SC1156
Programmable Synchronous DC/DC Controller for Advanced Microprocessors

Description

The SC1156 is a low-cost, full featured synchronous, voltage-mode controller designed for use in single ended power supply applications where efficiency is of primary concern. Synchronous operation allows for the elimination of heat sinks in many applications. The SC1156 is ideal for implementing DC/DC converters needed to power advanced microprocessors such as Pentium® II (Klamath), in both single and multiple processor configurations. Internal level-shift, high-side drive circuitry, and preset shoot-thru control, allows for use of inexpensive n-channel power switches.

SC1156 features include an integrated 5-bit VID DAC, temperature compensated voltage reference, triangle wave oscillator, current limit comparator, frequency shift over-current protection, and an accessible, internally compensated error amplifier. Power good signaling, logic compatible shutdown, and over voltage protection are also provided.

The SC1156 operates at a fixed 200KHz, providing an optimum compromise between efficiency, external component size, and cost.

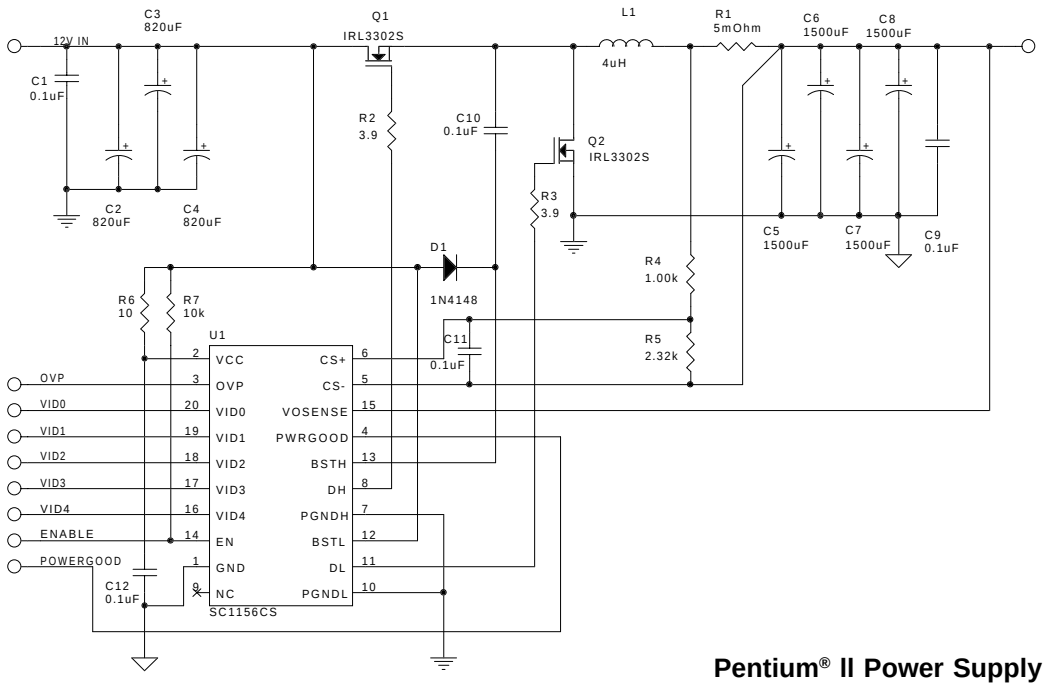
Features

- Low cost / full featured
- Synchronous operation
- 5 Bit VID DAC programmable output
- On-chip power good and OVP functions
- Designed to meet Intel VRM8.1 (Klamath)

Applications

- Pentium® II (Klamath) Core Supply
- Multiple MicroProcessor Supplies
- Voltage Regulation Modules (VRM)
- Programmable Power Supplies
- High Efficiency DC/DC Conversion

