41	TX1	Transformer			EPCOS
42	U1	IC	HV9606	SSOP	Supertex, Inc.