说明

PT2505 是一个三相，使用霍尔传感器的正弦波驱动无刷直流马达控制芯片，并具有不同的保护机制。三相控制是基于正弦波驱动，以减少电机换相电磁噪音。芯片内建+5V 稳压器，结合外部的高压栅级驱动器以及六个 N 通道 MOSFETs，让 PT2505 能工作于高压马达的应用，PT2505 提供以刻录方式来改变内部参数设置以优化不同的电机和应用。PT2505 的包装为 SSOP24 及 SSOP28，其中 SSOP24 的包装，它的接脚安排相容于 ROHM BD62017AFS。

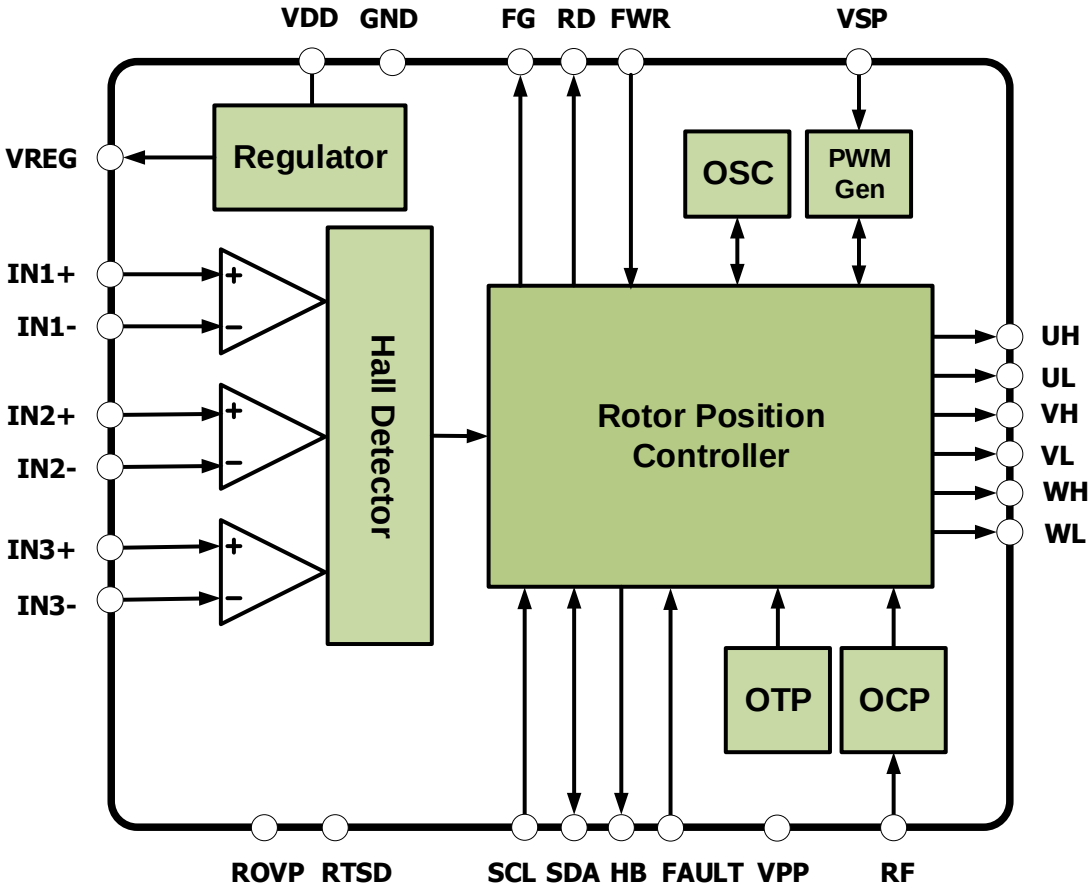
产品特性

- 霍尔传感器三相正弦控制无刷直流马达
- 过电流保护及过温度保护
- 欠电压保护及过电压保护
- 堵转保护及故障输入保护
- 正反转控制
- 直流, PWM, I2C 或频率输入速度控制
- FG 转速输出
- +5V 逻辑输出推动外部栅级驱动器
- 支持霍尔组件和霍尔传感器
- 利用 I2C 界面来做内部参数调整及 OTP 的读写

