

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

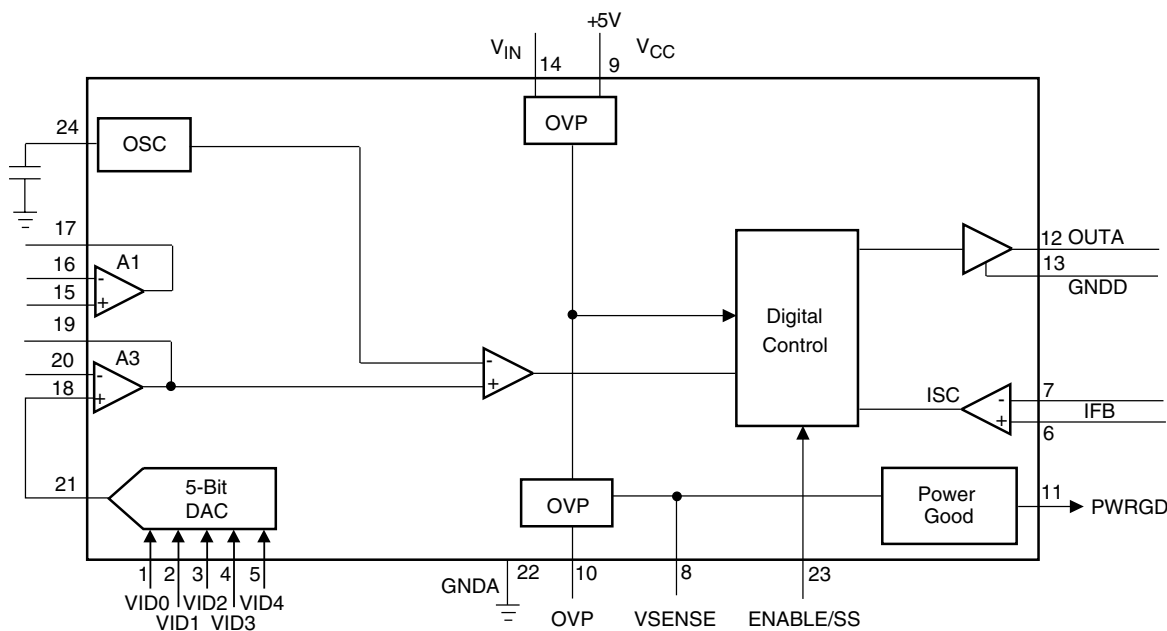
Applications

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

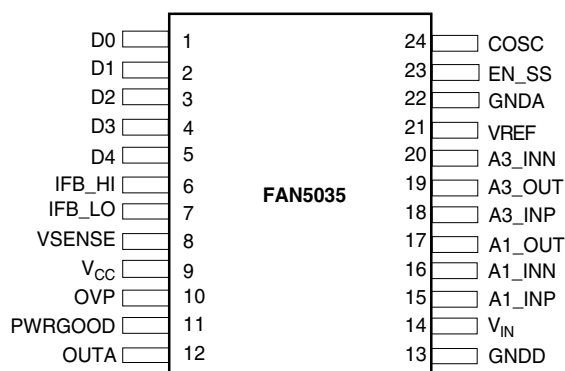
Description

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



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 $T_A = +25^\circ\text{C}$ 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	• -1.2		1.2	%
	VID4 = 1	• -1.6		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	Isourcing = 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/ μ sec

Electrical Specifications (continued)

($V_{CC} = 5V$, $V_{OUT} = 2.0V$, and $T_A = +25^\circ C$ 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	$R_{load} = 2K\Omega$ 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/ μ sec
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	$R_{load} = 2K\Omega$ to 2.5V	•	0.8		$V_{oscmid} + 0.8$	V
A3 Input Impedance	INP to Ground	•	9.33	11.67	14	K Ω
VID Lines						
D0-4 Pullup to V_{CC}		•	20	25		K Ω
D0-4 Logic High		•	2.1			V
D0-4 Logic Low		•			0.8	V
Protection						
Over-voltage Protection	V_{SENSE}/V_{REF}	•	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	K Ω
Short Circuit Threshold		•	72	80	88	mV
Short Circuit Threshold TC		•		12	31	$\mu V/^\circ C$
V_{IN} Input Impedance		•	48	60	72	K Ω
V_{IN} UVLO Rising		•			3.0	V
V_{IN} UVLO Falling		•	2.5			V
V_{IN} UVLO Hysteresis		•	160	250		mV
V_{SENSE} Input Impedance		•	28	35	42	K Ω
V_{SENSE} Propagation Delay	to OVP	•	270	350	442	nsec
V_{SENSE} 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 $T_A = +25^\circ C$ 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	10K Ω Pullup	•	$V_{CC} - 0.1$			V
Power Good Output Low	10K Ω 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

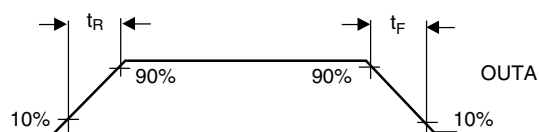
Table 1. Output Voltage Programming Codes

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

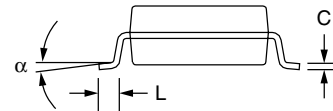
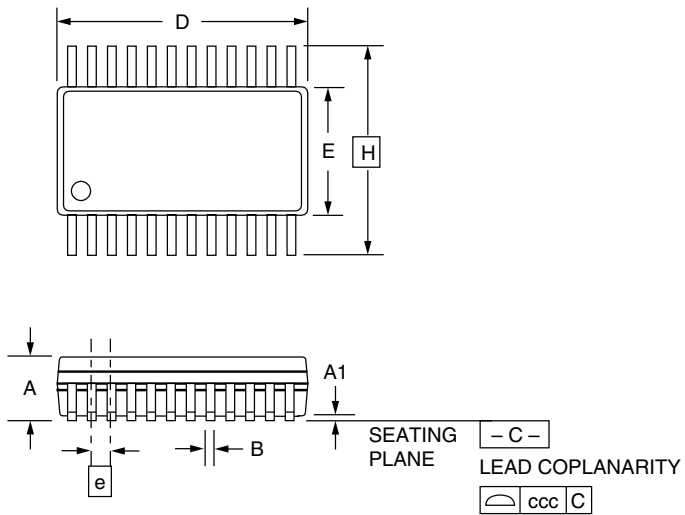
Mechanical Dimensions

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

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