APPLICATION FOCUS

Variable speed brushless DC motor pre-drivers

ZETEX SEMICONDUCTORS

The complete cooling solution

Fan assisted electronics cooling systems need to insure a lot more than just efficient air movement. They need to help minimize power consumption and keep noise – both audible and electrical – to the absolute minimum. The ZXBM series of dedicated motor pre-driver ICs achieves all of these goals and more.

Providing variable speed control for single and two-phase brushless DC fans and blowers up to 100W, the ZXBM motor pre-driver ICs provide designers with the flexibility to tailor a solution to fit the exact needs of an application.

That is why the ZXBM series provides accurate variable motor speed control in response to PWM, Negative Temperature Coefficient (NTC) thermistor or voltage inputs. To drive the motor windings, there is also the Zetex range of market leading bipolar transistors and MOSFETs.

The Zetex pre-driver range continues to evolve to meet the exacting specifications of the world's blue chip OEMs. Multiple fan cooling systems for high availability servers and mainframes demand even more stringent control of cooling, power and noise. The ZXBM series responds with added functionality: current limit, tail-end current control and combined PWM and thermistor control.

Two-phase motor pre-driver ICs

Part number	Supply voltage range V	Max. quiescent current mA	Min. speed setting	Output flag format	Package
ZXBM2001	4.5 - 18	3.25		RD/FG	MSOP10
ZXBM2002	4.5 - 18	3.25		RD	MSOP10
ZXBM2003	4.5 - 18	3.25		FG	MSOP10
ZXBM2004	4.7 - 18	7.5	✓	RD and FG	QSOP16

Single-phase motor pre-driver ICs

Part number	Supply voltage range V	Max. quiescent current mA	Th_{REF} output V	Min. speed setting	Current limit	Tail-end current control	Combined PWM and thermistor control	Output flag format	Package
ZXBM1004	4.7 - 18	8.5	3	✓				RD and FG	QSOP16
ZXBM1015	4.7 - 18	14.5	3	✓	✓			RD and FG	TSSOP20
ZXBM1016	6.7 - 18	20	5	✓	✓	✓		FG	TSSOP20
ZXBM1017	6.7 - 18	14.5	5	✓	✓			RD and FG	TSSOP20
ZXBM1018	7 - 18	15	5	✓	✓		✓	FG	TSSOP20

General features

- Supply voltage up to 18V
- Small outline surface mount packages
- Built-in Hall amplifier
- Built-in PWM oscillator
- Built-in lock detect function, rotational speed sensing and automatic recovery
- External driver transistors
- Optional speed control modes

Benefits

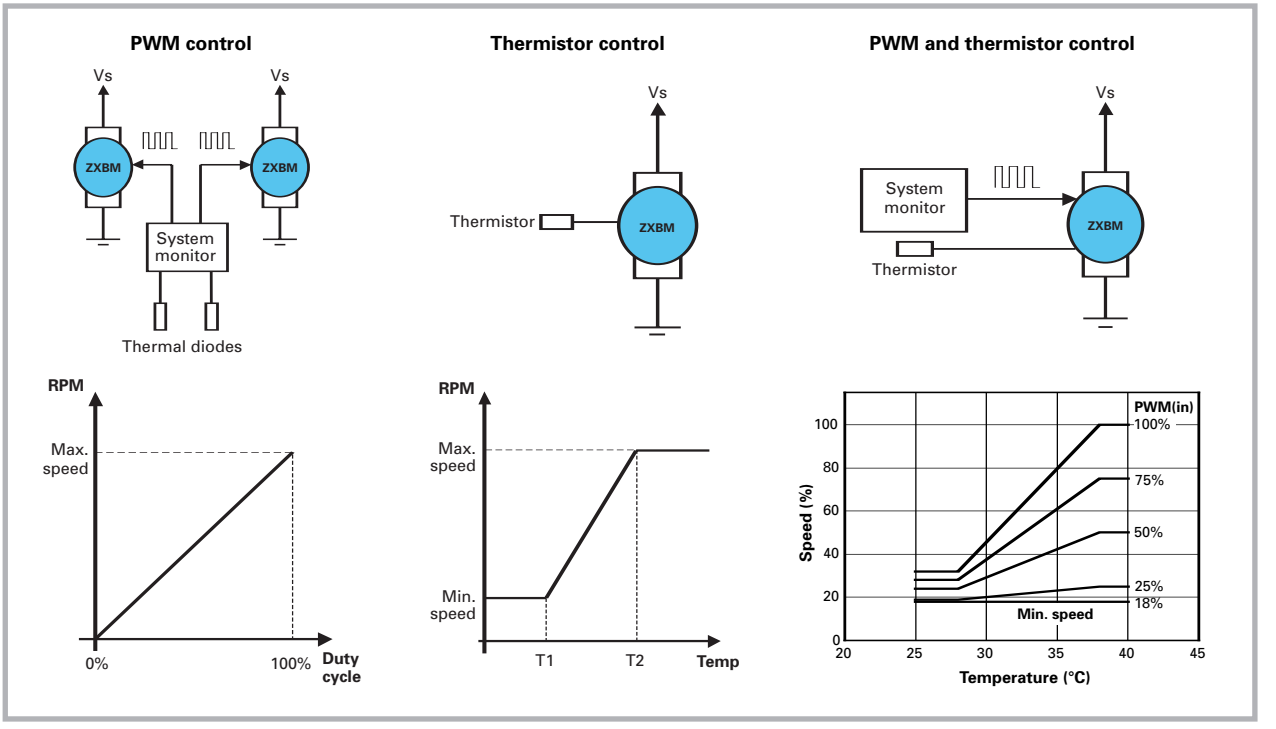
- Compact designs
- Suitable for 5V and 12V DC fans (24V and 48V with external pre-regulation)
- Suitable for full range of fans up to 100W
- Can be used for external PWM, thermal or voltage speed control