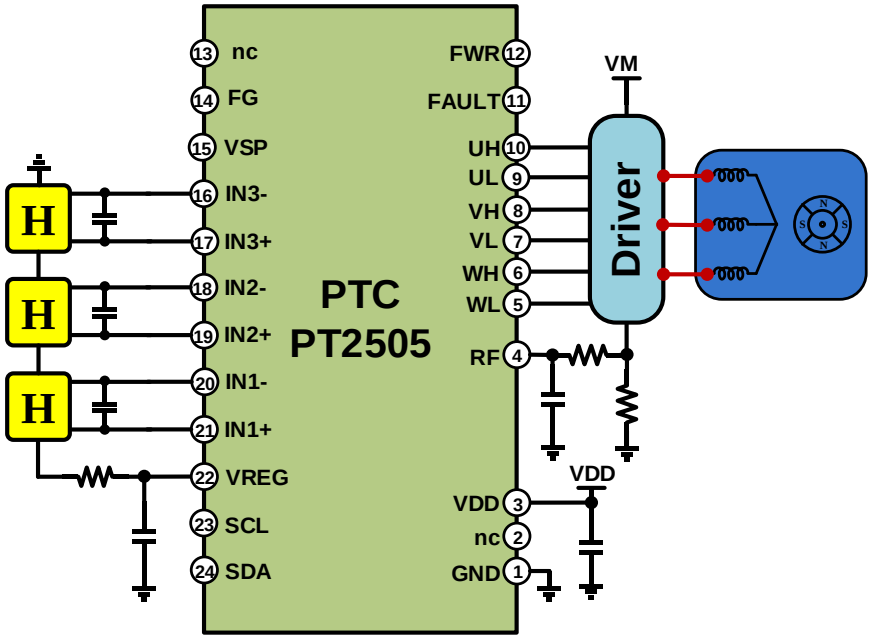
应用

- 三相控制无刷直流马达
- 风扇

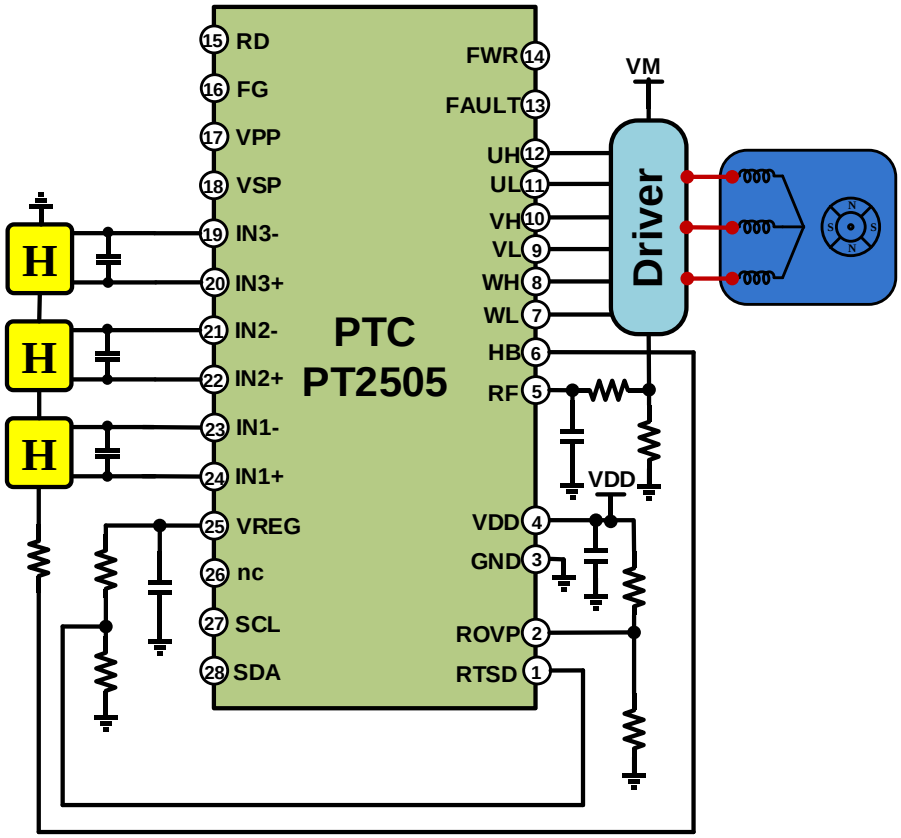
内部方块图



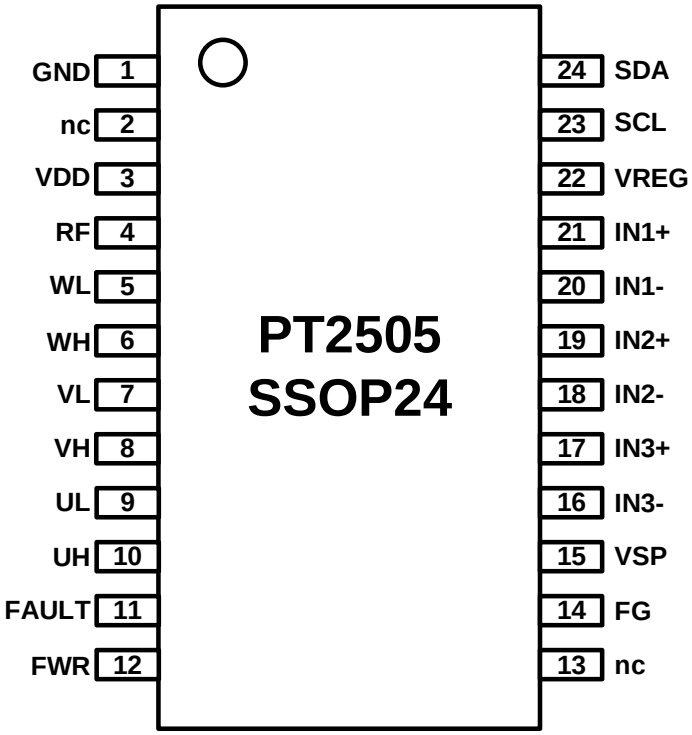
应用电路 – **SSOP24**

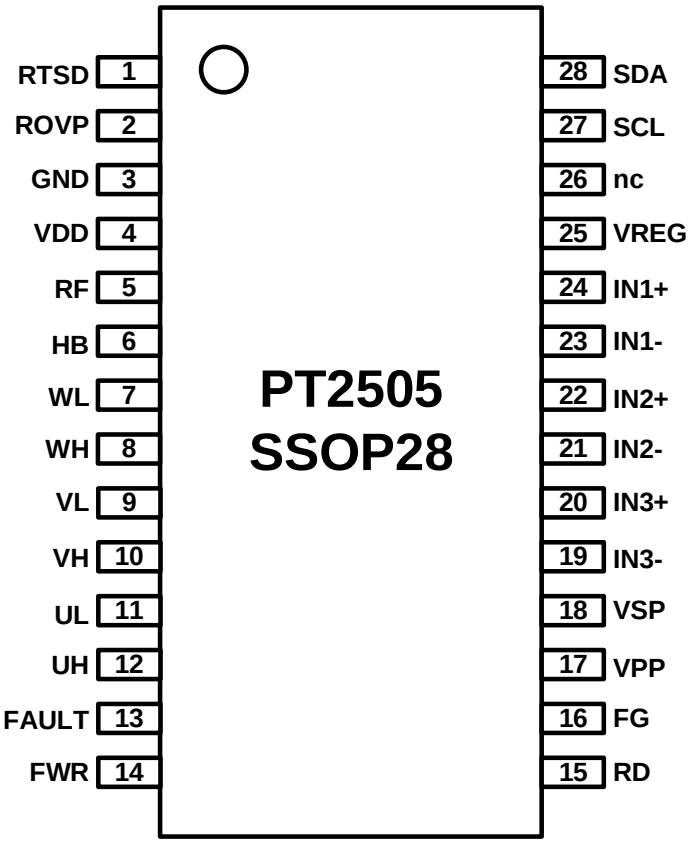


应用电路 – **SSOP28**



接脚安排


GND 1
nc 2
VDD 3
RF 4
WL 5
WH 6
VL 7
VH 8
UL 9
UH 10
FAULT 11
FWR 12
24 SDA
23 SCL
22 VREG
21 IN1+
20 IN1-
19 IN2+
18 IN2-
17 IN3+
16 IN3-
15 VSP
14 FG
13 nc
PT2505
SSOP24


RTSD 1
ROVP 2
GND 3
VDD 4
RF 5
HB 6
WL 7
WH 8
VL 9
VH 10
UL 11
UH 12
FAULT 13
FWR 14
28 SDA
27 SCL
26 nc
25 VREG
24 IN1+
23 IN1-
22 IN2+
21 IN2-
20 IN3+
19 IN3-
18 VSP
17 VPP
16 FG
15 RD
PT2505
SSOP28

接脚描述

接脚名称	I/O/P	描述	24 Pin Pin No.	28 Pin Pin No.
GND	P	信号接地	1	3
VDD	P	电源输入	3	4
RF	I	限流电压感测	4	5
HB	O	受控的+5V 电源用以供给霍尔传感器	nc	6
WL	O	W 相低端信号输出	5	7
WH	O	W 相高端信号输出	6	8
VL	O	V 相低端信号输出	7	9
VH	O	V 相高端信号输出	8	10
UL	O	U 相低端信号输出	9	11
UH	O	U 相高端信号输出	10	12
FAULT	I	外部故障信号输入 (低电位触发)	11	13
FWR	I	正反转控制(平常内部有电位拉升成反转状态)	12	14
RD	O	马达堵转指示(电位为高时表示异常状况).	nc	15
FG	O	电机转速指示	14	16
VPP	O	+7.5V 作为 OTP 刻录时使用,可由内部或外部提供	nc	17
VSP	I	DC 或 PWM 输入速度控制	15	18
IN3-	I	霍尔组件 3- 输入	16	19
IN3+	I	霍尔组件 3+或霍尔传感器 3 输入	17	20
IN2-	I	霍尔组件 2- 输入	18	21
IN2+	I	霍尔组件 2+或霍尔传感器 2 输入	19	22
IN1-	I	霍尔组件 1- 输入	20	23
IN1+	I	霍尔组件 1+或霍尔传感器 1 输入	21	24
VREG	O	+5V 稳压器输出	22	25
SCL	I	Serial clock input - I^2C control interface	23	27
SDA	I/O	Serial data input/output – I^2C control interface	24	28
RTSD	I	过温保护感测电阻输入	DB	1
ROVP	I	过压保护感测电阻输入	DB	2

功能描述

电源供给

PT2505 消耗电流小于 5mA，且内建+5V 稳压器用以供给内部的逻辑及模拟电路使用。 输出信号为 5V 的逻辑位准用以推动外部的栅级驱动器。

为了避免电源干扰或不稳定，PT2505 内部会检测 LDO 电压。当 LDO 电压超过 3V 时，会在 10ms 内告知逻辑电路开始运作。在电机系统，芯片很容易受到感应噪声的影响，建议放置适当数量的旁路电容器，而且离 IC 电源引脚越近越好。

速度控制界面

PT2505 可藉由输入 I²C命令，直流电压以及PWM信号来控制马达转速。当输入为PWM信号时，其高及低电压位准为5V的逻辑系统。输入PWM的载波频率建议介于15KHz到25KHz之间。当输入直流电压时,其上下限电压由V_{SPMIN}和V_{SPMAX}来决定。在使用外部分压电阻调整VSP时，要加以注意VSP 脚位在内部透过200kΩ 电阻连接至GND。

为了工作于不同的 VSP 范围，可以设定不同的 V_{SPMAX} 及 V_{SPMIN} 于缓存器中。V_{SPMAX} 的设定范围介于 3.0V 到 5.4V 而 V_{SPMIN} 的设定范围介于 0.3V 到 2.1V。其运作方式如**图 1.**

a. VspSel 选择 VSP 信号直接进入比较器或经过一个 2/3 的衰减电路再进入比较器
b. OschSel 及 OsclSel 可设定锯齿波波峰及波谷的数值
c. OschSel 的选择可得到波峰为 (3V, 3.6V). OsclSel 的选择可得到波谷为 (0.3V, 0.5V, 0.7V, 1.4V)
d. 结合以上的设定可得到以下 V_{SPMAX} 和 V_{SPMIN} 的组合
   组合一: V_{SPMAX} = (3V, 3.6V) / V_{SPMIN} = (0.3V, 0.5V, 0.7V, 1.4V)
   组合二: V_{SPMAX} = (4.5V, 5.4V) / V_{SPMIN} = (0.45V, 0.75V, 1.05V, 2.1V)
e. 控制缓存器地址是 0x54

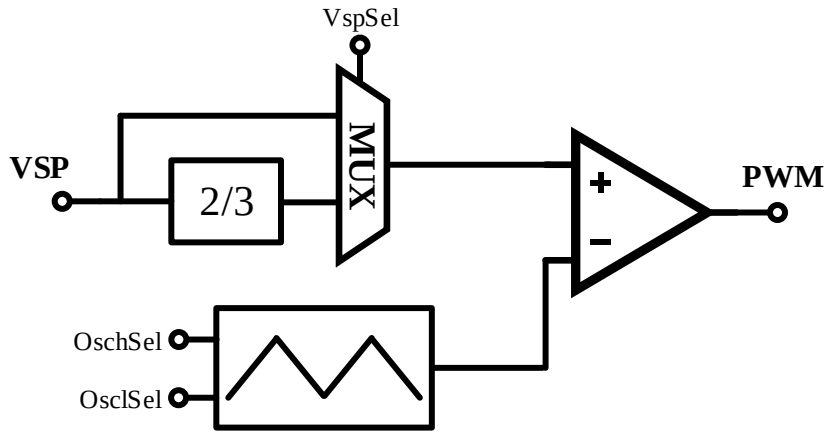


图 1 VSP 输入范围的解释

除了一般的电压输入，藉由缓存器 0x39 SpdEN 的设定，PT2505 还提供了闭回路的速度控制。配合 RiseStep, FallStep1 及 FallStep2 等参数，PT2505 能得到稳定的转速控制

转速的计算可表示成 Input Duty * Hz/Duty。当 VSP 输入频率命令做转速控制时，FG 的输出会追随输入频率命令。相关的参数为缓存器 0x39 的 IfDiv, SpdEn 及 FreqEn。

霍尔传感器控制方式

PT2505控制方式是基于霍尔传感器的信息，并产生正弦电压波形。它有利于提供准确无声（无电噪声）驱动控制。不同于无传感器控制方案，霍尔传感器控制提供了顺利启动没有反转。

如**图 2** 和**图 3** 中，三个霍尔传感器位置可以被配置为 60°或 120°的间隔方式，PT2505 可以通过内部参数来应对不同的配置方式。

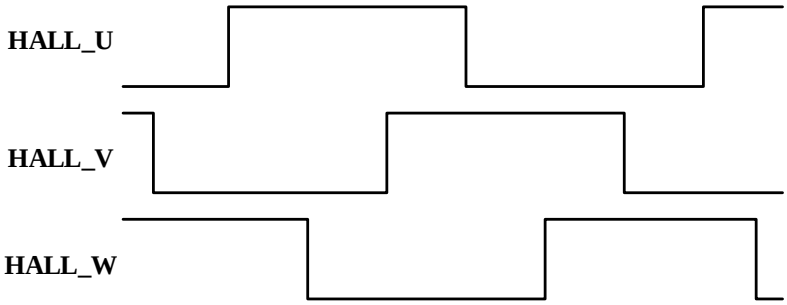


图 2 120 度间距的霍尔传感器信号

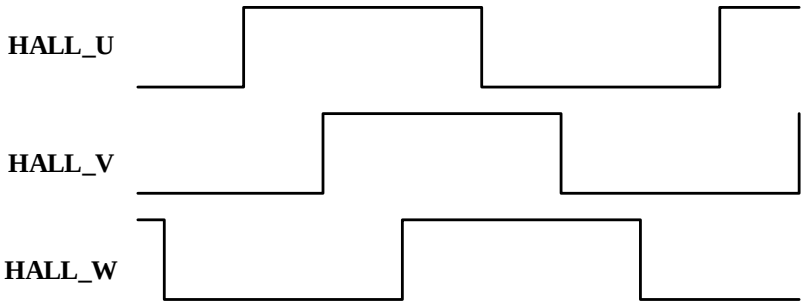


图 3 60 度间距的霍尔传感器信号

不同的霍尔传感器会因感度不同，摆放位置偏差等问题造成转子讯号产生相角差，如**图 4** 所示。PT2505 可以经由设定内部参数来补偿偏移，可补偿的范围从-60 度到+60 度，并就正转或反转的情形来分别调整。PT2505 可支持霍尔组件和霍尔传感器。

