



HY11P24

Datasheet

8-Bit RISC-Like Mixed Signal Microcontroller
Embedded Low Noise Amplifier
18-Bit $\Sigma\Delta$ ADC

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1. Features

- 8-bit RISC, 66 instructions included.
- Operating voltage range: 2.0V to 3.6V, operation temperature range: -40°C~85°C.
- External Crystal Oscillator and Internal High Precision RC Oscillator, 6 CPU clock rates enable users to have the most power-saving plan.
 - Active Mode 300uA@2MHz
 - Standby Mode 3uA@32KHz
 - Sleep Mode 1uA
- 8K Word OTP (One Time Programmable) Type program memory, 512 Byte Data Memory.
- Brownout detector and Watch dog Timer, prevents CPU from Crash.
- 18-bit fully differential input Sigma-Delta Analog-to-Digital Converter (A/D)
 - Build-in PGA (Programmable Gain Amplifier) 1/4x \ 1/2x \ 1x. ...128x, 10 input signal gain selection.
 - Build-in Input zero point adjustment can increase measurement range according to different application.
 - Built-in high impedance input buffer (Not suitable for 4x or upwards input gain)
 - Build-in absolute temperature sensor
- Ultra-Low input noise (<1uVpp) OPAMP provides high output impedance small signal amplification and low current voltage transformation.
- 1.0V and 1.2V low temperatures drift parameter internal analog circuit common ground that equips with Push-Pull drive ability to provide sensor driving voltage.
- LVD low voltage detection function has 14 steps of voltage detect configuration and external input voltage detectable function.
- VDDA can select 4 different output voltage that equips with 10mA low dropout regulator function.
- Enhanced comparator
 - Two sets power voltage generator
 - Equipped with 0.25x or 0.5x operating voltage comparison and auto-transformation function and 15 steps comparison voltage configuration
 - Build-in temperature sensor
- 8-bit Timer A
- 16-bit Timer B Module has Capture/Compare function
- 8-bit Timer C Module generates PWM/PFD waveform
- Serial Communication SPI and EUART Module
- Support 8 stack level

2. Pin Definition

2.1 LQFP44 Pin Diagram

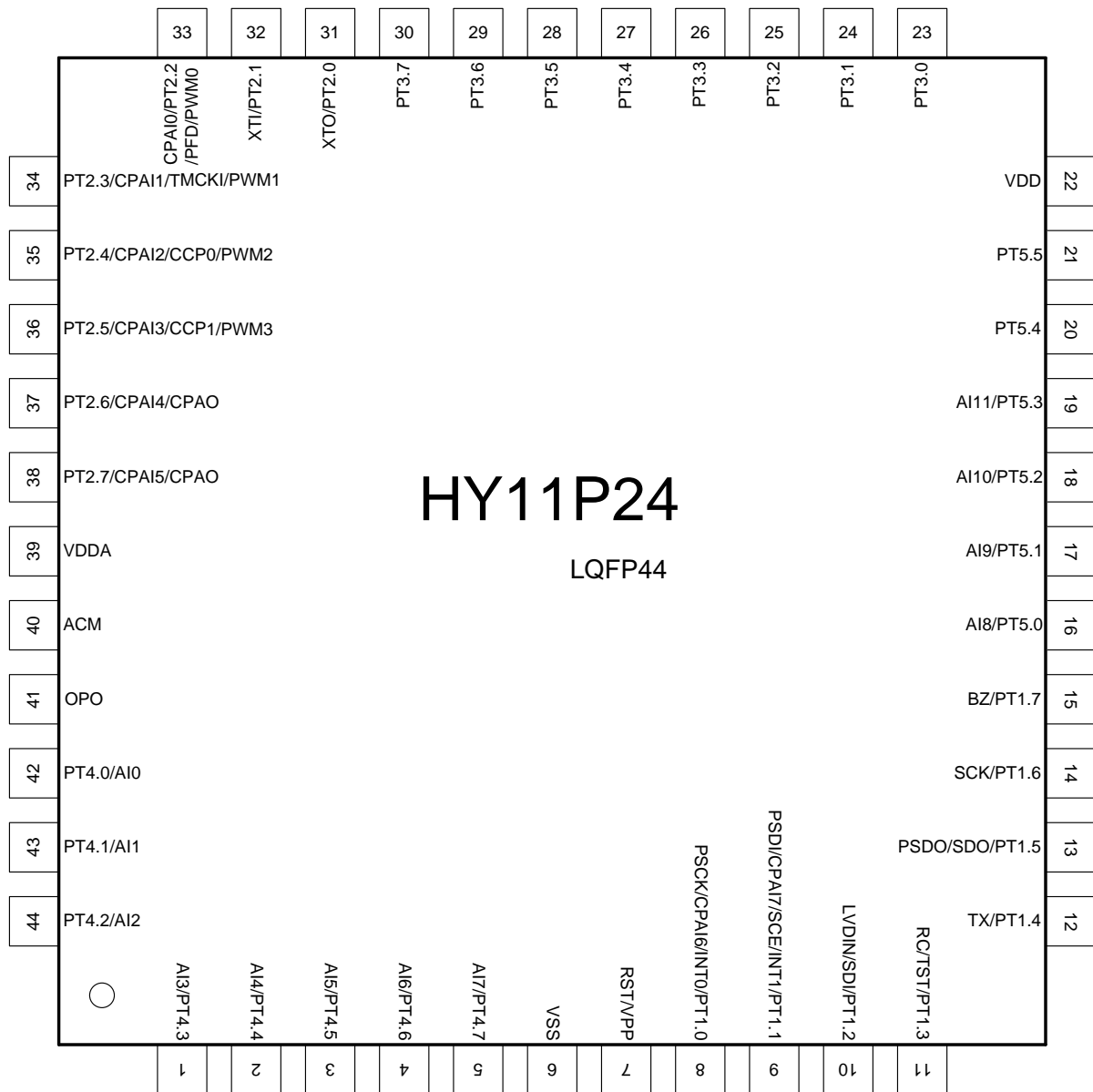


Figure 2-1 HY11P24 LQFP44 Pin Diagram

Note 1 : VPP and RST use the same pin. Input voltage cannot exceed 5.8V when not programming EPROM.

Note 2 : TST and PT1.3 use the same pin. Input voltage cannot exceed Vdd+0.3V while operating.

Note 3 : If PT1.3 has not been configured as external button pin, the anti-interference ability will be enhanced.