Applications

- Telecom mainframe fans and blowers
- Server and PC computer fans and blowers
- Industrial fans and blowers
- Automotive climate control
- Central heating blowers

Special features

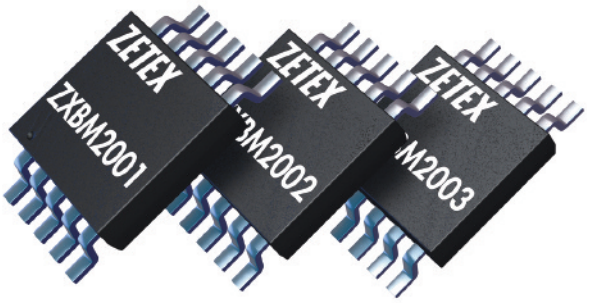
- Current limit:
  In multi-fan systems it is important to safeguard the power supply from current surges. A current monitoring circuit enables supply current on start-up and stall to be kept permanently within OEM specifications.
- Tail-end current control:
  The current spike occurring at the end of a motor commutation cycle has an adverse effect on circuit efficiency, cost and audible noise. Tail-end current control completely removes the spike.
- Combined PWM and thermistor control:
  For multi-fan systems the simultaneous use of PWM and thermistor speed control inputs help avoid hotspots and insure more even temperature gradients.



The ZXBM series suits a variety of thermal control schemes.