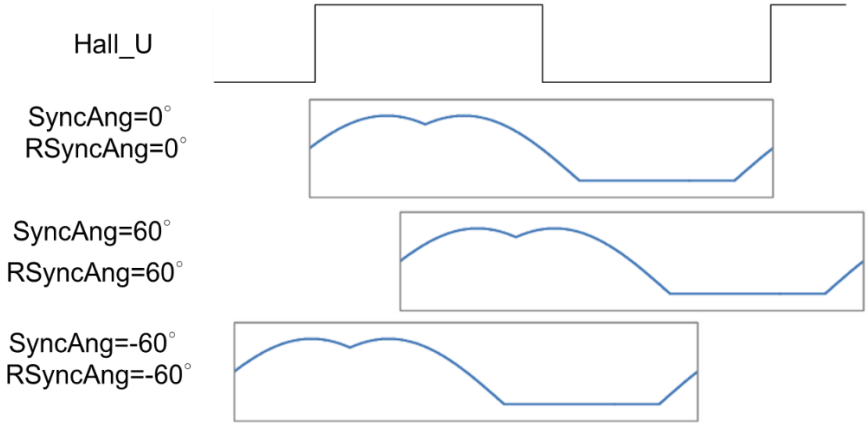


图 4 正反转时同步角度的调整

领先角设定

由于马达定子线圈的电感加载特性，线圈电流的相角差会随着转子速度增加而偏移。PT2505 提供了自动或手动方式来修正偏移以得到最佳的效率，其对应的参数是缓存器 0x30 的 PAAuto。在自动调整时 PT2505 提供了 16 条曲线 PASlope 以及最大领先角参数 MaxPA 来调整，**图 5** 是其示意图。

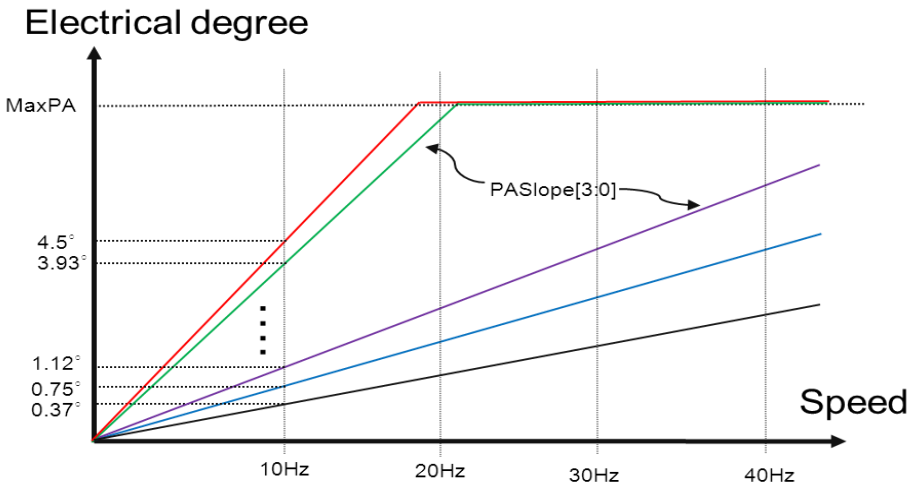


图 5 自动领先角调整曲线

此外最佳的效率点和 BEMF 强度，线圈电流，转子速度及线圈电感的大小有关。由于其非线性的相关特性，在手动调整方面 PT2505 提供了 PAM10HZ 到 PAM150HZ 的分区调整方式. 这里最大的对应转速是 150Hz，最大的领先角是由 MaxPA 所设定及限制，**图 6** 是其示意图。

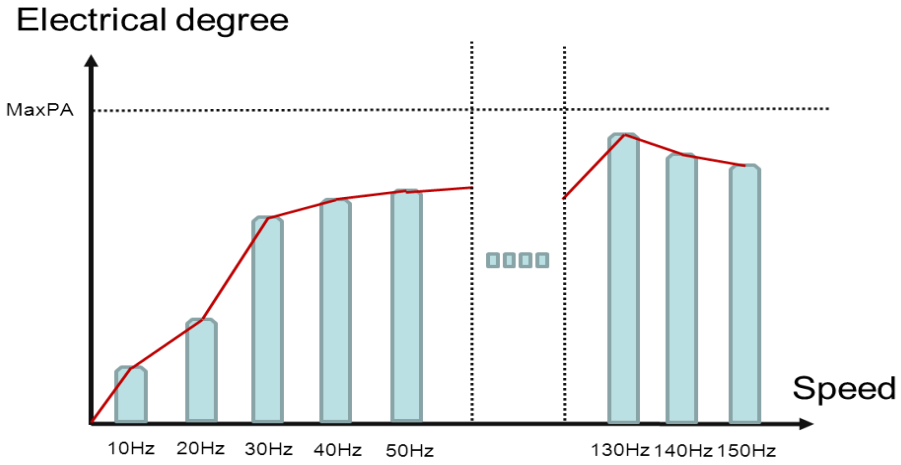


图 6 手动领先角的调整和转速的对应

输入速度命令对应曲线

PT2505 提供了平滑的加速及减速曲线可面对不同的负载特性. **图 7** 是示意图，藉由 StopDuty 的设定，使用者可以决定何时放开线圈的激磁以免产生噪音。

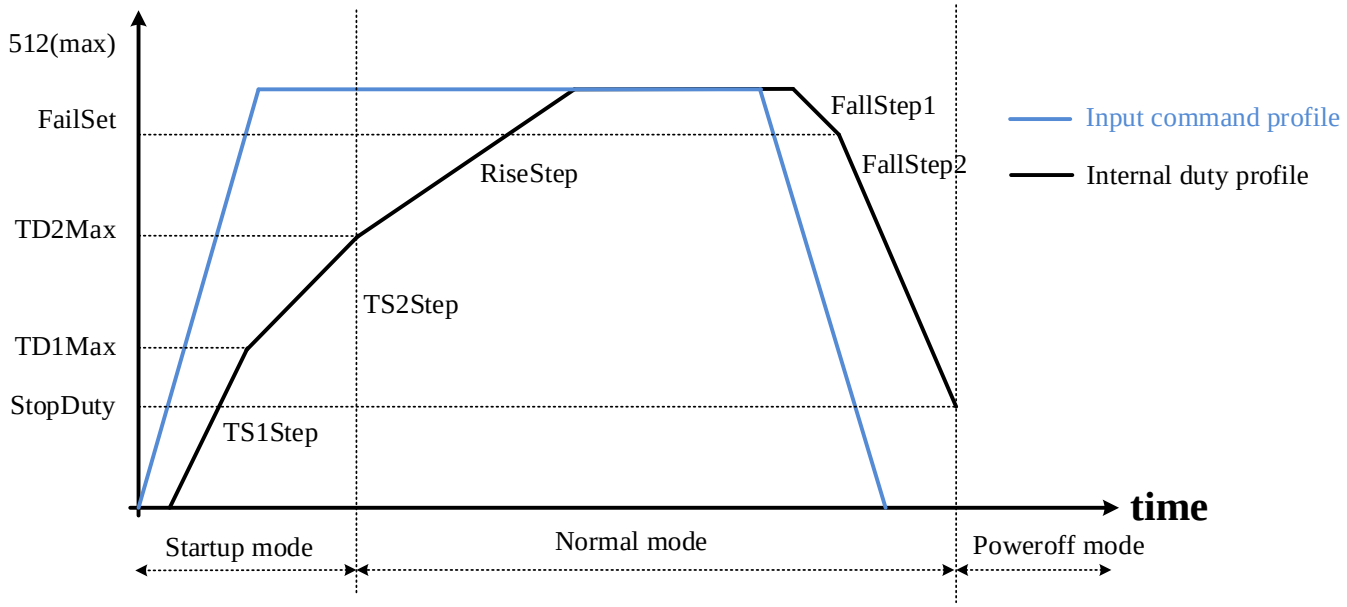


图 7 平滑的加速及减速参数调整

过电流保护

PT2505 具有两阶段的过电流保护，藉由放置于 RF 接脚的感测电阻及低通滤波器，能得知马达电流 I_{MOTOR}。当感测电阻上的电压 V_{RF} 大于 V_{OCPL} 时，OCPL 的条件会被触发，此时 PT2505 会降低 PWM 的周期直到 V_{RF} 小于 V_{OCPL}，当 V_{RF} 大于 V_{OCPH} 时，OCPH 的条件会被触发，PT2505 会立刻关掉 PWM 的控制信号进入锁住模式，**图 8** 是示意图。

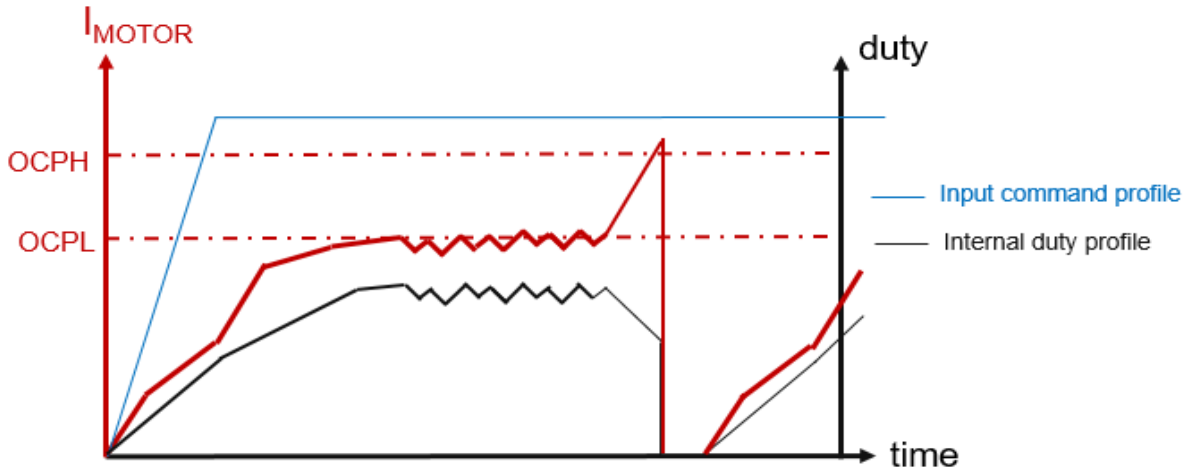


图 8 两阶段过电流保护

参数 OCPHFilter 及 OCPLFilter 可用来减少控制上的扰动，其范围介于 0.4us 到 0.4ms 之间。V_{OCPL}/ V_{OCPH} 可藉由参数 OCPLsel/OCPHsel 设成不同的位准。PT2505 还提供 OCPLL 的设定来限制马达最大启动电流。