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2.2 LQFP48 Pin Diagram

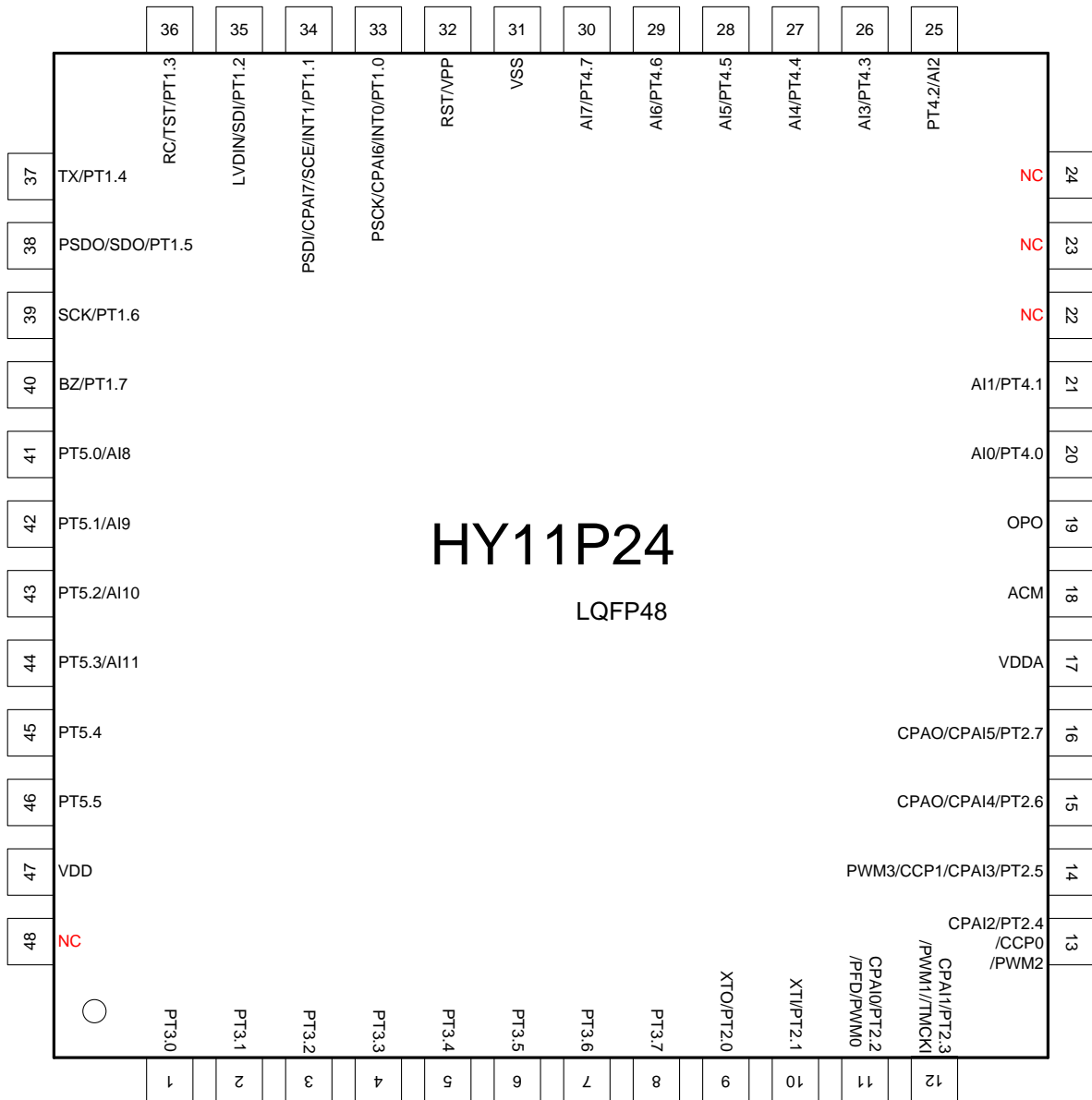


Figure 2-2 HY11P24 LQFP48 Pin Diagram

Note 1 : VPP and RST use the same pin. Input voltage cannot exceed 5.8V when not programming EPROM.

Note 2 : TST and PT1.3 use the same pin. Input voltage cannot exceed Vdd+0.3V while operating.

Note 3 : If PT1.3 has not been configured as external button pin, the anti-interference ability will be enhanced.

2.3 LQFP44 Pinout I/O Description

"I/O" input/output, "I" input, "O" output, "S" Smith Trigger, "C" CMOS features compatible input/output, "P" power supply, "A" analog channel

NO.	Pin Name	Pin Characteristic		Description	
		Pin Type	Buffer Type		
1	PT4.3/AI3	PT4.3	I	C	Digital input
		AI3	A	A	Analog input channel
2	PT4.4/AI4	PT4.4	I	C	Digital input
		AI4	A	A	Analog input channel
3	PT4.5/AI5	PT4.5	I	C	Digital input
		AI5	A	A	Analog input channel
4	PT4.6/AI6	PT4.6	I	C	Digital input
		AI6	A	A	Analog input channel
5	PT4.7/AI7	PT4.7	I	C	Digital input
		AI7	A	A	Analog input channel
6	VSS		P	P	Grounding pin for IC operation power source
7	RST/VPP	RST	I	S	Reset IC
		VPP	P	P	EPROM programming voltage source
8	PT1.0/INT0/PSCK/CPAI6	PT1.0	I	S	Digital input
		INT0	I	S	Interrupt source INT0
		PSCK	I	S	OTP programming interface SCK
		CPAI6	I	A	ECPA analog input channel
9	PT1.1/INT1/PSDI/SCE/CPAI7	PT1.1	I	S	Digital input
		INT1	I	S	Interrupt source INT1
		PSDI	I	S	OTP programming interface SDI
		SCE	I/O	S	SPI communication interface SCE
		CPAI7	I	A	ECPA analog input channel
10	PT1.2/SDI/LVDIN				

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		PT1.2	I	S	Digital input
		SDI	I/O	S	SPI communication interface SDI
		LVDIN	A	A	LVD external signal input
11	PT1.3/TST/RC	PT1.3	I	S	Digital input
		RC	I	S	EUART communication interface RC
		TST	I	S	Test Mode input pin (invalid)
12	PT1.4/TX	PT1.4	I/O	S	Digital I/O
		TX	I/O	S	EUART communication interface TX
13	PT1.5/PSDO/SDO	PT1.5	I/O	S	Digital I/O
		PSDO	O	C	OTP programming interface SDO
		SDO	I/O	S	SPI communication interface SDO
14	PT1.6/SCK	PT1.6	I/O	S	Digital I/O
		SCK	I/O	S	SPI communication interface SCK
15	PT1.7/BZ	PT1.7	I/O	S	Digital I/O
		BZ	O	C	Buzzer output
16	PT5.0/AI8	PT5.0	I	C	Digital input
		AI8	A	A	Analog input channel
17	PT5.1/AI9	PT5.1	I	C	Digital input
		AI9	A	A	Analog input channel
18	PT5.2/AI10	PT5.2	I	C	Digital input
		AI10	A	A	Analog input channel
19	PT5.3/AI11	PT5.3	I	C	Digital input
		AI11	A	A	Analog input channel
20	PT5.4		I	C	Digital input
21	PT5.5		I	C	Digital input
22	VDD		P	P	Voltage source for IC operation
23	PT3.0		I/O	C	Digital I/O
24	PT3.1		I/O	C	Digital I/O
25	PT3.2		I/O	C	Digital I/O

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26	PT3.3		I/O	C	Digital I/O
27	PT3.4		I/O	C	Digital I/O
28	PT3.5		I/O	C	Digital I/O
29	PT3.6		I/O	C	Digital I/O
30	PT3.7		I/O	C	Digital I/O
31	PT2.0/XTO	PT2.0	I/O	S	Digital I/O
		XTO	A	A	External oscillator output
32	PT2.1/XTI	PT2.1	I/O	S	Digital I/O
		XTI	A	A	External oscillator input
33	PT2.2/PFD/CPAI0/PWM0	PT2.2	I/O	C	Digital I/O
		PFD	O	C	PFD output
		CPAI0	I	A	ECPA analog input channel
		PWM0	O	C	PWM output
34	PT2.3/TMCKI/CPAI1/PWM1	PT2.3	I/O	S	Digital I/O
		TMCKI	I	S	TIMERC clock source input
		CPAI1	I	A	ECPA analog input channel
		PWM1	O	C	PWM output
35	PT2.4/CCP0/CPAI2/PWM2	PT2.4	I/O	S	Digital I/O
		CCP0	I	S	Capture/compare mode signal port
		CPAI2	I	A	ECPA analog input channel
		PWM2	O	C	PWM output
36	PT2.5/CCP1/CPAI3/PWM3	PT2.5	I/O	S	Digital I/O
		CCP1	I	S	Capture/compare mode signal port
		CPAI3	I	A	ECPA analog input channel
		PWM3	O	C	PWM output
37	PT2.6/CPAI4/CPAO	PT2.6	I/O	C	Digital I/O
		CPAI4	I	A	ECPA analog input channel
		CPAO	I	A	ECPA comparator output
38	PT2.7/CPAI5/CPAO	PT2.7	I/O	C	Digital I/O
		CPAI5	I	A	ECPA analog input channel

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	CPAO	I	A	ECPA comparator output
39	VDDA	P	P	Regulator output, analog circuit power source
40	ACM	P	P	Internal analog circuit command ground pin
41	OPO	A	A	OP output
42	PT4.0/AI0	I	C	Digital input
		A	A	Analog input channel
43	PT4.1/AI1	I	C	Digital input
		A	A	Analog input channel
44	PT4.2/AI2	I	C	Digital input
		A	A	Analog input channel

Table 2-1 Pin Definition and Function Description

2.4 LQFP48 Pinout I/O Description

"I/O" input/output, "I" input, "O" output, "S" Smith Trigger, "C" CMOS features compatible input/output, "P" power supply, "A" analog channel

