



**HY11P24**  
**Datasheet**  
**8-Bit RISC-like Mixed Signal Microcontroller**  
**Embedded Low Noise Amplifier**  
**18-Bit  $\Sigma\Delta$ ADC**

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## 1. 特點

- 8 位元加強型精簡指令集，共有 66 個指令  
包含硬體乘法指令及查表指令
- 2.2V to 3.6V 工作電壓範圍，-40°C~85°C 工作溫度範圍
- 外部石英震盪器及內部高精度 RC 震盪器，6 種 CPU 工作時脈切換選擇，可讓使用者達到最佳省電規劃
  - 運行模式 300uA@2MHz
  - 待機模式 3uA@32KHz
  - 休眠模式 1uA
- 8KWord OTP (One Time Programmable) Type 程式記憶體，512Byte 資料記憶體
- Brownout and Watch dog Timer，可防止 CPU 進入死機模式
- 18bit 全差動輸入  $\Sigma\Delta$ ADC 類比數位轉換器
  - 內置 PGA (Programmable Gain Amplifier) 及可有 1/4、1/2、1、.....128 倍 10 種輸入信號放大倍率選擇
  - 內置輸入零點調整，可針對不同應用增加其量測範圍
  - 內置高阻抗輸入緩衝器(4 倍以上輸入倍率不適用)
  - 內置絕對溫度感測器
- 超低輸入雜訊(<1uVpp)運算放大器，可提供高輸出阻抗小訊號的放大及小電流的電壓轉換
- 1.0V, 1.2V 的內部類比電路共地電壓源，具有 Push-Pull 驅動能力，可提供傳感器驅動電壓
- LVD 低電壓檢測功能具 14 段檢測電壓設置與外部輸入電壓檢測功能
- 類比電壓源 VDDA 可選擇 4 種不同輸出電壓，具 10mA 穩壓電壓源輸出能力
- 增強型比較器
  - 兩組電壓源產生器
  - 具 0.25 倍或 0.5 倍工作電壓比較與自動轉態功能及 15 段比較電壓設置
  - 內置溫度感測電路
- 8-bit Timer A
- 16-bit Timer B 模組具 Capture/Compare 功能
- 8-bit Timer C 模組具 PWM/PFD 波形產生功能
- 串列通訊 SPI、EUART 模組
- Support 8 stack level

## 2. 引腳定義

### 2.1 LQFP44 引腳圖

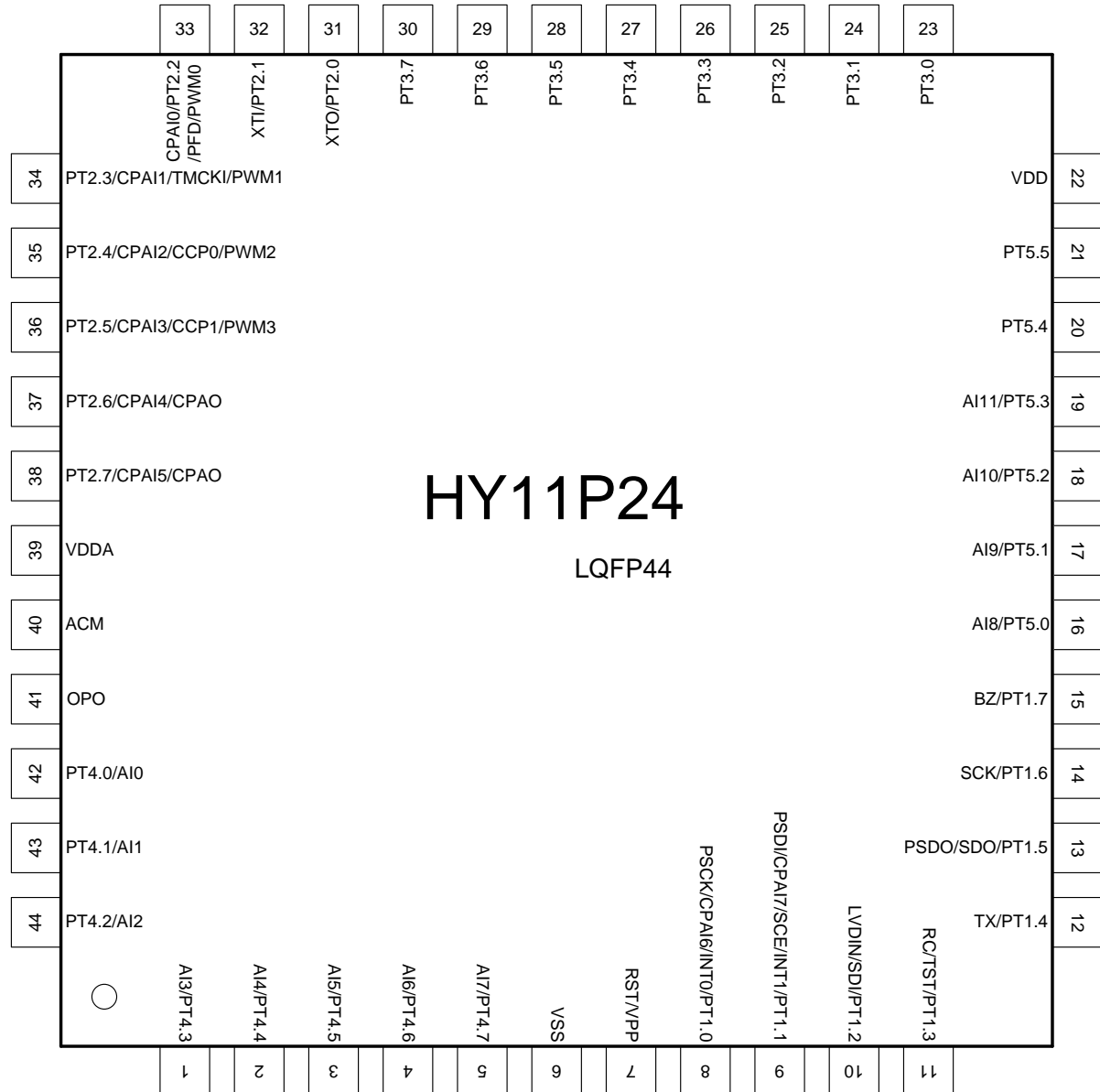


圖 2-1 HY11P24 LQFP44 引腳圖

註 1：VPP 與 RST 復用同一接口，非燒錄 EPROM 時禁止輸入電壓超過 5.8V

註 2：TST 與 PT1.3 復用同一接口，操作時禁止輸入電壓超過 VDD+0.3V

註 3：若不將 PT1.3 設定成外部引腳按鍵，可以提升抗干擾能力

### 2.2 LQFP48 引腳圖

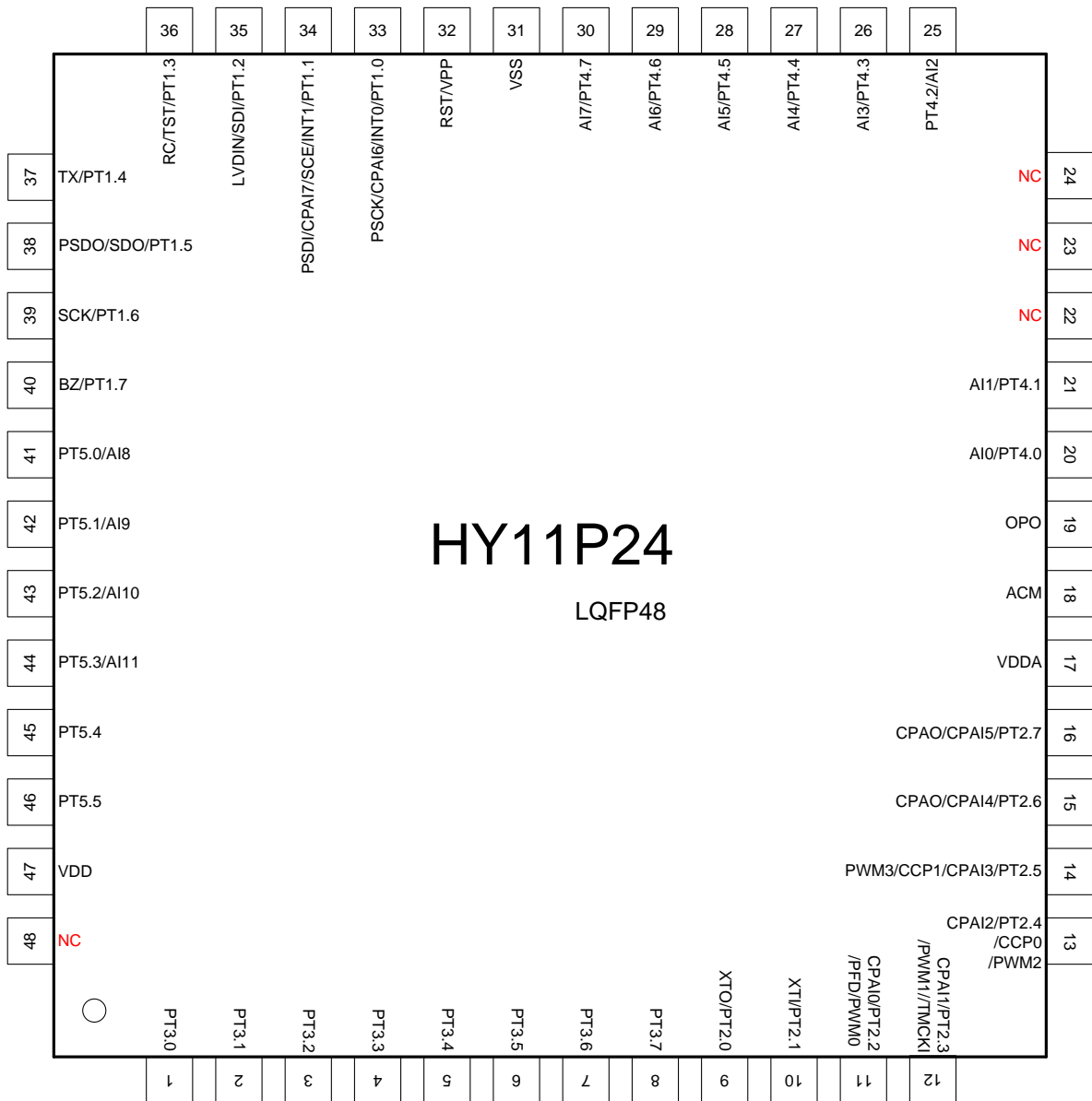


圖 2-1 HY11P24 LQFP48 引腳圖

註 1：VPP 與 RST 復用同一接口，非燒錄 EPROM 時禁止輸入電壓超過 5.8V

註 2：TST 與 PT1.3 復用同一接口，操作時禁止輸入電壓超過 VDD+0.3V

註 3：若不將 PT1.3 設定成外部引腳按鍵，可以提升抗干擾能力

## 2.3 I/O 引腳定義(LQFP44)

“I/O”輸入/輸出,“I”輸入,“O”輸出,“S”史密斯觸發,“C”CMOS 特性兼容輸出與輸入,“P”電壓源,“A”類比通道

編號	引腳名稱	引腳特性		功能說明	
		格式	緩衝		
1	PT4.3/AI3	PT4.3	I	C	數位輸入 類比輸入通道
		AI3	A	A	
2	PT4.4/AI4	PT4.4	I	C	數位輸入 類比輸入通道
		AI4	A	A	
3	PT4.5/AI5	PT4.5	I	C	數位輸入 類比輸入通道
		AI5	A	A	
4	PT4.6/AI6	PT4.6	I	C	數位輸入 類比輸入通道
		AI6	A	A	
5	PT4.7/AI7	PT4.7	I	C	數位輸入 類比輸入通道
		AI7	A	A	
6	VSS		P	P	晶片工作電壓源接地端
7	RST/VPP	RST	I	S	復位晶片
		VPP	P	P	EPROM 讀/寫時的電壓源
8	PT1.0/INT0/PSCK/CPAI6	PT1.0	I	S	數位輸入
		INT0	I	S	中斷源 INT0
		PSCK	I	S	OTP 讀/寫介面 SCK 接口
		CPAI6	I	A	ECPA 類比輸入通道
9	PT1.1/INT1/PSDI/SCE/CPAI7	PT1.1	I	S	數位輸入
		INT1	I	S	中斷源 INT1
		PSDI	I	S	OTP 讀/寫介面 SDI 接口
		SCE	I/O	S	SPI 通訊介面 SCE 接口
		CPAI7	I	A	ECPA 類比輸入通道
10	PT1.2/SDI/LVDIN	PT1.2	I	S	數位輸入
		SDI	I/O	S	SPI 通訊介面 SDI 接口



	LVDIN	A	A	LVD 外部信號輸入接口
11	PT1.3/TST/RC			
	PT1.3	I	S	數位輸入
	RC	I	S	EUART 通訊介面 RC 接口
	TST	I	S	測試模式致能輸入(未開放)
12	PT1.4/TX			
	PT1.4	I/O	S	數位輸入/輸出
	TX	I/O	S	EUART 通訊介面 TX 接口
13	PT1.5/PSDO/SDO			
	PT1.5	I/O	S	數位輸入/輸出
	PSDO	O	C	OTP 讀/寫介面 SDO 接口
	SDO	I/O	S	SPI 通訊介面 SDO 接口
14	PT1.6/SCK			
	PT1.6	I/O	S	數位輸入/輸出
	SCK	I/O	S	SPI 通訊介面 SCK 接口
15	PT1.7/BZ			
	PT1.7	I/O	S	數位輸入/輸出
	BZ	O	C	蜂鳴器輸出端
16	PT5.0/AI8			
	PT5.0	I	C	數位輸入
	AI8	A	A	類比輸入通道
17	PT5.1/AI9			
	PT5.1	I	C	數位輸入
	AI9	A	A	類比輸入通道
18	PT5.2/AI10			
	PT5.2	I	C	數位輸入
	AI10	A	A	類比輸入通道
19	PT5.3/AI11			
	PT5.3	I	C	數位輸入
	AI11	A	A	類比輸入通道
20	PT5.4	I	C	數位輸入
21	PT5.5	I	C	數位輸入
22	VDD	P	P	晶片工作電壓源
23	PT3.0	I/O	C	數位輸入/輸出
24	PT3.1	I/O	C	數位輸入/輸出
25	PT3.2	I/O	C	數位輸入/輸出
26	PT3.3	I/O	C	數位輸入/輸出
27	PT3.4	I/O	C	數位輸入/輸出