启动及堵转保护

根据霍尔传感器提供的初始位置讯息，PT2505 可判断启动及换向程序，启动时最大 PWM 周期由参数 TD2Max 控制，针对不同马达的应用这个参数决定了启动时最大的推力，并表现在马达加速及减速的特性曲线上。

在运转中，当 PT2505 未侦测到预期的霍尔传感器信号，就会进入锁住保护模式，在等待一段时间后会尝试再次启动运转(等待时间及启转时间由参数 CTRise 及 CTFall 决定)，且将参数 ExptNum 加一,此时如马达仍未能正常启转,而且 ExptNum 的数值大于 MaxExptNum 的设定，系统会进入死锁状态，不会再尝试去启动马达，死锁状态只能藉由开关电源来解除。

外部过电压及欠电压保护

外部过电压及欠电压的保护可藉由 OVPSEL bit 为 1 的设定来达成，在芯片内 V_{PRTH} 固定为 3.5V， V_{PRTL} 的触发位准藉由缓存器来调整，当 VDD 的电压大于 V_{PRTH} 或小于 V_{PRTL} 时，PT2505 会停止工作，用户可观察缓存器 SYS_CTRL2 中 OVP 位来得知触发状况，**图 9** 是示意图。

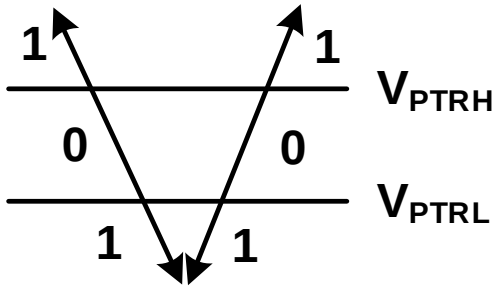


图 9 外部过电压及欠电压的触发位准

内部欠电压保护

内部欠电压的保护可藉由 OVPSEL bit 为 0 的设定来达成，当 VDD 低于 8V 时 PT2505 会停止工作，当电压上升至 9V 时欠压保护就会解除，系统缓存器 SYS_CTRL2 OVP bit 可得知目前工作状态。

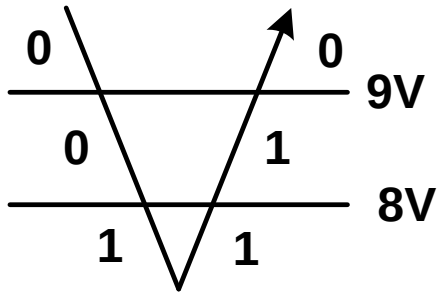


图 10 内部欠电压保护位准

过温保护及紧急煞车

PT2505 提供内部和外部的过温保护方式。
OTPSEL 设定为 1 时，PT2505 工作于内部过温保护模式，在芯片的温度超过 150℃时，PT2505 会进入过温保护停止工作，在芯片温度降到 95℃时过温保护会解除并继续工作，藉由系统缓存器 SYS_CTRL2 TSD bit 可得知目前工作状态。

OTPSEL 设定为 0 时，PT2505 工作于外部过温保护模式，外部的 NTC 温度感测电阻连接方式如**图 11**，在温度升高时 RTSD 的电压下降，当其小于 V_{REFL} 时过温保护启动，PT2505 停止工作，在芯片温度下降时 RTSD 的电压会上升，当其大于 V_{REFH} 时，过温保护会解除。
接脚 FAULT 输入为低电位时，PT2505 会立刻送出信号，将外部功率晶体的上臂开路下臂接地，做紧急煞车的动作。

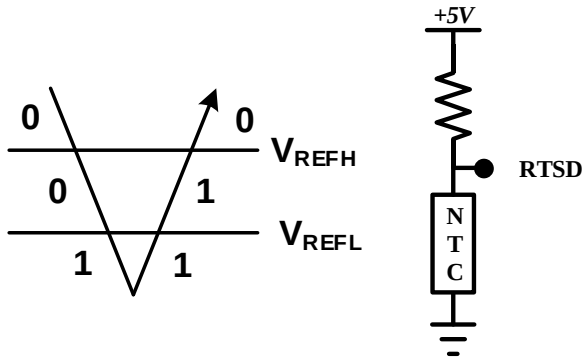


图 11 过温保护触发位准及 NTC 电阻的连接方法

FG 输出速度讯息

PT2505 输出 FG 作为电机转速指示，当转子运行一个电气周期时，FG 输出一对高和低信号，所以转速计算需要考虑到转子的极数，举例来说，如果转子是 8 极（四对极），电机跑一圈将有 4 个 FG 输出。电机转速通常以 RPM（每分钟转数）来表达，因此电机的旋转速度计算为：

RPM = FG×120 /极，FG 是频率（Hz），「极」是转子极数

FG 引脚为 5V 逻辑输出。
PT2505 提供了不同的 FG 输出配置，便于配合外界的程序计算，如**图 12** 所示, HU/HV/HW XOR 后会得到 3 倍的输出频率，，再配合 1/2/4/8 的除法器可得到下列的输出组合
(1, 1/2, 1/4, 1/8) 及(3, 3/2, 3/4, 3/8)

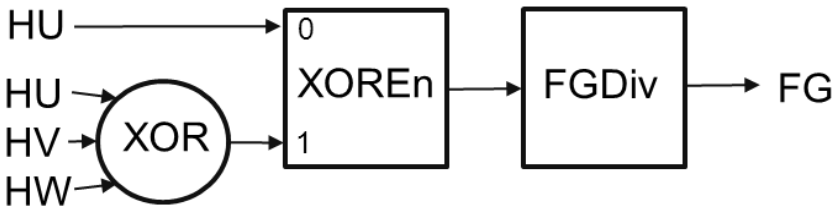


图 12 FG 输出配置

正反转设定

PT2505 可藉由控制接脚或缓存器的参数来设定马达正反转，在改变马达的转动方向时，马达会先停下来再往另一个方向转动. 这里建议进行正反转控制时，可藉由观察 FG 的信号以得到最好的降速曲线及反转等待时间。

顺风启动以及逆风启动设定

PT2505 能自动侦测马达是处于顺风或逆风的情形，在顺风启动时 PT2505 会先将马达刹车，直到速度降到可接受的范围，在逆风启动时 PT2505 会去调整启动的 PWM 周期并确保 BEMF 不会损伤高压组件，而启动 PWM 周期是由转子速度，比例因子及偏差量来计算，其公式如下

StartDuty=(RotorSpeed>>DNWScale*4) + DNWInit，这里 “>>” 表示数值右移

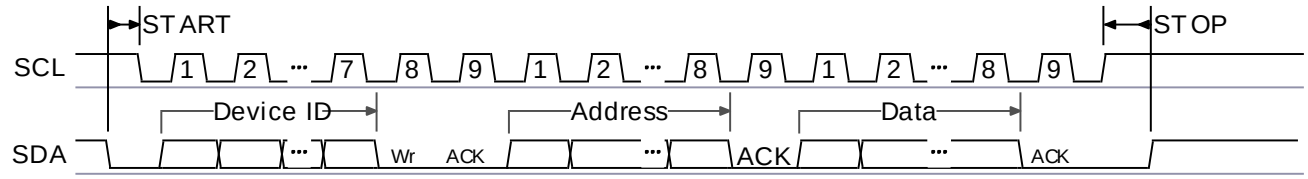
参数设定

PT2505 的外部过温及过流保藉由外部电阻来设定动作范围，其他可调整的参数都可纪录在 OTP(One Time Programming)的内存中，PT2505 可藉由 I²C 控制界面两次刻录到 OTP 中。

I²C 控制界面

PT2505 可以透过 I²C 的界面来存取内部缓存器的数值，并完成 OTP 的刻录，每笔 I²C 的命令由 **START** bit 开始，其中 **Device ID 是** 7-bit 用以表示芯片的地址，PT2505 的地址固定为 0110100b， **Wr/Rd** 用来表示读或写的动作，**ACK** 是接收端用来做确认的动作，告知发射端数据已收到或停止传送. **Address** 是 PT2505 的缓存器编号，接下来的数据就是用于缓存器的写入或读出，**STOP 表示** I²C 命令的结束，The I²C 在读写时都以一个 Byte 来运作，**图 13** 是其时序图，目前 I²C 界面最快可工作于 50 KHz。

I²C Byte Write



I²C Byte Read

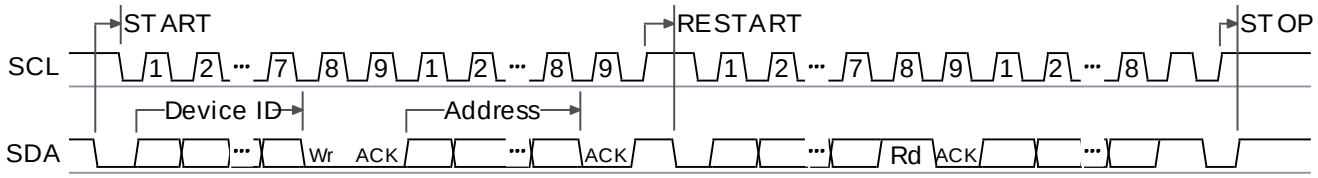


图 13 I²C byte 写入及读出时序

SpdSel[1:0]用以提供不同的马达应用，配合 RiseStep，FallStep1 和 FallStep2 等参数，PT2505 可得到稳定的转速输出。

控制缓存器数据表

缓存器地址 0x00 到 0x10

Bit								Address
7	6	5	4	3	2	1	0	Hex
PWM_I2C[9:8]		Reserved			PWMS	FWRS[1:0]		0
PWM_I2C[7:0]								1
FGCnt[7:0]								2
Mstate[2:0]			RDL	TSD	FGCnt[10:8]			3
OVP		FLD	SumErr	BlankErr[1:0]		OCPL	OCPH	4
OCPLL	PS	Reserved	VppAlarm	STestA_En	Stesth	SFwr	Sswinh	5
HVID								6
ExpNum[7:0]								7
Reserved							ExpNum[8]	8
ActDuty[7:0]								9
Reserved						ActDuty[9:8]		0A
NumID								0B
PTM				PCTL				10