NO.	Pin Name	Pin Characteristic		Description	
		Pin Type	Buffer Type		
1	PT3.0	I/O	C	Digital I/O	
2	PT3.1	I/O	C	Digital I/O	
3	PT3.2	I/O	C	Digital I/O	
4	PT3.3	I/O	C	Digital I/O	
5	PT3.4	I/O	C	Digital I/O	
6	PT3.5	I/O	C	Digital I/O	
7	PT3.6	I/O	C	Digital I/O	
8	PT3.7	I/O	C	Digital I/O	
9	PT2.0/XTO	PT2.0	I/O	S	Digital I/O
		XTO	A	A	External oscillator output
10	PT2.1/XTI	PT2.1	I/O	S	Digital I/O
		XTI	A	A	External oscillator input
11	PT2.2/PFD/CPAI0/PWM0	PT2.2	I/O	C	Digital I/O
		PFD	O	C	PFD output
		CPAI0	I	A	ECPA analog input channel
		PWM0	O	C	PWM output
12	PT2.3/TMCKI/CPAI1/PWM1	PT2.3	I/O	S	Digital I/O
		TMCKI	I	S	TIMERC clock source input
		CPAI1	I	A	ECPA analog input channel
		PWM1	O	C	PWM output
13	PT2.4/CCP0/CPAI2/PWM2	PT2.4	I/O	S	Digital I/O
		CCP0	I	S	Capture/compare mode signal port
		CPAI2	I	A	ECPA analog input channel
		PWM2	O	C	PWM output
14	PT2.5/CCP1/CPAI3/PWM3	PT2.5	I/O	S	Digital I/O
		CCP1	I	S	Capture/compare mode signal port
		CPAI3	I	A	ECPA analog input channel

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	PWM3	O	C	PWM output
15	PT2.6/CPAI4/CPAO			
	PT2.6	I/O	C	Digital I/O
	CPAI4	I	A	ECPA analog input channel
	CPAO	I	A	ECPA comparator output
16	PT2.7/CPAI5/CPAO			
	PT2.7	I/O	C	Digital I/O
	CPAI5	I	A	ECPA analog input channel
	CPAO	I	A	ECPA comparator output
17	VDDA	P	P	Regulator output, analog circuit power source
18	ACM	P	P	Internal analog circuit command ground pin
19	OPO	A	A	OP output
20	PT4.0/AI0			
	PT4.0	I	C	Digital input
	AI0	A	A	Analog input channel
21	PT4.1/AI1			
	PT4.1	I	C	Digital input
	AI1	A	A	Analog input channel
22	NC	-	-	unused
23	NC	-	-	unused
24	NC	-	-	unused
25	PT4.2/AI2			
	PT4.2	I	C	Digital input
	AI2	A	A	Analog input channel
26	PT4.3/AI3			
	PT4.3	I	C	Digital input
	AI3	A	A	Analog input channel
27	PT4.4/AI4			
	PT4.4	I	C	Digital input
	AI4	A	A	Analog input channel
28	PT4.5/AI5			
	PT4.5	I	C	Digital input
	AI5	A	A	Analog input channel
29	PT4.6/AI6			
	PT4.6	I	C	Digital input
	AI6	A	A	Analog input channel

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30	PT4.7/AI7	PT4.7	I	C	Digital input
		AI7	A	A	Analog input channel
31	VSS		P	P	Grounding pin for IC operation power source
32	RST/VPP	RST	I	S	Reset IC
		VPP	P	P	EPROM programming voltage source
33	PT1.0/INT0/PSCK/CPAI6	PT1.0	I	S	Digital input
		INT0	I	S	Interrupt source INT0
		PSCK	I	S	OTP programming interface SCK
		CPAI6	I	A	ECPA analog input channel
34	PT1.1/INT1/PSDI/SCE/CPAI7	PT1.1	I	S	Digital input
		INT1	I	S	Interrupt source INT1
		PSDI	I	S	OTP programming interface SDI
		SCE	I/O	S	SPI communication interface SCE
		CPAI7	I	A	ECPA analog input channel
35	PT1.2/SDI/LVDIN	PT1.2	I	S	Digital input
		SDI	I/O	S	SPI communication interface SDI
		LVDIN	A	A	LVD external signal input
36	PT1.3/TST/RC	PT1.3	I	S	Digital input
		RC	I	S	EUART communication interface RC
		TST	I	S	Test Mode input pin (invalid)
37	PT1.4/TX	PT1.4	I/O	S	Digital I/O
		TX	I/O	S	EUART communication interface TX
38	PT1.5/PSDO/SDO	PT1.5	I/O	S	Digital I/O
		PSDO	O	C	OTP programming interface SDO
		SDO	I/O	S	SPI communication interface SDO
39	PT1.6/SCK	PT1.6	I/O	S	Digital I/O
		SCK	I/O	S	SPI communication interface SCK

40	PT1.7/BZ	PT1.7 BZ	I/O O	S C	Digital I/O Buzzer output
41	PT5.0/AI8	PT5.0 AI8	I A	C A	Digital input Analog input channel
42	PT5.1/AI9	PT5.1 AI9	I A	C A	Digital input Analog input channel
43	PT5.2/AI10	PT5.2 AI10	I A	C A	Digital input Analog input channel
44	PT5.3/AI11	PT5.3 AI11	I A	C A	Digital input Analog input channel
45	PT5.4		I	C	Digital input
46	PT5.5		I	C	Digital input
47	VDD		P	P	Voltage source for IC operation
48	NC		-	-	unused

Table 2-2 Pin Definition and Function Description

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3. Application Circuit

3.1 Four Sets Bridge Sensor I

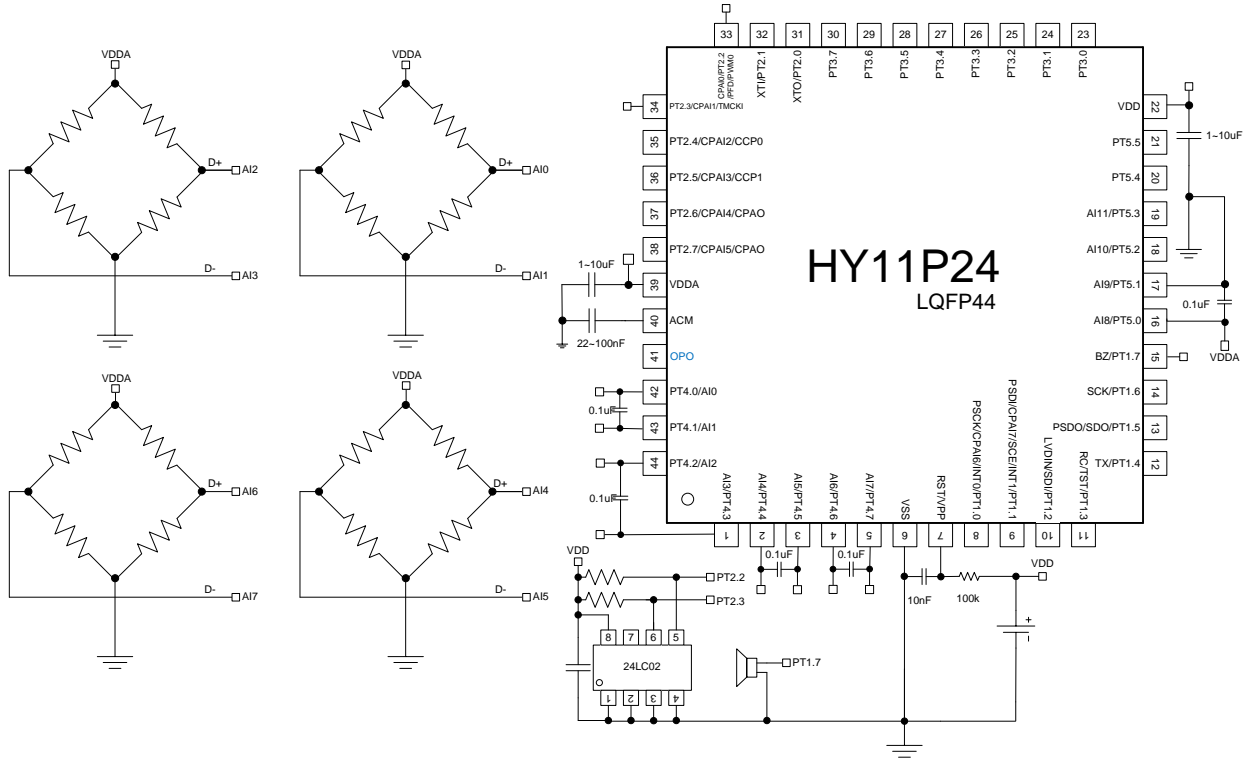


Figure 3-1 Application Circuit of Bridge Sensor

Note : DCSET[2:0] can conduct bias adjustment of Load Cell zero point voltage address