Typical Application Circuit



Pentium® II Power Supply

Absolute Maximum Ratings

Parameter	Symbol	Maximum	Units
VCC to GND	V_{IN}	-0.3 to +15	V
PGND to GND		+1	V
BST to GND		-0.3 to +26	V
Operating Temperature Range	T_A	0 to +70	°C
Junction Temperature Range	T_J	0 to +125	°C
Storage Temperature Range	T_{STG}	-65 to +50	°C
Thermal Resistance Junction to Case	θ_{JC}	30	°C/W
Thermal Resistance Junction to Ambient	θ_{JA}	95	°C/W
Lead Temperature (Soldering) 10 Sec.	T_{LEAD}	300	°C

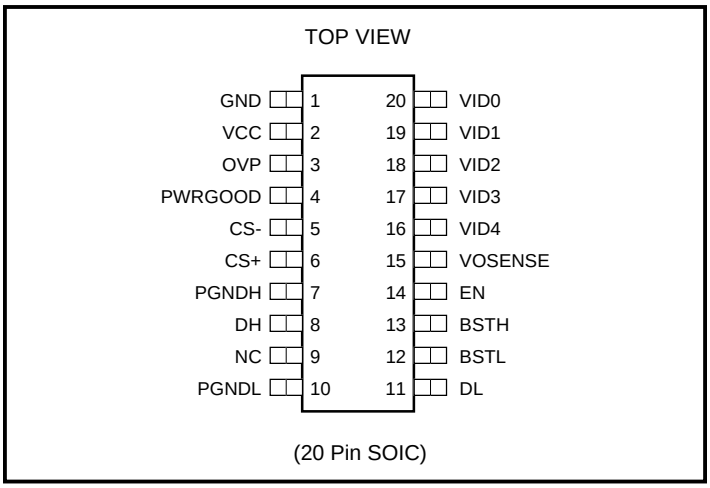
Electrical Characteristics

(Unless otherwise noted: V_{CC} = 11.4V to 12.6V; GND = PGND = 0V; FB = V_O; 0mV < (CS+ - CS-) < 60mV; T_J = 25°C)

Parameter	Conditions	Min	Typ	Max	Units
Output Voltage	I_O = 2A (1)	See Output Voltage Table			
Supply Voltage	V_{CC}	4.2		15	V
Supply Current	V_{CC} = 12.0V		5		mA
Load Regulation	I_O = 0.3A to 15A (1)		1		%
Line Regulation	All VID codes (1)		0.5		%
Gain (AOL)	VOSENSE to V_O		35		dB
Current Limit Voltage		60	70	80	mV
Oscillator Frequency		180	200	220	kHz
Oscillator Max Duty Cycle			95		%
DH Sink/Source Current	BSTH - DH = 4.5V, DH - PGNDH = 2V	1			A
DL Sink/Source Current	BSTL - DL = 4.5V, DL - PGNDL = 2V	1			A
OVP threshold Voltage			120		%
OVP source current	V_{OVP} = 3V	10			mA
Power good threshold voltage		90		110	%
Dead time		50	100		ns

