ACM6262-Q1 36V, 2.5A phase current, Single-Phase Brushless Motor Driver

1. Features

- **Input Voltage Range: 3V to 36V**
- **Supply voltage up to 50V tolerance**, support automotive load dump operation
- **Continuous Motor phase current up to 2.5A**
- **Ultra-Low EMI option**
  - PWM edge rate control
  - Spread spectrum
- **Soft Switching**
  - Adjustable square drive
  - Quasi-sine drive
  - Sine drive
- **Speed Loop** or **Voltage Loop** or **Power loop** or **Current Loop,** Curve programmable (linear, staircase)
- **Direction and Brake** with pin control
- Hall Lead/Lag time adjustable
- Internal or External Hall Control
- Built-in 5V LDO
- FG/RD multiple option
- Speed Command via PWM input or Analog Voltage Control
- Parameter programmable, >500 times
- 16 levels current limit (PWM cycle by cycle current limit), 0.078A ~ 2.5A range, programmable
- Protection
  - Over Current Protection
  - Lock Detection
  - UVLO/OVLO Protection
  - Over Temperature Protection

2. Applications

- Automotive Fan driver
- Pump driver

3. General Description

The ACM6262-Q1 device is designed for single phase motor driver that is composed of H-bridge power MOS.

It is suitable for variable speed curve applications, especially for cooler DC fan or pump that needs silent drivers.

ACM6262-Q1 integrates voltage or PWM speed control, adjustable speed curve, soft start, soft switch, lock protection, auto restart.

ACM6262-Q1 supports Speed loop or Voltage loop or Power loop or Current loop.

4. Device Information

Part number	Package	Body size
ACM6262-Q1	TSSOP (16)	6.4 mm × 5 mm

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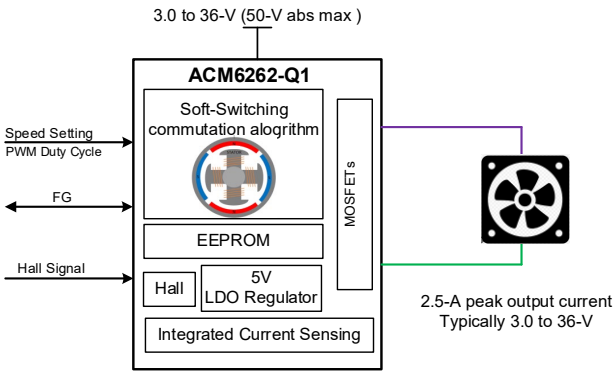


Simplified Schematic

Version History

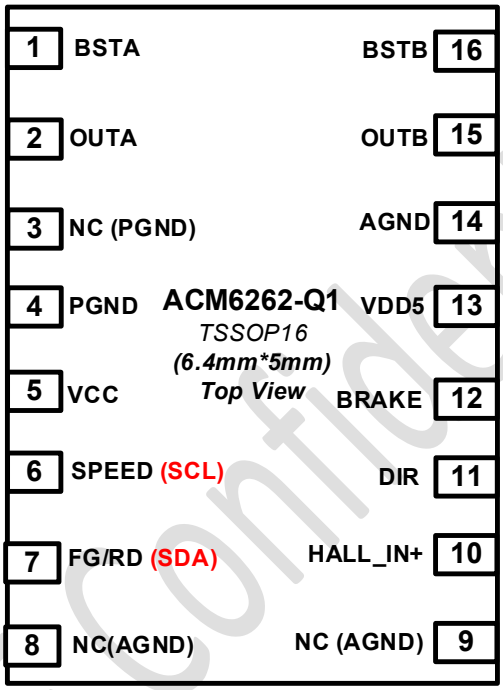
2025/01/09： update the pinout

2025/03/28: version 1.0, add the Hall position information X=1110μm, Y=-340μm

2025/06/07： version 1.1, update the Hall position information X=1107μm,Y=-140μm

5. Pin Configuration and Function Descriptions

5.1 TSSOP16 version



Pin No.	Name	Type	Description
1	BSTA	Power	Bootstrap for output A, connect to 1uF X5R, or better ceramic cap to OUTA
2	OUTA	Output	Motor Output Terminal A.
3,8,9	NC	NC	Not connected. **Suggest connect to Ground.**
4	PGND	Ground	Power Ground.
5	VCC	Power	Supply Voltage Input.
6	SPEED	Input	Speed Setting. PWM Signal Input or Analog voltage Input
7	FG/RD	Output	Rotation Speed Output. This is an open drain output.
10	HALL_IN+	Input	Hall Input. Connect to Hall sensor output.
11	DIR	Input	Direction control. Low, forward; High reverse.
12	BRAKE	Input	Brake control. High, brake; Low, Normal.
13	VDD5	Power	5V Regulator Output.
14	AGND	Ground	Analog Ground.
15	OUTB	Output	Motor Output Termina B
16	BSTB	Power	Bootstrap for output B, connect to 1uF X5R, or better ceramic cap to OUTB
Thermal Pad	-	GND	Must be connected to ground.

6. Device Family Comparison

Device Name	VDD	Control Type	Control Loop	Sensor	Output Phase Current
ACM6252	3.3V-18V	Sinusoidal or Trapezoidal single-phase brushless motor driver	Voltage	Single Hall Control	1.2A
ACM6262-Q1	3V-36V	Sinusoidal or Trapezoidal single-phase brushless motor driver	Voltage or Speed or Power	Single Hall Control	2.5A

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7. Specifications

7.1 Absolute Maximum Ratings

Operating with ambient temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
Input voltage(2)	VCC	-0.3	50	V
	SPEED	-0.3	45	
	BRAKE, DIR	-0.3	7	
	GND	-0.3	0.3	
Output voltage	OUTA, OUTB	-1	50	V
	VDD5	-0.3	7	
	FG/RO	-0.3	45	
Maximum junction temperature range, T_{J_MAX}		-40	150	℃
T_{stg}	Storage temperature	-55	150	℃

（1） Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

（2） All voltage values are with respect to the network ground terminal (GND) unless otherwise noted.