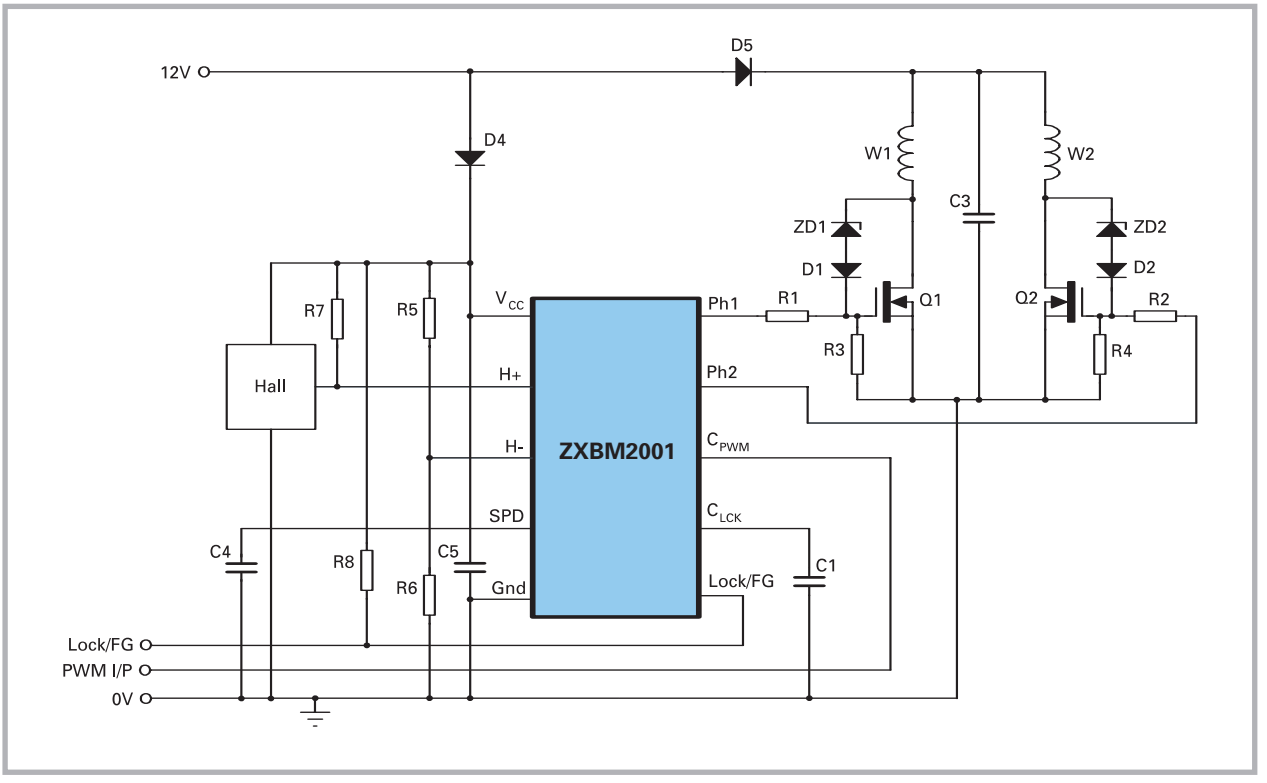
Basic variable speed control

The ZXBM2000 series of pre-driver ICs offers a complete variable speed control solution for two-phase DC brushless fan motors up to 100W. Speed control is implemented via the application of a variable voltage, an NTC thermistor or PWM input signal.



Features

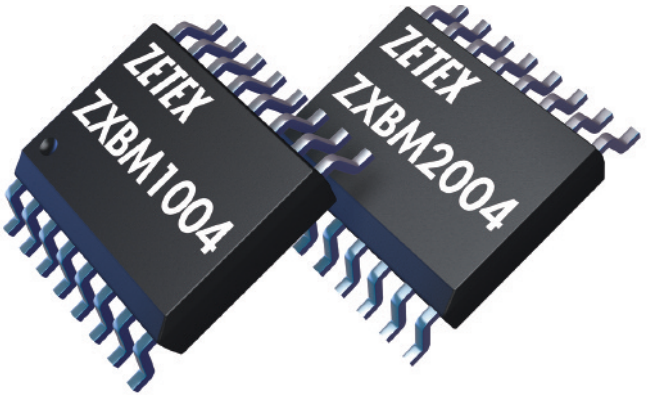
- Built-in speed sensing, locked rotor detect and auto restart
- Integral Hall amplifier
- Combined rotor lock (RD) and speed (FG) signal - ZXBM2001
- Rotor lock output - ZXBM2002
- Speed (FG) pulse output - ZXBM2003
- 4.5 to 18V supply voltage range (60V with external regulator)
- MSOP10 package



Variable speed control circuit for a two-phase motor using the ZXBM2001 and an external PWM input.