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28	PT3.5		I/O	C	數位輸入/輸出
29	PT3.6		I/O	C	數位輸入/輸出
30	PT3.7		I/O	C	數位輸入/輸出
31	PT2.0/XTO	PT2.0	I/O	S	數位輸入/輸出
		XTO	A	A	外接振盪器輸出端
32	PT2.1/XTI	PT2.1	I/O	S	數位輸入/輸出
		XTI	A	A	外接振盪器輸入端
33	PT2.2/PFD/CPAI0/PWM0	PT2.2	I/O	C	數位輸入/輸出
		PFD	O	C	PFD 輸出接口
		CPAI0	I	A	ECPA 類比輸入通道
		PWM0	O	C	PWM 輸出接口
34	PT2.3/TMCKI/CPAI1/PWM1	PT2.3	I/O	S	數位輸入/輸出
		TMCKI	I	S	TIMERC 時脈源輸入接口
		CPAI1	I	A	ECPA 類比輸入通道
		PWM1	O	C	PWM 輸出接口
35	PT2.4/CCP0/CPAI2/PWM2	PT2.4	I/O	S	數位輸入/輸出
		CCP0	I	S	捕捉/比較模式信號接口
		CPAI2	I	A	ECPA 類比輸入通道
		PWM2	O	C	PWM 輸出接口
36	PT2.5/CCP1/CPAI3/PWM3	PT2.5	I/O	S	數位輸入/輸出
		CCP1	I	S	捕捉/比較模式信號接口
		CPAI3	I	A	ECPA 類比輸入通道
		PWM3	O	C	PWM 輸出接口
37	PT2.6/CPAI4/CPAO	PT2.6	I/O	C	數位輸入/輸出
		CPAI4	I	A	ECPA 類比輸入通道
		CPAO	I	A	ECPA 比較器輸出接口
38	PT2.7/CPAI5/CPAO	PT2.7	I/O	C	數位輸入/輸出
		CPAI5	I	A	ECPA 類比輸入通道
		CPAO	I	A	ECPA 比較器輸出接口
39	VDDA		P	P	穩壓器輸出 · 類比電路電壓源

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40	ACM		P	P	內部類比電路共地電源
41	OPO		A	A	運算放大器輸出
42	PT4.0/AI0	PT4.0 AI0	I A	C A	數位輸入 類比輸入通道
43	PT4.1/AI1	PT4.1 AI1	I A	C A	數位輸入 類比輸入通道
44	PT4.2/AI2	PT4.2 AI2	I A	C A	數位輸入 類比輸入通道

表 2-1 引腳定義與功能說明

### 2.4 I/O 引腳定義(LQFP48)

“I/O”輸入/輸出,“I”輸入,“O”輸出,“S”史密斯觸發,“C”CMOS 特性兼容輸出與輸入,“P”電壓源,“A”類比通道

編號	引腳名稱	引腳特性		功能說明	
		格式	緩衝		
1	PT3.0	I/O	C	數位輸入/輸出	
2	PT3.1	I/O	C	數位輸入/輸出	
3	PT3.2	I/O	C	數位輸入/輸出	
4	PT3.3	I/O	C	數位輸入/輸出	
5	PT3.4	I/O	C	數位輸入/輸出	
6	PT3.5	I/O	C	數位輸入/輸出	
7	PT3.6	I/O	C	數位輸入/輸出	
8	PT3.7	I/O	C	數位輸入/輸出	
9	PT2.0/XTO	PT2.0	I/O	S	數位輸入/輸出
		XTO	A	A	外接振盪器輸出端
10	PT2.1/XTI	PT2.1	I/O	S	數位輸入/輸出
		XTI	A	A	外接振盪器輸入端
11	PT2.2/PFD/CPAI0/PWM0	PT2.2	I/O	C	數位輸入/輸出
		PFD	O	C	PFD 輸出接口
		CPAI0	I	A	ECPA 類比輸入通道
		PWM0	O	C	PWM 輸出接口
12	PT2.3/TMCKI/CPAI1/PWM1	PT2.3	I/O	S	數位輸入/輸出
		TMCKI	I	S	TIMERC 時脈源輸入接口
		CPAI1	I	A	ECPA 類比輸入通道
		PWM1	O	C	PWM 輸出接口
13	PT2.4/CCP0/CPAI2/PWM2	PT2.4	I/O	S	數位輸入/輸出
		CCP0	I	S	捕捉/比較模式信號接口
		CPAI2	I	A	ECPA 類比輸入通道
		PWM2	O	C	PWM 輸出接口
14	PT2.5/CCP1/CPAI3/PWM3	PT2.5	I/O	S	數位輸入/輸出
		CCP1	I	S	捕捉/比較模式信號接口
		CPAI3	I	A	ECPA 類比輸入通道

	PWM3	O	C	PWM 輸出接口
15	PT2.6/CPAI4/CPAO			
	PT2.6	I/O	C	數位輸入/輸出
	CPAI4	I	A	ECPA 類比輸入通道
	CPAO	I	A	ECPA 比較器輸出接口
16	PT2.7/CPAI5/CPAO			
	PT2.7	I/O	C	數位輸入/輸出
	CPAI5	I	A	ECPA 類比輸入通道
	CPAO	I	A	ECPA 比較器輸出接口
17	VDDA	P	P	穩壓器輸出·類比電路電壓源
18	ACM	P	P	內部類比電路共地電源
19	OPO	A	A	運算放大器輸出
20	PT4.0/AI0			
	PT4.0	I	C	數位輸入
	AI0	A	A	類比輸入通道
21	PT4.1/AI1			
	PT4.1	I	C	數位輸入
	AI1	A	A	類比輸入通道
22	NC	-	-	未使用
23	NC	-	-	未使用
24	NC	-	-	未使用
25	PT4.2/AI2			
	PT4.2	I	C	數位輸入
	AI2	A	A	類比輸入通道
26	PT4.3/AI3			
	PT4.3	I	C	數位輸入
	AI3	A	A	類比輸入通道
27	PT4.4/AI4			
	PT4.4	I	C	數位輸入
	AI4	A	A	類比輸入通道
28	PT4.5/AI5			
	PT4.5	I	C	數位輸入
	AI5	A	A	類比輸入通道
29	PT4.6/AI6			
	PT4.6	I	C	數位輸入
	AI6	A	A	類比輸入通道
30	PT4.7/AI7			
	PT4.7	I	C	數位輸入

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	AI7	A	A	類比輸入通道
31	VSS	P	P	晶片工作電壓源接地端
32	RST/VPP			
	RST	I	S	復位晶片
	VPP	P	P	EPROM 讀/寫時的電壓源
33	PT1.0/INT0/PSCK/CPAI6			
	PT1.0	I	S	數位輸入
	INT0	I	S	中斷源 INT0
	PSCK	I	S	OTP 讀/寫介面 SCK 接口
	CPAI6	I	A	ECPA 類比輸入通道
34	PT1.1/INT1/PSDI/SCE/CPAI7			
	PT1.1	I	S	數位輸入
	INT1	I	S	中斷源 INT1
	PSDI	I	S	OTP 讀/寫介面 SDI 接口
	SCE	I/O	S	SPI 通訊介面 SCE 接口
	CPAI7	I	A	ECPA 類比輸入通道
35	PT1.2/SDI/LVDIN			
	PT1.2	I	S	數位輸入
	SDI	I/O	S	SPI 通訊介面 SDI 接口
	LVDIN	A	A	LVD 外部信號輸入接口
36	PT1.3/TST/RC			
	PT1.3	I	S	數位輸入
	RC	I	S	EUART 通訊介面 RC 接口
	TST	I	S	測試模式致能輸入(未開放)
37	PT1.4/TX			
	PT1.4	I/O	S	數位輸入/輸出
	TX	I/O	S	EUART 通訊介面 TX 接口
38	PT1.5/PSDO/SDO			
	PT1.5	I/O	S	數位輸入/輸出
	PSDO	O	C	OTP 讀/寫介面 SDO 接口
	SDO	I/O	S	SPI 通訊介面 SDO 接口
39	PT1.6/SCK			
	PT1.6	I/O	S	數位輸入/輸出
	SCK	I/O	S	SPI 通訊介面 SCK 接口
40	PT1.7/BZ			
	PT1.7	I/O	S	數位輸入/輸出
	BZ	O	C	蜂鳴器輸出端
41	PT5.0/AI8			

		PT5.0 AI8	I A	C A	數位輸入 類比輸入通道
42	PT5.1/AI9	PT5.1 AI9	I A	C A	數位輸入 類比輸入通道
43	PT5.2/AI10	PT5.2 AI10	I A	C A	數位輸入 類比輸入通道
44	PT5.3/AI11	PT5.3 AI11	I A	C A	數位輸入 類比輸入通道
45	PT5.4		I	C	數位輸入
46	PT5.5		I	C	數位輸入
47	VDD		P	P	晶片工作電壓源
48	NC		-	-	未使用

