FAN5035

High Performance Programmable DC-DC Controller

Features

- Programmable output from 1.3V to 3.5V using an integrated 5-bit DAC
- Remote sense
- 1MHz operation
- 85% efficiency typical at full load
- Integrated Power Good and Enable/Soft Start functions
- Uncommitted Op-amp
- Drives N-channel MOSFETs
- Over-current and over-voltage protection
- 24 pin TSSOP package

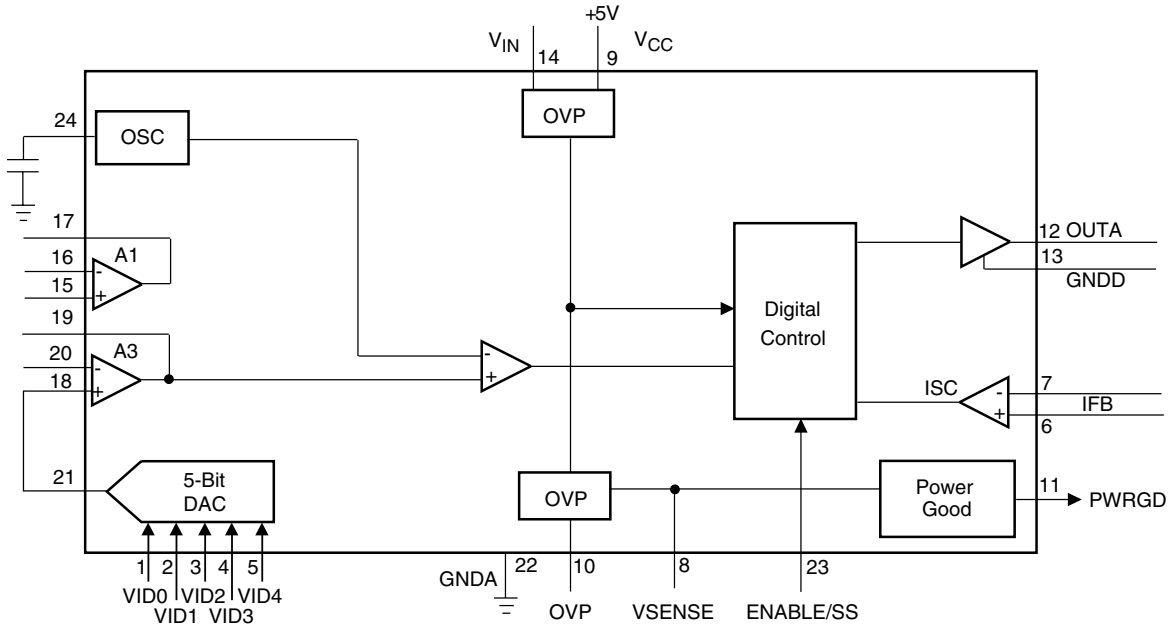
Applications

- Power supply for Pentium® III
- VRM for Pentium III processor
- Programmable step-down power supply

Description

The FAN5035 is a voltage-mode DC-DC controller IC which provides a highly accurate, programmable output voltage for high-performance processors. The FAN5035 features remote voltage sensing, adjustable current limit and 1MHz operation. The FAN5035 uses a 5-bit D/A converter to program the output voltage from 1.3V to 3.5V. An on-board precision low TC reference achieves tight tolerance voltage regulation without expensive external components. The FAN5035 also offers integrated functions including Power Good, Output Enable/Soft Start, current limiting, over-voltage protection, and an uncommitted op-amp, and is available in a 24 pin TSSOP package.

Block Diagram



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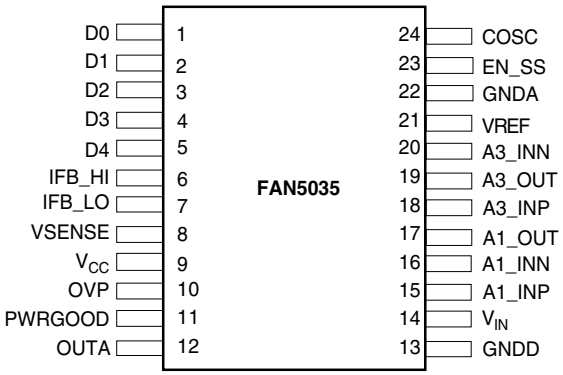
Pin Assignments