缓存器地址 0x21 到 0x5E

								20
TS1Step[7:0]								21
TD2Max[7:0]								22
TS1Step[8]	DnWScale[1:0]		TD1Max[5:0]					23
TS2Step[7:0]								24
RiseStep[7:0]								25
DnWInit[5:0]						TS2Step[8]	RiseStep[8]	26
FallStep1[7:0]								27
FallStep2[7:0]								28
HallP[2:0]			DeadTime[2:0]			FallStep1[8]	FallStep2[8]	29
FallSet[7:0]								2A
StopDuty[7:0]								2B
OCPHDis	FLT	HallSel		ZcTarget[3:0]				2C
ZCCntMn[7:0]								2D
FilterMax[9:8]		ZCCntMn[13:8]						2E
FilterMax[7:0]								2F
HallPwrEn	OCPLSlope[1:0]		PAAuto	PASlope[3:0]				30
RSyncAng[7:0]								31
SyncAng[7:0]								32
CTRise[3:0]				CTFall[3:0]				33
Deadlock[7:0]								34
TimeUp1[7:0]								35
HsfEn	Deadlock[8]	TimeUp1[13:8]						36
TimeUp2[7:0]								37
ShortNum[1:0]		TimeUp2[13:8]						38
HsMos	HallCode	PllEn	IfDiv	SpdEn	FreqEn	SpdHyst[1:0]		39
CID[7:0]								3A
MaxPA[7:0]								3B
Pam10Hz[7:0]								3C
Pam20Hz[7:0]								3D

Pam30Hz[7:0]							3E
Pam40Hz[7:0]							3F
Pam50Hz[7:0]							40
Pam60Hz[7:0]							41
Pam70Hz[7:0]							42
Pam80Hz[7:0]							43
Pam90Hz[7:0]							44
Pam100Hz[7:0]							45
Pam110Hz[7:0]							46
Pam120Hz[7:0]							47
Pam130Hz[7:0]							48
Pam140Hz[7:0]							49
Pam150Hz[7:0]							4A
TrimClk[7:0]							4B
OVPSel[3:0]							4C
OCPHFltr[7:0]							4D
OCPLFltr[5:0]						OCPHFltr[9:8]	4E
UpWSel[1:0]		TSOVDis	DutyDcrs[1:0]		HallUP	HallVP	HallWP	4F
UpWNum[7:0]							50
MinDuty[7:0]							51
	VPPToleranceOe	VPP7p5En	ENDG				52
ADutyEn					FGDiv[1:0]		HXorEn	53
VspSel	OschSel	OsclSel[1:0]		LdoTrim[3:0]				54
OCPLLSel[3:0]						OvphSel	OtpSel	55
MaxDuty[7:0]							56
PFrEn	PFr	PSDis	OCPLLEn	OCPLLFltr	PWMSmp	MaxDuty[9:8]		57
Reserved		PllPiKi[1:0]		Reserved		PllPiKp[1:0]		58
HSmthEn	HSmthT	QSDEn	XNor3Ha	OneHall	UVWP[2:0]			59
OCPLSel[3:0]				OCPHSel[3:0]				5A
StartFrq[1:0]		Reserved				VspOffBk	MSpdSel	5B
SDutyCtl[3:0]				Reserved	AlignTime[2:0]			5C
Reserved	IRSpd[2:0]			Reserved	Racc[2:0]			5D
HzPDuty[7:0]								5E

控制缓存器功能描述

地址 0x0~0x11 是系统控制缓存器，提供如工作模式 PWM 周期 正反转等讯息

Address	Register Name	Description		Default	Unit	R/W
0x00	**SYS_CTL1**	Bit[7:6]	PWM_I2C[9:8]			R/W
		Bit [5:4]	Reserved			
		Bit[2]	**PWMS,** PWM Selection 1 : select internal PWM duty control 0 : external VSP control	0		
		Bit[1:0]	**FWRS**, FWR is controlled by 0x : external FWR pin 10_b : FWR is 0 11_b : FWR is 1	0		
0x01	**PWM_I2C**	**PWM_I2C**[7:0]: When PWMS set 1, PWM duty is controlled by PWM_I2C[9:0]		0	duty	R/W
0x02	**FGCnt[7:0]**	Combine FGCnt[10:8] to get a 11 bit frequency counter value for every second		0	count	R
0x03	**SYS_CTL2**	Bit[7:5]	**MState**, Motor status 3'b000 : Startup 3'b001 : Normal 3'b010 : PWMOff 3'b011 : AlignStartUp 3'b100 : LockOn 3'b101: DeadLock 3'b110: PowerSavingAck 3'b111: PowerSaving			R
		Bit[4]	**RDL**, normal operation status 0 : motor is in the normal state 1 : motor is not in the normal state			
		Bit[3]	**TSD**, TSD signal from the RSEN pin 0 : Comparator result is correct 1 : Comparator result is not correct			
		Bit[2:0]	FGCnt[10:8]			
0x04	**SYS_CTL3**	Bit[7]	**OVP**, Overvoltage Protection: 0: Normal 1: Overvoltage happening			R
		Bit[5]	**FLD**, Frequency lock up detection 1: Frequency locked up 0: Frequency not locked up			
		Bit[4]	**SumErr**, OTP checksum error indicator. If the first byte is 0x5A, the checksum is generated automatically. 1 : OTP checksum is error 0 : OTP checksum is correct.			
		Bit[3:2]	**BlankErr**, OTP blanking check. 00 : Bank 0 and 1 is blank. 01 : Bank 0 is blank, bank 1 is not blank. 10 : Bank 0 is not blank, bank 1 is blank. 11 : Bank 0 and 1 is not blank.			

Address	Register Name	Description		Default	Unit	R/W
		Bit[1]	**OCPL**, 1 : RF pin voltage exceed low level threshold. 0 : RF pin voltage is under low level threshold.			
		Bit[0]	**OCPH** 1 : RF pin voltage exceed high level threshold. 0 : RF pin voltage is under high level threshold.			
0x05	**OCPLL**	Bit[7]	**OCPLL** 1: Maximum Start-up current Alarm 0: Normal			R
	PS	Bit[6]	**PS**, Power Saving Signal 1: Power Saving happening 0: Normal			
		Bit[5]	Reserved			
	VppAlarm	Bit[4]	**VppAlarm**, VppAlarm Signal 0: VPP OK 1: VPP not normal			
		Bit[3:0]	Reserved for system test			
0x06	**HVID**	**HVID**, Hardware version control ID				R
0x07	**ExpNum[8:0]**	**ExpNum**, Combine with ExpNum[8] to get a ExpNum[8:0] register. The EXPTNUM will add one automatically when exception happens, for example, OCPH or LockOn state happens.			count	R
0x08		Bit[7:1]	Reserved			R
		Bit[0]	ExpNum[8]			
0x09	**ActDuty[9:0]**	**ActDuty**, Combine with ActDuty[9:8] to get a ActDuty[9:0] register array. The register array means real work duty in motor system.			duty	R
0x0a		Bit[7:2]	Reserved			R
		Bit[1:0]	ActDuty[9:8]			

地址 0x21~0x5F 是纪录于 OTP 中对应的缓存器，提供各类马达控制参数

Address	Register Name	Description		Default	Unit	R/W
0x21	**TS1Step**	Combine with bit 7 of sub-address 0x23 to form 9-bit of TS1Step[8:0] TS1Step is the first stage slope before reaching TD1MAX in the startup mode. Please refer to **Figure** 7. Unit is ms		10	0.25ms	R/W
0x22	**TD2Max**	TD2Max is the maximum duty of the second stage startup. Please refer to **Figure** 7		50	4 duty	R/W
0x23	**TS1Step[8]**	Bit [7]	TS1Step[8]			R/W
	DnWScale [1:0]	Bit[6:5]	**DnWScale**[1:0], a scale of current speed in Hz, for example, the current speed is 48Hz, DnwScale set to 3, then the initial duty is startup from (48>> 3)x4 + DnwInit.	0	scale	
	TD1Max[4:0]	Bit[4:0]	**TD1Max** is the maximum duty of the first stage startup. Please refer to **Figure** 7.	3	4 duty	
0x24	**TS2Step[7:0]**	**TS2Step**, Combine with bit 1 of sub-address 0x26 to form 9-bit of TS2Step[8:0] TS2Step is the second stage slope before reaching TD2MAX in the startup mode. Please refer to **Figure** 7.		47	0.25 ms	R/W
0x25	**RiseStep[7:0]**	**RiseStep**, Combine with bit 0 of sub-address 0x26 to form 9-bit of RiseStep[8:0] RiseStep is the update slope before reaching the OCPL or desire speed setting. Please refer to **Figure** 7.		47	0.25 ms	R/W
0x26	**DnWInit[5:0]**	Bit [7:2]	**DnWInit**[5:0], Combine with DnWScale[1:0], a suitable initial force to startup the motor when motor in a forward running situation.	0	4 duty	R/W
	TS2Step[8]	Bit [1]	**TS2Step**[8]			
	RiseStep[8]	Bit [0]	**RiseStep**[8]			
0x27	**FallStep1[7:0]**	**FallStep1**, The first stage slope of slow down before the actual duty down to Fallset.		47	0.25 ms	R/W
0x28	**FallStep2[7:0]**	**FallStep2**, The second stage slope of slow down before the actual duty down to StopDuty		47	0.25 ms	R/W
0x29	**HallP[2:0]**	Bit[7:5]	**HallP,** Hall Input Permutation 3'b000: [U, V, W] 3'b001: [U, W, V] 3'b010: [V, U, W] 3'b011: [V, W, U] 3'b100: [W, U, V] 3'b101: [W, V, U] Others: [U, V, W]	0	clock	R/W
	DeadTime [2:0]	Bit[4:2]	**DeadTime**, Dead time setting, range from 0.4us to 2.4us, suit for wide voltage operation. 0: 0.4us, 1: 0.8us, 2: 1.2us, 3: 1.6us, 4: 2.0us, 5~7: 2.4us			
	FallStep1[8]	bit [1]	**FallStep1**[8]			