表 2-2 引腳定義與功能說明

## 3. 應用電路

### 3.1 四組橋式感測器 I

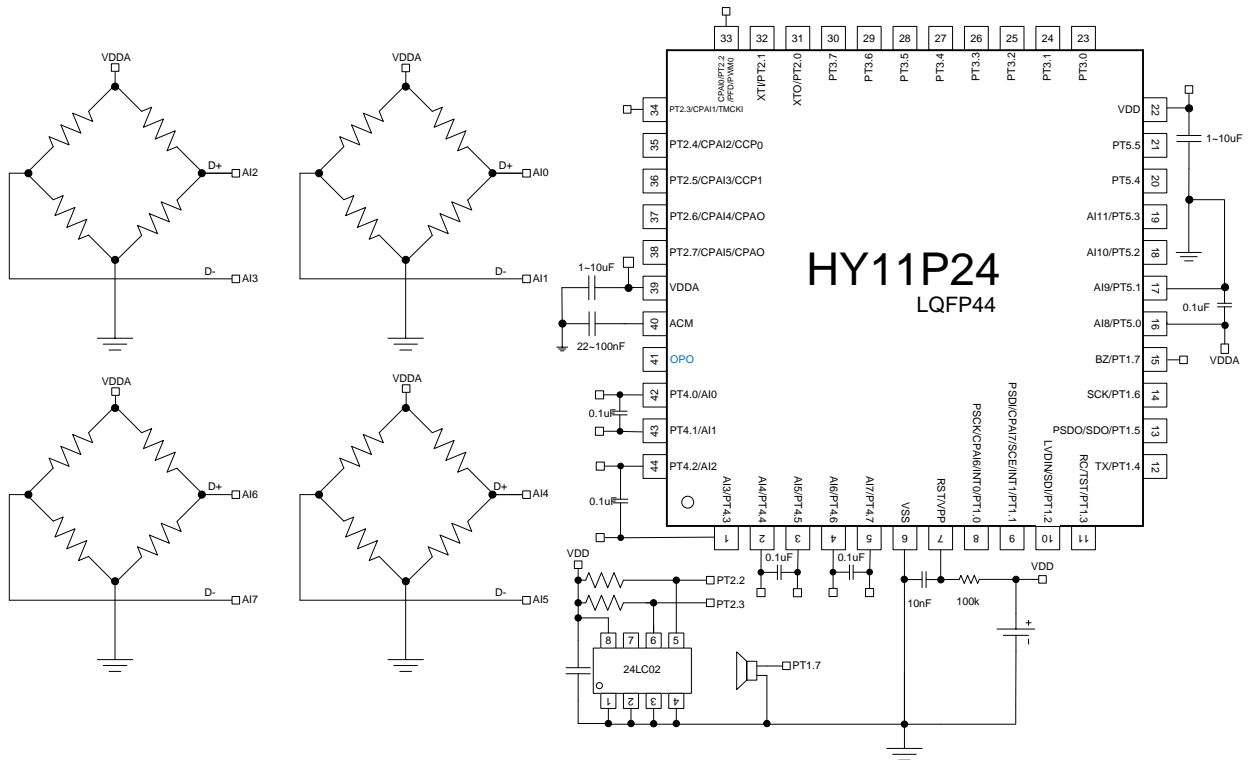


圖 3-1 橋式感測器應用電路

註：關於 Load Cell 零點電壓位置可透過 DCSET[2:0]進行偏壓調整



### 3.2 四組橋式感測器 II

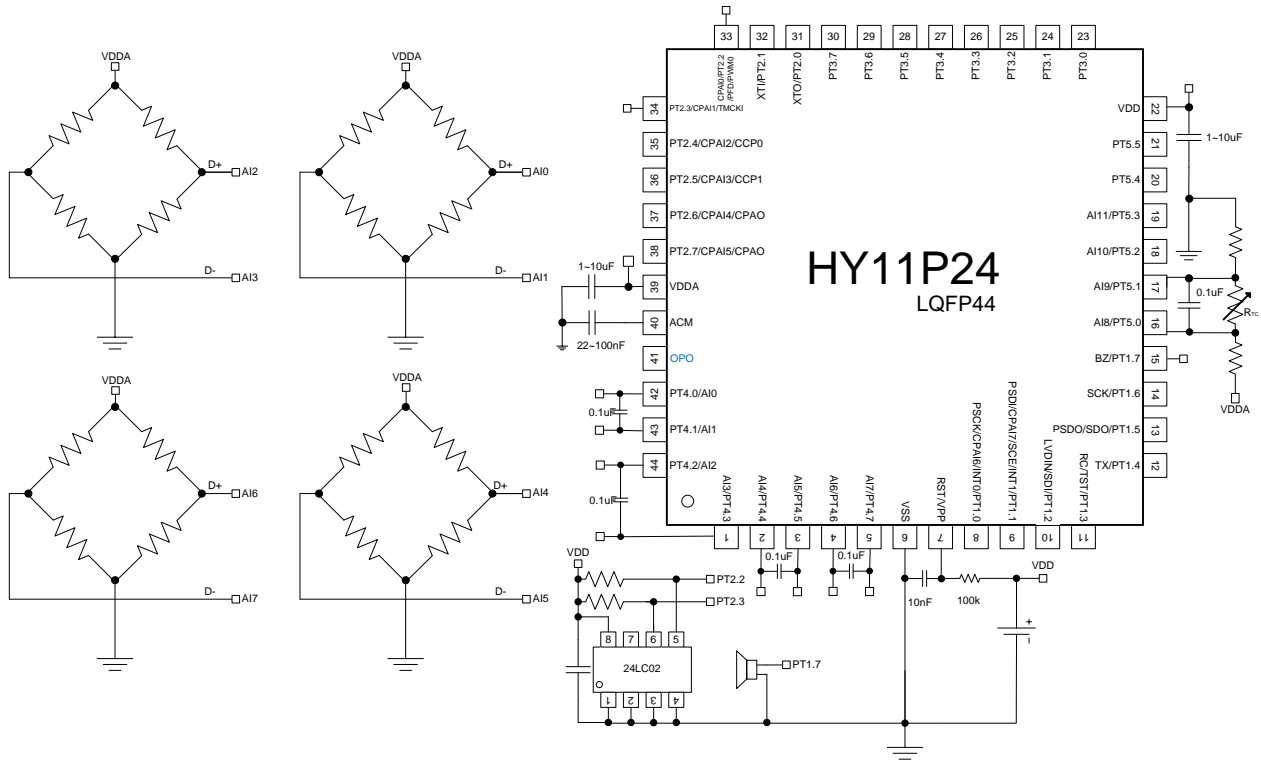


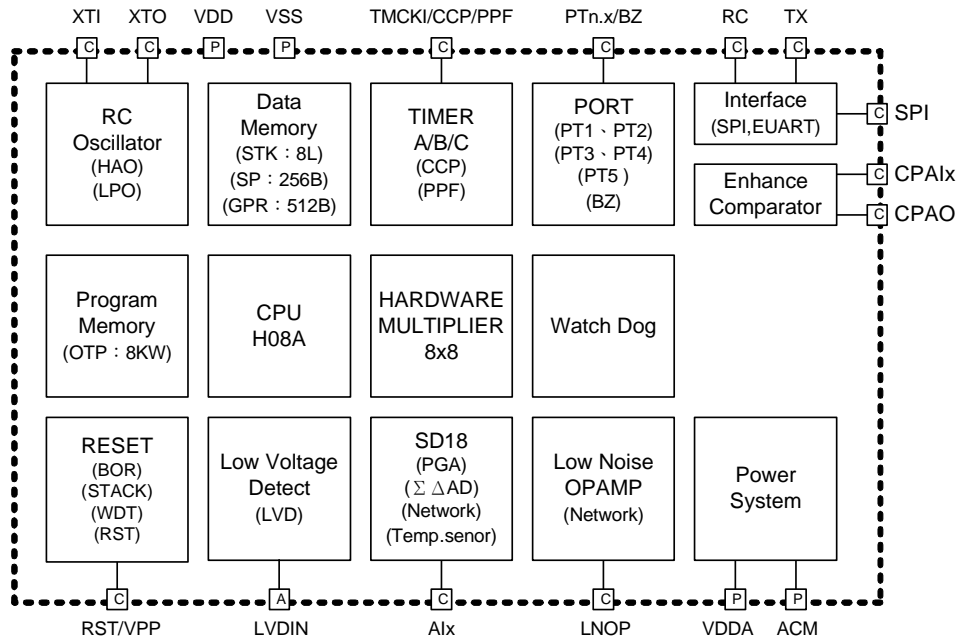
圖 3-2 具溫度補償的橋式感測器應用電路

註：使用溫度補償電阻 NTC 基本線路

註：關於 Load Cell 零點電壓位置可透過 DCSET[2:0]進行偏壓調整

## 4. 功能概述

### 4.1 內部方塊圖



P Power Pad  
 D Digital Pad  
 A Analog Pad  
 C Common I/O Pad

圖 4-1 HY11P24 內部方塊圖

### 4.2 相關說明與支援文件

晶片功能相關使用說明書

DS-HY11P24-Vxx    HY11P24 說明書

UG-HY11S14-Vxx    HY11Pxx 系列使用說明書

APD-CORE002-Vxx    H08A 指令說明書

開發工具相關使用說明書

# HY11P24

Embedded 18-Bit  $\Sigma\Delta$ ADC  
8-Bit RISC-like Mixed Signal Microcontroller