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3.2 Four Sets Bridge Sensor II

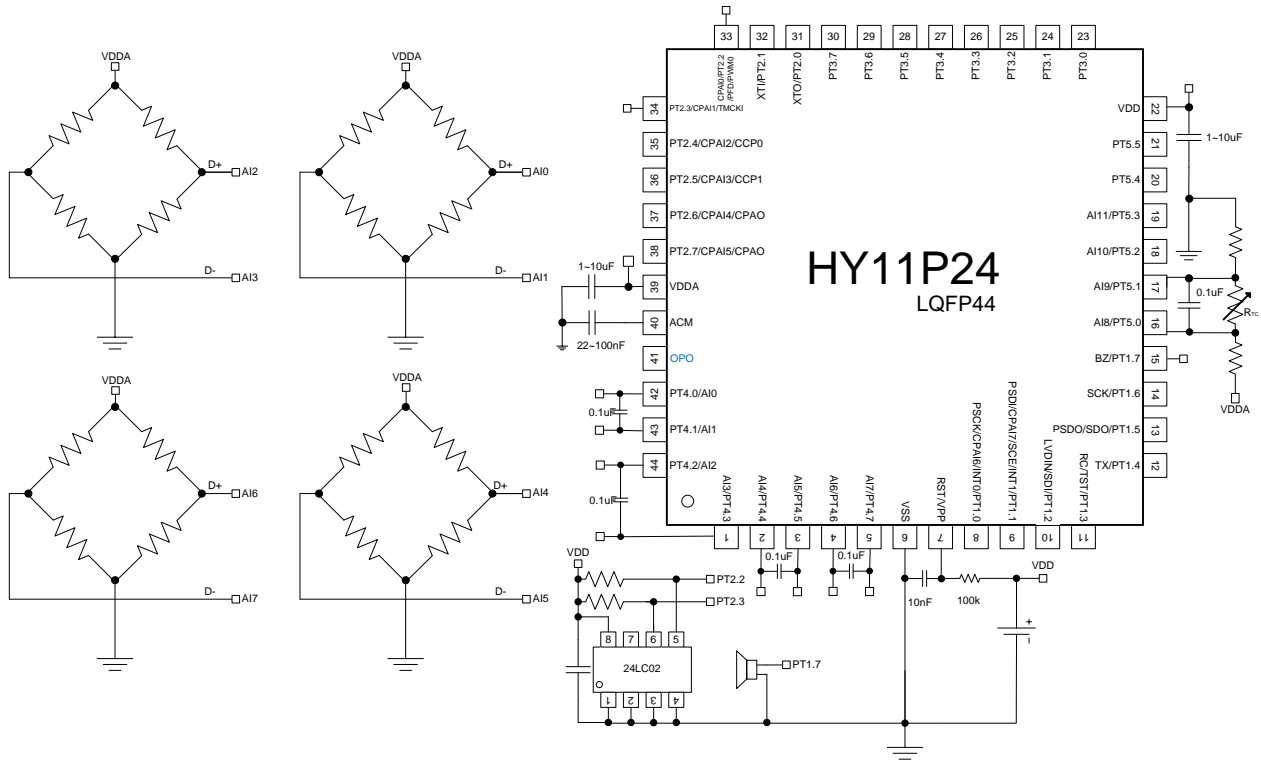


Figure 3-2 Application Circuit of Temperature Compensation Bridge Sensor

Note 1 : Using temperature compensation resistor NTC basic circuit

Note 2 : DCSET[2:0] can conduct bias adjustment of Load Cell zero point voltage address

4. Function Outline

4.1 Internal Block Diagram

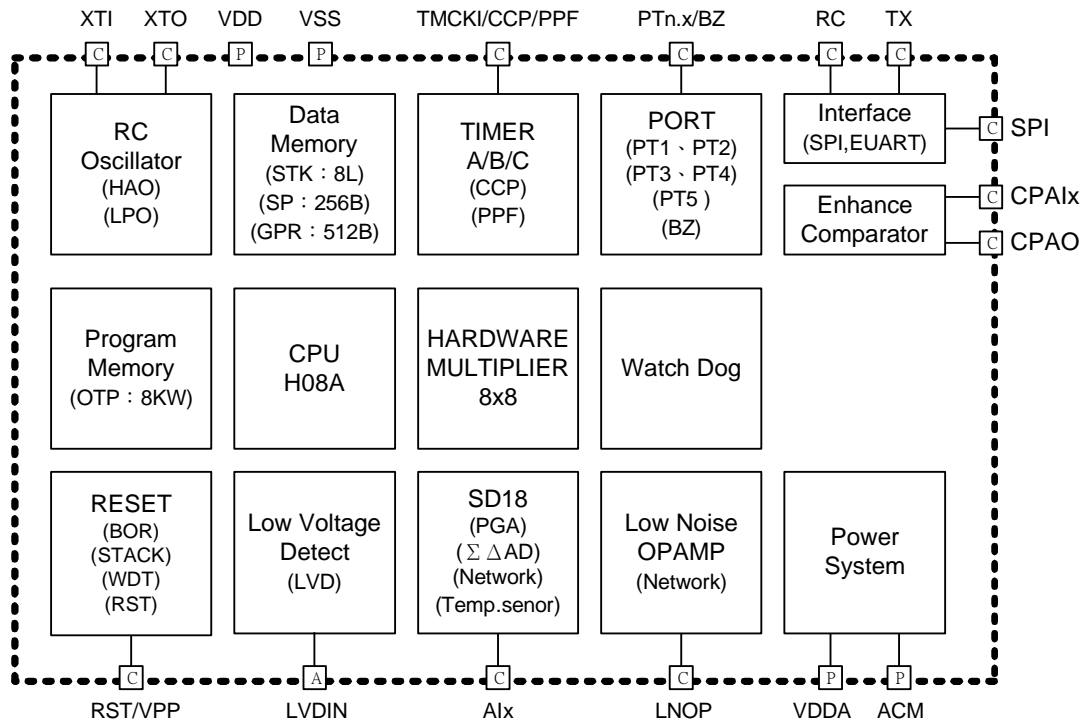


Figure 4-1 HY11P24 Internal Block Diagram

4.2 Related Description and Supporting Documents

IC Function Related Operating Instruction

DS-HY11P24-Vxx	HY11P24 Data Sheet
UG-HY11S14-Vxx	HY11Pxx Series Users' Manual
APD-CORE002-Vxx	H08A Instruction Description

Development Tool Related Operating Instruction

APD-HYIDE006-Vxx	HY11xxx Series Development Tool Software Instruction Manual
APD-HYIDE005-Vxx	HY11xxx Series Development Tool Hardware Instruction Manual
APD-OTP001-Vxx	OTP Products Programming Pin Manual

Product Production Related Operating Instruction

APD-HYIDE004-Vxx	HY1xxxx Series Production Line Specialized Programmer Manual
BDI-HY11P24-Vxx	HY11P24 Individual Product Die Bonding Information