7.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins(1)	+/- 6000	V
		Charged-device model (CDM),per JEDEC specification JESD22-C101, all pins(2)	+/- 1500	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.3 Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
Supply Voltage	VCC	3	12	36	V
T_A	Ambient Operating Temperature	-40		125	℃

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7.4 Electrical Characteristics

Over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SUPPLY CURRENT						
I_{VCC}	Operating Current	T_A=25˚C; SPEED = 0.4 V; $V_{(VCC)}$=12V;		5		mA
	Shutdown Current	T_A=25˚C; SPEED = 0 V; $V_{(VCC)}$=12V;		10		μA
OVLO, Over Voltage protection threshold						
OVLO_R	V_{CC} Under Voltage Protection Threshold 0	Rise Threshold, T_A = 25˚C		17.38		V
OVLO_F		Fall Threshold, T_A = 25˚C		16.28		
OVLO_R	V_{CC} Under Voltage Protection Threshold 1	Rise Threshold, T_A = 25˚C		18.78		
OVLO_F		Fall Threshold, T_A = 25˚C		17.80		
OVLO_R	V_{CC} Under Voltage Protection Threshold 2	Rise Threshold, T_A = 25˚C		30.18		
OVLO_F		Fall Threshold, T_A = 25˚C		28.80		
OVLO_R	V_{CC} Under Voltage Protection Threshold 3	Rise Threshold, T_A = 25˚C		32.58		
OVLO_F		Fall Threshold, T_A = 25˚C		31.11		
OVLO_R	V_{CC} Under Voltage Protection Threshold 4	Rise Threshold, T_A = 25˚C		34.58		
OVLO_F		Fall Threshold, T_A = 25˚C		33.02		
OVLO_R	V_{CC} Under Voltage Protection Threshold 5	Rise Threshold, T_A = 25˚C		35.76		
OVLO_F		Fall Threshold, T_A = 25˚C		34.12		
OVLO_R	V_{CC} Under Voltage Protection Threshold 6	Rise Threshold, T_A = 25˚C		39.46		
OVLO_F		Fall Threshold, T_A = 25˚C		37.55		
OVLO_R	V_{CC} Under Voltage Protection Threshold 7	Rise Threshold, T_A = 25˚C		42.40		
OVLO_F		Fall Threshold, T_A = 25˚C		40.28		
UVLO, Under voltage protection threshold						
UVLO_R	V_{CC} Under Voltage Protection Threshold 0	Rise Threshold, T_A = 25˚C		2.88		V
UVLO_F		Fall Threshold, T_A = 25˚C		2.72		
UVLO_R	V_{CC} Under Voltage Protection Threshold 1	Rise Threshold, T_A = 25˚C		6.59		
UVLO_F		Fall Threshold, T_A = 25˚C		6.25		
UVLO_R	V_{CC} Under Voltage Protection Threshold 2	Rise Threshold, T_A = 25˚C		8.21		
UVLO_F		Fall Threshold, T_A = 25˚C		7.77		
UVLO_R	V_{CC} Under Voltage Protection Threshold 3	Rise Threshold, T_A = 25˚C		8.90		
UVLO_F		Fall Threshold, T_A = 25˚C		8.41		
UVLO_R	V_{CC} Under Voltage Protection Threshold 4	Rise Threshold, T_A = 25˚C		8.98		
UVLO_F		Fall Threshold, T_A = 25˚C		8.49		
UVLO_R	V_{CC} Under Voltage Protection Threshold 5	Rise Threshold, T_A = 25˚C		9.83		
UVLO_F		Fall Threshold, T_A = 25˚C		9.28		
UVLO_R	V_{CC} Under Voltage Protection Threshold 6	Rise Threshold, T_A = 25˚C		14.88		
UVLO_F		Fall Threshold, T_A = 25˚C		14.01		
UVLO_R	V_{CC} Under Voltage Protection Threshold 7	Rise Threshold, T_A = 25˚C		17.76		
UVLO_F		Fall Threshold, T_A = 25˚C		16.65		
LDO OUTPUT						
VDD5	Output Voltage	T_A = -40˚C~125˚C	4.8	5	5.2	V
	Output current limit		20	25	35	mA
INTEGRATED MOSFET						
$R_{DS(ON)}$	Series resistance (High side + Low side)	T_A=25˚C; V_{VCC}=12V;		330		mΩ
		T_A=85˚C; V_{VCC}=12V;		420		
SPEED – PWM DIGITAL MODE						
V_{DIG_IH}	PWM input high voltage		2.3			V
V_{DIG_IL}	PWM input low voltage				1.1	V
f_{PWM}	PWM input frequency		0.04		100	kHz
LOCK DETECTION RELEASE TIME						
T_{LOCK_OFF}	Lock release time	Register adjustable	0.2	5	20.8	s

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PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
T_{LOCK_ENTER}	Lock enter time	Register adjustable		0.5 or 1 or 1.5		s
OVERCURRENT PROTECTION						
I_{OC_LIMIT}	Over-current protection threshold	T_A = 25°C; PHASE	2.81	3.125	3.4	A
OUTPUT SWITCHING FREQUENCY						
F_{SW}	Output Switching Frequency	Register adjustable, 25kHz, 50kHz adjustable		25	50	kHz
LOCK DETECTION CURRENT THRESHOLD						
I_{LIMIT}	current limit threshold	Register adjustable	0.078		2.5	A
INTERNAL HALL SENSOR						
Positive Magnetic Threshold, B_{OP}		T_J = 150°C	0	1.5	3	mT
Negative Magnetic Threshold, B_{RP}		T_J = 150°C	-3	-1.5	0	mT
THERMAL SHUTDOWN						
T_{SDN}	Shutdown temperature threshold	Shutdown temperature Register adjustable		157		°C
T_{SDN_HYS}		Hysteresis		20		°C

8. *Typical Characteristics*

9. *Detailed Description*

9.1 Overview

The ACM6262-Q1 is an All-In-One single-coil Brushless-DC fan or pump driver, designed according to the ACME automotive Design-For-Test (DFT) IC design flow and automotive package design flow. ACM6262-Q1 integrates Logic Control, Hall sensor, Gate drivers, MOSFETs and EEPROM together. ACM6262-Q1 supports Brake control, direction control, PWM or VSP speed control with flexible loop control mode (Voltage loop, Speed loop, Power loop or Current Loop).