APD-HYIDE006-Vxx HY11xxx 系列開發工具軟體使用說明書

APD-HYIDE005-Vxx HY11xxx 系列開發工具硬體使用說明書

APD-OTP001-Vxx OTP 產品燒錄引腳說明書

產品生產相關使用說明書

APD-HYIDE004-Vxx HY1xxxx 系列生產線專用燒錄器說明書

BDI-HY11P24-Vxx HY11P24 個別產品的裸片打線資訊

## 4.3 SD18 Network

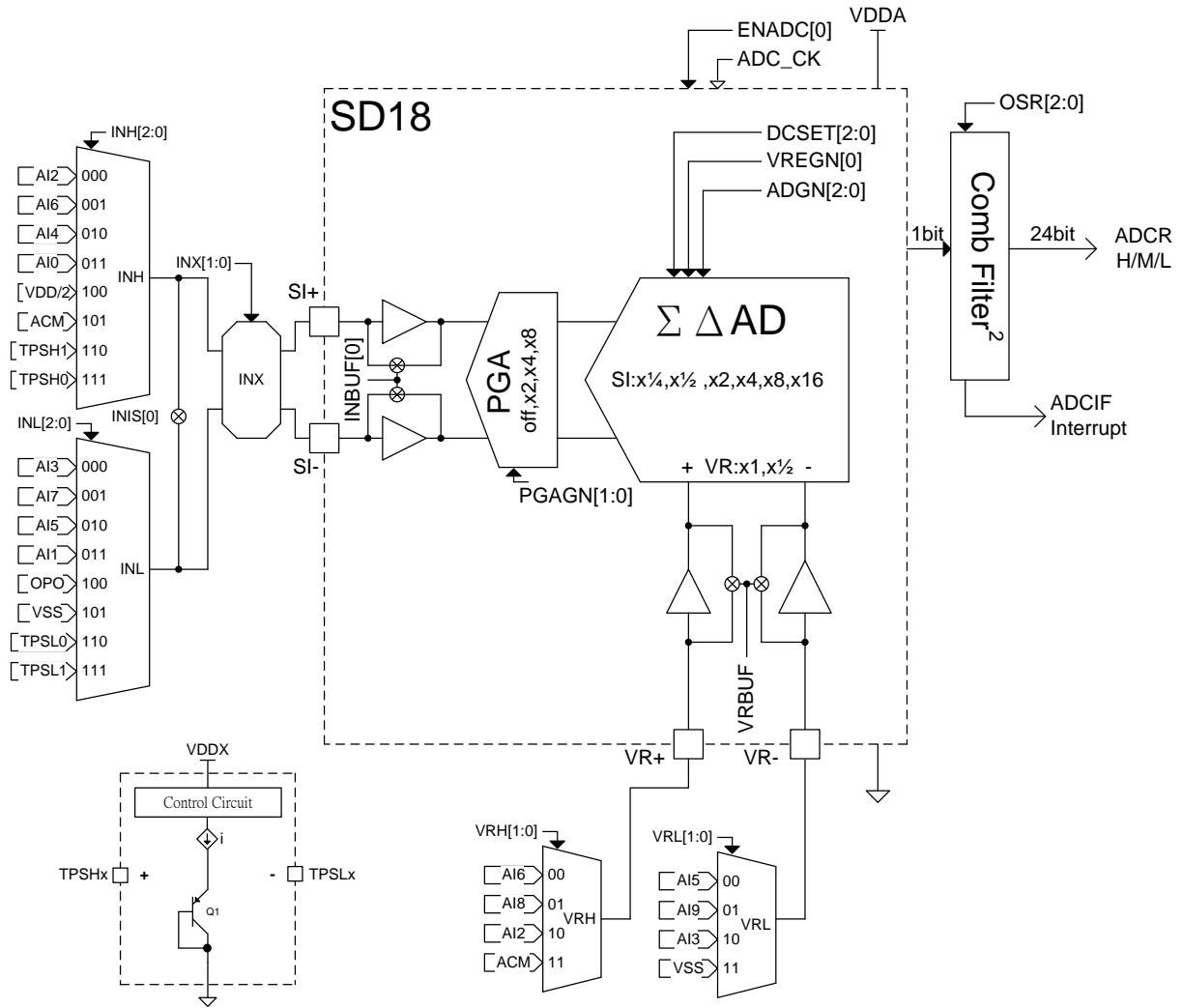


圖 4-2 SD18 Network

## 4.4 Low Noise OPAMP Network

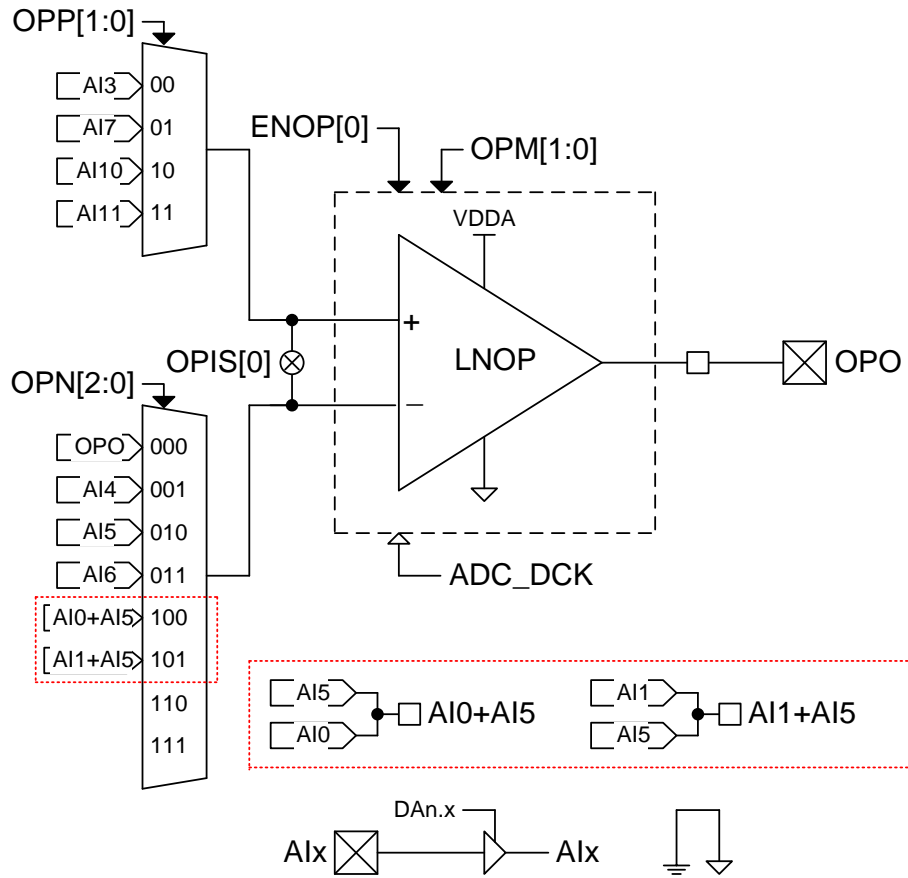


圖 4-3 Low Noise OPAMP Network

## 4.5 Enhance Comparator Network

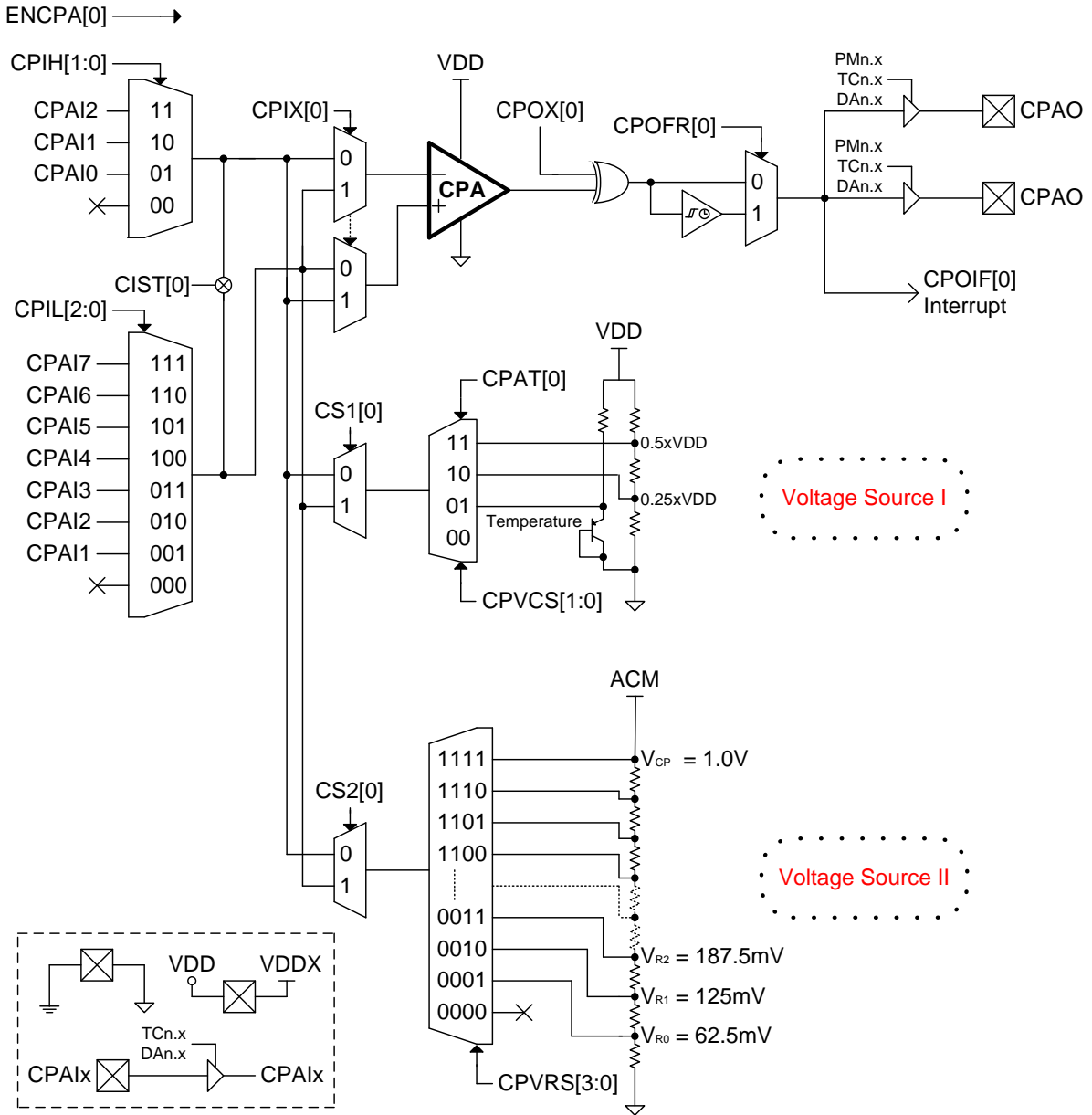


圖 4-4 Enhance Comparator Network

### 5. 暫存器列表

“r”no use,“w”read/write,“w”write,“r”read,“r0”only read 0,“r1”only read 1,“w0”only write 0,“w1”only write 1															
“.”unimplemented bit,“x”unknown,“u”unchanged,“d”depends on condition															
Address	File Name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	A-RESET	i-RESET	R/W			
00H	INDF0	Contents of FSR0 to address data memory value of FSR0 not changed								N/A	N/A	*****			
01H	POINC0	Contents of FSR0 to address data memory value of FSR0 post-incremented								N/A	N/A	*****			
02H	PODEC0	Contents of FSR0 to address data memory value of FSR0 post-decremented								N/A	N/A	*****			
03H	PRINC0	Contents of FSR0 to address data memory value of FSR0 pre-incremented								N/A	N/A	*****			
04H	PLUSW0	Contents of FSR0 to address data memory value of FSR0 offset by W								N/A	N/A	*****			
05H	INDF1	Contents of FSR1 to address data memory value of FSR0 not changed								N/A	N/A	*****			
06H	POINC1	Contents of FSR1 to address data memory value of FSR0 post-decremented								N/A	N/A	*****			
07H	PODEC1	Contents of FSR1 to address data memory value of FSR0 post-decremented								N/A	N/A	*****			
08H	PRINC1	Contents of FSR1 to address data memory value of FSR0 pre-incremented								N/A	N/A	*****			
09H	PLUSW1	Contents of FSR1 to address data memory value of FSR0 offset by W								N/A	N/A	*****			
0FH	FSROH							FSR0[9]	FSR0[8]	....xx	....uu	*****			
10H	FSR0L	Indirect Data Memory Address Pointer 0 Low Byte,FSR0[7:0]								xxxx xxxx	uuuu uuuu	*****			
11H	FSR1H							FSR1[9]	FSR1[8]	....xx	....uu	*****			
12H	FSR1L	Indirect Data Memory Address Pointer 1 Low Byte,FSR1[7:0]								xxxx xxxx	uuuu uuuu	*****			
16H	TOSH			TOS[12]	TOS[11]	TOS[10]	TOS[9]	TOS[8]		...0 0000	...0 0000	*****			
17H	TOSL	Top-of-Stack Low Byte (TOS<7:0>)								0000 0000	0000 0000	*****			
18H	STKPTR	STKFL	STKUN	STKOV	STKPTR[3:0]								000. 0000	000. 0000	r,r,w0,rw0,-r,r,r,r
1AH	PCLATH				PC[12]	PC[11]	PC[10]	PC[9]	PC[8]	...0 0000	...0 0000	*****			
1BH	PCLATL	PC Low Byte for PC<7:0>								0000 0000	0000 0000	*****			
1DH	TBLPTRH				TBLPTR[12]	TBLPTR[11]	TBLPTR[10]	TBLPTR[9]	TBLPTR[8]	...0 0000	...0 0000	*****			
1EH	TBLPTRL	Program Memory Table Pointer Low Byte (TBLPTR<7:0>)								0000 0000	0000 0000	*****			
1FH	TBLDH	Program Memory Table Latch High Byte								0000 0000	0000 0000	*****			
20H	TBLDL	Program Memory Table Latch Low Byte								0000 0000	0000 0000	*****			
21H	PRODH	Product Register of Multiply High Byte								xxxx xxxx	uuuu uuuu	r,r,r,r,r,r,r,r			
22H	PRODL	Product Register of Multiply Low Byte								xxxx xxxx	uuuu uuuu	r,r,r,r,r,r,r,r			
23H	INTE1	GIE	ADCIE	TMCIE	TMBIE	TMAIE	WDTIE	E1IE	E0IE	0000 0000	0000 0000	*****			
24H	INTE2	TXIE	RCIE			CPOIE	SSPIE	CCP1IE	CCP0IE	00.. 0000	00.. 0000	*****			
26H	INTF1		ADCIF	TMCIF	TMBIF	TMAIF	WDTIF	E1IF	E0IF	.000 0000	.000 0000	*****			
27H	INTF2	TXIF	RCIF			CPOIF	SSPIF	CCP1IF	CCP0IF	00.. 0000	00.. 0000	*****			
29H	WREG	Working Register								xxxx xxxx	uuuu uuuu	*****			
2AH	BSRCN							BSR[1]	BSR[0]	....00	....00	*****			
2BH	STATUS				C	DC	N	OV	Z	...x xxxx	...u uuuu	*****			
2CH	Pstaus	PD	TO	IDL	BOR		SKERR			000d .0.	u0uu .d.	rw0,rw0,rw0,rw0,-rw0,-r-			
2DH	LVDCN		LVDFG	LVD	LVDON	VLDX[3:0]				.000 0000	.000 uuuu	*****			
30H	PWRCN	ENVDDA	VDDAX[1:0]	ENACM						0000 ....	0000 ....	*****			
31H	MCKCN1	ADCS[2:0]		ADCK	XTHSP	XTSP	ENXT	ENHAO		0000 0001	0000 0001	*****			
32H	MCKCN2		LCK	HCK	HSS[1:0]		CPUCK[1:0]			.00 0000	.00 0000	*****			
33H	MCKCN3				PERCK	BZS[2:0]				.... 0000	.... 0000	*****			
34H	CPACN1	ENCPA	CPIST	CPIX	CPIH[1:0]		CPIL[2:0]			0000 0000	0000 0000	*****			
35H	CPACN2		CPOX	CPOFR	CS1	CPAT	CPVCS[1:0]			.000 000.	.000 000.	*****			
36H	CPACN3				CS2	CPVRX[3:0]				...0 0000	...0 0000	*****			
37H	OPCN1	ENOP	OPM[1:0]		OPP[1:0]		OPN[2:0]			0000 0000	0000 0000	*****			
39H	ADCRH	ADC conversion memory HighByte								xxxx xxxx	uuuu uuuu	r,r,r,r,r,r,r,r			
3AH	ADCRM	ADC conversion memory Middle Byte								xxxx xxxx	uuuu uuuu	r,r,r,r,r,r,r,r			
3BH	ADCRL	ADC conversion memory Low Byte								xxxx xxxx	uuuu uuuu	r,r,r,r,r,r,r,r			
3CH	ADCCN1	ENADC	ENHIGN	ENCHP	PGAGN[1:0]		ADGN[2:0]			0000 0000	0000 0000	*****			
3DH	ADCCN2			INBUF	VRBUF	VREGN	DCSET[2:0]			.00 0000	.00 0000	*****			
3EH	ADCCN3	OSR[2:0]								000. ....	000. ....	*****			
3FH	AINET1	INH[2:0]			INL[2:0]			INIS	OPIS	0000 0000	0000 0000	*****			
40H	AINET2	VRH[1:0]		INX[1:0]		VRL[1:0]				.000 000.	.000 000.	*****			
41H	TMACN	ENTMA	TMACK	TMAS[1:0]		ENWDT	WDTs[2:0]			0000 0000	0000 0000	***** w1,***			
42H	TMAR	TimerA data register								xxxx xxxx	uuuu uuuu	r,r,r,r,r,r,r,r			
43H	TMBCN	ENTMB	TMACK	TMBS[1:0]		TMBSYC	TMBR2R			0000 00..	0000 00..	*****			
44H	TMBRH	TimerB High Byte data register								xxxx xxxx	uuuu uuuu	*****			
45H	TMBRL	TimerB Low Byte data register								xxxx xxxx	uuuu uuuu	*****			
46H	TMCCN	ENTMC	TMCCK[1:0]		TMCS[2:0]		TMCS0[1:0]			0000 0000	0000 0000	*****			
47H	PRC	TimerC programmable register								1111 1111	1111 1111	*****			
48H	TMCR	TimerC register								0000 0000	0000 0000	r,r,r,r,r,r,r,r			
49H	CCPCN	CCP1M[3:0]				CCP0M[3:0]					0000 0000	0000 0000	*****		
4AH	CCP0RH	CCP0 High Byte data register								xxxx xxxx	uuuu uuuu	*****			
4BH	CCP0RL	CCP0 Low Byte data register								xxxx xxxx	uuuu uuuu	*****			
4CH	CCP1RH	CCP1 High Byte data register								xxxx xxxx	uuuu uuuu	*****			
4DH	CCP1RL	CCP1 Low Byte data register								xxxx xxxx	uuuu uuuu	*****			
4EH	PASC	PASF	PASC[1:0]							0.00 ....	0.00 ....	*****			
4FH	PWMCN	ENPWM	ENPFD	PWMRL[1:0]						0000 ....	0000 ....	*****			
50H	PDBD	ENPRS	DBDC[6:0]								0000 0000	0000 0000	*****		
51H	PWMR	PWM MSB Byte register								xxxx xxxx	uuuu uuuu	*****			

表 5-1(a) HY11P24 暫存器列表

# HY11P24

## Embedded 18-Bit $\Sigma$ ADC 8-Bit RISC-like Mixed Signal Microcontroller

“.”no use,“\*”read/write,“w”write,“r”read,“r0”only read 0,“r1”only read 1,“w0”only write 0,“w1”only write 1  
“.”unimplemented bit,“x”unknown,“u”unchanged,“d”depends on condition

Address	File Name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	A-RESET	i-RESET	R/W	
5EH	SSPCON1	SSPEN	CKP	CKE	SMP	—	—	SSPM<1:0>		0000 ..00	uuuu ..uu	***r***	
60H	SSPSTA	SSPBUY	SSPOV	Reserve for IIC						BF	00... ..0	00... ..0	r,r,r,r,r,r,r,f
61H	SSPBUF	SSP Receive Buffer/Transmit Register									xxxx xxxx	uuuu uuuu	***r***
63H	URCON	ENSP	ENTX	TX9	TX9D	PARITY	—	—	WUE	0000 0..0	0000 0..0	***r***	
64H	URSTA	—	RC9D	PERR	FERR	OERR	RCIDL	TRMT	ABDOVF	.000 0110	.000 0110	r,r,r,r,r,r,r,w0	
65H	BAUDCON	—	—	—	—	ENCR	RC9	ENADD	ENABD	.... 0000	.... 0000	r,r,r,r,r,r,r,f	
66H	BRGRH	Baud Rate Generator Register High Byte									...x xxxx	...u uuuu	***r***
67H	BRGRL	Baud Rate Generator Register Low Byte									xxxx xxxx	uuuu uuuu	***r***
68H	TXREG	UART Transmit Register									xxxx xxxx	uuuu uuuu	***r***
69H	RCREG	UART Receive Register									xxxx xxxx	uuuu uuuu	r,r,r,r,r,r,r,f
6AH	PT4	PT4.7	PT4.6	PT4.5	PT4.4	PT4.3	PT4.2	PT4.1	PT4.0	xxxx xxxx	uuuu uuuu	r,r,r,r,r,r,r,f	
6BH	PT4DA	DA4.7	DA4.6	DA4.5	DA4.4	DA4.3	DA4.2	DA4.1	DA4.0	1111 1111	1111 1111	***r***	
6CH	PT4PU	PU4.7	PU4.6	PU4.5	PU4.4	PU4.3	PU4.2	PU4.1	PU4.0	0000 0000	0000 0000	***r***	
6DH	PT1	PT1.7	PT1.6	PT1.5	PT1.4	PT1.3	PT1.2	PT1.1	PT1.0	xxxx xxxx	uuuu uuuu	***r,r,r,r	
6EH	TRISC1	TC1.7	TC1.6	TC1.5	TC1.4	—	—	—	—	0000 ....	0000 ....	***r***	
6FH	PT1DA	—	—	—	—	—	DA1.2	DA1.1	DA1.0	.... .000	.... .000	r,r,r,r,r,r,f	
70H	PT1PU	PU1.7	PU1.6	PU1.5	PU1.4	PU1.3	PU1.2	PU1.1	PU1.0	0000 0000	0000 0000	***r***	
71H	PT1M1	—	—	—	—	INTEG1[1:0]		INTEG0[1:0]		.... 0000	.... 0000	r,r,r,r,r,r,f	
72H	PT1M2	—	PM1.7[0]	—	PM1.6[0]	—	PM1.5[0]	—	PM1.4[0]	.0.0 0.0	.0.0 0.0	r,r,r,r,r,r,f	
74H	PT2	PT2.7	PT2.6	PT2.5	PT2.4	PT2.3	PT2.2	PT2.1	PT2.0	xxxx xxxx	uuuu uuuu	***r***	
75H	TRISC2	TC2.7	TC2.6	TC2.5	TC2.4	TC2.3	TC2.2	TC2.1	TC2.0	0000 0000	0000 0000	***r***	
76H	PT2DA	DA2.7	DA2.6	DA2.5	DA2.4	DA2.3	DA2.2	—	—	0000 00..	0000 00..	***r***	
77H	PT2PU	PU2.7	PU2.6	PU2.5	PU2.4	PU2.3	PU2.2	PU2.1	PU2.0	0000 0000	0000 0000	***r***	
78H	PT2M1	—	PM2.3[0]	PM2.2[1]	PM2.2[0]	—	—	—	—	.000 ....	.000 ....	r,r,r,r,r,r,f	
79H	PT2M2	PWMTR[1:0]		PM2.6[0]	PM2.5[1]	PM2.5[0]	PM2.4[1]	PM2.4[0]	—	00.0 0000	00.0 0000	***r***	
7AH	PT3	PT3.7	PT3.6	PT3.5	PT3.4	PT3.3	PT3.2	PT3.1	PT3.0	xxxx xxxx	uuuu uuuu	***r***	
7BH	TRISC3	TC3.7	TC3.6	TC3.5	TC3.4	TC3.3	TC3.2	TC3.1	TC3.0	0000 0000	0000 0000	***r***	
7DH	PT3PU	PU3.7	PU3.6	PU3.5	PU3.4	PU3.3	PU3.2	PU3.1	PU3.0	0000 0000	0000 0000	***r***	
80H ~ FFH	—	GENERAL PURPOSE REGISTER @ 128Byte									xxxx xxxx	uuuu uuuu	***r***
100H ~ 17FH	—	GENERAL PURPOSE REGISTER @ 128Byte									xxxx xxxx	uuuu uuuu	***r***
192H	PT5	—	—	PT5.5	PT5.4	PT5.3	PT5.2	PT5.1	PT5.0	..xx xxxx	..xx uuuu	r,r,r,r,r,r,f	
193H	PT5DA	—	—	—	—	DA5.3	DA5.2	DA5.1	DA5.0	.... 1111	.... 1111	r,r,r,r,r,r,f	
194H	PT5PU	—	—	PU5.5	PU5.4	PU5.3	PU5.2	PU5.1	PU5.0	..00 0000	..00 0000	r,r,r,r,r,r,f	
200H ~ 2FFH	—	GENERAL PURPOSE REGISTER @ 256Byte									xxxx xxxx	uuuu uuuu	***r***

圖 5-1(b) HY11P24 暫存器列表(續)



## 6. 電氣特性

Absolute maximum ratings over operating free-air temperature (unless otherwise noted)

Voltage applied at $V_{DD}$ to $V_{SS}$	-0.2 V to 4.0 V
Voltage applied to any pin	-0.2 V to $V_{DD} + 0.3$ V
Voltage applied to RST/VPP pin	-0.2 V to 6.9 V
Voltage applied to TST/PT1.3 pin	-0.2 V to $V_{DD} + 1$ V
Diode current at any device terminal	$\pm 2$ mA
Storage temperature, Tstg: (unprogrammed device)	-55°C to 150°C
(programmed device)	-40°C to 85°C
Total power dissipation	0.5w
Maximum output current sink by any PORT1 to PORT3 I/O pin	25mA

### 6.1 Recommended operating conditions

$T_A = -40^\circ\text{C} \sim 85^\circ\text{C}$ , unless otherwise noted

Sym.	Parameter		Test Conditions	Min.	Typ.	Max.	unit	
$V_{DD}$	Supply Voltage		All digital peripherals and CPU	2.2		3.6	V	
			Analog peripherals	2.4		3.6		
$V_{SS}$	Supply Voltage			0		0		
XT	External	Watch crystal	$V_{DD} = 2.2\text{V}$ , ENXT[0]=1	XTSP[0]=0, XTHSP[0]=0		32.768K	Hz	
	Oscillator	Ceramic resonator		XTSP[0]=1, XTHSP[0]=0		450K		8M
	Frequency	Crystal		XTSP[0]=1, XTHSP[0]=0		1M		8M

## 6.2 Internal RC Oscillator

$T_A = 25^\circ\text{C}, V_{DD} = 3.0\text{V}$ , unless otherwise noted

Sym.	Parameter	Test Conditions	Min.	Typ.	Max.	unit
HAO	High Speed Oscillator frequency	ENHAO[0]=1	1.8	2.0	2.2	MHz
LPO	Low Power Oscillator frequency	$V_{DD}$ supply voltage be enable LPO	22	28	35	KHz