4.3 SD18 Network

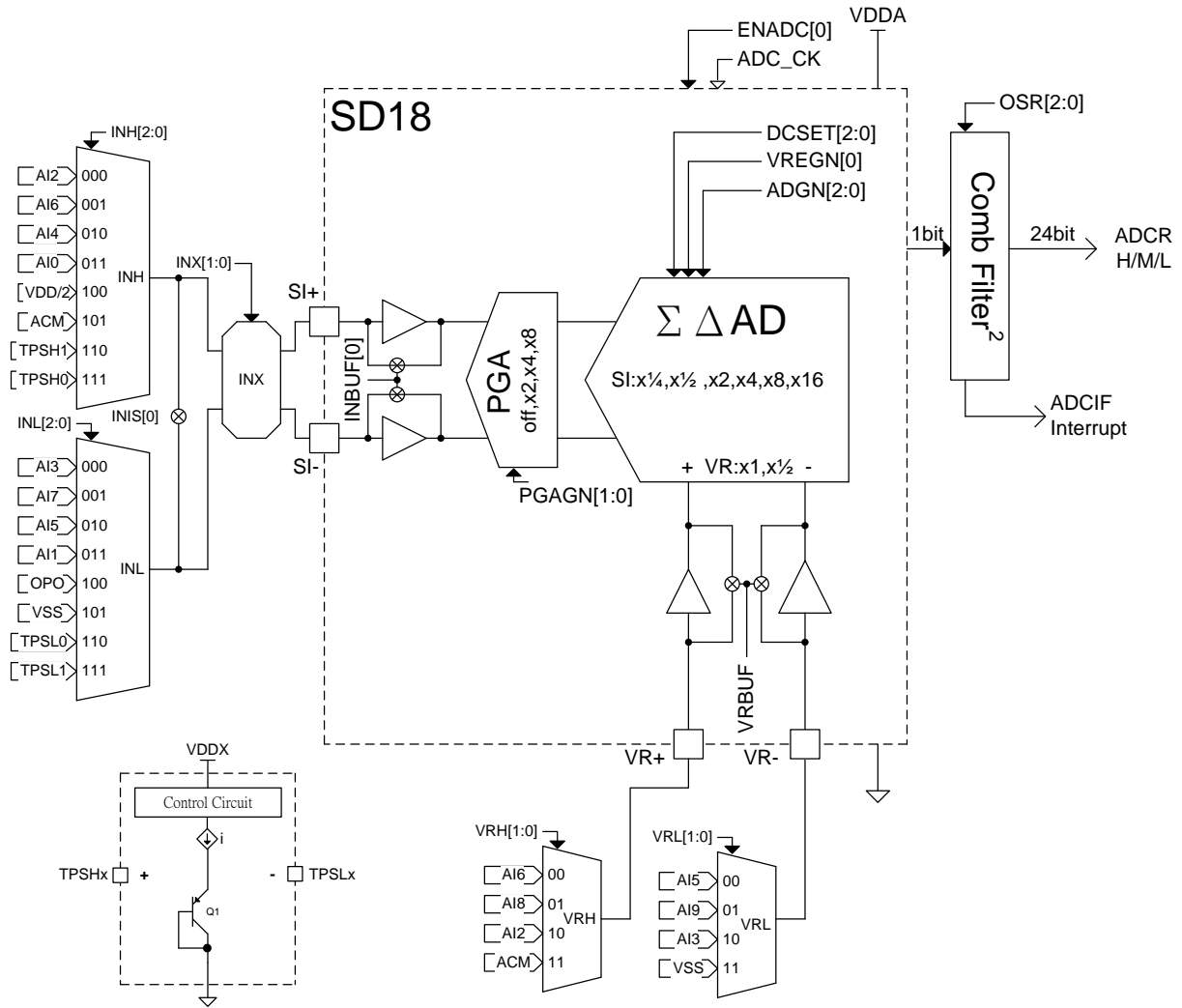


Figure 4-2 SD18 Network

4.4 Low Noise OPAMP Network

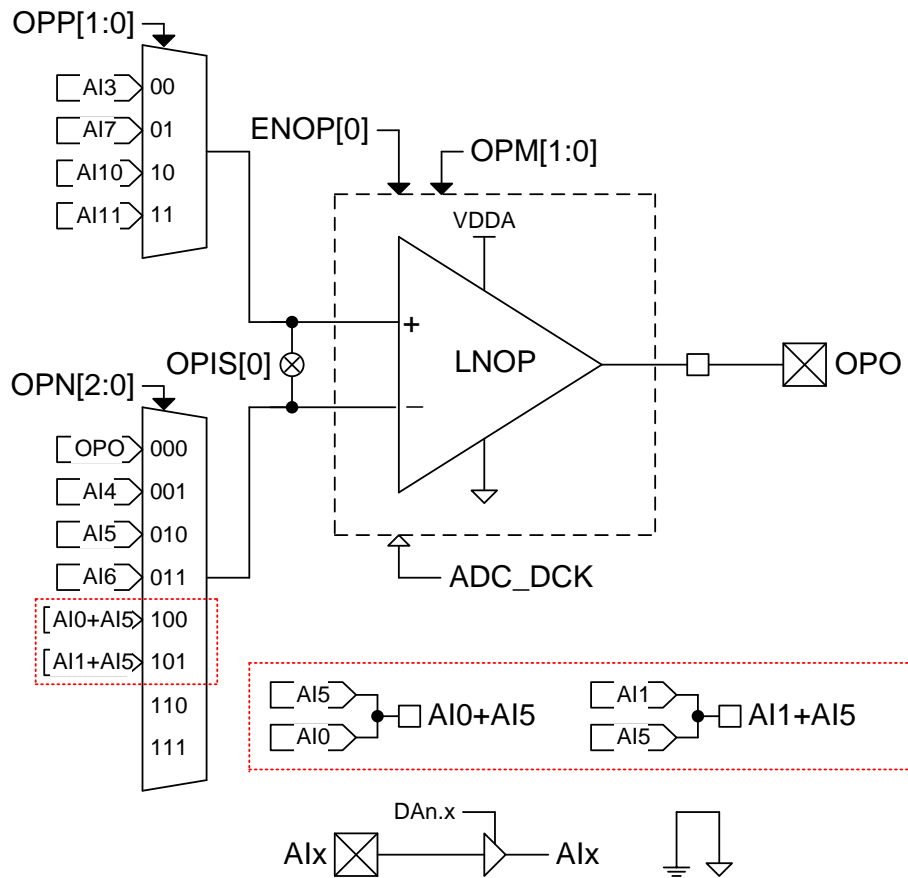


Figure 4-3 Low Noise OPAMP Network

4.5 Enhance Comparator Network

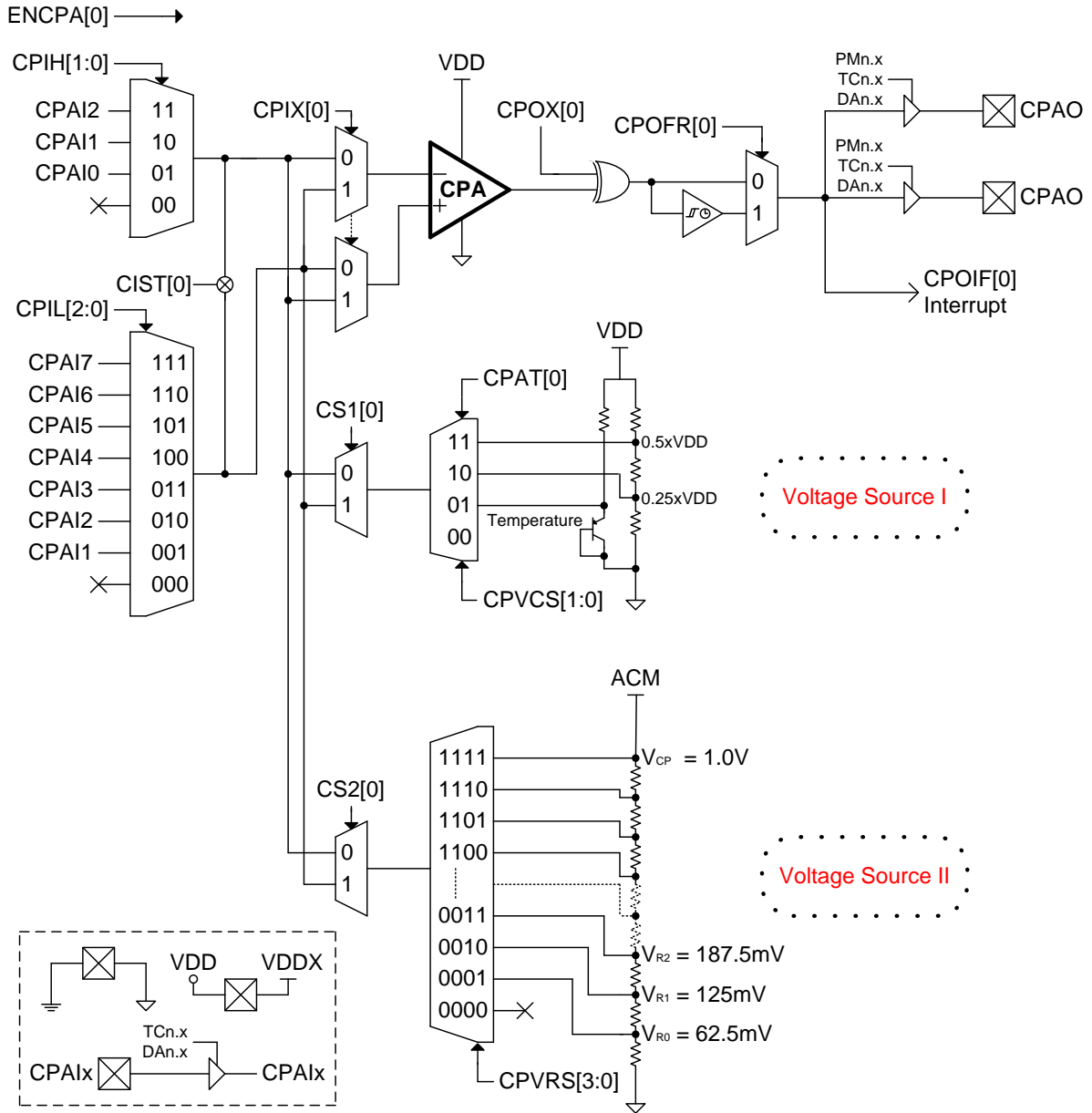


Figure 4-4 Enhance Comparator Network

5. Register List

“no use,”“r”read/write,“w”write,“r”read,“r0”only read 0,“r1”only read 1,“w0”only write 0,“w1”only write 1
“u”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-incremented								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	FSR0H	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,rw0,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	PSLTAUS	PD	TO	IDL	BOR	SKERR								000d .0..	uduu .d..	rw0,rw0,rw0,rw0,-,rw0,-,-
2DH	LVDON	LVDFG LVD LVDON VLDX[3:0]								.000 0000	.000 0000	*****				
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	LSCK HSCK HSS[1:0] CPUCPK[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] OPP1[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	TMBCK	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] TMCS1[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	PASCF[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	*****				