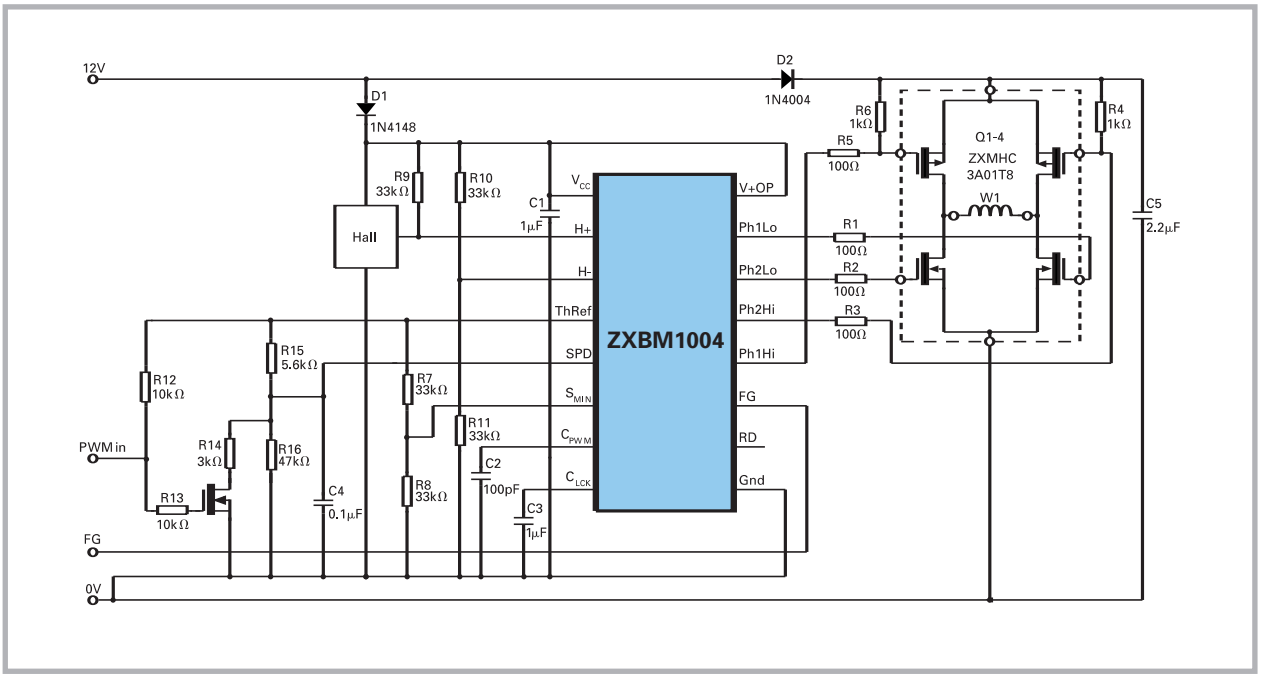
Variable speed control with minimum speed setting

To prevent a fan from running too slowly or stalling, the ZXBM1004 single-phase motor pre-driver and the ZXBM2004 two-phase motor pre-driver include a minimum speed setting. The ZXBM1004 has all the attributes of the ZXBM2004 plus additional outputs to drive an external H-bridge circuit. Variable speed control is achieved by driving the low-side of the H-bridge with a PWM signal, the duty cycle of which is controlled by a variable voltage, an NTC thermistor or PWM input.



Features

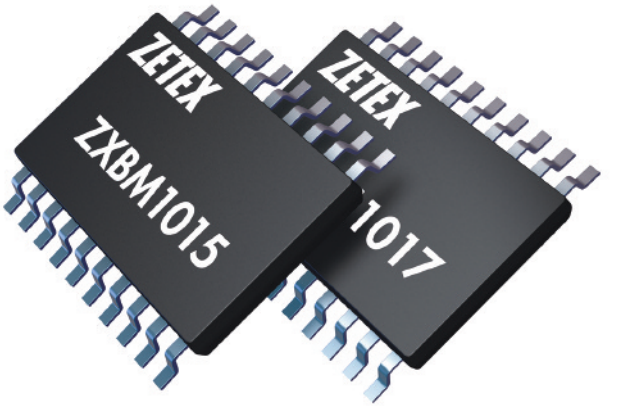
- Adjustable minimum speed setting
- Low noise
- Auto restart
- Integral Hall amplifier
- Locked rotor and speed output signals
- 4.7 to 18V supply voltage range (60V with external regulator)
- QSOP16 package



Variable speed control circuit for a single-phase motor using the ZXBM1004 and an external PWM input.

