Advanced Information

High Frequency Multi-Function Current Mode PWM Controller

Ordering Information

Device	Package Options		
	28-pin DIP	SOW-28	Die
HV9221	HV9221P	HV9221WG	HV9221X

Features

- ☐ Current-mode control
- ☐ 15 to 450 volt input range internal start-up circuit
- ☐ 50μA standby supply current
- ☐ 2mA operating supply current
- ☐ Under-voltage lockout
- ☐ Internal soft start
- ☐ 1% tolerance band gap voltage reference
- ☐ 1.5 MHz low offset error amplifier
- ☐ 1 MHz oscillator
- ☐ High current output drivers (1.5A peak, 0.5A continuous)
- ☐ Driver outputs have low output impedance with V_{CC} = 0V
- ☐ Current sense leading edge threshold switching
- ☐ Fast (25 nsec) over current shutdown
- ☐ Buffered slope compensation ramp generators
- ☐ Fault tolerant single pin synchronization of multiple converters
- ☐ All pins are ESD protected

General Description

The Supertex HV9221 is a dual high-speed Current Mode Switching Power Supply controller that can start and run directly from almost any DC input from 15 volts DC to rectified and filtered 240 volt AC line. This unique input circuit allows the HV9221 to self-start directly from a high voltage input, and subsequently take the power from an auxiliary converter output which it is controlling, thus allowing very efficient operation while maintaining input-to-output galvanic isolation limited only by the insulation system of the associated magnetic assembly. When powered by the auxiliary converter outputs or with both outputs disabled (oscillator shuts down) the input current on the $+V_{IN}$ pin is reduced to a maximum of 50μA which is beneficial especially in telecommunication applications.

Operating Modes

1. Single push-pull converter.
2. Dual 49% duty cycle controller with 180° phasing.
3. Dual 99% duty cycle controller with 180° phasing.

Absolute Maximum Ratings*

$+V_{IN}$, Input Voltage		-0.5V to +450V
V_{CC}, Supply Voltage		-0.5V to +15.5V
Operating Temperature Range		-40°C to +85°C
Storage Temperature Range		-65°C to +150°C
Power Dissipation @ 25°C	SOW-28	1.0W
	28-pin DIP	1.2W

Note:
*All voltages are referenced to GND.

Electrical Characteristics

(Unless otherwise specified, $-V_{IN}$ = 0V, V_{CC} = 10V; -40ºC ≤ T_A ≤ +85ºC)