Address	Register Name	Description		Default	Unit	R/W
	FallStep2[8]	bit [0]	**FallStep2**[8]			
0x2A	**FallSet[7:0]**	**FallSet**, the first stage duty for the actual duty decrease to.		40	4 duty	R/W
0x2B	**StopDuty[7:0]**	**StopDuty**, the second stage duty for the actual duty decrease to.		64	4 duty	R/W
0x2C	**ZCTarget**	Bit[7]	**OCPHDis**, OCPH diablbe 1: OCPH function disable 0: OCPH function normal	6	count	R/W
		Bit[6]	**FLT**, Frequency lock threshold 1, 0: 1/32 difference compared with the desired frequency.			
		Bit[5]	**HallSel**, Hall selection 0: Hall Sensor 1: Hall element			
		Bit[3:0]	**ZcTarget**, Six-step startup count before entering normal state			
0x2D	**ZCCntMn[7:0]**	Bit[7:0]	**ZCCntMn**, combine ZCCntMn[13:8] to get a ZCCntMn[13:0]. The register array means the minimum pulse width of zero crossing signal.	200	4 clock	
0x2E	**FilterMax[9:8]**	Bit[7:6]	**FilterMax**[9:8]	0		R/W
	ZCCntMn[13:8]	Bit[5:0]	ZCCntMn[13:8]			
0x2F	**FilterMax[7:0]**	**FilterMax**, combine with bit[7:6] of sub-address 0x2E, to form 10-bit of FilterMax[9:0]. FilterMax is the deglitch time period both for the hall sensor/hall element signal.		100	4 clock	R/W
0x30	**HallPwrEn**	Bit[7]	**HallPwrEn**, HB power output control 0: Turn off HB output during power-off mode, 1: HB output is always enable.	0		R/W
	OCPLSlope [1:0]	Bit[6:5]	**OCPLSlope**, OCPL update rate selection when the OCPL event happens. 0: 1.5ms, 1: 3ms, 2:5.75ms, 4:11.75ms	2		
	PAAuto	Bit[4]	**PAAuto**, Phase leading adjustment selection, 0: manually, 1: auto	1		
	PASlope[3:0]	Bit[3:0]	**PASlope**, when PAAuto set to 1, there are 16 slope curves selection according to the rotation speed. Please check **Figure 5** and **6** for further explanation. The sixteen slope of phase advance per 10Hz is 4.5, 3.93, 3.56, 3.18, 3.0 ,2.8, 2.6, 2.43, 2.25, 2.06, 1.87, 1.68, 1.5, 1.12, 0.75, 0.37 degree.	7		
0x31	**RSyncAng [7:0]**	**RSyncAng**, Hall sensor synchronization angle for the reversion rotation.		0		R/W
				45	0.75 deg	
0x32	**SyncAng [7:0]**	**SyncAng**, Hall sensor synchronization angle for the forward rotation		45	0.75 deg	R/W
0x33	**CTRisel[3:0]**	Bit[7:4]	**CTRise**, Maximum time period before entering normal mode. If startup period exceed this period, lock-on number plus one and restart again.	2	0.5 sec.	R/W

Address	Register Name	Description		Default	Unit	R/W
	CTFal[3:0]	Bit[3:0]	**CTFall**, Rest time period between each startup.	1	0.5 sec.	
0x34	**DeadLock [7:0]**	**DeadLock**, Combine DeadLock[8] to get a DeadLock[8:0]. The register array means the maximum exception number before entering dead-lock state. The exception includes OCPH and lock-on. When entering dead-lock state, PT2505 release it only by system power on again.		20	times	R/W
0x35	**TimeUp1[7:0]**	**TimeUp**, Combine TimeUp1[13:8] to a TimUp1[13:0]. The register array means that the minimum time when zero crossing signals must toggle without toggling once before. With the condition, system will restart the motor.		8'hE8	1ms	R/W
0x36	**HsfEn**	Bit[7]	**HsfEn**, Hall U signal falling edge sampling Enable 0: Disable, 1: Enable	8'h03		R/W
	DeadLock	Bit[6]	**DeadLock**[8]			
	TimeUp1 [13:8]	Bit[5:0]	**TimeUp1**[13:8]			
0x37	**TimeUp2[7:0]**	**TimeUp2**, Combine TimeUp2[13:8] to get a TimeUp2[13:0] . The register array means that the minimum time when zero crossing signals must toggle with toggling at least once before. With this condition, system will restart the motor.		232	1ms	R/W
0x38	**ShortNum[1:0]**	Bit[7:6]	**ShortNum**, The number of short pulses of zero crossing signals	8'hC3		R/W
	TimeUp2[13:8]	Bit[5:0]	**TimeUp2**[13:8]			
0x39	**SPDCtrl**	Bit[7]	**HsMos**, high side MOS type selection 1:NMOS, 0:PMOS	0		R/W
		Bit[6]	**HallCode**, Hall effect sensor position 0: 60 degree spacing, 1: 120 degree spacing	0		
		Bit[5]	**PllEn**, PLL enable: 0: disable, 1: enable	0		
		Bit[4]	**IfDiv**; Input frequency divider for VSP speed command 0: divide by 1, 1: divide by 4	0		
		Bit[3]	**SpdEn**; Speed input enable in VSP pin 0: PWM Pulse Control, 1: Speed Control	0		
		Bit[2]	**FreqEn**; Frequency input enable in VSP pin. 1: Speed controlled by VSP frequency 0: Speed controlled by VSP duty	0		

Address	Register Name	Description		Default	Unit	R/W
		Bit[1:0]	**SpdHyst**; Speed Control Hysteresis setting 00: Disable speed hysteresis control. 01: The difference between current hall sensor U speed and the desired speed is less than 1/16 of the desired speed, the function works. 10: The difference between current hall sensor U speed and the desired speed is less than 1/64 of the desired speed, the function works. 11: The difference between current hall sensor U speed and the desired speed is less than 1/128 of the desired speed, the function works.	0		
0x3B	**MaxPA[7:0]**	**MaxPA**, Maximum phase advance limitation		60	0.75 deg.	R/W
0x3C~ 0x4A	**Pam10HZ~ Pam150HZ**	Phase advance adjusted manually from 10Hz to 150Hz according the rotation speed.		2,4,6,8,10 ,12,13,15, 17,18,20, 21,23,24, 25	0.75 deg	R/W
0x4B	**TrimClk[7:0]**	**TrimClk**[7:0] provide 8 bits for precise basic clock output.		164	level	R/W
0x4C	**OVPSel[3:0]**	Bit[7:4]	**OVPSel**, over voltage protection level(VPRTL), selection, range from 0.8V~3.2V(0x0~0xE), 16 level settings.	8	level	R/W
		Bit[3:0]	Reserved			
0x4D	**OCPHFltr [7:0]**	**OCPHFltr**, combine with bit[1:0] of sub-address 0x4E, to form 10-bit of deglitch time period for the OCPH signal, range from 0.4us to 0.4ms.		256	4 clock	R/W
0x4E	**OCPLFltr [5:0]**	Bit[7:2]	**OCPLFltr**, deglitch time period for the OCPL signal, range from 0.4us to 25.6us.	8	4 clock	R/W
	OCPHFltr [9:8]	Bit[1:0]	**OCPHFltr**[9:8]			
0x4F	**UpWSel[1:0]**	Bit[7:6]	**UpWSel**, upwind startup setting, the motor brake until the speed reach: 0:4Hz, 1:6Hz, 2:8Hz, 3:12Hz, then start up with six-step till the motor in the forward direction.	0		R/W
	TSOVDis	Bit[5]	**TSOVDis**, thermal Shut down/Over Voltage Protection Disable 0: Enable 1: Disable			

Address	Register Name	Description		Default	Unit	R/W
	DutyDcrs[1:0]	Bit[4:3]	**DutyDcrs**, duty decrease when OCPL happens : 1. Duty control: 00: 25% specified duty decrease 01: 50% specified duty decrease 10: 100% specified duty decrease 11: decreased by 1 2. Speed control 00: 50% specified speed decrease 01: 80% specified speed decrease 10: 100% specified speed decrease 11: decreased by 1			
	HallUP	Bit[2]	**HallUP**, Hall U polarity 0: inverse Hall U 1: not inverse Hall U			
	HallVP	Bit[1]	**HallVP**, Hall V polarity: 0: inverse Hall V 1: not inverse Hall V			
	HallWP	Bit[0]	**HallWP**, Hall W polarity: 0: inverse Hall W 1: not inverse Hall W			
0x50	**UpWNum[7:0]**	**UpWNum**, ExpNum add 1 if the low-side braking time exceed UpWNum*0.5 second		20	number	R/W
0x51	**MinDuty[7:0]**	**MinDuty**, The motor is activated until the duty setting exceed MinDuty		0	2 duty	R/W
0x52	**VPPToleranceOe**	Bit[6]	**VPPToleranceOe**, the bit is to control the power MOSFET switch. 0: the power MOSFET is turned off 1: the power MOSFET is turned on and connected to internal VREG.	1		R/W
	VPP7p5En	Bit[5]	**Vpp7p5En**, The bit is to enable the internal 7.5 V regulator. 0: the internal 7.5 V regulator is disabled. 1: the internal 7.5 V regulator is enabled to provide the OTP programing power.	0		
	ENDG	Bit[4]	**ENDG**, The bit is enable analog deglitch function of hall element. 0: The deglitch function is ignored. 1: The deglitch function is enable.	1		
0x53	**ADutyEn**	Bit[7]	**ADutyEn**, Average PWM duty 1: Average PWM duty 0: Disable the function	0		R/W
	FGDiv[1:0]	Bit[2:1]	**FGDiv**: FG divide setting, 00:1, 01:2, 10:4, 11:8			
	HXorEn	Bit[0]	**HXorEn**: FG XOR enable setting, 0:disable, 1:enable			
0x54	**VspSel**	Bit[7]	**VspSel** is used to select the VSP input attenuation 0: no attenuation, 1: attenuate to 2/3*VSP	0		R/W
	OschSel	Bit[6]	OschSel is used to set the PWM input high level. 0: PWM input high level is set to 3V. 1: PWM input high level is set to 3.6V.	0		