9.2 Function Block Diagram

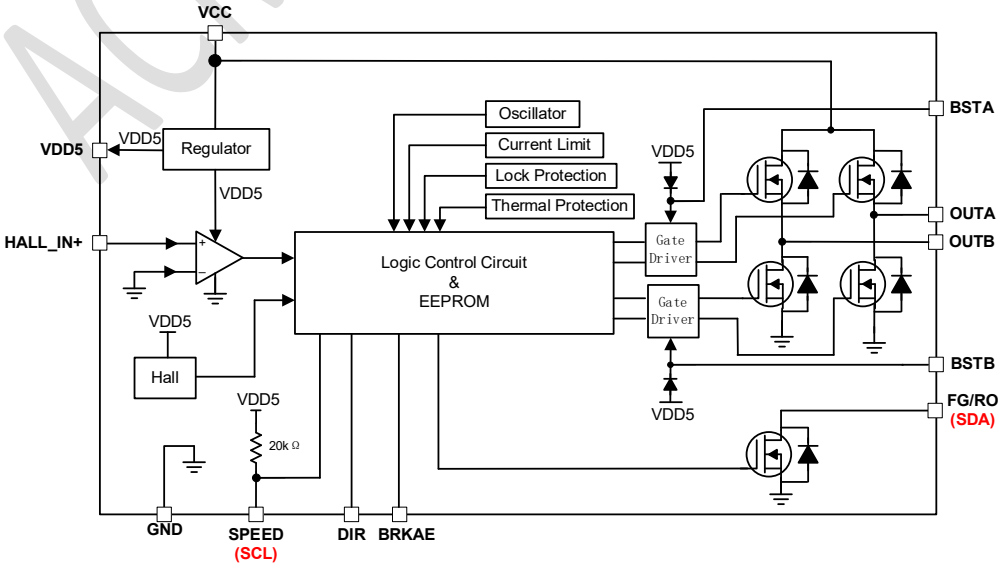

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Figure 1 Function Block Diagram

9.3 Feature Description

9.3.1 Regulators

The ACM6262-Q1 includes a 5V LDO. The 5V LDO is powered by VCC. 5V LDO is designed for internal circuits. But can also been used for voltage divider for the SPEED, HALL_IN, FG/RD, DIR, BRAKE interface.

VDD5 capacitor must be connected to GND.

The 5V LDO output current capability is 25mA.

9.3.2 Protection Circuits

9.3.2.1 Thermal Shutdown

The ACM6262-Q1 has a built-in thermal shutdown function, which shuts down the device when junction temperature is more than 157℃ (default value) and recovers operating conditions when junction temperature falls to 137C. The threshold (110 °C, 124 °C, 140 °C and 157 °C) can be adjustable via register.

9.3.2.2 Under-voltage Protection

The ACM6262-Q1 has built-in UVLO function block. The hysteresis of UVLO threshold is 0.2V. The device is locked out when VCC is down to 2.634V and woke up at 2.83V. The Under Voltage threshold can be adjustable via register. 2.633V or 6.257V or 7.775V or 8.415V or 9.275V or 13.99V or 16.67V.

9.3.2.3 Over-voltage Protection

The ACM6262-Q1 has built-in OVLO function block. The hysteresis of OVLO threshold is 1V. If set the OVP threshold to 18.78V, the device is locked out when VCC is up to 18.78V and woke up at 17.8V.

The Over Voltage threshold can be adjustable via register. 17.38V or 18.78V or 30.18V or 32.58V or 34.58V or 35.76V or 39.46V or 42.40V.

9.3.2.4 Over-current Protection

The over-current protection function acts to protect the device if the current, as measured from the MOSFETs, exceeds the IOC-limit threshold (~3.2A). It protects the device from phase-to-phase short-circuit conditions; ACM6262-Q1 places the output drivers into a high-impedance state and maintains this condition until the over-current is no longer present.

9.3.2.5 Lock Detection (Hall Abnormal)

When the motor is blocked or stopped by an external force over the lock detection time (default detection time is

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0.5s), the lock protection is triggered, and the device stops driving the motor immediately. After the lock release time (register adjustable, 0.2s~25.8s), the ACM6262-Q1 resumes driving the motor again. If the lock condition is still present, it enters the next lock protection cycle until the lock condition is removed. With this lock protection, the motor and device does not get overheated or damaged due to the motor being locked.

9.3.3 Motor Speed Control

The ACM6262-Q1 offers 3 methods for indirectly controlling the seed of the motor by adjusting the output voltage amplitude. This can be accomplished by varying the supply voltage (VCC) or by controlling the Speed Command. The Speed Command can be controlled in one of 2 ways. The user can set the Speed Command on the SPEED pin by adjusting either the duty cycle of PWM input (SPEED pin configured for PWM mode) or the analog input voltage.

9.3.4 PWM Soft-switch Function

The ACM6262-Q1 built in PWM soft-switching output control circuit to improve the vibration and noise of the fan motor operation. At start-up operation, the ACM6262-Q1 drive the output driver by square wave to force the fan motor start to rotate. After several square wave outputs, the internal PWM soft-switch control circuit will be enabled to drive fan motor to improve vibration and noise. ACM6262 supports adjustable soft switch (both rise and fall edge can be adjustable separately, 5.6 ˚,11.2 ˚,16.9 ˚,22.5 ˚,28.1 ˚,33.8 ˚,39.4 ˚,45 ˚), Quasi-SINE or SINE.

9.3.5 PWM Soft-start and Soft-off Function

ACM6262-Q1 use soft-start function to avoid peak current at power-on and lock-restart moments.

Starting with configurable start duty cycle and ramp rate, the accelerate rate and the decelerate rate can be adjust separately.

Figure 2 shows an example: Set the **start duty cycle** to **50%**, and the Ramp rate is 0.5VCC/s.

In case the **Target Speed is 100%**, the output PWM duty cycle will start with 50%, and increase at an acceleration of 0.5VCC/s until the output duty cycle is 100%.

In case the **Target Speed is 80%**, the output PWM duty cycle will start with 50%, and increase at an acceleration of 0.5VCC/s until the output duty cycle is 80%.

In case the **Target Speed is 10%**, the output PWM duty cycle will start with 50%, and increase at an acceleration of 0.5VCC/s until 3 polarity changes been detected, then decrease at an acceleration of 0.25VCC/s until the output duty cycle is 10%.