NOTE:
(1) Specification refers to Typical Application Circuit

Pin Configuration



Ordering Information

Device (1)	Package	Temp Range (T_J)
SC1156SW.TR	SO-20	0° to 125°C

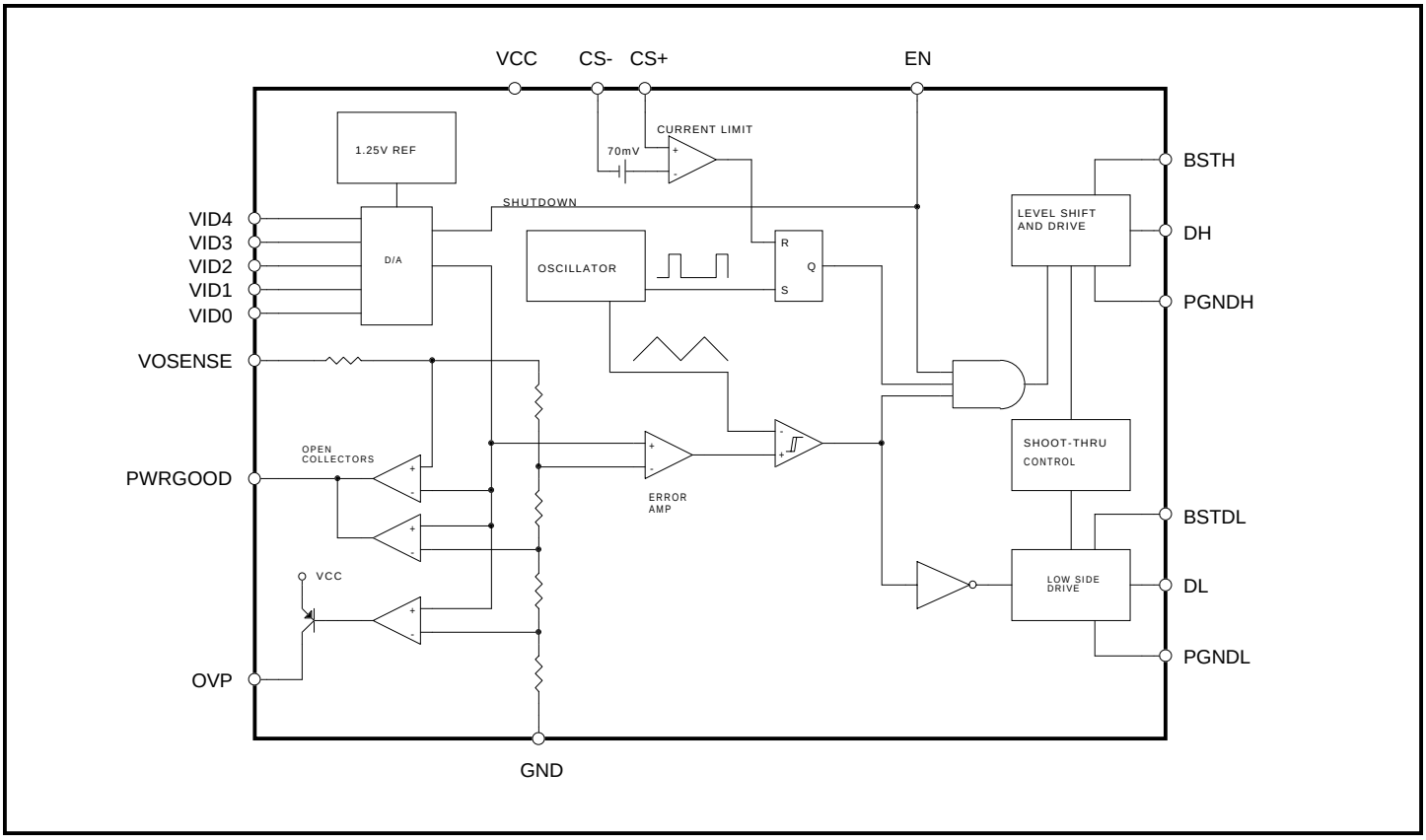
Note:
(1) Only available in tape and reel packaging. A reel contains 1000 devices.

Pin Descriptions

Pin #	Pin Name	Pin Function
1	GND	Small Signal Analog and Digital Ground
2	VCC	Chip Supply Voltage
3	OVP	High Signal out if V_O>setpoint + 20%
4	PWRGOOD (1)	Open collector logic output, high if V_O within 10% of setpoint
5	CS-	Current Sense Input (negative)
6	CS+	Current Sense Input (positive)
7	PGNDH	Power Ground for High Side Switch
8	DH	High Side Driver Output
9	NC	Not Connected
10	PGNDL	Power Ground for Low Side Switch
11	DL	Low Side Driver Output
12	BSTL	Vcc for Low Side Driver (Boost)
13	BSTH	Vcc for High Side Driver (Boost)
14	EN (1)	Logic low shuts down the converter
15	VOSENSE	Feedback
16	VID4 (1)	Programming Input (MSB)
17	VID3 (1)	Programming Input
18	VID2 (1)	Programming Input
19	VID1 (1)	Programming Input
20	VID0 (1)	Programming Input (LSB)

NOTE:
(1) All logic inputs and outputs are open collector TTL compatible.