Address	Register Name	Description		Default	Unit	R/W
	OsclSel[1:0]	Bit[5:4]	**OsclSel**[1:0] is used to set the PWM input low level. 00: PWM input low level is set to 0.3V. 01: PWM input low level is set to 0.5V. 10: PWM input low level is set to 0.7V. 11: PWM input low level is set to 1.4V.	0		
	LdoTrim[3:0]	Bit[3:0]	**LdoTrim**[3:0] provide 4 bit for precise 5V output (VREG).	8		
0x55	**OCPLLSel [3:0]**	Bit[7:4]	**OCPLLSel**, Over current protection level(OCPLL) selection, range from 0.04V to 0.2V, 16 level settings.	8		R/W
		Bit[3:2]	Reserved			
	OvphSel	Bit[1]	**OvphSel** is used to set internal (default) or external over voltage protection.	0		
	OtpSel	Bit[0]	**OtpSel** is used to set internal (default) or external over temperature protection.	1		
0x56	**MaxDuty[7:0]**	**MaxDuty**, combine MaxDuty[9:8] to get a MaxDuty[9:0]. The register array means maximum duty option			duty	R/W
0x57	**PFrEn**	Bit[7]	**PFrEn**; Parameter Forward/Reverse rotation Enable 0: disable 1: enable	8'h23		R/W
	PFr	Bit[6]	**PFr**; Parameter Forward/Reverse rotation control On the condition PfrEn = 1'b1, the bit's function as 1: Forward Rotation 0: Reverse Rotation			
	PSDis	Bit[5]	**PSDis**; Power Saving Disable 0: Power Saving Normal 1: Power Saving Disable			
	OCPLLEn	Bit[4]	**OCPLLEn,** Maximum start-up current limitation Enable 0: disable 1: enable			
	OCPLLFltr	Bit[3]	**OCPLLFltr,** the setting of the minimum width of OCPLL for validity 0: 32 system clock 1: 128 system clock			
	PWMSmp	Bit[2]	**PWMSmp,** PWM sampling rate setting 0: 20K 1: 40K			
	MaxDuty[9:8]	Bit[1:0]	MaxDuty[9:8]			
0x58		Bit[7:6]	Reserved	8'h12		R/W
	PllPiKi[1:0]	Bit[5:4]	**PllPiKi**, Ki value of PI for DPLL 00: 1/16 01: 1/32 10: 1/64 11: 1/128			
		Bit[3:2]	Reserved			
	PllPiKp[1:0]	Bit[1:0]	**PllPiKp**, Kp value of PI for DPLL 00: 0.5 01: 1 10: 2 11: 4			
0x59	**HSmthEn**	Bit[7]	**HSmthEn**, Hall U Sensor Signal Smooth Enable 1: Enable 0: disable			

Address	Register Name	Description		Default	Unit	R/W
	HSmthEn	Bit[6]	**HSmthT**, Hall U Sensor Signal Smooth Threshold on the condition HSmthEn = 1. 1: The difference between current hall U sensor signal and average hall U sensor one is less than 1/16 cycles of the average hall U sensor signal, the cycles of the average hall U signal will be adopted as the real cycles of the current hall U signal for now. 0: The difference between current hall U sensor signal and average hall U sensor one is less than 1/8 cycles of the average hall u sensor signal, the cycles of the average hall U signal will be adopted as the real cycles of the current hall U signal for now.	8'h20		R/W
	OSDEn	Bit[5]	**OSDEn**, Half second Detection Enable 1: Enable 0: Disable			
	Xor3Ha	Bit[4]	**Xor3Ha**, The setting of the function ,XOR Hall U, Hall V, and Hall W as the tracked signal in frequency speed mode 1: enable 0: disable			
	OneHall	Bit[3]	**OneHall**, One Hall input: 0: three Hall 1: one Hall			
	UVWP	Bit[2:0]	**UVWP**, U/V/W drive signal permutation: 3'b000: {UH, VH, WH} {UL, VL, WL} 3'b001: {UH, WH, VH} {UL, WL, VL} 3'b010: {VH, UH, WH} {VL, UL, WL} 3'b011: {VH, WH, UH} {VL, WL, UL} 3'b100: {WH, UH, VH} {WL, UL, VL} 3'b101: {WH, VH, UH} {WL, VL, UL} Others: {UH, VH, WH} {UL, VL, WL}			
0x5A	**OCPLSel[3:0]**	Bit[7:4]	**OCPLSel**, Over current protection level selection, range from 0.08V to 0.4V, 16 level settings.	8		R/W
	OCPHSel [3:0]	Bit[3:0]	**OCPHSel**, Over current protection level selection, range from 0.14V to 0.7V, 16 level settings.	8		R/W
0x5B	**StartFrq**	Bit[7:6]	**StartFrq**, It means the smallest frequency where the motor can run from Start-Up to Normal state. During the start-up period, the motor can't reach the speed, then it will enter lock-on state. The setting as 00: 3HZ 01: 4HZ 10: 5HZ 11: 6HZ The two bits are only written.	8'h00		R/W
		Bit[5:2]	Reserved			
	VspOffBk	Bit[1]	**VspOffBk**, When PWM is off, braking enables or disables. 0: disable 1: braking until FG<= 4HZ			
	MSpdSel	Bit[0]	**MSpdSel**, Max Speed Selection for Duty control: 0: Maxspeed is HzPDuty * 64 1: Maxspeed is HzPDuty * 512			

Address	Register Name	Description		Default	Unit	R/W
0x5C	**SDutyCtl [3:0]**	Bit[7:4]	**SDutyCt**l, Section Duty setting for speed control: 4'b0000: Disable 4'b0001: 1 section 4'b0010: 2 sections 4'b0011: 3 sections 4'b0100: 4 sections 4'b0101: 5 sections 4'b0110: 6 sections 4'b0111 : 7 sections 4'b1000: 8 sections 4'b1001: 9 sections 4'b1010: 10 sections 4b'1011: 11 sections 4'b1100: 12 sections 4'b1101: 13 sections 4'b1101: 14 sections 4'b1111 : 15 sections	8'h75		R/W
		Bit[3]	Reserved			
	AlignTime [2:0]	Bit[2:0]	**AlignTime**, Align Time 3'b000: 0.04s 3'b001: 0.08s 3'b010: 0.16s 3'b011: 0.32s 3'b100: 0.64s 3'b101: 1.28s 3'b110: 2.56s 3'b111: 5.12s			
0x5D		Bit[7]	Reserved			
	IRSpd[2:0]	Bit[6:4]	**IRSpd**, Initial rotating speed setting 3'b000: 1 HZ 3'b001: 2 HZ 3'b010: 3 HZ 3'b011: 4 HZ 3'b100: 5 HZ 3'b101: 6 HZ 3'b110: 8 HZ 3'b111: 16 HZ	8'h00		R/W
		Bit[3]	Reserved			
	Racc[2:0]	B[2:0]	**Racc**, Rotating acceleration 3'b000: 0.1 HZ/s 3'b001: 0.3 HZ/s 3'b010: 0.6 HZ/s 3'b011: 1.2 HZ/s 3'b100: 2.4 HZ/s 3'b101: 4.8 HZ/s 3'b110: 9.6 HZ/s 3'b111: 19.2 HZ/s			
0x5E	**HzPDuty[7:0]**	**HzPDuty**, The number of Hz per Duty for speed control by duties. Bit 7-6 : Integral part Bit 5-0 : Fractional part		8'h40		R/W

绝对最大额定值

Parameter	Symbol	Min.	Max.	Unit
供电电压	V_{DD}	5	30	V
输入/输出接脚电压	–	-0.3	5	V
工作温度范围	T_A	-40	+85	°C
储存温度范围	T_{STG}	-55	+125	°C

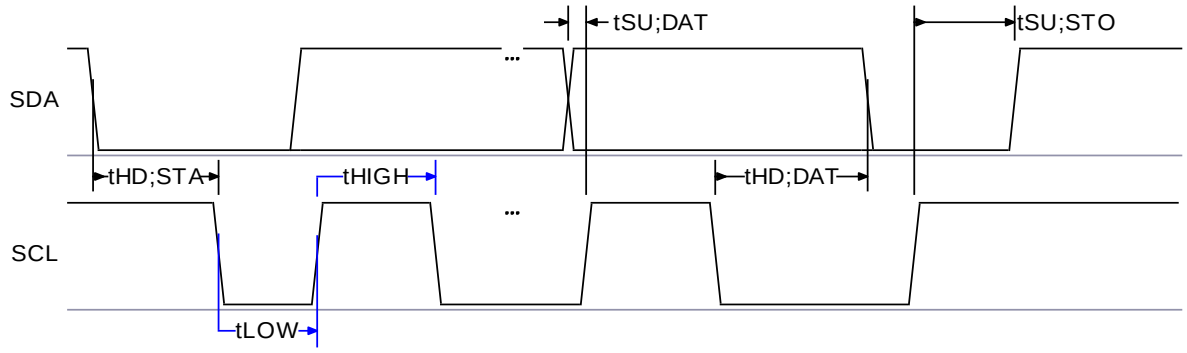
电气特性

一般工作条件: V_{DD} =24.0V, GND=0V, T_A = +27°C.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
一般特性						
供电电压	V_{DD}		9*	24	28	V
消耗电流	I_{DD}			5**	7	mA
稳压器输出电压	V_{REG}		4.75	5	5.25	V
稳压器输出电流	I_{REG}	$(V\_{NOLOAD} - V\_{LOAD20mA})/V\_{NOLOAD} < 5\%$		20		mA
外部过温保护 (OtpSel=0)						
下限电压	V_{REFL}	RTSD 接脚 低于下限电压时触发		1.2		V
上限电压	V_{REFH}	RTSD 接脚 高低于上限电压时释放		2.6		V
外部欠电压及过电压保护(OvphSel=1)						
下限电压***	V_{PRTL}	ROVP 接脚 低于下限电压时触发	0.8		3.2	V
上限电压	V_{PRTH}	ROVP 接脚 高于上限电压时触发		3.5		V
内部欠电压保护 (OvphSel=0)						
释放电压	V_{UVH}		8.5	9.0	9.5	V
触发电压	V_{UVL}		7.5	8.0	8.5	V
磁滞区间电压	V_{UVHY}		0.5	1.0	1.5	V
过电流保护						
下限电压***	V_{OCPL}	RF pin	0.08		0.4	V
上限电压	V_{OCPH}	RF pin	0.14		0.7	V
驱动级输出						
低电位输出	V_{DOL}	UH,VH,WH,UL,VL,WL	0	0.14	0.60	V
高电位输出	V_{DOH}	UH,VH,WH,UL,VL,WL	V_{REG} - 0.6	V_{REG} - 0.2	V_{REG}	V
霍尔传感器放大器特性						
共模电压范围	V_{HCM}	使用霍尔组件	+0.5		V_{REG} - 0.5	V
霍尔传感器放大器灵敏度	V_{HSEN}			80		mV
HB 输出电压	V_{HB}	I_{HB}= 10mA	4.5			V
输入/输出界面						
低电位输出	V_{OL}	FG, FAULT, RD		0	0.3	V
高电位输出	V_{OH}	FG, FAULT, RD	4.0	4.5	5.5	V
PWM 周期控制						
最小周期电压	V_{SPMIN}		0.3		2.1	V
最大周期电压	V_{SPMAX}		3.0		5.4	V
PWM 输入频率****	F_{PWM_IN}	PWM input (VSP pin)		20		KHz