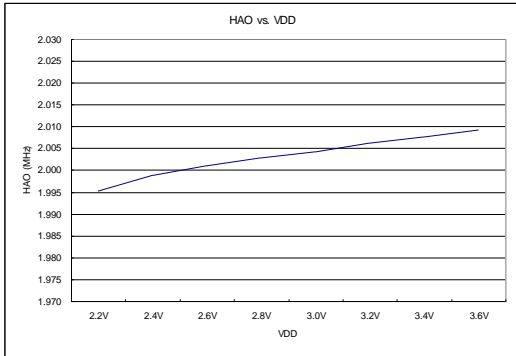


Figure 6.2-1 HAO vs. VDD

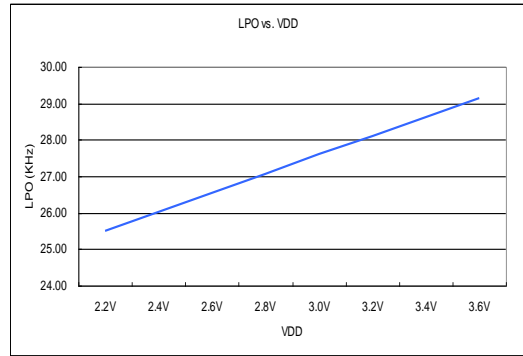


Figure 6.2-2 LPO vs. VDD

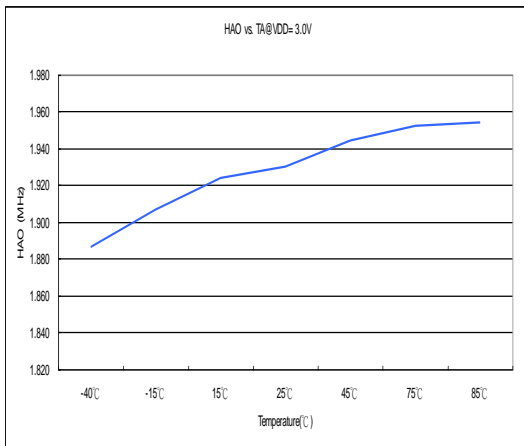


Figure 6.2-3 HAO vs. Temperature

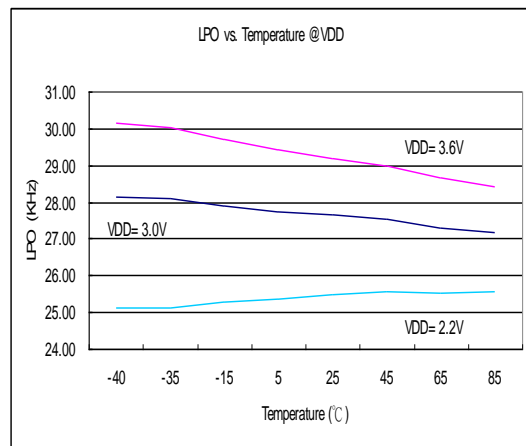


Figure 6.2-4 LPO vs. Temperature

### 6.3 Supply current into VDD excluding peripherals current

$T_A = 25^\circ\text{C}, V_{DD} = 3.0\text{V}, \text{OSC\_LPO} = 28\text{KHz}$ , unless otherwise noted

Sym.	Parameter	Test Conditions	Min.	Typ.	Max.	unit
$I_{AM1}$	Active mode 1	OSC_CY = 8MHz, OSC_HAO = off, CPU_CK = 8MHz		1.34	2	mA
$I_{AM2}$	Active mode 2	OSC_CY = off, OSC_HAO = 2MHz, CPU_CK = 2MHz		0.36	0.55	mA
$I_{AM3}$	Active mode 3	OSC_CY = off, OSC_HAO = 2MHz, CPU_CK = 1MHz		0.2	0.3	mA
$I_{LP1}$	Low Power 1	OSC_CY = 32768Hz, OSC_HAO = off, CPU_CK = 16384Hz		7	12	$\mu\text{A}$
$I_{LP2}$	Low Power 2	OSC_CY = off, OSC_HAO = off, CPU_CK = LPO, Idle state		1.65	3	$\mu\text{A}$
$I_{LP3}$	Low Power 3	OSC_CY = off, OSC_HAO = off, CPU_CK = off, Sleep state		0.65	1.2	$\mu\text{A}$

OSC\_CY : External Oscillator frequency.

OSC\_HAO : Internal High Accuracy Oscillator frequency.

CPU\_CK : CPU core work frequency.

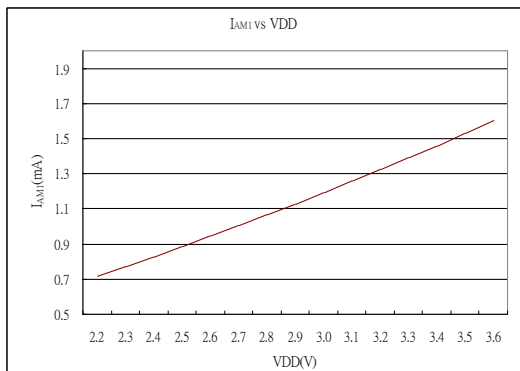


Figure 6.3-1  $I_{AM1}$  vs. VDD

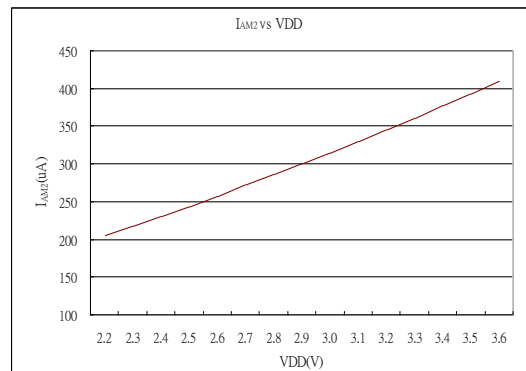


Figure 6.3-2  $I_{AM2}$  vs. VDD

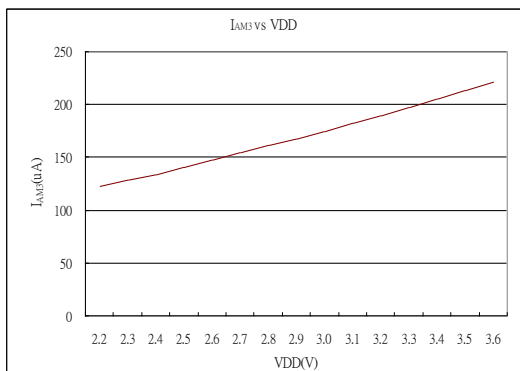


Figure 6.3-3  $I_{AM3}$  vs. VDD

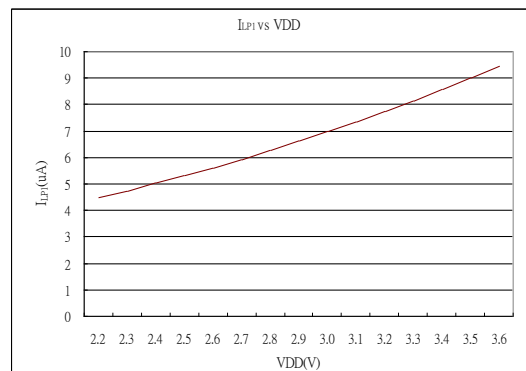


Figure 6.3-4  $I_{LP1}$  vs. VDD

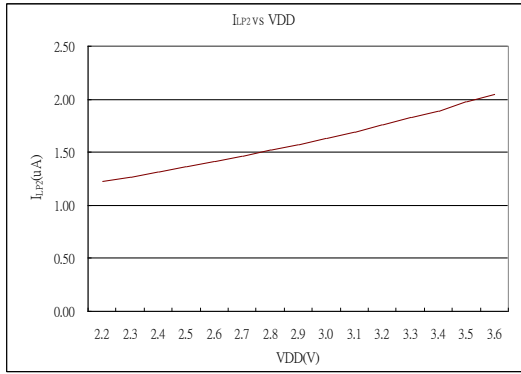


Figure 6.3-5 I<sub>LP2</sub> vs. VDD

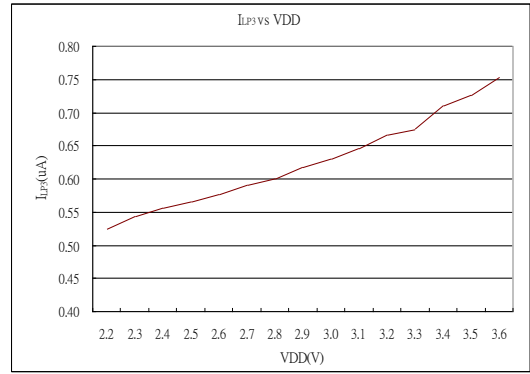


Figure 6.3-6 I<sub>LP3</sub> vs. VDD

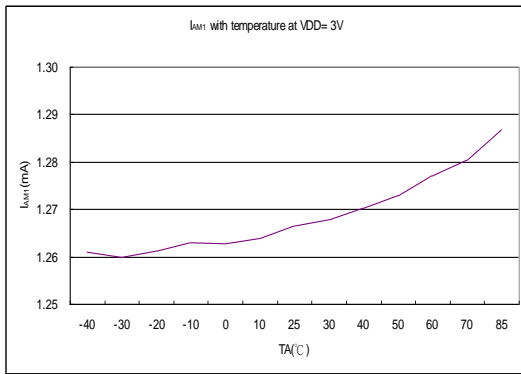


Figure 6.3-7 I<sub>AM1</sub> vs. Temperature

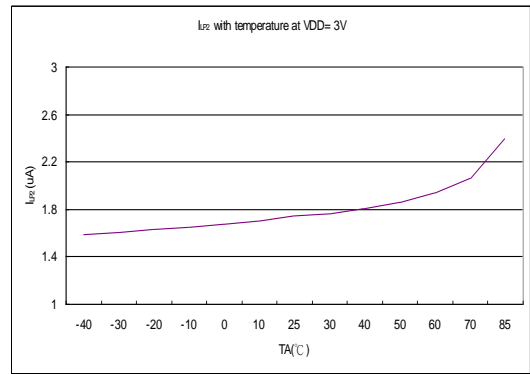


Figure 6.3-8 I<sub>LP2</sub> vs. Temperature

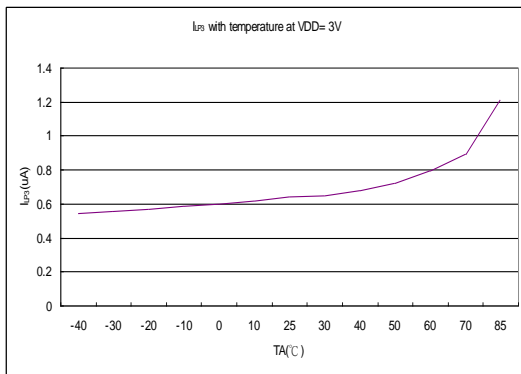


Figure 6.3-9 I<sub>LP3</sub> vs. Temperature

### 6.4 Port1~5

$T_A = 25^\circ\text{C}, V_{DD} = 3.0\text{V}$ , unless otherwise noted

Sym.	Parameter	Test Conditions	Min.	Typ.	Max.	unit
<b>Input voltage and Schmitt trigger and leakage current and timing</b>						
$V_{IH}$	High-Level input voltage				2.1	V
$V_{IL}$	Low-Level input voltage		0.9			
$V_{hys}$	Input Voltage hysteresis( $V_{IH} - V_{IL}$ )			0.8		V
$I_{LKG}$	Leakage Current				0.1	$\mu\text{A}$
$R_{PU}$	Port pull high resistance			180		$\text{k}\Omega$
<b>Output voltage and current and frequency</b>						
$V_{OH}$	High-level output voltage	$I_{OH}=10\text{mA}$	$V_{DD} - 0.3$			V
$V_{OL}$	Low-level output voltage	$I_{OL}=-10\text{mA}$			$V_{SS} + 0.3$	