Block Diagram



Theory of Operation

The D/A Converter generates an output voltage determined by an internal trimmed bandgap voltage reference and the status of the VID0 through VID4 inputs. This voltage is applied to the non-inverting input of the error amplifier, the inverting input of the error amplifier is fed from the VOSENSE pin via a precision resistor divider. The error amplifier itself is a transconductance amplifier with an internal load resistor. The open loop gain is internally set to approximately 40 dB.

The internal oscillator uses an on-chip capacitor and a trimmed precision current source to set the frequency of oscillation to 200 kHz. The triangular output of the oscillator is compared to the output of the error amplifier. The output of the PWM comparator is a pulse width modulated signal whose duty cycle increases as the voltage at the VOSENSE pin decreases.

The output of the current limit comparator goes high when its input voltage exceeds approximately 70mV, this sets the current limit latch, immediately terminating the current ON time. The current limit latch is reset in the middle of the OFF time when the triangular wave oscillator reaches its highest point .

When the output of the PWM comparator is high, output DH is driven high, provided that the VID code is valid, the current limit latch has not been set and the Enable (EN) pin is not pulled low. When the PWM comparator output is low DL is always driven high.

The Shoot-through control circuitry modifies the DH and DL waveforms slightly, ensuring that there is a short delay between one turning OFF and the other turning ON. This ensures that the ON times of the external FETs driven by DH and DL do not overlap.

Output Voltage Table

Unless otherwise noted: V_{CC} = 4.75V to 5.25V; GND = PGND = 0V; FB = V_O; 0mV < (CS+ - CS-) < 60mV; T_J = 25°C

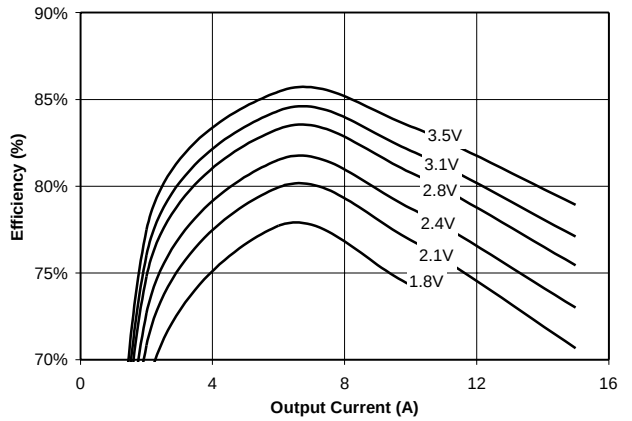
Parameter	Conditions	VID 43210	Min	Typ	Max	Units
Output Voltage (1)	I_O = 2A in Application circuit (Figure 1)	00101	1.782	1.800	1.818	V
		00100	1.832	1.850	1.868	
		00011	1.881	1.900	1.919	
		00010	1.931	1.950	1.969	
		00001	1.980	2.000	2.020	
		00000	2.030	2.050	2.070	
		11111	1.980	2.000	2.020	
		11110	2.079	2.100	2.121	
		11101	2.178	2.200	2.222	
		11100	2.277	2.300	2.323	
		11011	2.376	2.400	2.424	
		11010	2.475	2.500	2.525	
		11001	2.574	2.600	2.626	
		11000	2.673	2.700	2.727	
		10111	2.772	2.800	2.828	
		10110	2.871	2.900	2.929	
		10101	2.970	3.000	3.030	
		10100	3.069	3.100	3.131	
		10011	3.168	3.200	3.232	
		10010	3.267	3.300	3.333	
		10001	3.366	3.400	3.434	
		10000	3.465	3.500	3.535	