Table 5-1(a) HY11P24 Register List

“.”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***

Table 5-1(b) HY11P24 Register List (continued)

6. Electrical Characteristics

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	± 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			32.768K	Hz	
	Oscillator	Ceramic resonator		XTSP[0]=0, XTHSP[0]=0				
		Crystal		XTSP[0]=1, XTHSP[0]=0	450K			8M
Frequency			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

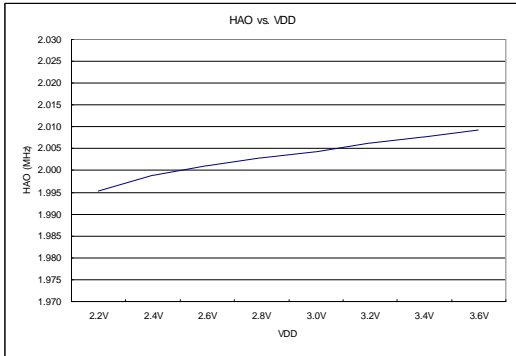


Figure 6.2-1 HAO vs. VDD

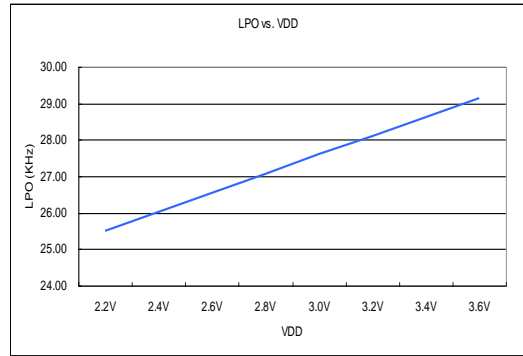


Figure 6.2-2 LPO vs. VDD

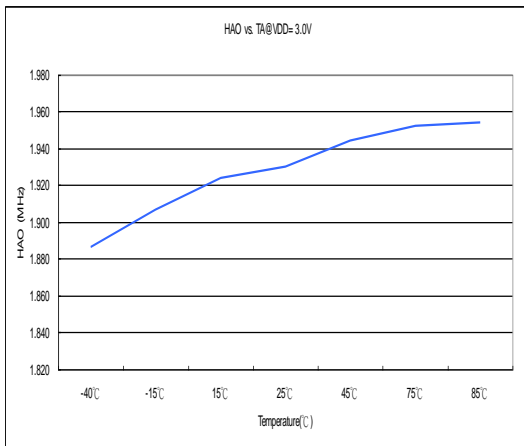


Figure 6.2-3 HAO vs. Temperature

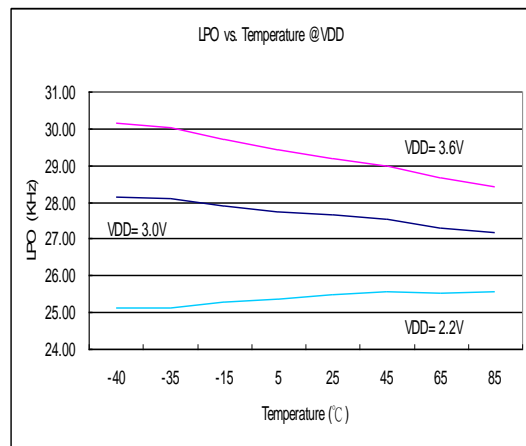


Figure 6.2-4 LPO vs. Temperature

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	uA
I_{LP2}	Low Power 2	OSC_CY = off, OSC_HAO = off, CPU_CK = LPO, Idle state		1.65	3	uA
I_{LP3}	Low Power 3	OSC_CY = off, OSC_HAO = off, CPU_CK = off, Sleep state		0.65	1.2	uA

OSC_CY : External Oscillator frequency.

OSC_HAO : Internal High Accuracy Oscillator frequency.

CPU_CK : CPU core work frequency.