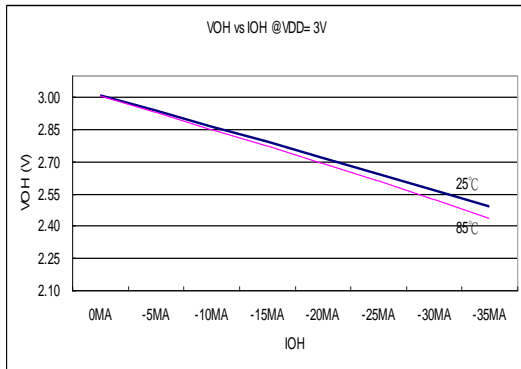


Figure 6.4-1  $V_{OH}$  vs.  $I_{OH}$  @  $V_{DD}=3.0\text{V}$

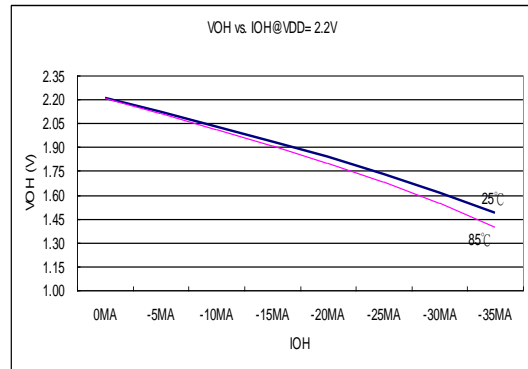


Figure 6.4-2  $V_{OH}$  vs.  $I_{OH}$  @  $V_{DD}=2.2\text{V}$

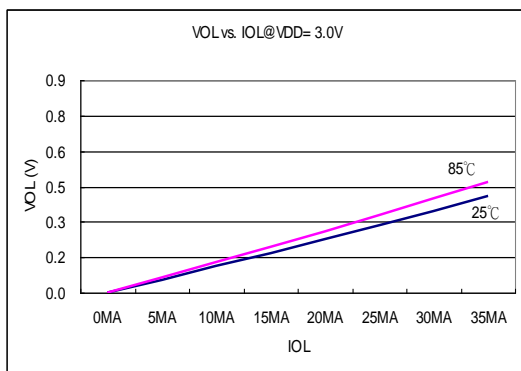


Figure 6.4-3  $V_{OL}$  vs.  $I_{OL}$  @  $V_{DD}=3.0\text{V}$

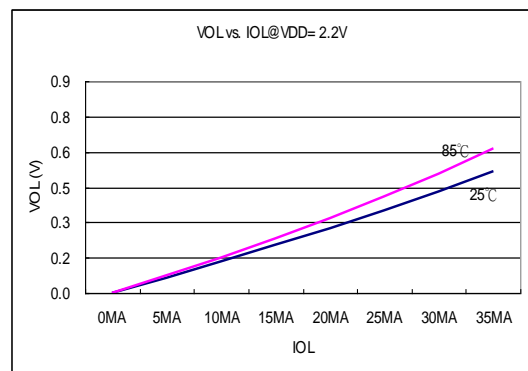


Figure 6.4-4  $V_{OL}$  vs.  $I_{OL}$  @  $V_{DD}=2.2\text{V}$

### 6.5 Reset(Brownout, External RST pin, Low Voltage Detect)

$T_A = 25^\circ\text{C}, V_{DD} = 3.0\text{V}$ , unless otherwise noted

Sym.	Parameter	Test Conditions	Min.	Typ.	Max.	unit	
BOR	Pulse length needed to accepted reset internally, $t_{d-LVR}$		2			us	
	$V_{DD}$ Start Voltage to accepted reset internally (L→H), $V_{LVR}$		1.6	1.85	2.1	V	
	Hysteresis, $V_{HYS-LVR}$			70		mV	
RST	Pulse length needed as RST/VPP pin to accepted reset internally, $t_{d-RST}$		2			us	
	Input Voltage to accepted reset internally		0.9			V	
	Hysteresis, $V_{HYS-RST}$			0.8		V	
LVD	Operation current, $I_{LVD}$			10	15	uA	
	External input voltage to compare reference voltage			1.2		V	
	Compare reference voltage temperature drift	$T_A = -40^\circ\text{C} \sim 85^\circ\text{C}$		100		ppm/ $^\circ\text{C}$	
	Detect $V_{DD}$ voltage rang by user option, $V_{LVD} VLDx[3:0]=1110b$			3.3		V	
	Detect $V_{DD}$ voltage rang by user option, $V_{LVD} VLDx[3:0]=1101b$			3.2			
	Detect $V_{DD}$ voltage rang by user option, $V_{LVD} VLDx[3:0]=1100b$			3.1			
	Detect $V_{DD}$ voltage rang by user option, $V_{LVD} VLDx[3:0]=1011b$			3.0			
	Detect $V_{DD}$ voltage rang by user option, $V_{LVD} VLDx[3:0]=1010b$			2.9			
	Detect $V_{DD}$ voltage rang by user option, $V_{LVD} VLDx[3:0]=1001b$			2.8			
	Detect $V_{DD}$ voltage rang by user option, $V_{LVD} VLDx[3:0]=1000b$			2.7			
	Detect $V_{DD}$ voltage rang by user option, $V_{LVD} VLDx[3:0]=0111b$			2.6			
	Detect $V_{DD}$ voltage rang by user option, $V_{LVD} VLDx[3:0]=0110b$			2.5			
	Detect $V_{DD}$ voltage rang by user option, $V_{LVD} VLDx[3:0]=0101b$			2.4			
	Detect $V_{DD}$ voltage rang by user option, $V_{LVD} VLDx[3:0]=0100b$			2.3			
	Detect $V_{DD}$ voltage rang by user option, $V_{LVD} VLDx[3:0]=0011b$			2.2			
	Detect $V_{DD}$ voltage rang by user option, $V_{SVS} VLDx[3:0]=0010b$			2.1			
	Detect $V_{DD}$ voltage rang by user option, $V_{SVS} VLDx[3:0]=0001b$			2.0			
BOR : Brownout Reset LVR : Low Voltage Reset of BOR LVD : Low Voltage Detect RST : External Reset pin							

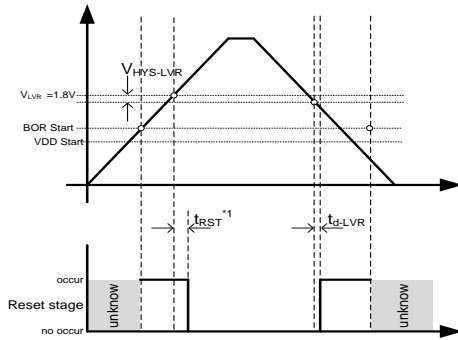


Figure 6.5-1 BOR reset diagram

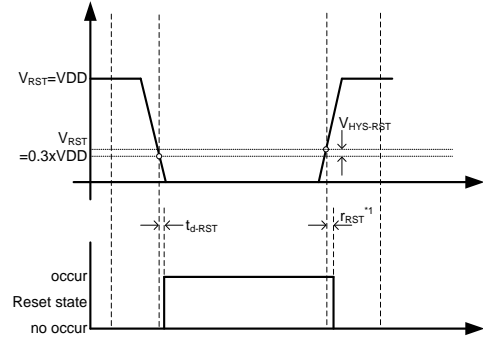


Figure 6.5-2 RST reset diagram

\*1  $t_{RST}$  : Please see BOR Introduce of HY11Pxx series User's Guide (UG-HY11S14-Vxx).

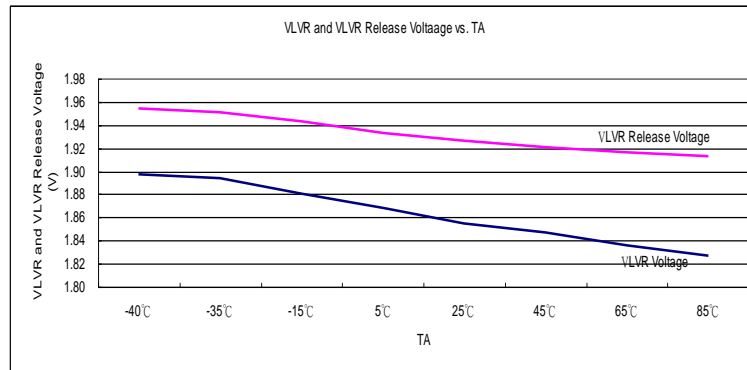


Figure 6.5-3 LVR vs. Temperature

### 6.6 Power System

$T_A = 25^\circ\text{C}, V_{DD} = 3.0\text{V}$ , unless otherwise noted

Sym.	Parameter	Test Conditions		Min.	Typ.	Max.	unit
VDDA	VDDA operation current, $I_{VDDA}$	$I_L = 0\text{mA}$	VDDAX[1:0]=00b		22		$\mu\text{A}$
	Select VDDA output voltage	$I_L = 0.1\text{mA}$ , $V_{DD} \geq V_{DDA} + 0.2\text{V}$	VDDAX[1:0]=00b		3.3		V
			VDDAX[1:0]=01b		2.9		V
			VDDAX[1:0]=10b		2.6		V
			VDDAX[1:0]=11b		2.4		V
	Dropout voltage	$I_L = 10\text{mA}$	VDDAX[1:0]=00b		135		mV
			VDDAX[1:0]=01b		150		mV
VDDAX[1:0]=10b				165		mV	
VDDAX[1:0]=11b				180		mV	
Temperature drift	VDDAX[1:0]=11b	$T_A = -40^\circ\text{C} \sim 85^\circ\text{C}$		50		ppm/ $^\circ\text{C}$	
$V_{DD}$ Voltage drift	$I_L = 0.1\text{mA}$	$V_{DD} = 2.5\text{V} \sim 3.6\text{V}$		$\pm 0.2$		%/V	
ACM	ACM operation current, $I_{ACM}$	$I_L = 0\text{mA}$			20		$\mu\text{A}$
	Output voltage, $V_{ACM}$	ENACM[0]=1, *1	$I_L = 0\text{uA}$		1.0		V
	Output voltage with Load		$I_L = \pm 200\text{uA}$	0.98	1.02	$V_{ACM}$	
	Output voltage, $V_{ACM}$	ENACM[0]=1, *2	$I_L = 0\text{uA}$		1.2		V
	Output voltage with Load		$I_L = \pm 200\text{uA}$	0.98	1.02	$V_{ACM}$	
	Temperature drift	ENACM[0]=1,	$T_A = -40^\circ\text{C} \sim 85^\circ\text{C}$		50		ppm/ $^\circ\text{C}$
	$V_{DDA}$ Voltage drift	$I_L = 10\text{uA}$			100		$\mu\text{V}/\text{V}$

VDDA : Adjust Voltage Regulator  
ACM : Analog Common Mode Voltage

\*1:  $V_{ACM} = 1.0\text{V}$  is just for VDDAX[1:0]=1xb mode. (at A/D differential voltage reference < 1.4V)  
\*2:  $V_{ACM} = 1.2\text{V}$  is just for VDDAX[1:0]=0xb mode. (at A/D differential voltage reference > 1.4V)

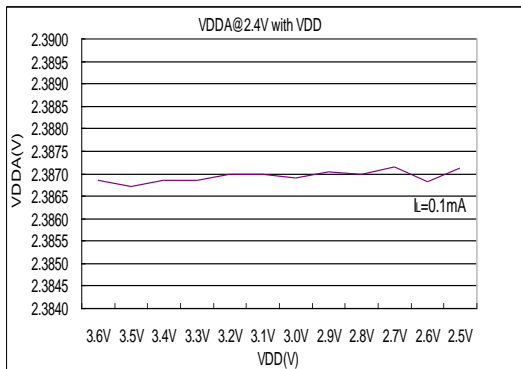


Figure6.6-1 VDDA  $I_L=0.1\text{mA}$  vs. VDD

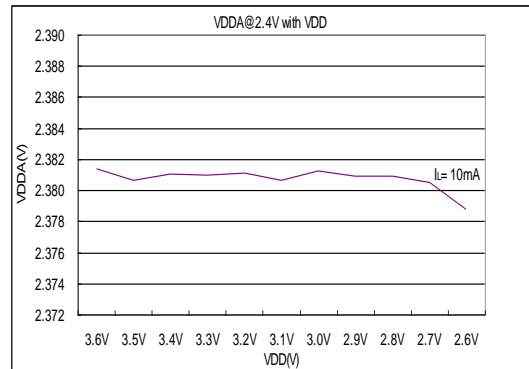


Figure6.6-2 VDDA  $I_L=10\text{mA}$  vs. VDD



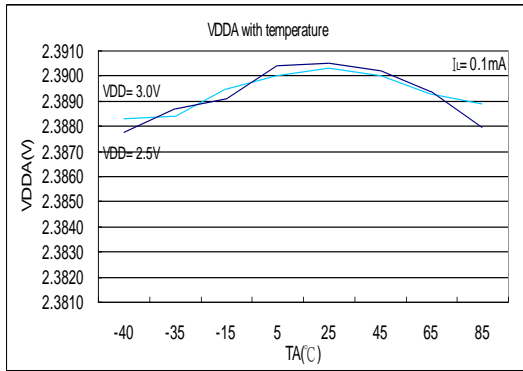


Figure6.6-3 VDDA  $I_L=0.1mA$  vs. Temperature

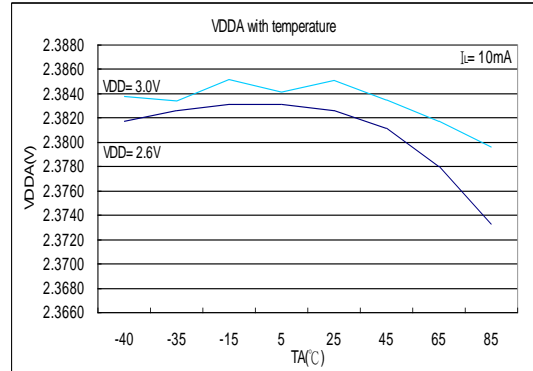


Figure6.6-4 VDDA  $I_L=10mA$  vs. Temperature

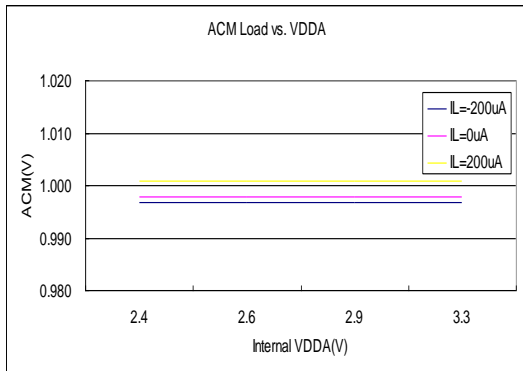


Figure6.6-5 ACM Load vs. VDDA (a)

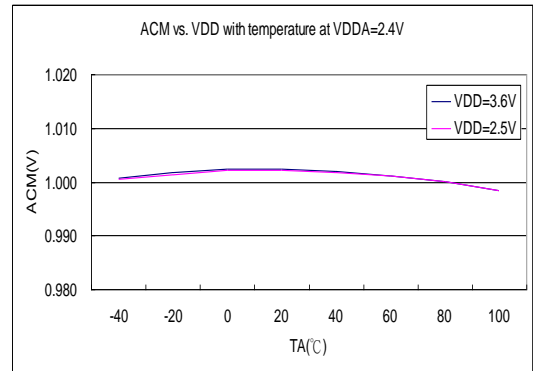


Figure6.6-6 ACM vs. Temperature (a)

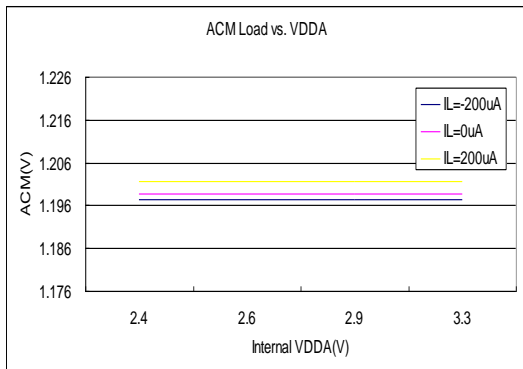


Figure6.6-5 ACM Load vs. VDDA (b)

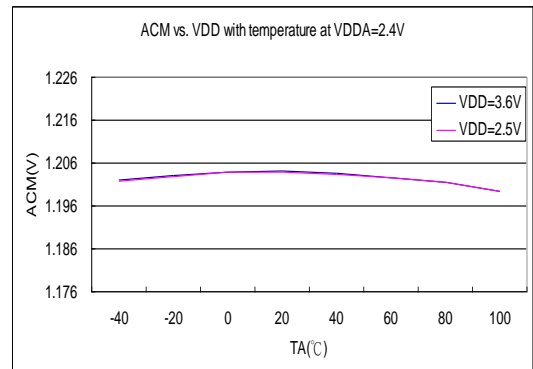


Figure6.6-6 ACM vs. Temperature (b)

## 6.7 Low Noise OPAMP

$T_A = 25^\circ\text{C}, V_{DD} = 3.0\text{V}, V_{DDA} = 2.4\text{V}$ , unless otherwise noted

Sym.	Parameter	Test Conditions		Min.	Typ.	Max.	unit
$V_{LNO}$	Supply voltage at VDDA	ENVDDA[0]=0		2.4		3.6	V
$I_{LNO}$	Operation supply current		OPM[1:0]=xxb		200		$\mu\text{A}$
$V_{OS-OP}$	Input offset voltage without chopper.		OPM[1:0]=1xb	-2		2	mV
	Input offset voltage with chopper		OPM[1:0]=0xb		20		$\mu\text{V}$
	Input offset voltage temperature drift.	OPM[1:0]=00b OPM[1:0]=10	$T_A = -40^\circ\text{C} \sim 85^\circ\text{C}$		0.1 2		$\mu\text{V}/^\circ\text{C}$
$V_{OLR}$	Unit gain load regulation	$V_O = 1.2\text{V}$ , $V_{DDA} = 2.4\text{V}$	$I_L = +1\text{mA}$ $I_L = -1\text{mA}$		0.1		$\%V_O$
CMVR	Common-mode voltage input range		OPM[1:0]=xxb	0.1		$V_{DDA} - 1.1$	V
CMRR	Common-mode rejection ratio		OPM[1:0]=xxb		90		dB