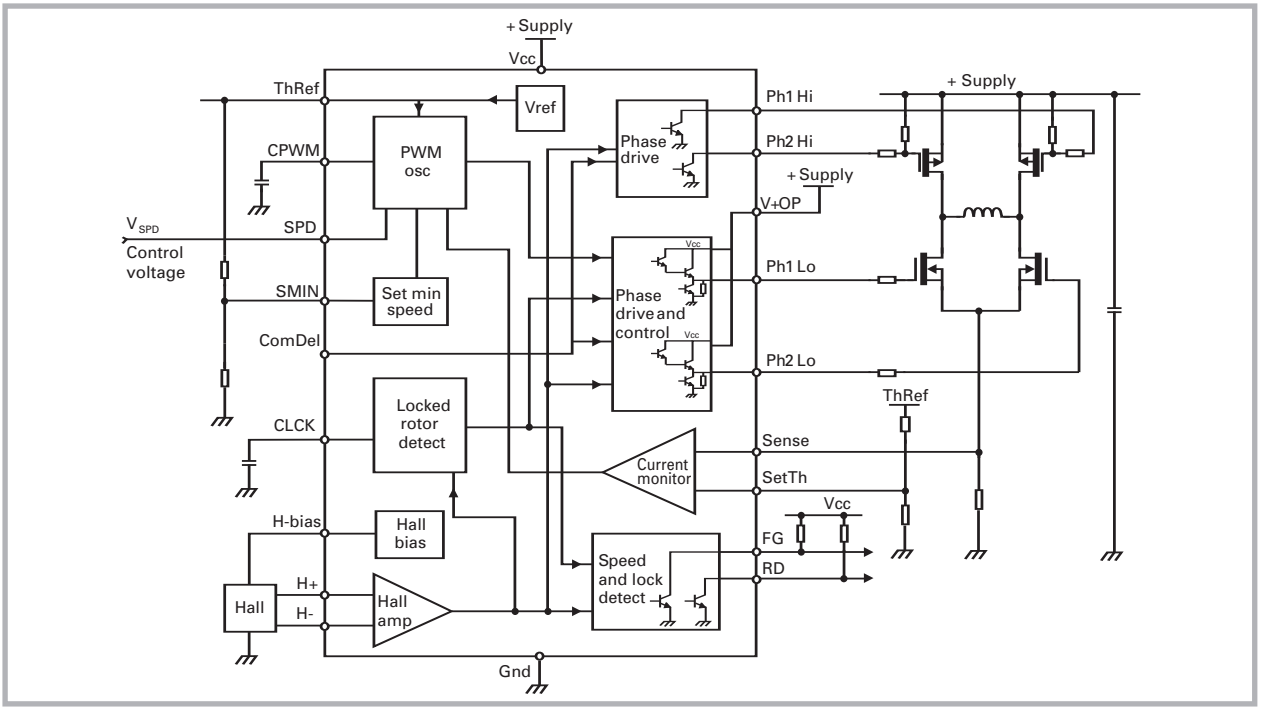
Variable speed control with minimum speed setting and current limit

In multi-fan systems it is important to safeguard the power supply from current surges. The ZXBM1015 and ZXBM1017 single-phase motor pre-drivers therefore include a current monitoring circuit that enables supply current on start-up and stall to be kept permanently within OEM specifications. The ICs also offer a configurable phase commutation delay, which allows OEMs to accurately meet the requirements of different motor sizes and so further optimize efficiency. The ZXBM1015 has a 3V reference which is suitable for desktop and server requirements where as the ZXBM1017 has a 5V reference for more specific OEM and 48V requirements. Speed control is via variable voltage, NTC thermistor or PWM input.



Features

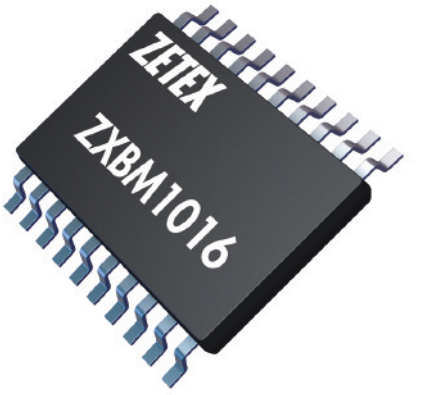
- Variable commutation delay
- Hall bias output
- Current limit
- Adjustable minimum speed setting
- Low noise
- Auto restart
- Integral Hall amplifier
- Locked rotor and speed output signals
- 4.7 to 18V supply voltage range (60V with external regulator)
- TSSOP20 package



Variable speed control circuit using an external voltage. The ZXBM1015 and ZXBM1017 include an integrated current limit.

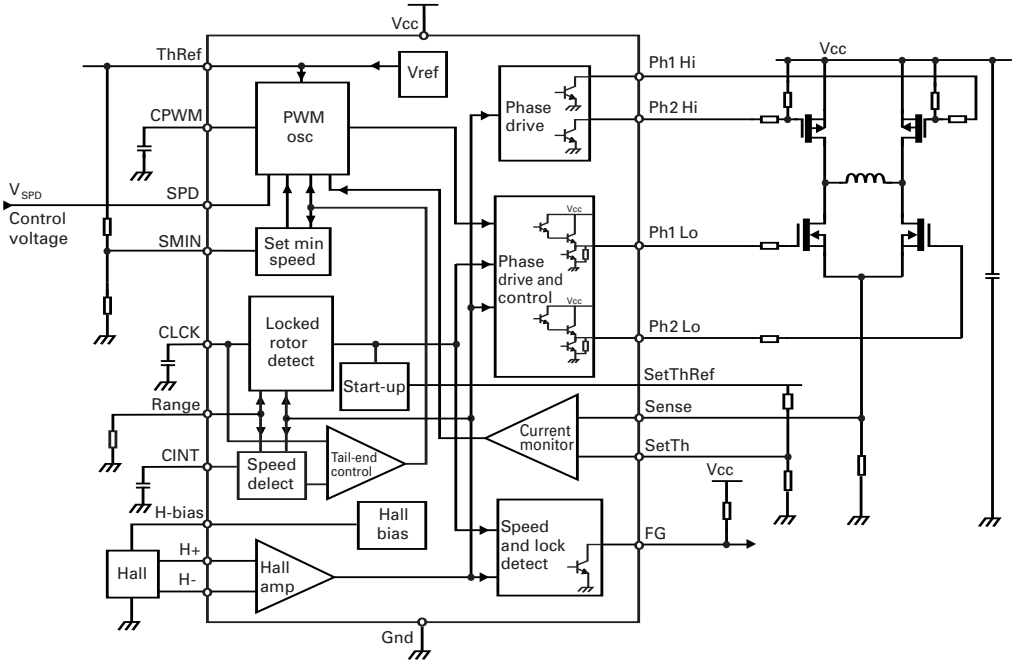
Variable speed control with minimum speed setting, current limit and tail-end current control