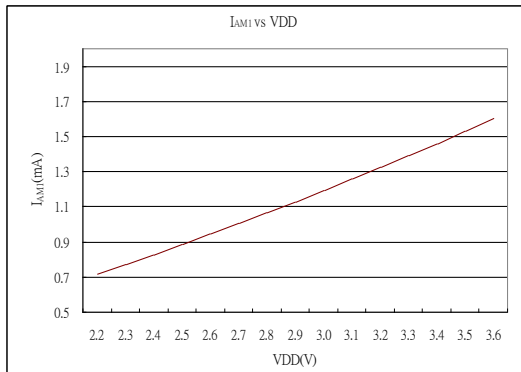


Figure 6.3-1 I_{AM1} vs. VDD

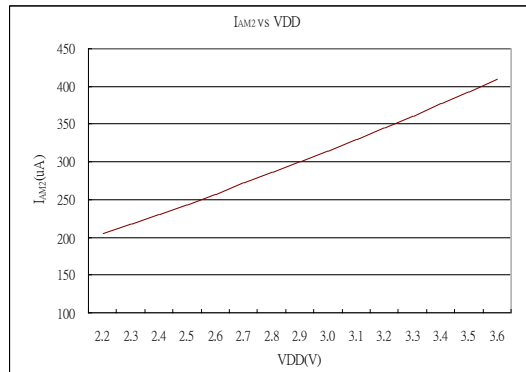


Figure 6.3-2 I_{AM2} vs. VDD

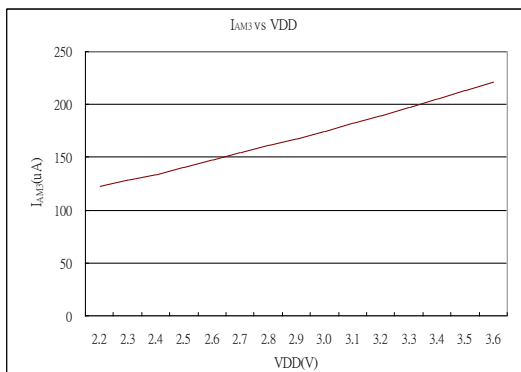


Figure 6.3-3 I_{AM3} vs. VDD

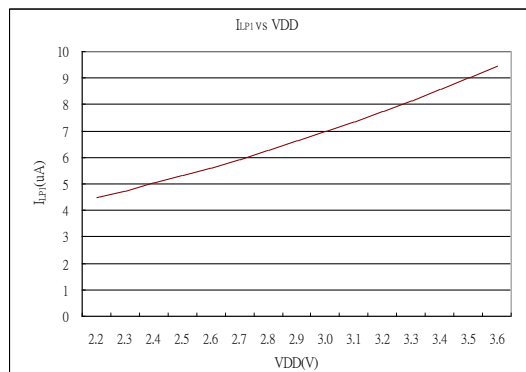


Figure 6.3-4 I_{LP1} vs. VDD

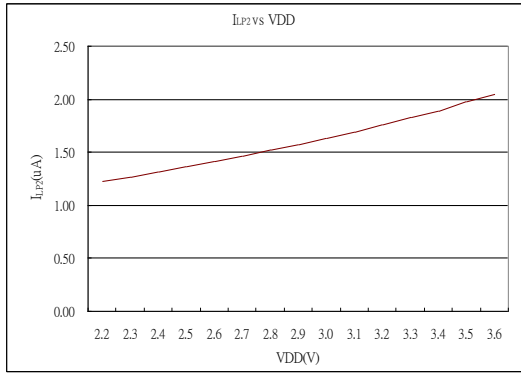


Figure 6.3-5 I_{LP2} vs. VDD

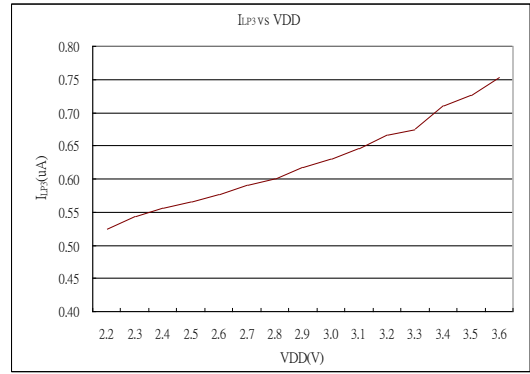


Figure 6.3-6 I_{LP3} vs. VDD

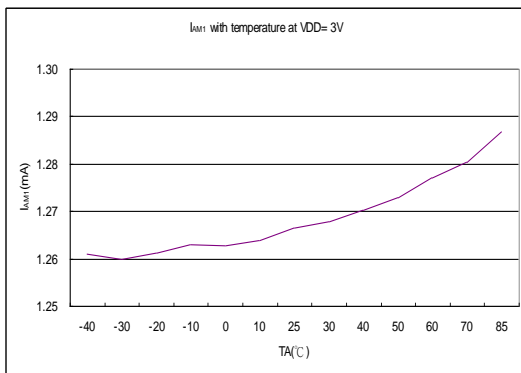


Figure 6.3-7 I_{AM1} vs. Temperature

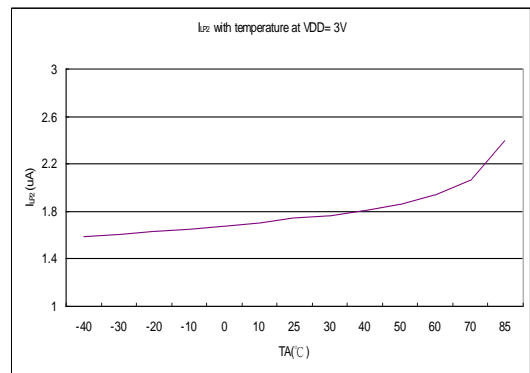


Figure 6.3-8 I_{LP2} vs. Temperature

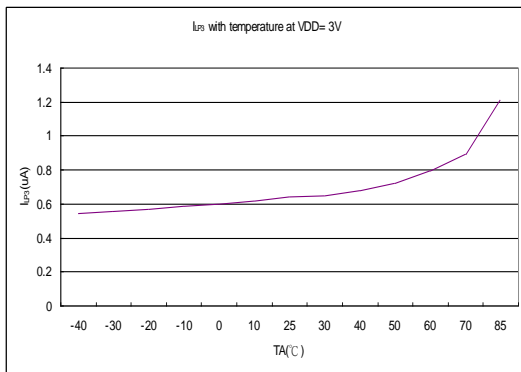


Figure 6.3-9 I_{LP3} vs. Temperature

6.4 Port 1~5

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

Sym.	Parameter	Test Conditions	Min.	Typ.	Max.	unit
Input voltage and Schmitt trigger and leakage current and timing						
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	μA
R_{PU}	Port pull high resistance			180		$\text{k}\Omega$
Output voltage and current and frequency						
V_{OH}	High-level output voltage	$I_{OH}=10\text{mA}$	$V_{DD} - 0.3$			V
V_{OL}	Low-level output voltage	$I_{OL}=-10\text{mA}$			$V_{SS} + 0.3$	