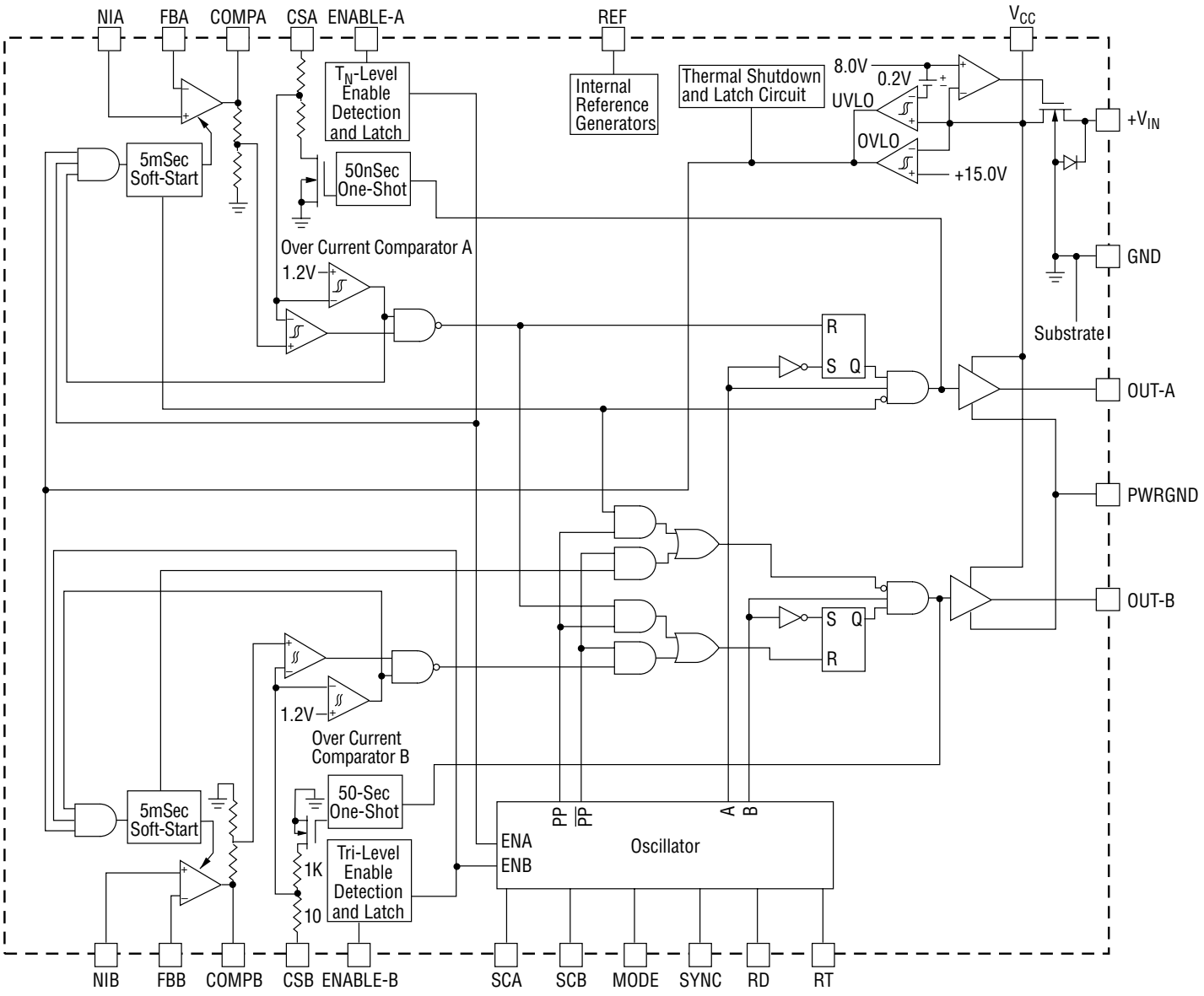
Symbol	Parameters	Min	Typ	Max	Unit	Conditions
Pre-regulator/Start-up						
$+V_{IN}$	Input voltage	15		450	V	
$+I_{IN}$	Input leakage current		20	50	µA	$+V_{IN}$ = 450V, V_{CC} = V_{REG}, Enable A & B = 0
I_{START}	Pre-regulator start-up current	40			mA	$+V_{IN}$ = 15V, V_{CC} = Vuvlo, Enable A & B = 0
V_{PR}	V_{CC} pre-regulator voltage	7.8	8.0	8.2	V	$+V_{IN}$ = 15 to 450V
V_{DELTA}	V_{PR} - Vuvlo (turn-on)	0.1	0.2	0.3	V	
V_{HYST}	Under voltage lockout hysteresis	0.9	1.0	1.1	V	
	Over voltage lockout	14.5	15.0	15.5	V	
	Over voltage lockout hysteresis	2.5	3.0	3.5	V	
Supply						
I_{CC}	Supply current			2	mA	C_{LOAD} = 50pF, f_{OSC} = 500KHz
Reference						
V_R	Reference output voltage	2.48	2.50	2.52	V	T_A = 25°C
	Load regulation		1	5	mV	0 mA < I_{REF} < 3mA
	Line regulation		2		mV	UVLO stop threshold +0.5V < V_{CC} < 13V
V_R	Reference output voltage	2.45	2.50	2.55	V	Full temp. range, 0mA < I_{REF} < 3mA
	Output noise voltage			200	µV	10Hz < f < 10KHz, T_J = 25°C
	Long term stability		3		mV	T_A = 125°C, 1000 hrs.
I_{SREF}	Short circuit current	-4	-6	-10	mA	
Error Amplifiers						
I_{FB} or I_{NI}	Input bias current		±25	±200	nA	V_{FB} = 3.0V, V_{NI} = 2.5V
V_{OS}	Input offset voltage		±5	±25	mV	
V_{CM}	Common mode input range	0		V_{CC}	V	
A_{VOL}	Open loop voltage gain	60	80		dB	
BW	Unity gain bandwidth	1.5	2.5		MHz	
I_{OUT}	Output current sourcing		-2	-1	mA	V_{FB} < V_{NI}
I_{OUT}	Output current sinking	2	4		mA	V_{FB} > V_{NI}
P_{SRR}	Power supply rejection	50	90		dB	8.5V < V_{CC} < 14.5
MOSFET Driver Outputs						
V_{OL}	Output low level		0.10	0.15	V	I_{OUT} = 20mA
			0.3	0.6	V	I_{OUT} = 500mA
			0.5	0.7	V	I_{OUT} = 20mA, V_{CC} = 0V
V_{OH}	Output high level (V_{CC} - V_{OUT})		0.12	0.2	V	I_{OUT} = -20mA
			0.4	0.7	V	I_{OUT} = -500mA
I_{SOURCE}	Peak output current sourcing		-1500	-1300	mA	V_{OUT} = 0V
I_{SINK}	Peak output current sinking	1300	1500		mA	V_{OUT} = V_{CC}
	Output rise time		20	30	ns	C_{LOAD} = 2nF
	Output fall time		20	30	ns	C_{LOAD} = 2nF