Pin Definitions

Pin Number	Pin Name	Pin Function Description
1–5	D0-4	**Voltage Identification Code Inputs.** These open collector/TTL compatible inputs will program the output voltage over the ranges specified in Table 1. Pull-up resistors are internal to the controller.
6–7	IFB_HI IFB_LO	**Current Feedback.** These pins are the input for the current feedback control loop. Layout of these traces is critical to system performance.
8	VSENSE	**Voltage Sense.** Pin 8 is used as the input for Power Good and over-voltage protection.
9	V_{CC}	**Analog V_{CC}.** Connect to system 5V supply and decouple with a 0.1µF ceramic capacitor.
10	OVP	**Over-Voltage Protection**. This pin drives an SCR when the output voltage is too high.
11	PWRGOOD	**Power Good Flag.** An open collector output that will be logic LOW if the output voltage is not within ±10% of the nominal output voltage setpoint.
12	OUTA	**Output.** Connect this pin to a driver for an N-channel MOSFET. The trace from this pin to the driver should be <0.5".
13	GNDD	**Power Ground.** Return pin for high currents flowing in pin 12 (OUTA). Connect to a low impedance ground.
14	V_{IN}	**Input Voltage.** Under-voltage detector input.
15–17	A1_INP A1_INN A1_OUT	**Uncommitted Op Amp.**
18–20	A3_INP A3_INN A3_OUT	**Voltage Feedback Op Amp.** This op amp is used for voltage feedback from the output, and for loop compensation.
21	VREF	**Reference Voltage.** Decouple with a 0.1µF ceramic capacitor.
22	GNDA	**Analog Ground.** Return path for low power analog circuitry. This pin should be connected to a low impedance system ground plane to minimize ground loops.
23	EN_SS	**Output Enable.** A logic LOW on this pin will disable the output. An internal current source allows for open collector control. This pin also doubles as soft start.
24	COSC	**Oscillator Capacitor.** Attach a capacitor from pin 24 to ground to set the oscillator frequency.

Absolute Maximum Ratings

Supply Voltage V_{CC}	13V
All Other Pins	V_{CC}
Junction Temperature, T_J	150°C
Storage Temperature	-65 to 150°C
Lead Soldering Temperature, 10 seconds	300°C
Power Dissipation, P_D	950mW
Thermal Resistance Junction-to-case, Θ_{JC}	16°C/W

Recommended Operating Conditions

Parameter	Conditions	Min.	Typ.	Max.	Units
Supply Voltage V_{CC}		4.75	5	5.25	V
V_{IN}			3.3		V
Ambient Operating Temperature		0		70	°C

Electrical Specifications

(V_{CC} = 5V, V_{OUT} = 2.0V, and T_A = +25°C using circuit in Figure 1, unless otherwise noted.)
The • denotes specifications which apply over the full operating temperature range

Parameter	Conditions		Min.	Typ.	Max.	Units
Voltage Reference						
Output Voltage	See Table I	•	1.3		3.5	V
Voltage Reference Accuracy	VID4 = 0 VID4 = 1	• •	-1.2 -1.6		1.2 1.6	%
Current Feedback						
Current Feedback Input Range		•	0		V_{CC}–0.5	V
IFB Propagation Delay	to OUTA	•	180	250	324	nsec
Oscillator						
Oscillator Frequency	COSC=47pF		900		1100	KHz
Oscillator Frequency Range			200		1500	KHz
Oscillator Frequency TC		•		328		Hz/°C
Oscillator Duty Cycle		•	45		55	%
Oscillator Ramp Amplitude		•	0.75	0.9	1.05	V_{PP}
Oscillator Ramp Mean	(Voscmax + Voscmin)/2	•	1.85	2.05	2.25	V
Output Driver						
OUTA Rise Time	100pF Load	•		49	72	nsec
OUTA Fall Time	100pF Load	•		60	80	nsec
OUTA Voltage Low	Isink = 20mA	•			0.5	V
OUTA Voltage High	Isource = 20mA	•	V_{CC}–1.1			V
A1 Amplifier						
A1 Output Current		•	1.7	3		mA
A1 Gain-Bandwidth		•	11	15		MHz
A1 Open Loop Gain		•	50	55		dB
A1 Slew Rate		•	10	15		V/µsec