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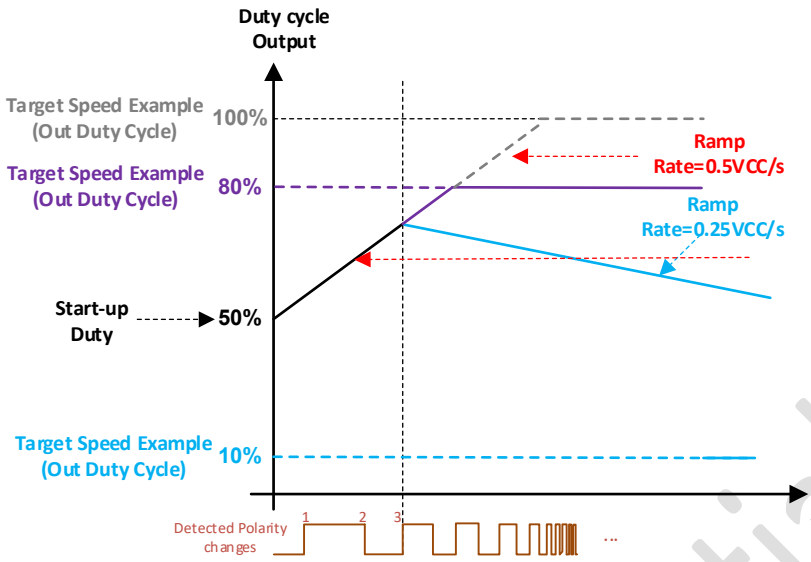

Figure 2 PWM Soft-start setting

The start duty cycle is 8 steps programmable. **Range = 3.125%-100%** (3.125%, 6.5%, 12.5%, 25%, 37.5%, 50%, 75%, 100%).

The accelerate ramp rate is 8 steps programmable. **Range = 0.125VCC/s – 1VCC/s**. (0.125VCC/s, 0.25VCC/s, 0.5VCC/s, 1VCC/s).

The decelerate ramp rate is 8 steps programmable. **Range = 0.125VCC/s – 1VCC/s**. (0.125VCC/s, 0.25VCC/s, 0.5VCC/s, 1VCC/s).

9.3.7 Cycle By Cycle current limit Function

ACM6262-Q1 supports Cycle by Cycle current limit (PWM duty cycle) to limit the phase current. The current threshold can be adjustable from 0.078A~2.5A. 16 steps. 0.078A per steps with range 1.25A; 0.156A per steps with range 2.5A. The range also can be adjustable via register.

9.3.8 Lead/Lag time

ACM6262-Q1 supports Lead/Lag time setting. Supports Forward and reverse spin Lead/Lag time set separately. The lead/lag time range is adjustable from -2500us~2500us.

9.4 Speed Profile

ACM6262-Q1 supports Voltage Loop (Output PWM duty remap with Input PWM duty) or Speed Loop or Current Loop or Power loop.

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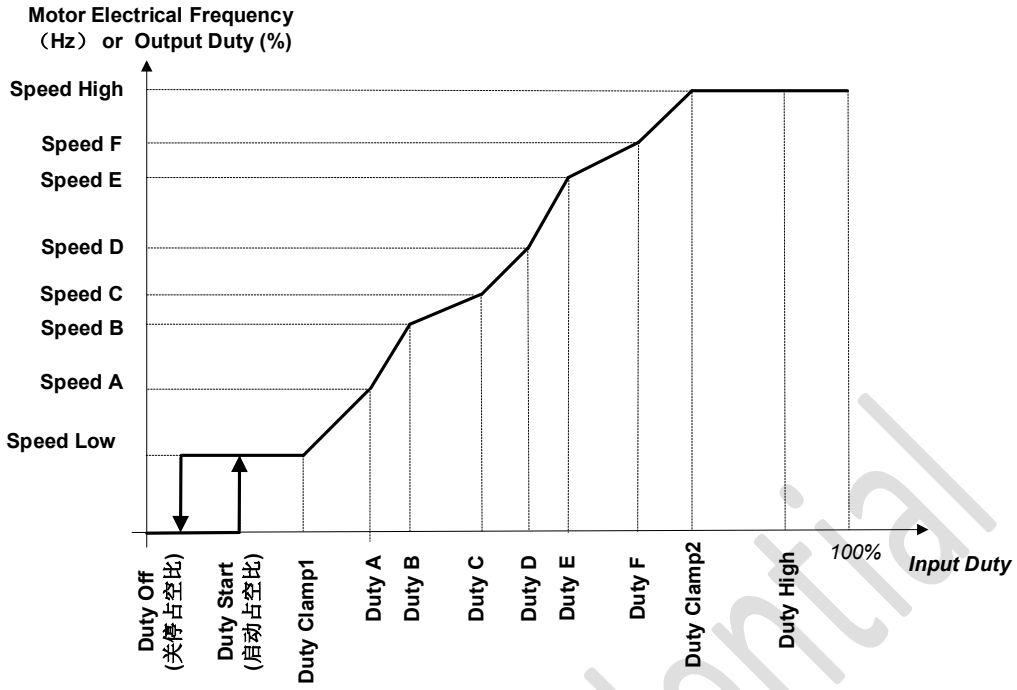