For single and two-phase brushless DC motors, the current spike occurring at the end of the commutation cycle has an adverse effect on circuit efficiency, cost and audible noise. The tail-end current control feature of the ZXBM1016 single-phase motor pre-driver completely removes the spike. Besides improving overall circuit efficiency, it enables the use of lower rated, lower cost power switching devices and bridge capacitors. The stress on motor core plates is also reduced therefore removing audible 'clicks'. Speed control is via variable voltage, NTC thermistor or PWM input.



Features

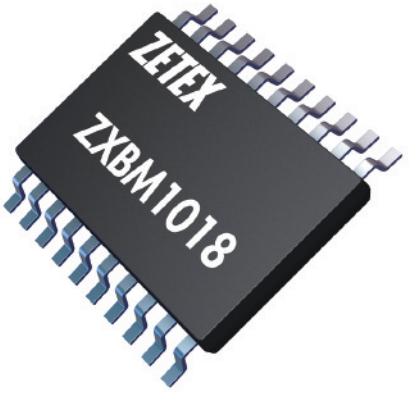
- High efficiency
- Current limit
- Adjustable minimum speed setting
- Low noise
- Auto restart
- Integral Hall amplifier
- Locked rotor and speed output signals
- 6.7 to 18V supply voltage range (60V with external regulator)
- TSSOP20 package



Variable speed control circuit using an external voltage. The ZXBM1016 includes integrated tail-end current control.

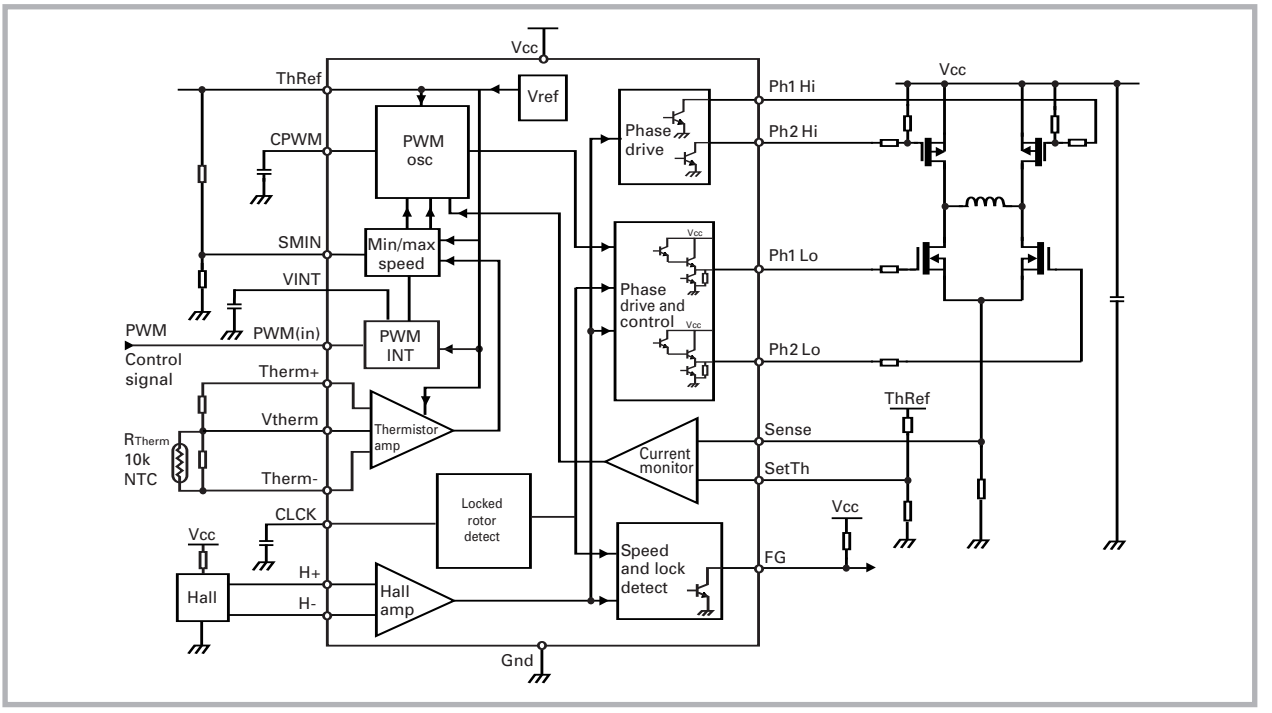
Variable speed control with minimum speed setting, current limit and combined PWM and thermistor inputs