Electrical Specifications (continued)

(V_{CC} = 5V, V_{OUT} = 2.0V, and T_A = +25°C using circuit in Figure 1, unless otherwise noted.)
The • denotes specifications which apply over the full operating temperature range

Parameter	Conditions		Min.	Typ.	Max.	Units
A1 Offset Voltage		•		0.9	3	mV
A1 Input Bias Current		•		340	500	nA
A1 Common Mode Input Range		•	-0.1		V_{CC}–1.6	V
A1 Output Voltage Swing	Rload = 2KΩ to 2.5V	•	0.9		V_{CC}–0.95	V
A3 Amplifier						
A3 Output Current		•	1.7	3		mA
A3 Gain-Bandwidth		•	11	15		MHz
A3 Open Loop Gain		•	50	55		dB
A3 Slew Rate		•	10	15		V/µsec
A3 Offset Voltage		•		0.9	3	mV
A3 Input Bias Current		•		340	500	nA
A3 Common Mode Input Range		•	0.25		V_{CC}–0.98	V
A3 Output Voltage Swing	Rload = 2KΩ to 2.5V	•	0.8		Voscmid + 0.8	V
A3 Input Impedance	INP to Ground	•	9.33	11.67	14	KΩ
VID Lines						
D0-4 Pullup to V_{CC}		•	20	25		KΩ
D0-4 Logic High		•	2.1			V
D0-4 Logic Low		•			0.8	V
Protection						
Over-voltage Protection	VSENSE/VREF	•	112	115	120	%
Over-voltage Hysteresis		•	1.2	3		%
Over-voltage Output High	No Load	•	V_{CC}–0.2			V
Over-voltage Current	VOVP = 3V	•	40	50		mA
Over-voltage Output Low		•			0.5	V
Over-voltage Input Impedance	Output Low	•	8	10	12	KΩ
Short Circuit Threshold		•	72	80	88	mV
Short Circuit Threshold TC		•		12	31	µV/°C
V_{IN} Input Impedance		•	48	60	72	KΩ
V_{IN} UVLO Rising		•			3.0	V
V_{IN} UVLO Falling		•	2.5			V
V_{IN} UVLO Hysteresis		•	160	250		mV
VSENSE Input Inpedance		•	28	35	42	KΩ
VSENSE Propagation Delay	to OVP	•	270	350	442	nsec
VSENSE Propagation Delay	to OUTA	•	250	340	400	nsec
V_{CC} UVLO Rising		•			4.5	V
V_{CC} UVLO Falling		•	4.0			V
V_{CC} UVLO Hysteresis		•	160	250		mV

Electrical Specifications (continued)

(V_{CC} = 5V, V_{OUT} = 2.0V, and T_A = +25°C using circuit in Figure 1, unless otherwise noted.)
The • denotes specifications which apply over the full operating temperature range

Parameter	Conditions		Min.	Typ.	Max.	Units
Soft Start/Enable						
Soft Start Charge Current	VEN_SS = 1V	•	8	10	12	µA
Soft Start Discharge Current		•	-6	-5	-4	µA
Soft Start Pin Voltage			20		80	%V_{CC}
Power Good						
Power Good Output High	10KΩ Pullup	•	V_{CC} – 0.1			V
Power Good Output Low	10KΩ Pullup	•			0.5	V
Power Good Sink Current	VPG = 0.4V	•	2.0	2.0		mA
Power Good High Threshold	VSENSE/VREF	•	106		111	%
Power Good Low Threshold	VSENSE/VREF	•	89		94	%
Power Good Threshold Hysteresis		•	1.2	2		%
Power Good Propagation Delay	VSENSE to PWRGOOD			60		nsec
Power Good Rise Time				140		nsec
Power Good Fall Time				15		nsec
V_{CC} Supply						
V_{CC} Supply Current	EN_SS and D0-4 open D0-4 grounded During soft-start	•		16 17 22	22	mA