Figure 3 Linear curve example 1

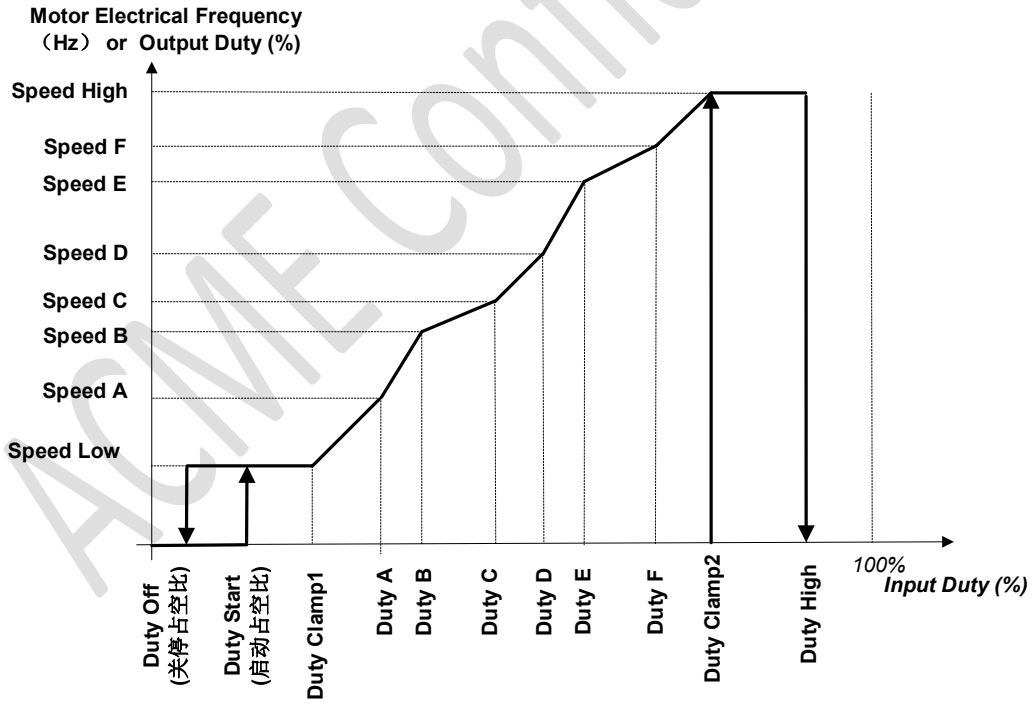

Figure 4 Linear curve example 2

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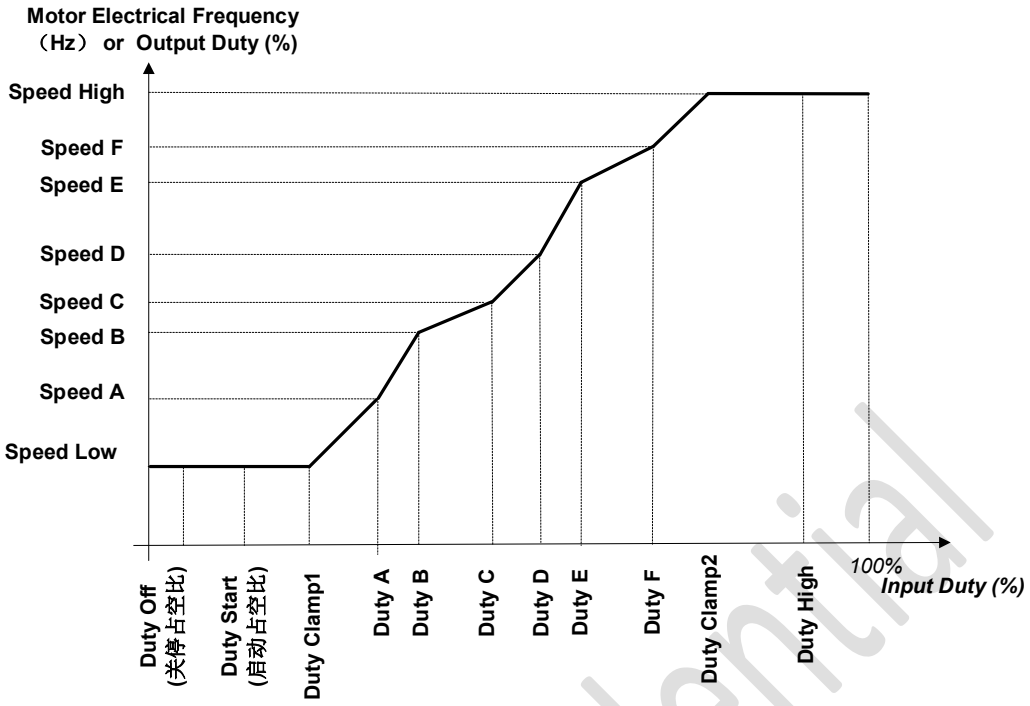