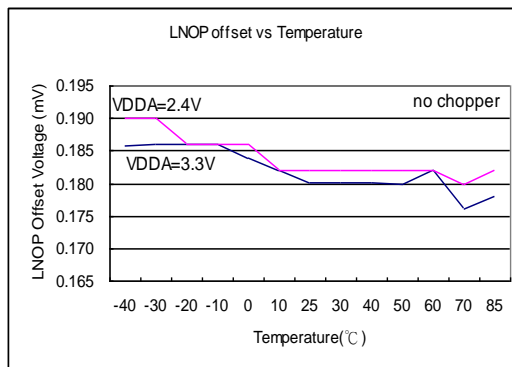


Figure 6.7-1 LNOP Offset Temperature

## 6.8 SD18, Power Supply and recommended operating conditions

$T_A = 25^\circ\text{C}, V_{DD} = 3.0\text{V}, V_{DDA} = 2.4\text{V}$ , unless otherwise noted

Sym.	Parameter	Test Conditions		Min.	Typ.	Max.	unit
$V_{SD18}$	Supply Voltage at VDDA	ENVDDA[0]=0		2.4		3.6	V
$f_{SD18}$	Modulator sample frequency, ADC_CK			25	250	300	KHz
	Over Sample Ratio, OSR			256		32768	
$I_{SD18}$	Operation supply current without PGA	ENADC[0]=1 INBUF[0]=1, VRBUF[0]=0	GAIN=4, ADC_CK=250KHz	168		uA	
		ENADC[0]=1 INBUF[0]=0, VRBUF[0]=1		150			
		ENADC[0]=1 INBUF[0]=0, VRBUF[0]=0		120			

### 6.8.1 PGA, Power Supply and recommended operating conditions

$T_A = 25^\circ\text{C}, V_{DD} = 3.0\text{V}, V_{DDA} = 2.4\text{V}$ , unless otherwise noted

Sym.	Parameter	Test Conditions		Min.	Typ.	Max.	unit
$V_{PGA}$	Supply Voltage at VDDA	ENVDDA[0]=0		2.4		3.6	V
$I_{PGA}$	Operation supply current	PGAGN[1:0]=<01> or <1x>			320		uA
$G_{PGA}$	Gain temperature drift	$T_A = -40^\circ\text{C} \sim 85^\circ\text{C}$	GAIN=128		5		ppm/°C

### 6.8.2 SD18, performance II ( $f_{SD18}=250\text{KHz}$ )

$T_A = 25^\circ\text{C}, V_{DD} = 3.0\text{V}, V_{DDA} = 2.9\text{V}, V_{VR} = 1.0\text{V}, \text{GAIN} = 1$  without PGA, unless otherwise noted

Sym.	Parameter	Test Conditions		Min.	Typ.	Max.	unit
INL	Integral Nonlinearity(INL)	$V_{DDA} = 2.4\text{V}, V_{VR} = 1.0\text{V}, \Delta\text{SI} = \pm 200\text{mV}$			$\pm 0.003$	$\pm 0.01$	%FSR
		$V_{DDA} = 2.4\text{V}, V_{VR} = 1.0\text{V}, \Delta\text{SI} = \pm 450\text{mV}$					
	No Missing Codes <sup>3</sup>	ADC_CK=250KHz, OSR[2:0]=010b		23			Bits
$G_{SD18}$	Temperature drift Gain 1~x16 (INBUF[0]=0b) Gain 1~x4 (INBUF[0]=1b)	INBUF[0]=0b, VRBUF[0]=0b	$T_A = -40^\circ\text{C} \sim 85^\circ\text{C}$	2		ppm/°C	
		INBUF[0]=1b, VRBUF[0]=0b					
		INBUF[0]=0b, VRBUF[0]=1b					
		INBUF[0]=1b, VRBUF[0]=1b					
$E_{os}$	Offset error of Full Scale Rang input voltage range with Chopper and Buffer(INBUF, VRBUF) without PGA	$\Delta\text{AI} = 0\text{V}$ $\Delta\text{VR} = 0.9\text{V}$ DCSET[2:0]=<000>	Gain=2		1	%FSR	
	Offset error of Full Scale Rang input voltage range with Chopper without PGA and Buffer(INBUF, VRBUF)	* $\Delta\text{AI}$ is external short	Gain=2		1		

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## Embedded 18-Bit $\Sigma$ ADC 8-Bit RISC-like Mixed Signal Microcontroller

CM <sub>SD18</sub>	Offset temperature drift with chopper without PGA and Buffer (INBUF,VRBUF).		GAIN=1	2	uV/°C
			GAIN=2	1	
			GAIN=4	0.5	
	Offset temperature drift with chopper and Buffer (INBUF,VRBUF) without PGA.		GAIN=1	2	
			GAIN=2	1	
			GAIN=4	0.5	
	Offset temperature drift with chopper without Buffer (INBUF,VRBUF).		GAIN=128	0.02	
CM <sub>SD18</sub>	Common-mode rejection	V <sub>CM</sub> =0.7V to 1.7V, V <sub>VR</sub> =1.0V, without PGA	V <sub>SI</sub> =0V, GAIN=1	90	dB
		V <sub>CM</sub> =0.7V to 1.7V, V <sub>VR</sub> =1.0V, without PGA	V <sub>SI</sub> =0V, GAIN=16	75	
PSRR	DC power supply rejection	V <sub>D</sub> =3.0V, $\Delta$ V <sub>D</sub> = $\pm$ 100mV, V <sub>I</sub> , V <sub>VR</sub> =1.0V, V <sub>SI</sub> =1.2V, V <sub>SI</sub> =1.2V,	GAIN=1 PGA=off	75	dB
			GAIN=16 PGA=8		

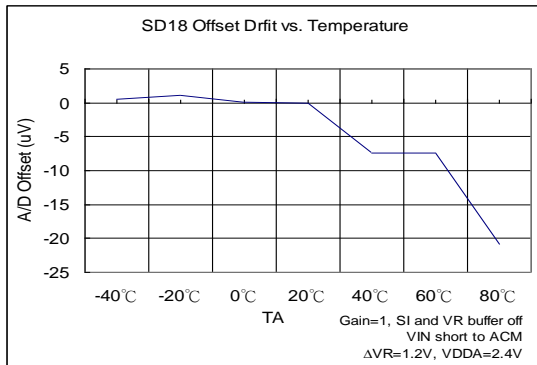


Figure 6.8-1(a) SD18 Offset Temperature drift

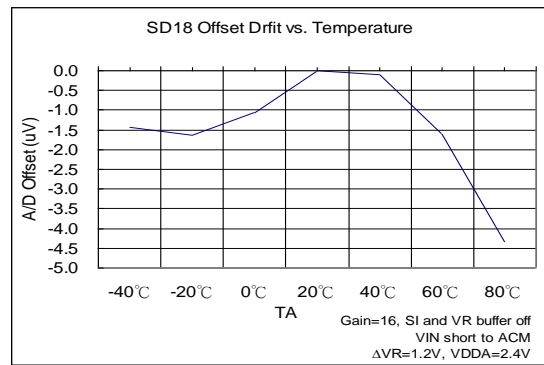


Figure 6.8-1(b) SD18 Offset Temperature drift

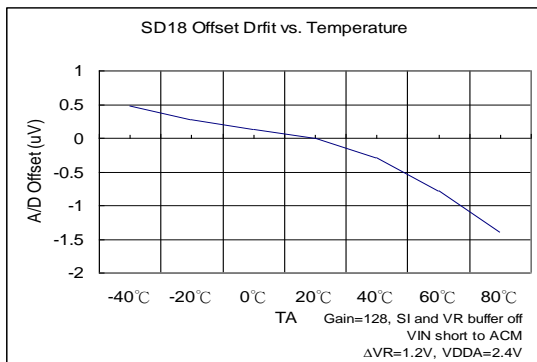


Figure 6.8-1(c) SD18 Offset Temperature drift

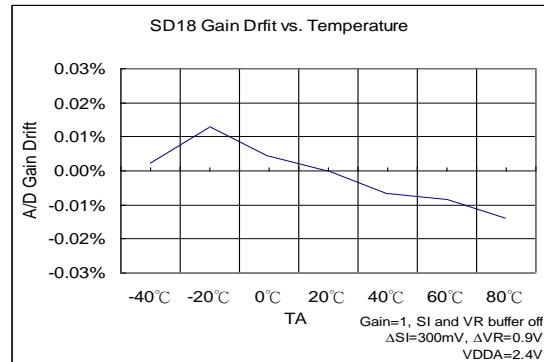


Figure 6.8-2(a) SD18 Gain drift with temperature

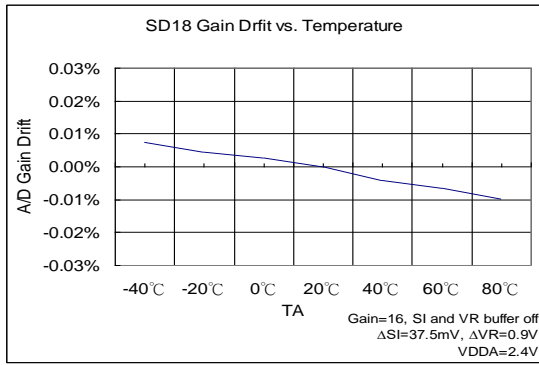


Figure6.8-2(b) SD18 Gain drift with temperature

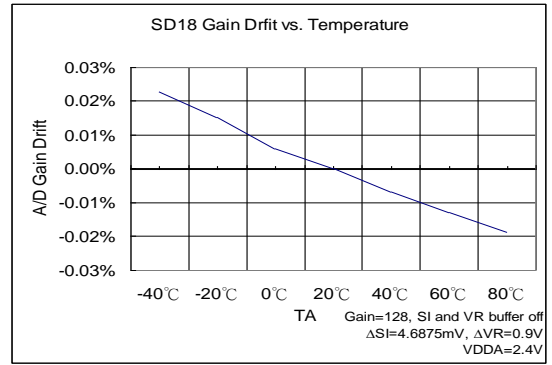


Figure6.8-2(c) SD18 Gain drift with temperature

### 6.8.3 SD18, Temperature sensor

$T_A = 25^\circ\text{C}, V_{DD} = 3.0\text{V}, V_{DDA} = 2.4\text{V}$ , unless otherwise noted

Sym.	Parameter	Test Conditions	Min.	Typ.	Max.	unit
TC <sub>S</sub>	Sensor temperature drift			178		$\mu\text{V}/^\circ\text{C}$
KT	Absolute Temperature Scale $0^\circ\text{K}$	INBUF[0]=1		-289		$^\circ\text{C}$
TC <sub>ERR</sub>	One point calibrate error temperature	Calibration at $25^\circ\text{C}$ of $-40^\circ\text{C} \sim 85^\circ\text{C}$		$\pm 2$		$^\circ\text{C}$

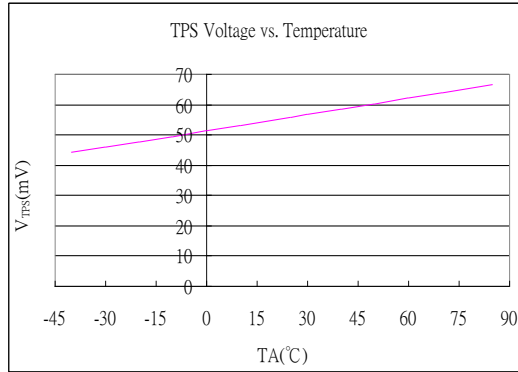


Figure 6.8-3 TPS output voltage vs. temperature drift

# HY11P24

Embedded 18-Bit  $\Sigma\Delta$ ADC  
8-Bit RISC-like Mixed Signal Microcontroller



## 6.8.4 SD18 Noise Performance

$T_A = 25^\circ\text{C}, V_{DD} = 3.0\text{V}, V_{DDA} = 2.4\text{V}$ , unless otherwise noted

HY11P24 針對 SD18 提供了重要的輸入雜訊規格。Table6.8-4(a), Table6.8-4(b) 列出典型的雜訊規格表與 Gain, Output rate, 及單端最大輸入電壓等關係。測試條件設定在外部輸入訊號短路，參考電壓為 1.2V，取樣 1024 筆資料。

<b>ENOB(RMS) with OSR/GAIN at A/D Clock=250Khz, VDDA=2.4V, VREF=1.2V</b>													
Max. Vin(mV) =0.9*VREF <sup>(1)</sup>	OSR				256	512	1024	2048	4096	8192	16384	32768	
	Output rate(HZ)				977	488	244	122	61	31	15	8	
	Gain	=	PGA	x	ADGN								
±2400	0.25	=	1	x	0.25	16.3	17.4	17.9	18.5	19.0	19.5	20.0	20.4
±2160	0.5	=	1	x	0.5	16.3	17.3	17.9	18.4	18.9	19.4	19.8	20.2
±1080	1	=	1	x	1	16.2	17.2	17.8	18.3	18.8	19.3	19.7	20.1
±540	2	=	1	x	2	16.1	17.1	17.6	18.2	18.7	19.2	19.6	20.0
±270	4	=	1	x	4	16.0	16.9	17.5	18.0	18.5	18.9	19.4	19.8
±135	8	=	1	x	8	15.9	16.6	17.2	17.7	18.2	18.7	19.2	19.6
±68	16	=	1	x	16	15.6	16.3	16.8	17.3	17.7	18.3	18.8	19.3
±34	32	=	2	x	16	14.8	15.3	15.9	16.4	16.9	17.4	17.8	18.3
±17	64	=	4	x	16	14.5	15.0	15.5	16.0	16.5	17.0	17.5	18.0
±8	128	=	8	x	16	14.0	14.6	15.1	15.6	16.0	16.6	17.0	17.5

(1) Max.Vin (mV) is the max. input voltage of single end to ground (VSS).