Intel specifications for multi-fan systems require the simultaneous use of PWM and thermistor speed control inputs in order to avoid hotspots and to insure more even temperature gradients. The ZXBM1016 single-phase fan motor pre-driver therefore offers both inputs, which can either be used together or in isolation.



Features

- Current limit
- Adjustable minimum speed setting
- Low noise
- Auto restart
- Integral Hall and thermistor amplifiers
- Speed output signals
- 7 to 18V supply voltage range (60V with external regulator)
- TSSOP20 package



Variable speed control circuit using combined PWM and thermistor inputs.

Transistors for single-phase fan motor driving

To interface the ZXBM motor pre-driver ICs with single-phase motor windings, Zetex offers a wide range of suitable bipolar transistor and MOSFET packages:

MOSFET H-bridges

Part number	Polarity	BV_{DSS} V	I_D A	I_{DM} A	$R_{DS(on)}$ @ V_{GS} =10V mΩ	Package
ZXMHC10A07T8	2 x N + 2 x P	100 -100	1.4 -1.3	-	-	SM-8
ZXMHC3A01T8	2 x N + 2 x P	30 -30	3.1 -2.3	14.5 -10.8	120 210	SM-8
ZXMHC6A07T8	2 x N + 2 x P	60 -60	1.8 -1.5	8.7 -7.5	300 425	SM-8

N and P-channel MOSFETs

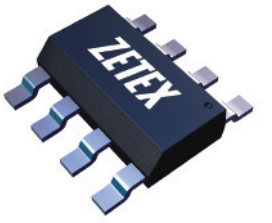
Part number	Polarity	BV_{DSS} V	I_D A	I_{DM} A	$R_{DS(on)}$ @ V_{GS} =10V mΩ	Package
ZXMC3A16DN8	N + P	30 -30	6.4 -5.4	-30 -25	35 48	SO8
ZXMC4559DN8	N + P	60 -60	4.7 -3.9	22 -18	55 105	SO8

Low-side N-channel MOSFET switches

Part number	Polarity	BV_{DSS} V	I_D A	I_{DM} A	$R_{DS(on)}$ @ V_{GS} =10V mΩ	Package
ZXMN10A09K	N	100	7.7	27	85	DPAK
ZXMN3A04K	N	30	18.4	66	20	DPAK
ZXMN6A09K	N	60	11.2	40	45	DPAK

High-side PNP bipolar switches

Part number	Polarity	V_{CEO} V	I_C A	I_{CM} A	$V_{CE(sat)}$ @ I_C =2A mV	Package
ZXT790AK	PNP	-40	-3	-6	-450	DPAK
ZXT951K	PNP	-60	-6	-15	-165	DPAK
ZXT953K	PNP	-100	-5	-10	-175	DPAK



Transistors for two-phase fan motor driving

To interface the ZXBM motor pre-driver ICs with two-phase motor windings, Zetex offers a wide range of suitable bipolar transistor and MOSFET packages:

NPN bipolar transistors

Part number	Polarity	V_{CEO} V	I_C A	$V_{CE(sat)}$ Max mV	$V_{CE(sat)}$ @ I_C A	$V_{CE(sat)}$ @ I_B mA	Package
FCX1053A	NPN	75	3	200 440	1 4.5	10 200	SOT89
FCX493	NPN	100	1	300	0.5	50	SOT89
FCX619	NPN	50	3	25 320	0.1 2.75	10 100	SOT89
FMMT493A	NPN	60	1	500	1	100	SOT23
FMMT619	NPN	50	2	20 220	0.1 2	10 50	SOT23
FMMT624	NPN	125	1	220 250	0.5 1	10 50	SOT23
FZT855	NPN	150	5	65 355	0.5 5	50 500	SOT223
ZXTN2010G	NPN	60	6	70 260	1 6	50 300	SOT223
ZXTN2011G	NPN	100	6	65 220	1 5	100 500	SOT223