Figure 5 Linear curve example 3

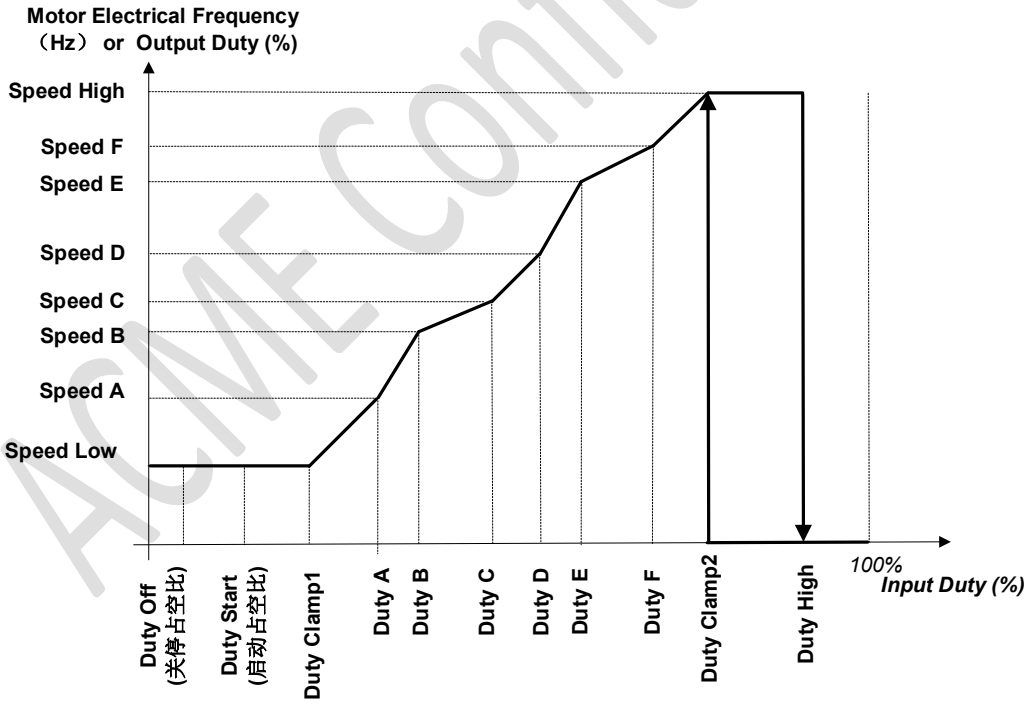

Figure 6 Linear curve example 4

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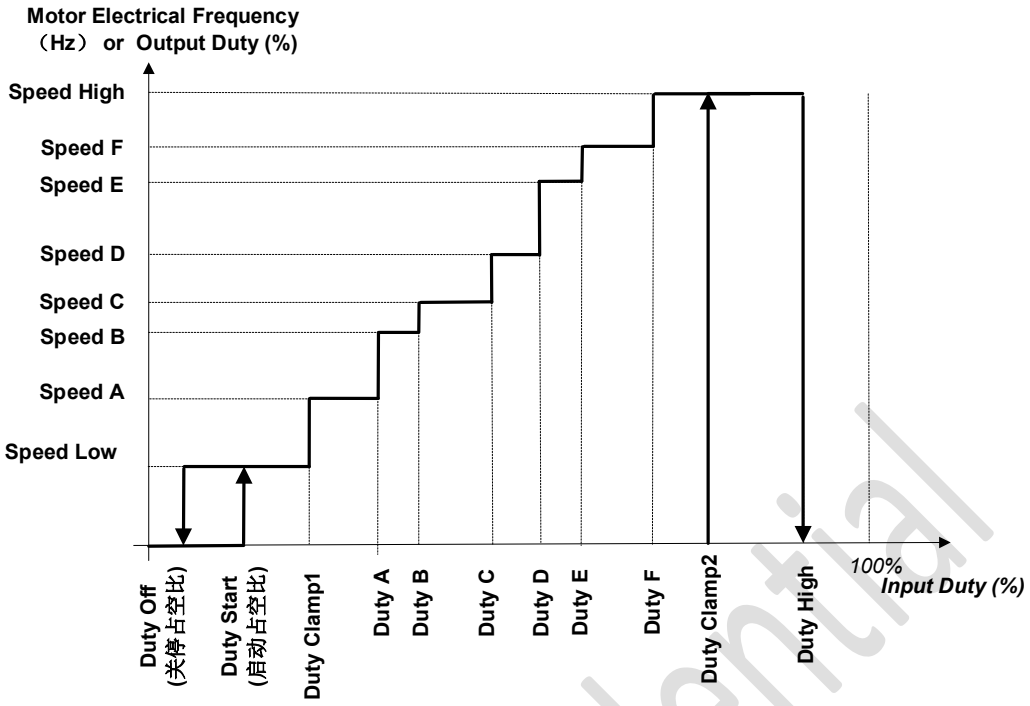

Figure 7 Stair-case curve example 1

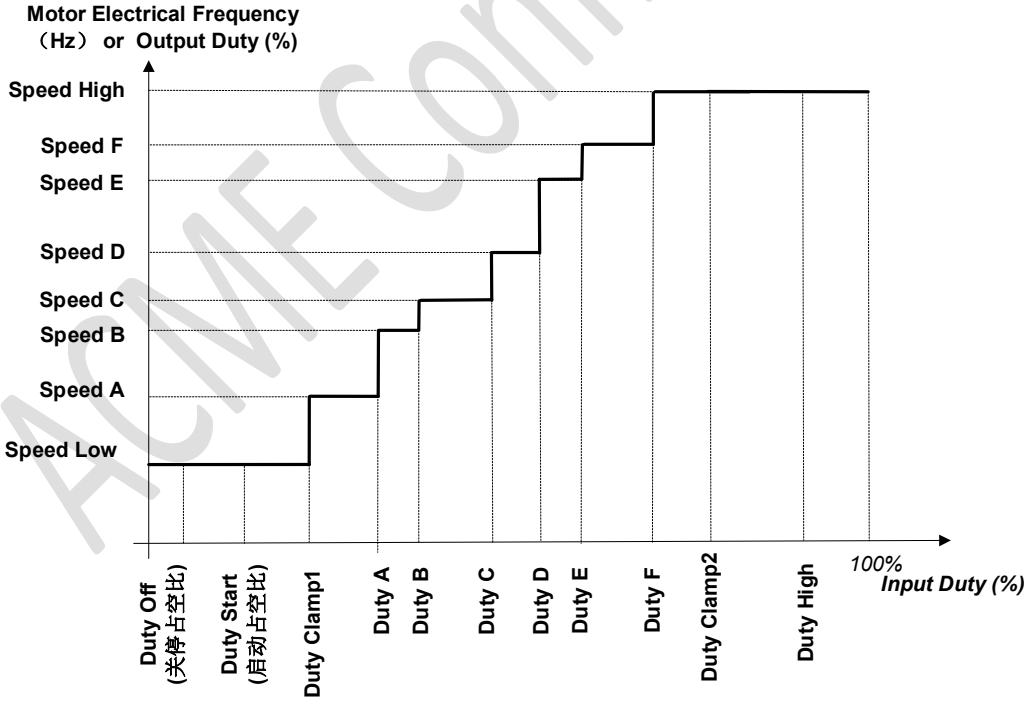

Figure 8 Stair-case curve example 2

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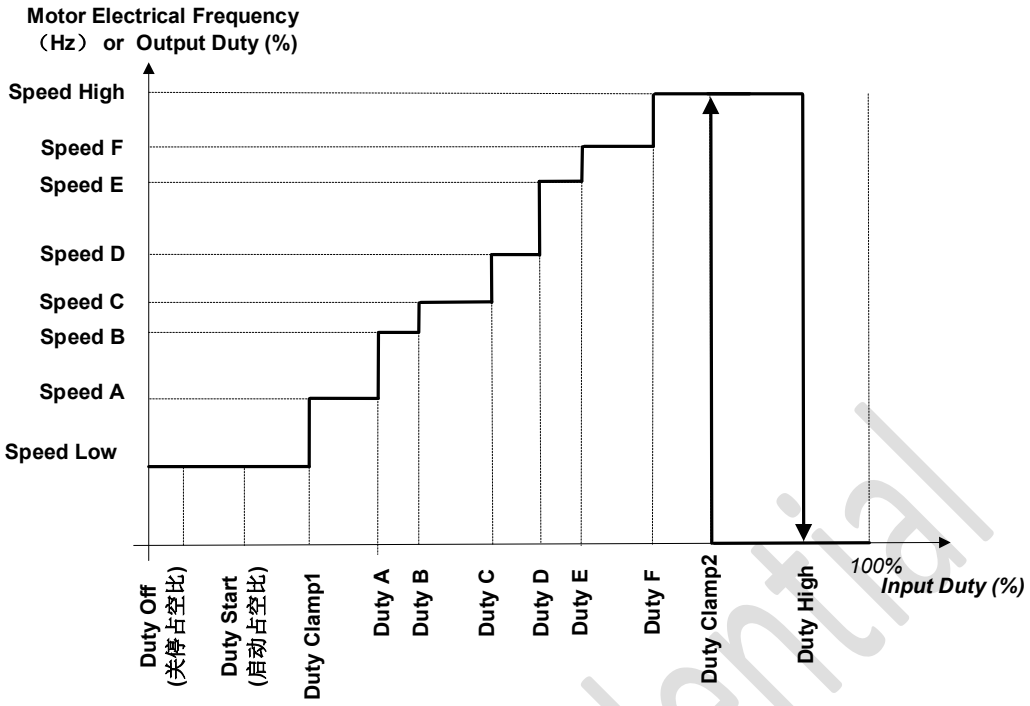