NOTE:

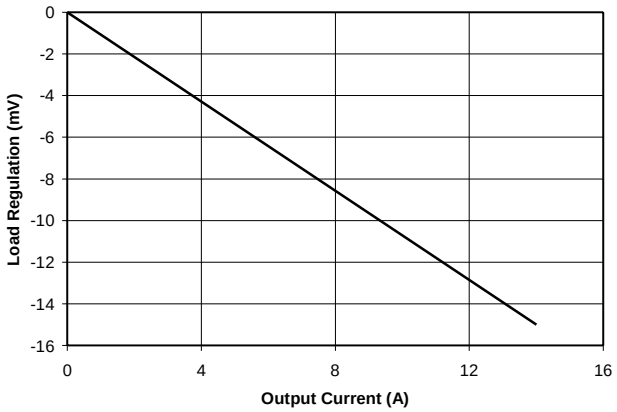
(1) All VID codes not specifically listed are invalid and cause shutdown exactly as if the shutdown pin had been asserted.

Characteristic Curves

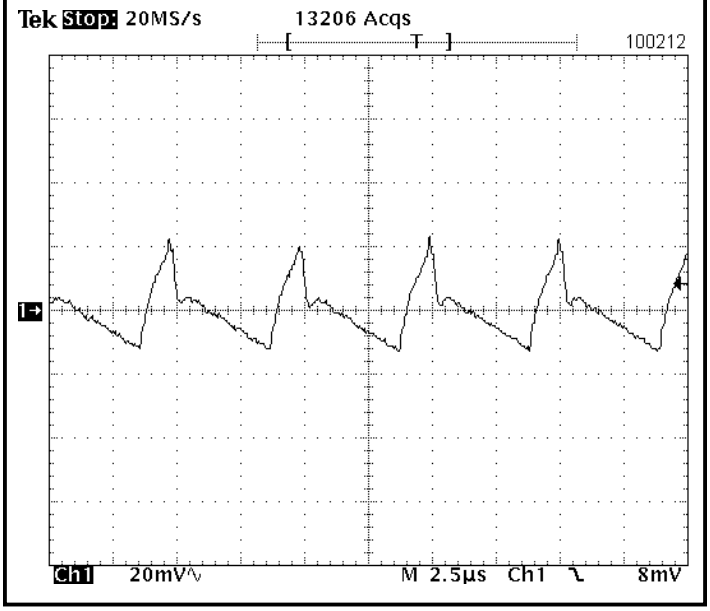
SC1156 Efficiency in Application Circuit



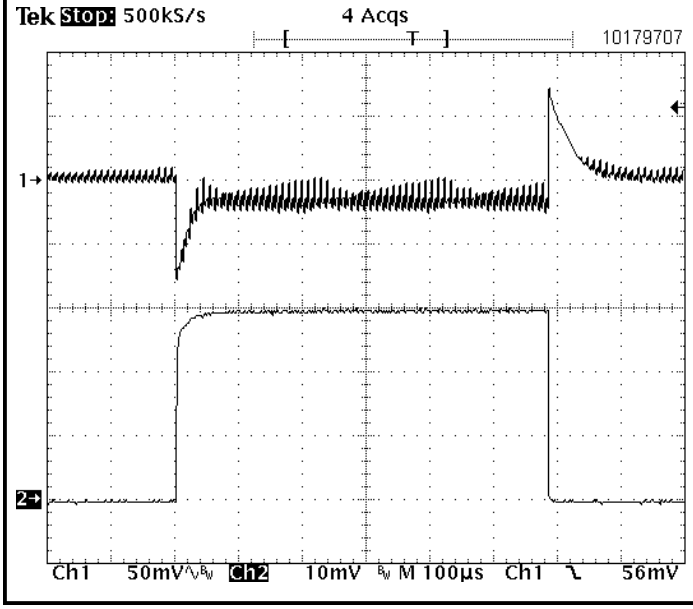
SC1156 Regulation in Application Circuit