Table 1. Output Voltage Programming Codes

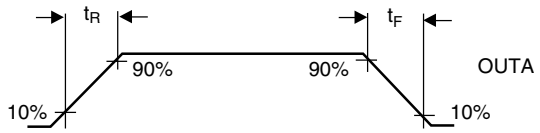
VID4	VID3	VID2	VID1	VID0	Nominal V_{OUT}
0	1	1	1	1	1.30V
0	1	1	1	0	1.35V
0	1	1	0	1	1.40V
0	1	1	0	0	1.45V
0	1	0	1	1	1.50V
0	1	0	1	0	1.55V
0	1	0	0	1	1.60V
0	1	0	0	0	1.65V
0	0	1	1	1	1.70V
0	0	1	1	0	1.75V
0	0	1	0	1	1.80V
0	0	1	0	0	1.85V
0	0	0	1	1	1.90V
0	0	0	1	0	1.95V
0	0	0	0	1	2.00V
0	0	0	0	0	2.05V
1	1	1	1	1	2.0V
1	1	1	1	0	2.1V
1	1	1	0	1	2.2V
1	1	1	0	0	2.3V
1	1	0	1	1	2.4V
1	1	0	1	0	2.5V
1	1	0	0	1	2.6V
1	1	0	0	0	2.7V
1	0	1	1	1	2.8V
1	0	1	1	0	2.9V
1	0	1	0	1	3.0V
1	0	1	0	0	3.1V
1	0	0	1	1	3.2V
1	0	0	1	0	3.3V
1	0	0	0	1	3.4V
1	0	0	0	0	3.5V

Note:

0 = processor pin is tied to GND.

1 = processor pin is open.

Test Parameters



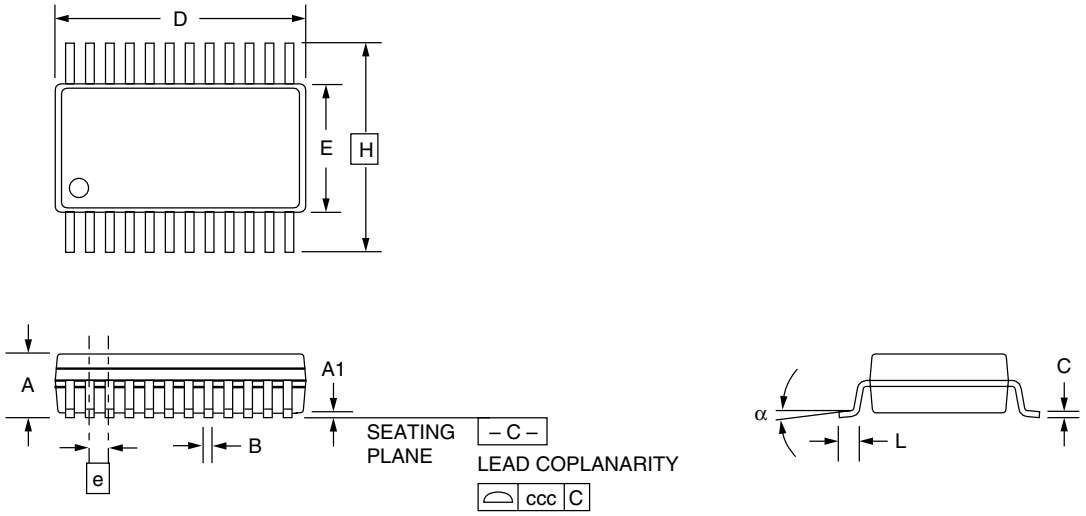
Mechanical Dimensions

24-Lead TSSOP

Symbol	Inches		Millimeters		Notes
	Min.	Max.	Min.	Max.	
A	—	.047	—	1.20	
A1	.002	.006	0.05	0.15	
B	.007	.012	0.19	0.30	
C	.004	.008	0.09	0.20	
D	.303	.316	7.70	7.90	2
E	.169	.177	4.30	4.50	2
e	.026 BSC		0.65 BSC		
H	.252 BSC		6.40 BSC		
L	.018	.030	0.45	0.75	3
N	24		24		5
α	0°	8°	0°	8°	
ccc	—	.004	—	0.10	

Notes:

1. Dimensioning and tolerancing per ANSI Y14.5M-1982.
2. "D" and "E" do not include mold flash. Mold flash or protrusions shall not exceed .006 inch (0.15mm).
3. "L" is the length of terminal for soldering to a substrate.
4. Terminal numbers are shown for reference only.
5. Symbol "N" is the maximum number of terminals.



Ordering Information

Product Number	Package
FAN5035MTCX	24-pin TSSOP

10/31/01 0.0m 000
Stock#DS30005035