Figure 9 Stair-case curve example 3

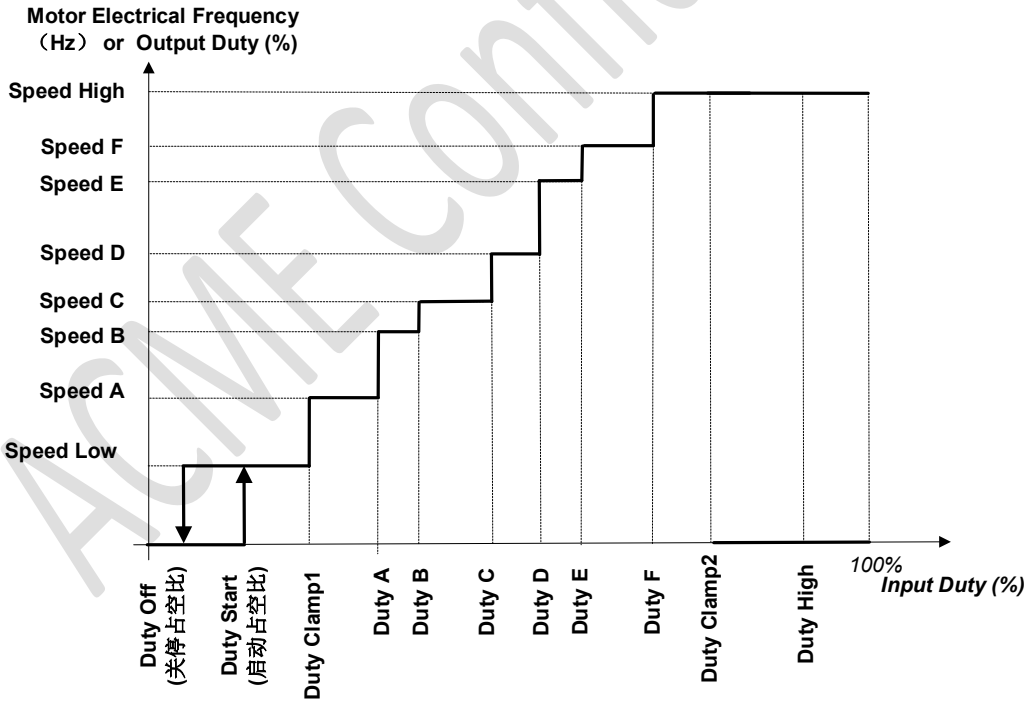

Figure 10 Stair-case curve example 4

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9.4.13 Application Schematic