Electrical Characteristics (continued)

(Unless otherwise specified, $-V_{IN}$ = 0V, V_{CC} = 10V; -40ºC ≤ T_A ≤ +85ºC)

Symbol	Parameters	Min	Typ	Max	Unit	Conditions
Oscillator						
f_{OSC}	Initial accuracy	900	1000	1100	KHz	R_T = TBD, R_D = 0
		450	500	550	KHz	R_T = TBD, R_D = 0
		90	100	110	KHz	R_T = TBD, R_D = 0
	Temperature coefficient		100	300	ppm/C	f_{OSC} = 100KHz
	Voltage stability		1	2	%	f_{OSC}=100KHz, 15V >V_{CC} > 8V
$V_{SYNC(out)high}$	Sync output voltage - high	4.5	5.0	5.5	V	
$I_{CYNC(out)high}$	Sync output current - high			10	µA	
$V_{SYNC(out)low}$	Sync output voltage - low		0.3	0.5	V	
$I_{SYNC(out)low}$	Sync output current - low	0.5	-1.0		mA	
$V_{SYNC(in)}$	Maximum Sync input voltage			5.5	V	
$V_{SYNC(in)}$	Sync threshold - low	0.8	1.7	2.0	V	
$I_{SYNC(in)}$	Sync input current - low		-20	-30	µA	
Current Sensing						
V_{CSA} & V_{CSB}	Usable control current sense range	0.5		1.0	V	
V_{CSA} & V_{SCB}	Current limit threshold	1.1	1.2	1.3	V	
V_{CSA} & V_{CSB}	Leading edge current limit threshold	1.1	1.3	1.5	V	
	Leading edge threshold time	45	50	55	nsec	
	Current limit delay to output		30	50	nsec	
Slope Compensation Ramp Generators						
V_{CSA} or V_{CSB}	Peak voltage	0.9	1	1.1	V	49% duty cycle or push-pull mode
V_{SCA} or V_{SCB}	Peak voltage	1.8	2.0	2.2	V	99% duty cycle mode
V_{SCA} or V_{SCB}	Valley voltage	0	0.01	0.02	V	
	Output impedance			5	Ω	
Logic Controls Inputs (ENABLE-A, ENABLE-B, PP, 49%/99%)						
V_{ENABLE}	Maximum input voltage			V_{CC}	V	
V_{ENABLE}	Open terminal voltage		0.5V_{CC}		V	
$V_{ENABLE(high)}$	Pull high threshold voltage	-1.8	-2.0	-2.2	V	Referenced to V_{CC}
$I_{ENABLE(high)}$	Pull high input current		100		µA	
$V_{ENABLE(low)}$	Pull low threshold voltage	1.8	2.0	2.2	V	
$I_{ENABLE(low)}$	Pull low input current		-100		µA	
Over Temperature Shutdown						
	Shutdown junction temperature	110	125	140	°C	
	Hysteresis (temperature drop)	40	50	60	°C	

Block Diagram



Pin Descriptions

GND - Ground connection for all low level analog and digital circuits.

PWRGND - This pin provides ground return for the high transient currents of the output driver circuits.

$+V_{IN}$ - This is the start-up pre-regulator input which can accept input voltages in the range of 15 to 450 volts DC.

V_{CC} - This is the supply pin to the PWM circuit. During start-up this pin is powered by the start-up linear pre-regulator which regulates to a nominal voltage of 8 volts over the full input voltage range of the $+V_{IN}$ pin.

OUT-A, OUT-B - These high current push-pull outputs of the PWM are designed to drive the gates of power MOSFETs.

REF - This pin provides a 1% accuracy 2.5 volts buffered, low output impedance reference.

ENABLE-A, ENABLE B - These input pins provide means for shutting down the PWM.

MODE - This input is used to select the operating mode of this PWM. The mode selections are as follows:

Pin Connection	Operating Mode
GND	49% Dual PWM
OPEN	99% Dual PWM
V_{CC}	49% Single Push-Pull PWM

SYNC - This bidirectional Input/Output negative transition active pin provides a means for synchronizing several PWM chips or synchronizing against an application system master oscillator.

SCA, SCB - These low impedance output buffered ramp generators provide positive going ramp outputs corresponding to the mode of operation of this PWM circuit and is intended to enable the user to provide optimal slope compensation to the feedback circuits.

CSA, CSB - These are the current sense inputs to the PWM comparators.

COMPA, COMPB - The low impedance output of the error amplifiers.

FBA, FBB - The high impedance inverting input of the error amplifiers.

NIA, NIB - The high impedance non-inverting input of the error amplifiers.

RT - The oscillator charging current is set by the value of the resistor connected from RT to GND.

RD - External resistor to GND to control the discharge rate of the internal timing capacitor.