* 针对 VPP 由内部产生的情形，如须于较低电压工作，可将 VDD 和 VREG 连在一起，并由外部供给 VPP
**霍尔传感器会消耗额外的电流，这里只计算芯片所消耗的电流
***上下限电压可利用 I²C 界面来设定
****输入 PWM 信号时采用 5V 的逻辑位准

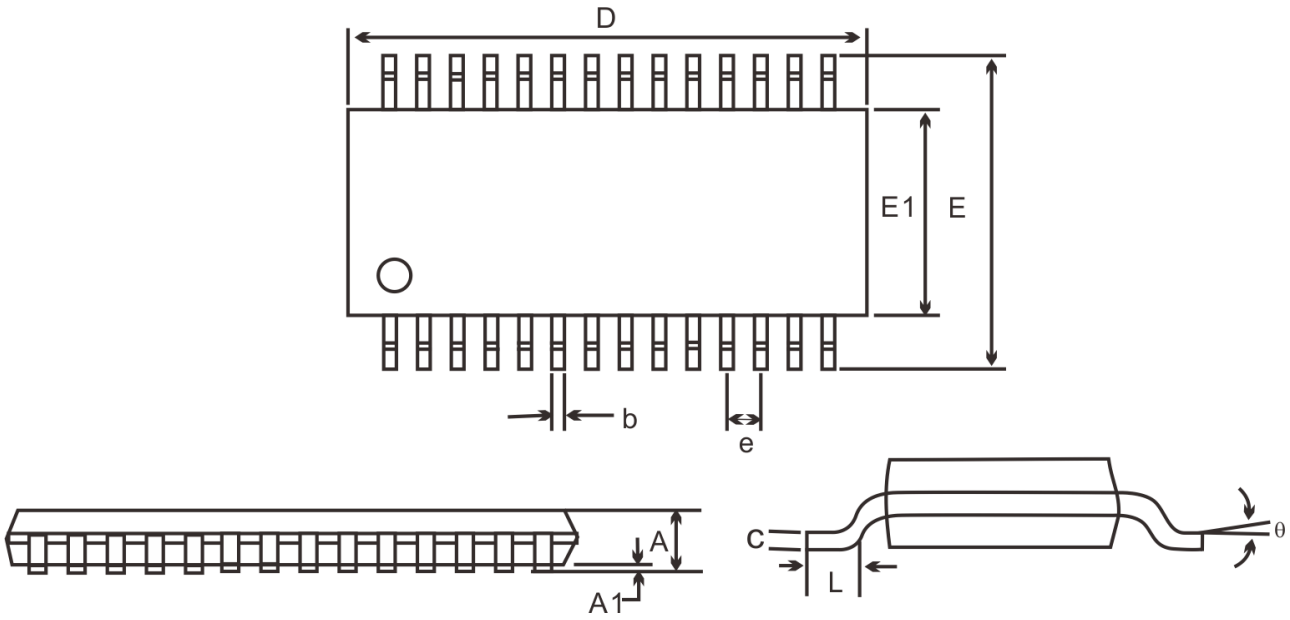
I²C 时序图:



Parameter	Symbol	Min	Max	Unit
SCL 频率	f_{SCL}	0	50	KHz
START 信号的保持时间	$t_{HD;STA}$	4		µS
SCL 为低电位的时间	t_{LOW}	4.7		µS
SCL 为高电位的时间	t_{HIGH}	4.0		µS
Data 的建立时间	$t_{SU;DAT}$	250		nS
Data 的保持时间	$t_{HD;DAT}$	5.0		µS
STOP 信号的建立时间	$t_{SU;STO}$	4.0		µS

包装讯息

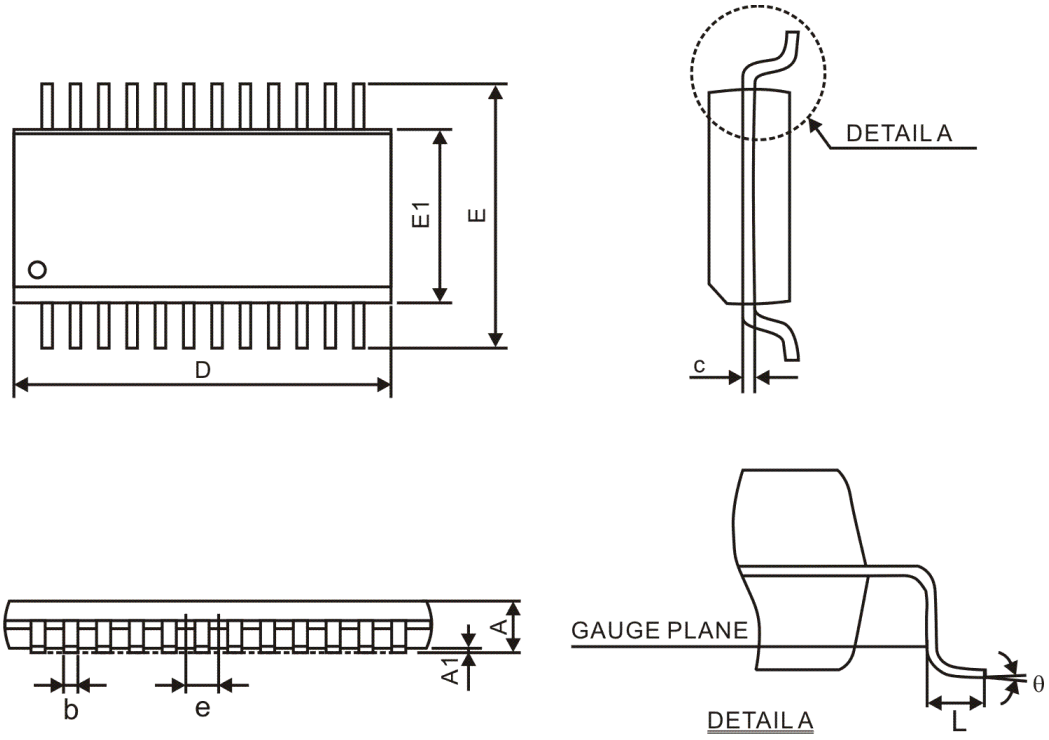
28 Pins, SSOP 150MIL



Symbol	Dimensions(mm)		
	Min.	Nom.	Max.
A	-	-	1.750
A1	0.100	-	0.250
b	0.200	-	0.300
c	0.100	-	0.250
e	0.635 BSC		
D	9.9 BSC		
E	5.99 BSC		
E1	3.91 BSC		
L	0.410	-	1.270
θ	0°	-	8°

Notes : Refer to JEDEC MO-137 AF

24 Pins, SSOP 150MIL



Symbol	Dimensions(mm)		
	Min.	Nom.	Max.
A	-	-	1.750
A1	0.100		0.250
b	0.200	-	0.300
c	0.100	-	0.250
e	0.635 BSC		
D	8.66 BSC		
E	5.99 BSC		
E1	3.91 BSC		
L	0.410	-	1.270
θ	0°	-	8°

Notes :Refer to JEDEC MO-137 AE

IMPORTANT NOTICE

Princeton Technology Corporation (PTC) reserves the right to make corrections, modifications, enhancements, improvements, and other changes to its products and to discontinue any product without notice at any time.
PTC cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a PTC product. No circuit patent licenses are implied.

Princeton Technology Corp.
2F, 233-1, Baociao Road,
Sindian Dist., New Taipei City 23145, Taiwan
Tel : 886-2-66296288
Fax: 886-2-29174598
http://www.princeton.com.tw

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for Motor/Motion/Ignition Controllers & Drivers ***category:***

Click to view products by Princeton ***manufacturer:***

Other Similar products are found below :

LV8133JA-ZH LV8169MUTBG LV8774Q-AH LV8860PV-TLM-H MC33931EKR2 FSB50250UTD FSB50550TB2 FSBF15CH60BTH FSBS10CH60T MP6507GR-P MP6508GF MSVGW45-14-2 MSVGW54-14-5 NTE7043 CAT3211MUTAG LA6245P-CL-TLM-E LA6245P-TLM-E LA6565VR-TLM-E LB11650-E LB1694N-E LB1837M-TLM-E LB1845DAZ-XE LC898111AXB-MH LC898300XA-MH SS30-TE-L-E STK531-345A-E STK581U3A0D-E STK58AUNP0D-E STK621-068C-E STK621-140C STK621-728S-E STK625-728-E STK672-400B-E STK672-432AN-E STK672-432BN-E STK672-440AN-E STK672-442AN-E AMIS30621AUA FSB50550ASE 26700 LV8161MUTAG LV8281VR-TLM-H LV8702V-TLM-H LV8734VZ-TLM-H LV8773Z-E LV8807QA-MH MC33932EK MCP8024T-H/MP TND027MP-AZ BA5839FP-E2