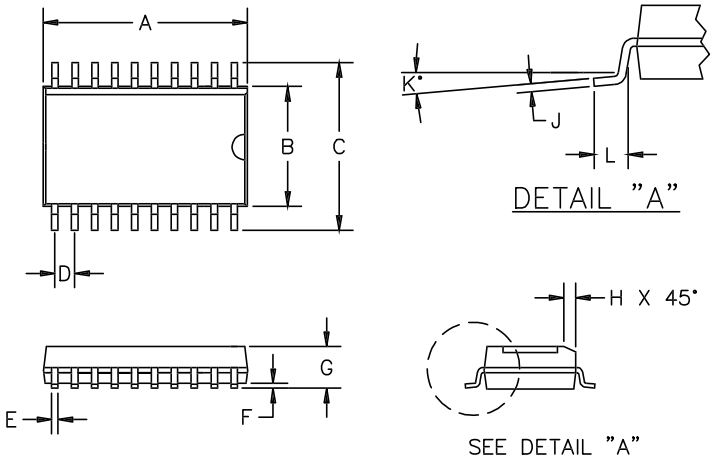
Ripple at Vo=2.00V; Io=15A in Application circuit



Transient at Vo=2.00V; Io= 0 to 15A in App. circuit



Outline Drawing - SO-20

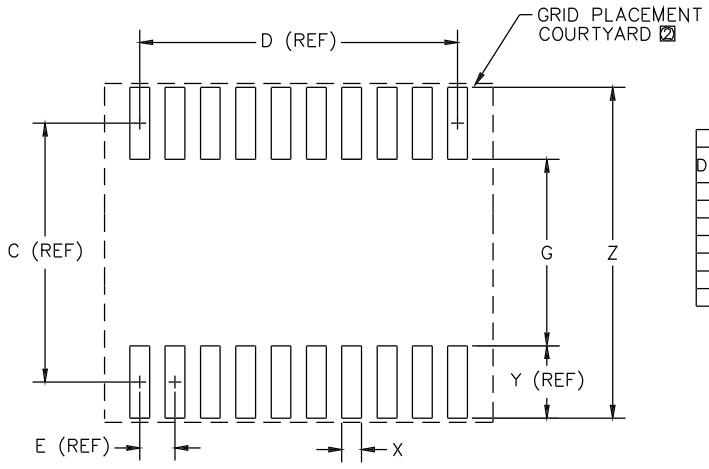


DIMENSIONS [1]					
DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	.496	.512	12.6	13.0	[2]
B	.291	.299	7.40	7.60	[2]
C	.394	.419	10.0	10.65	–
D	.050	BSC	1.27	BSC	–
E	.013	.020	0.33	0.51	–
F	.004	.012	.10	.30	–
G	.092	.104	2.35	2.65	–
H	.010	.030	.25	.75	–
J	.009	.013	.23	.32	–
K	0°	8°	0°	8°	–
L	.016	.050	.40	1.27	–

[2] DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTUSIONS
[1] CONTROLLING DIMENSION : MILLIMETERS.

Ref. MS-013AC

Land Pattern - SO-20



DIMENSIONS [1]					
DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
C	–	.362	–	9.20	–
D	–	.45	–	11.43	–
E	–	.05	–	1.27	–
G	.260	.268	6.60	6.80	–
X	.02	.03	.60	.80	–
Y	–	.102	–	2.60	–
Z	.457	.465	11.60	11.80	–

[2] GRID PLACEMENT COURTYARD IS 28 X 24 ELEMENTS (14mm X 12mm) IN ACCORDANCE WITH THE INTERNATIONAL GRID DETAILED IN IEC PUBLICATION 97.
[1] CONTROLLING DIMENSION: MILLIMETERS.

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