Table6.8-4(a) SD18 ENOB Table

<b>RMS Noise(uV) with OSR/GAIN at A/D Clock=250Khz, VDDA=2.4V, VREF=1.2V</b>													
Max. Vin(mV) =0.9*VREF	OSR				256	512	1024	2048	4096	8192	16384	32768	
	Output rate(HZ)				977	488	244	122	61	31	15	8	
	Gain	=	PGA	x	ADGN								
±2400	0.25	=	1	x	0.25	121.08	57.40	38.74	26.66	18.39	13.21	9.49	6.98
±2160	0.5	=	1	x	0.5	61.63	29.23	19.21	13.51	9.78	7.02	5.12	3.91
±1080	1	=	1	x	1	32.21	15.70	10.25	7.31	5.19	3.77	2.80	2.13
±540	2	=	1	x	2	16.59	8.54	5.91	4.06	2.86	2.06	1.48	1.12
±270	4	=	1	x	4	9.00	4.84	3.33	2.37	1.67	1.19	0.87	0.65
±135	8	=	1	x	8	5.04	2.97	2.02	1.44	1.01	0.73	0.51	0.39
±68	16	=	1	x	16	3.03	1.84	1.29	0.92	0.70	0.46	0.33	0.24
±34	32	=	2	x	16	2.61	1.81	1.27	0.89	0.62	0.45	0.32	0.23
±17	64	=	4	x	16	1.66	1.13	0.80	0.56	0.41	0.29	0.20	0.14
±8	128	=	8	x	16	1.13	0.77	0.55	0.38	0.28	0.19	0.14	0.10

Table6.8-4(b) SD18 RMS Noise Table

The RMS noise are referred to the input. The Effective Number of Bits (ENOB(RMS Bit)) is defined as:

$$\text{ENOB(RMS)} = \frac{\ln\left(\frac{\text{FSR}}{\text{RMS Noise}}\right)}{\ln(2)}$$

$$\text{RMS Noise} = \frac{\left(2 \times \text{VREF} \times \sqrt{\sum_{k=1}^{1024} (\text{ADO}[k] - \text{Average})^2}\right)}{2^{23}}$$

Where FSR (Full- Scale Range)=  $2 \times \text{VREF}/\text{Gain}$ .

$$\text{Average} = \frac{\sum_{k=1}^{1024} (\text{ADO}[k])}{1024}$$

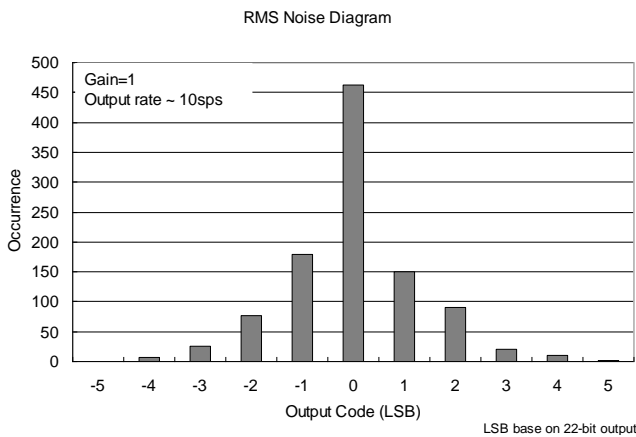


Figure6.8-4(a) RMS Noise Diagram

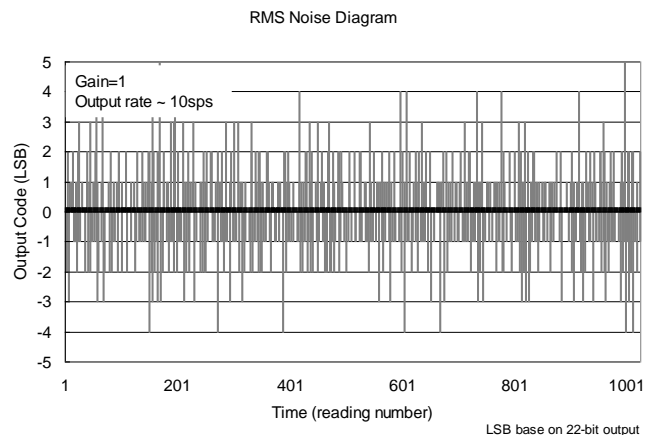


Figure6.8-4(b) Output Code Diagram

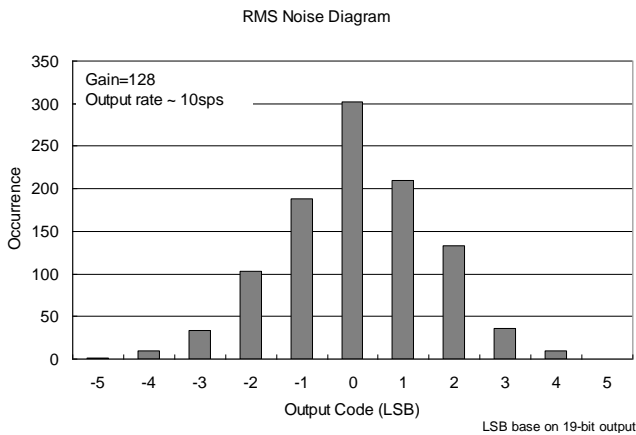


Figure6.8-4(c) RMS Noise Diagram

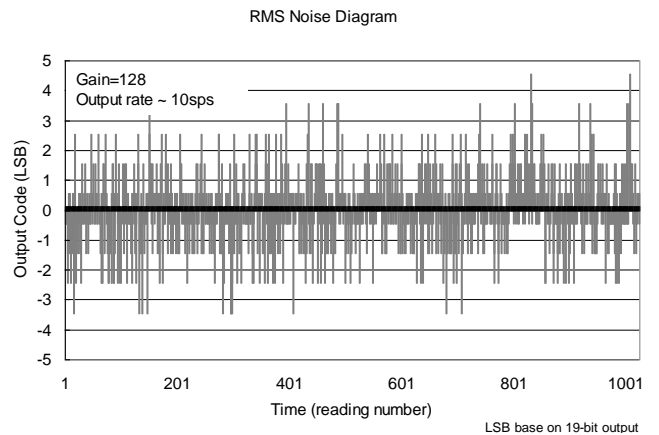


Figure6.8-4(d) Output Code Diagram



## 7. 訂貨資訊

下單品名 <sup>1</sup>	封裝型式	引腳數	封裝型式 描述方式		程式碼 編號 <sup>2</sup>	出貨包裝 形式	個裝 數量	材料 組成	MSL <sup>3</sup>
			D	000					
HY11P24-D000	Die	-	D	000	000	-	140	Green <sup>4</sup>	-
HY11P24-L044	LQFP	44	L	044	000	Tray	160	Green <sup>4</sup>	MSL-3
HY11P24-L048	LQFP	48	L	048	000	Tray	250	Green <sup>4</sup>	MSL-3

### <sup>1</sup> 產品名稱 – 封裝型式描述方式 – 程式碼編號 (空白片 / 標準品 / 代客燒錄碼)

例如：您的代客燒錄服務申請的程式碼編號為 008，且需要的產品是裸片出貨。則

下單品名為 HY11P24-D000-008

例如：您的需求是不帶程式碼的空白片且需要的產品是裸片出貨。則下單品名為

HY11P24-D000

例如：您的需求是不帶程式碼的空白片且需要的產品是封裝片 LQFP44 出貨，則下

單品名為 HY11P24-L044，且需以 Tray 出貨，則除下單品名外，請特別註明

出貨包裝形式為 Tray

例如：您的代客燒錄服務申請的程式碼編號為 009，而需求的產品是封裝片 LQFP48

出貨，則下單品名為 HY11P24-L048-009，且需以 Tray 出貨，則除下單品名

外，請特別註明出貨包裝形式為 Tray

### <sup>2</sup> 程式碼編號

“001”~“999” 為標準品或代客燒錄申請的程式碼編號，而空白晶片不帶此碼。

### <sup>3</sup> MSL:

濕度敏感性等級係依據 IPC/JEDEC J-STD-020 的規範加以試驗分級，並參考

IPC/JEDEC J-STD-033 的標準處理、包裝、運輸與使用。

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## <sup>4</sup> Green (RoHS & no Cl/Br):

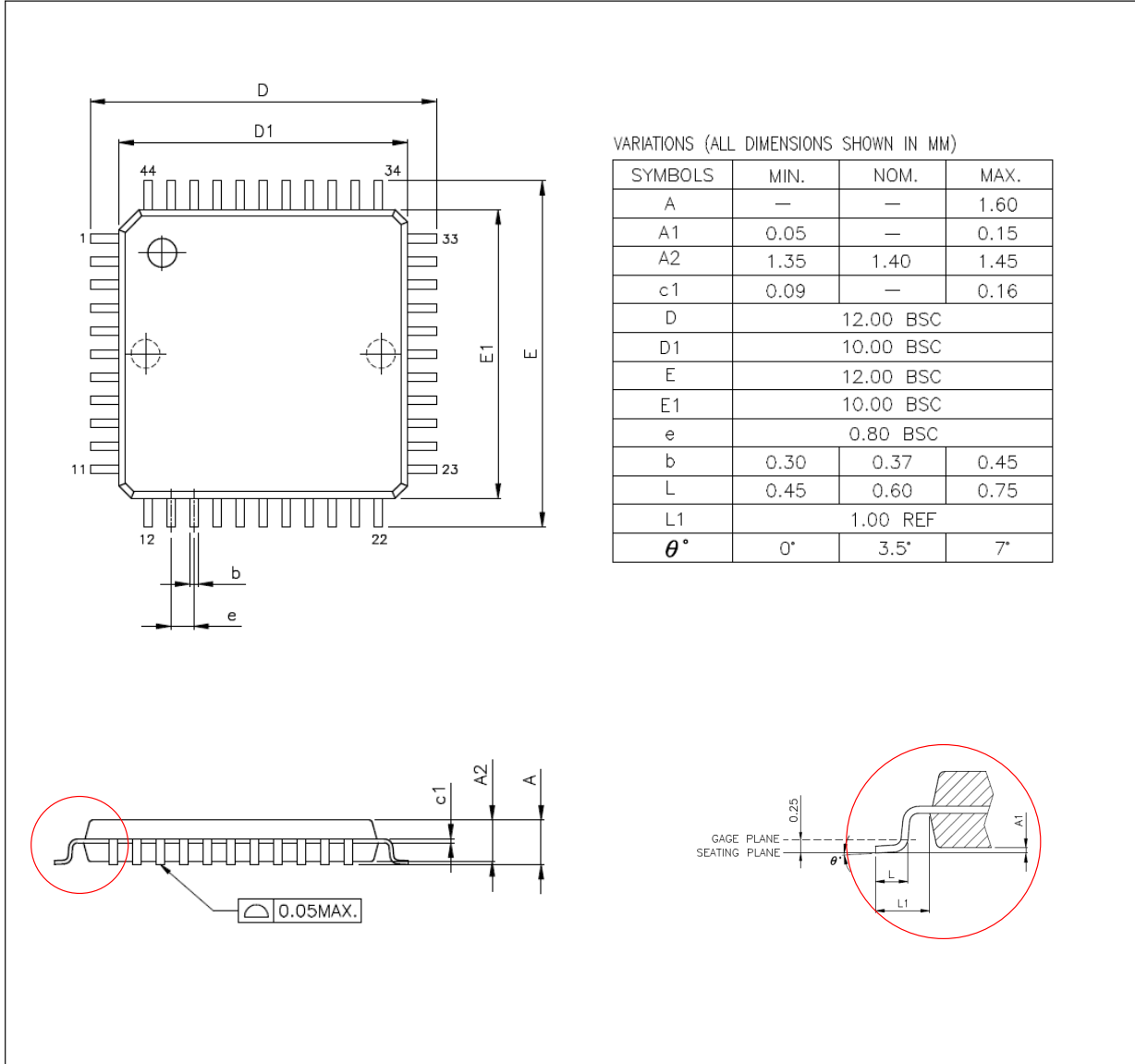
HYCON 產品皆為 Green Product，符合 RoHS 指令以及無鹵素規定(Br/Cl<0.1%)

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## 8. 封裝型式資訊

### 8.1 LQFP44(L044)

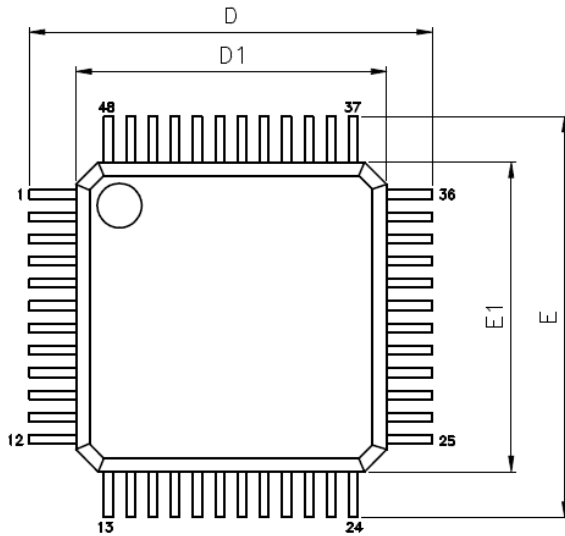


JEDEC MS-026 compliant

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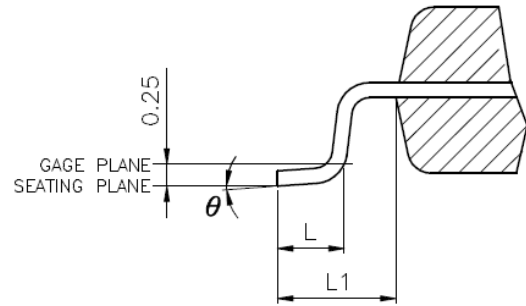
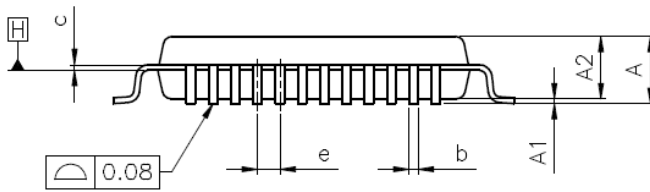
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## 8.2 LQFP48(L048)



VARIATIONS (ALL DIMENSIONS SHOWN IN MM)

SYMBOLS	MIN.	NOM.	MAX.
A	--	--	1.60
A1	0.05	--	0.15
A2	1.35	1.40	1.45
b	0.17	0.22	0.27
c	0.09	--	0.20
D	9.00 BSC		
D1	7.00 BSC		
E	9.00 BSC		
E1	7.00 BSC		
e	0.50 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
$\theta$	0°	3.5°	7°



JEDEC MS-026 compliant

## 9. 修訂記錄

以下描述本文件差異較大的地方，而標點符號與字形的改變不在此描述範圍。

版本	頁次	變更摘要
V01	ALL	初版發行
V02	4	修訂 68 個指令成 67 個指令，特點內容修改
	6~8	文字內容修改，增加引腳說明
	10~11	電路圖內容修改
	13~14	增加暫存器內容
	17~28	章節內容修改
V03	4	修訂特點內容
	7	修訂 I/O 引腳定義內容
	22~23	修訂章節內容
V04	1	修訂封面格式
	4	修訂特點內容
	5	增加註 3 內容說明
	10~11	修訂應用電路圖，增加 RST 的 RC 電路
	20	刪除 Detect V <sub>DD</sub> voltage error 內容說明
V05	13	增加 SD18 Network 章節
	23	修訂 Power System 溫飄規格
	29~30	增加 SD18 Noise Performance 章節
V06	4	修改 1.特點內容
	16	修改 6.電氣特性內容
	31	修改 RMS Noise Diagram
V07	6	增加 LQFP48 引腳圖
	14	修改圖 4-2 INH/INL
	25	修改圖片背景顏色
	33	增加訂貨資訊
	35	增加封裝型式資訊
V08	13	修改開發工具相關使用說明書編號
	33	增加訂貨資訊內容
V09	5~6	放大引腳圖
	7	增加 CPAI7 名稱
	11~14	增加 I/O 引腳定義(LQFP48)
	19	增加 Low Noise OPAMP Network

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20      增加 Enhance Comparator Network