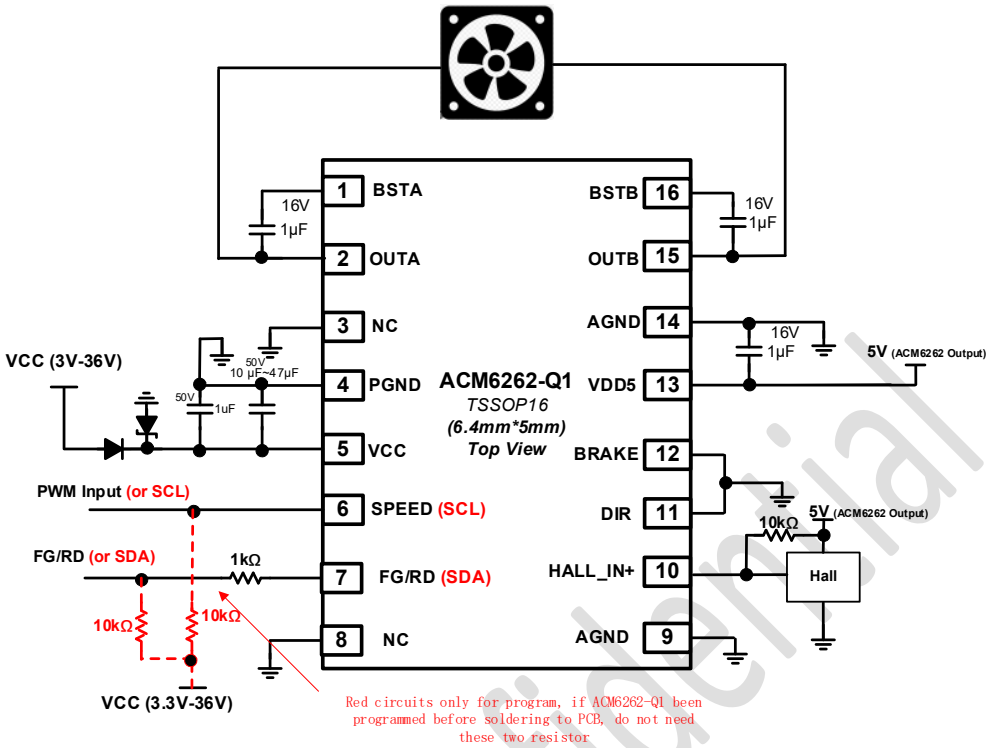

Figure 11 Application Schematic -External Hall Sensor

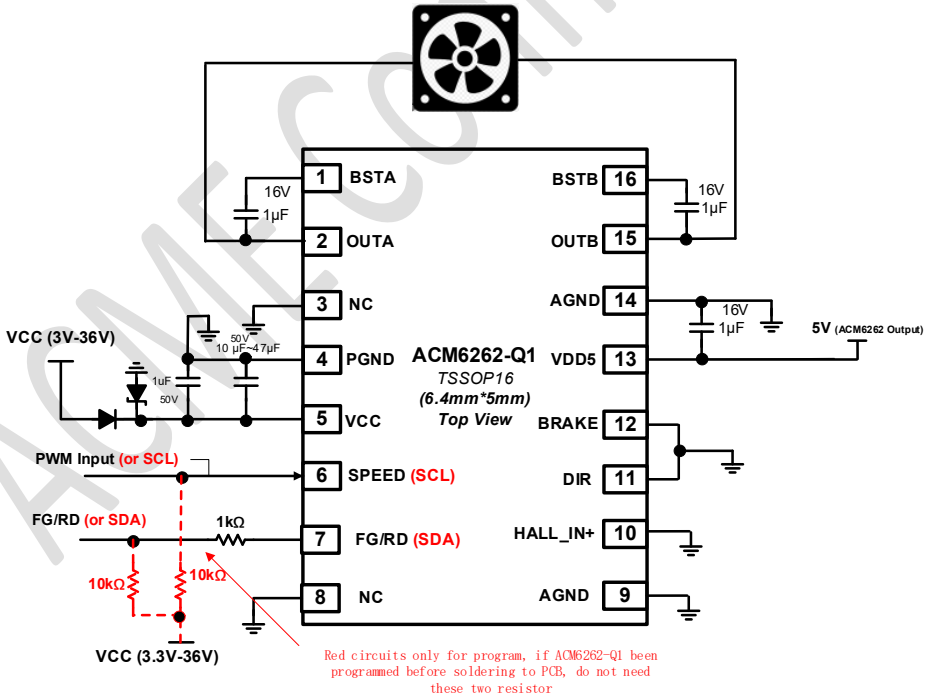

Figure 12 Application Schematic -Internal Hall Sensor

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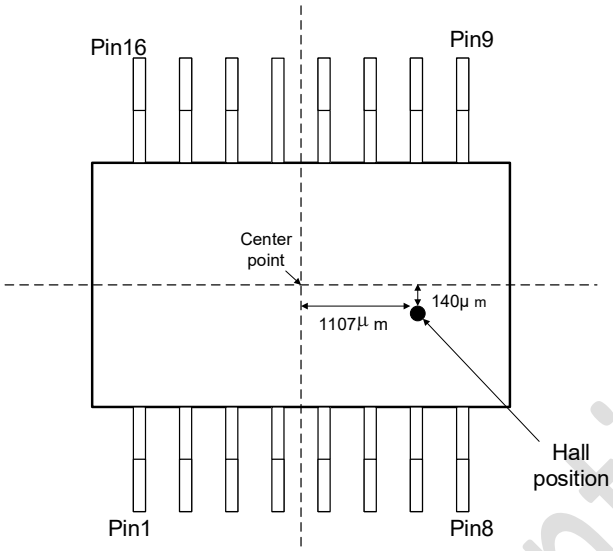
9.5 Internal Hall Position



10. Package Dimensions

Orderable Device	Package Type	MPQ	MOQ	Eco Plan	MSL Level	Device Marking
ACM6262-Q1	TSSOP16 Tape and Reel	3000	3000	RoHS Compliant Lead-Free Finish	MSL3	ACM6262-Q1

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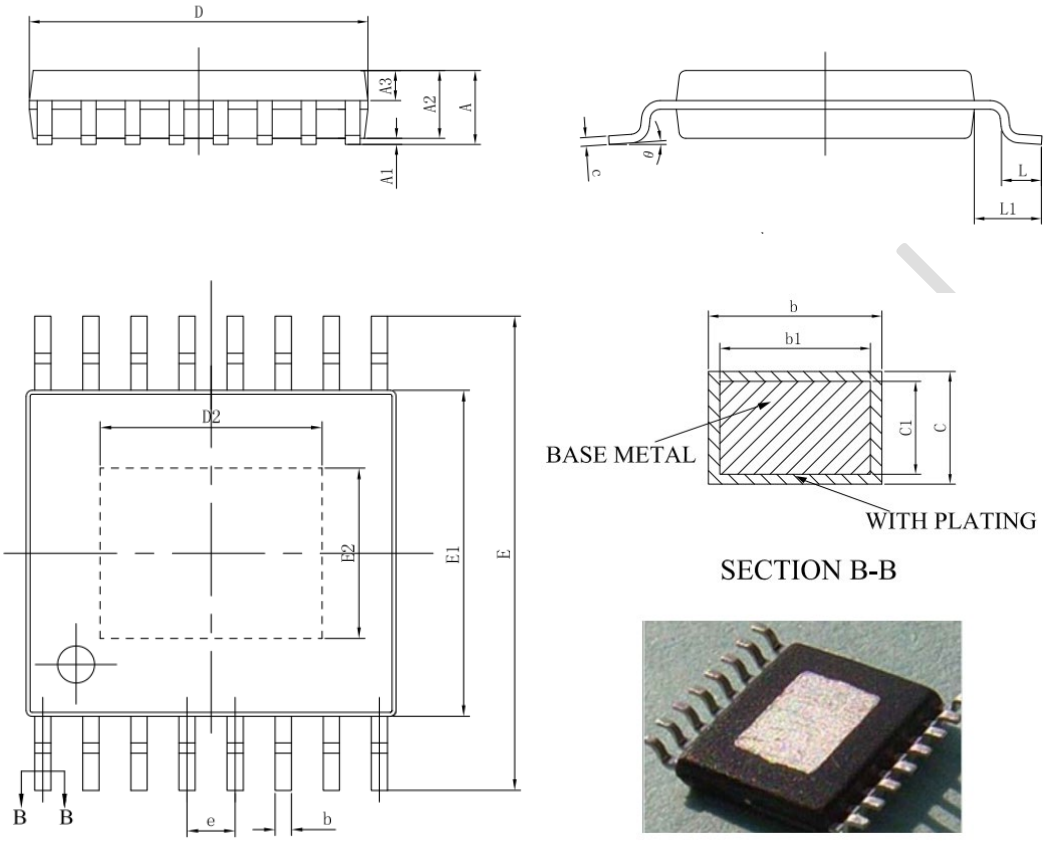
10.1 TSSOP16



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SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.00	—	0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	—	0.28
b1	0.19	0.22	0.25
c	0.13	—	0.17
c1	0.12	0.13	0.14
D	4.90	5.00	5.10
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65BSC		
L	0.45	—	0.75
L1	1.00BSC		
θ	0	—	8°

Size (mm) / L/F Size (mil)	D2	E2
91*118	2.80REF	2.10REF
118*118	2.80REF	2.80REF

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