60V N-channel MOSFETs

Part number	Polarity	BV_{DSS} V	I_D	$R_{DS(on)}$ @ V_{GS} =10V Ω	Package
ZXMN6A07Z	N	60	2.2	0.3	SOT89
ZXMN6A09K	N	60	11.2	0.045	DPAK
ZXMN6A11Z	N	60	3.2	0.14	SOT89
ZXMN6A25DN8	2 x N	60	4.7	0.055	SO8

100V N-channel MOSFETs

Part number	Polarity	BV_{DSS} V	I_D	$R_{DS(on)}$ @ V_{GS} =10V Ω	Package
ZXMN10A07Z	N	100	1.4	0.7	SOT89
ZXMN10A08DN8	2xN	100	2.1	0.25	SO8
ZXMN10A09K	N	100	7.7	0.085	DPAK
ZXMN10A11G	N	100	2.4	0.35	SOT223

Application notes

The following application notes for the ZXBM1004 and ZXBM2004 can be found at www.zetex.com/motorappsnotes

AN41 - Fan motor speed control using a thermistor input

AN42 - Fan motor speed control using PWM input

AN43 - Interfacing to the motor windings

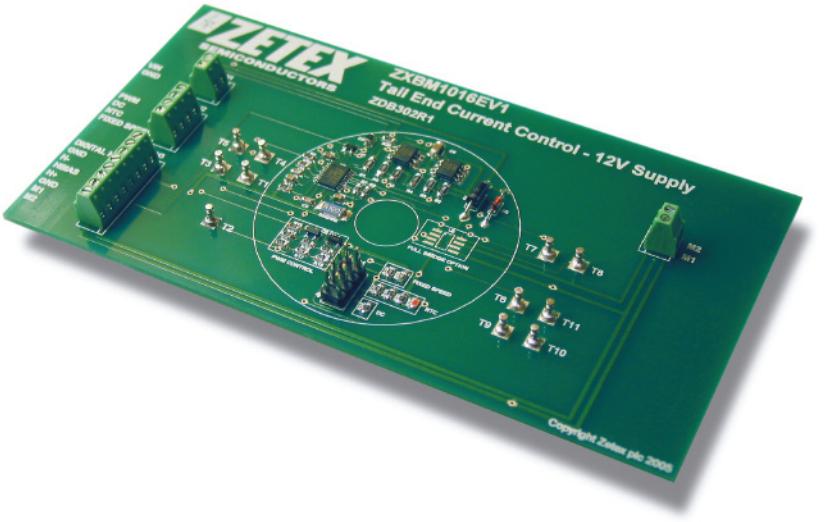
For further motor control application information visit www.zetex.com/motorapplications

Demonstration boards

Subject to availability and qualification procedures, demonstration boards can be made available to customers for many of the ZXBM series motor pre-driver ICs. Boards can also be modified or designed for specific customer applications.

To request a demonstration board contact your local Zetex office:

asia.sales@zetex.com
europe.sales@zetex.com
usa.sales@zetex.com



ZETEX
SEMICONDUCTORS

About Zetex

Zetex Semiconductors designs and manufactures high performance semiconductor solutions for analog signal processing and the management of power in automotive, communications, consumer and industrial electronics.

Meeting the demand for greater power economy, precision and speed in analog circuit design, the broad Zetex product range comprises application specific linear ICs and discrete semiconductor devices in multiple package configurations.

As a specialist in analog technology, Zetex offers a diverse series of ICs for motor control, lighting and DC-DC conversion as well as audio, video and linear applications. Its discrete component range features trench MOSFETs, IntelliFET™ smart MOSFETs and bipolar transistors.

Headquartered near Manchester in the UK, Zetex Semiconductors has manufacturing and sales operations in Asia, Europe and the USA and is supported by distributors in more than 45 countries.

For more information about Zetex, please visit
www.zetex.com
www.zetex.cn

Zetex Semiconductors is committed to protecting the environment and compliance with all relevant national and international legislation. Zetex products are fully compliant with the European Union's RoHS directive (2002/95/EC). For further information visit www.zetex.com/leadfree

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