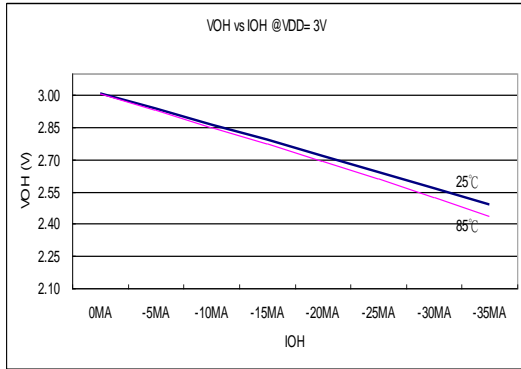


Figure 6.4-1 V_{OH} vs. I_{OH} @ $V_{DD}=3.0\text{V}$

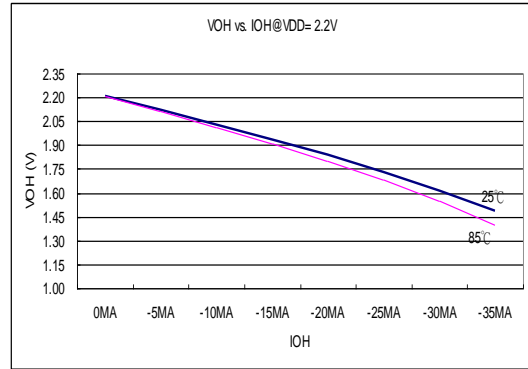


Figure 6.4-2 V_{OH} vs. I_{OH} @ $V_{DD}=2.2\text{V}$

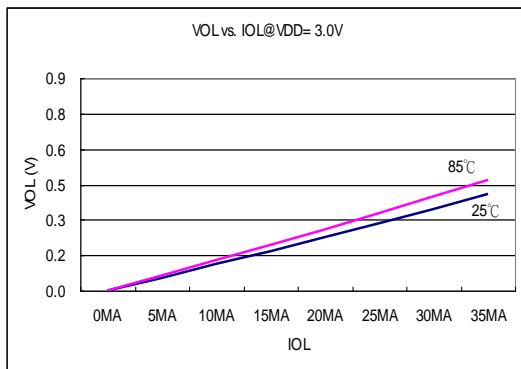


Figure 6.4-3 V_{OL} vs. I_{OL} @ $V_{DD}=3.0\text{V}$

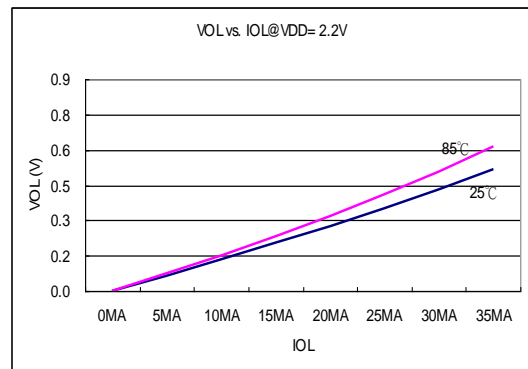


Figure 6.4-4 V_{OL} vs. I_{OL} @ $V_{DD}=2.2\text{V}$

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							

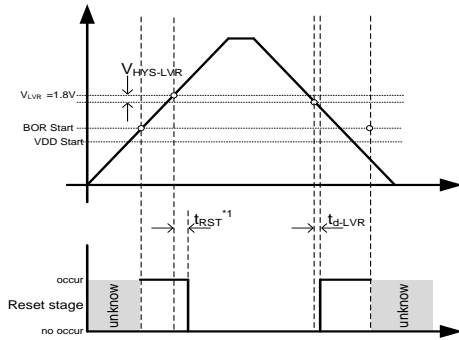


Figure 6.5-1 BOR Reset Diagram

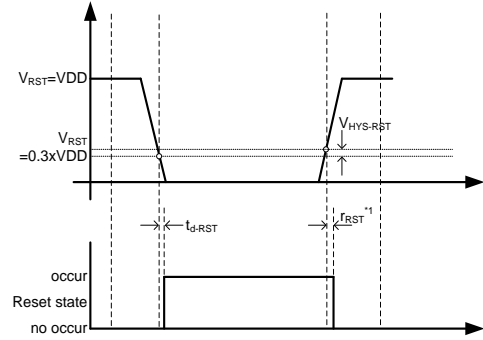


Figure 6.5-2 RST Reset Diagram

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

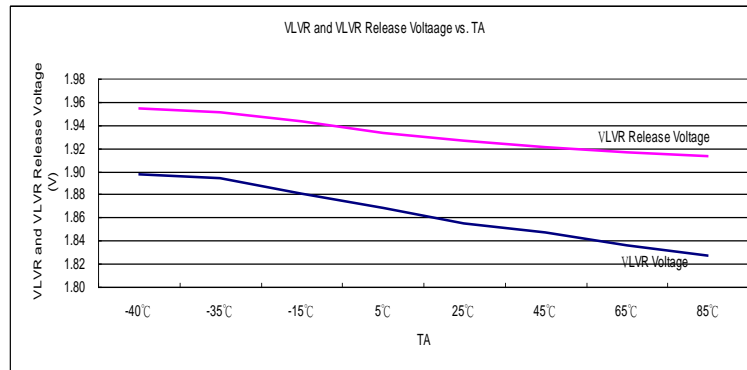


Figure 6.5-3 LVR vs. Temperature

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		μA
	Select VDDA output voltage	$I_L = 0.1\text{mA}$, $V_{DD} \geq V_{VDDA} + 0.2\text{V}$	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	$I_L = 0.1\text{mA}$	$V_{DD} = 2.5\text{V} \sim 3.6\text{V}$		± 0.2		%/V	
ACM	ACM operation current, I_{ACM}	$I_L = 0\text{mA}$			20		μA
	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)

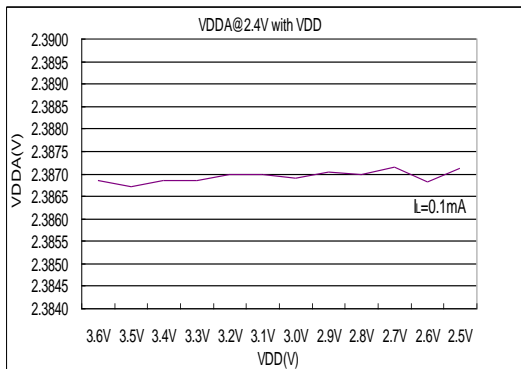


Figure 6.6-1 VDDA $I_L=0.1\text{mA}$ vs. VDD

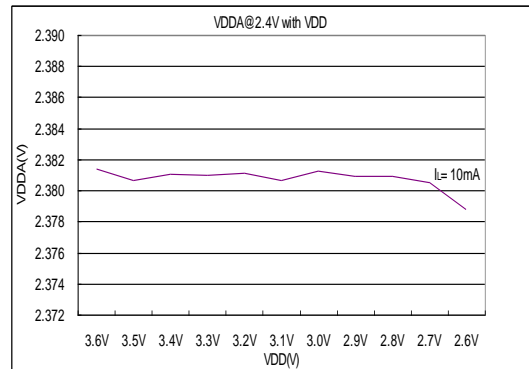


Figure 6.6-2 VDDA $I_L=10\text{mA}$ vs. VDD

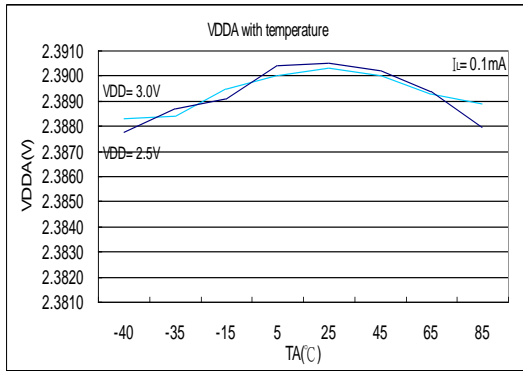


Figure 6.6-3 VDDA IL=0.1mA vs. Temperature

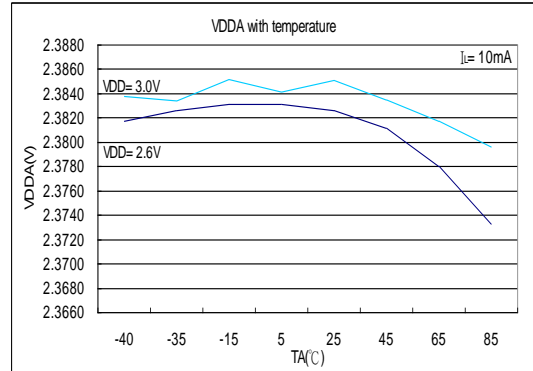


Figure 6.6-4 VDDA IL=10mA vs. Temperature

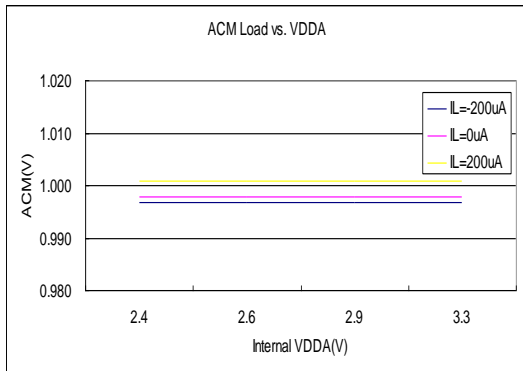


Figure 6.6-5 ACM Load vs. VDDA (a)

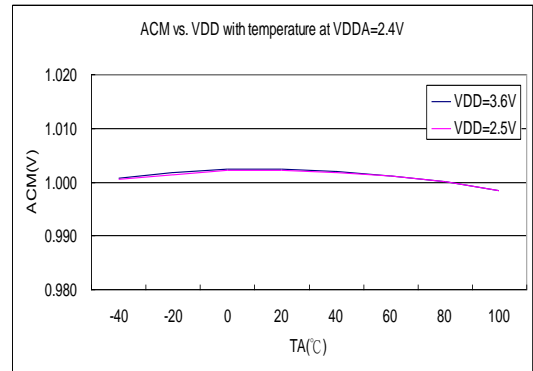


Figure 6.6-6 ACM vs. Temperature (a)

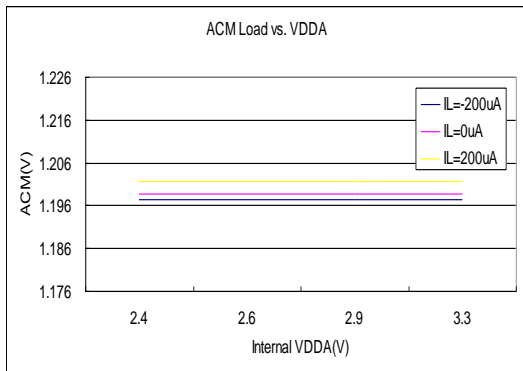


Figure 6.6-5 ACM Load vs. VDDA (b)

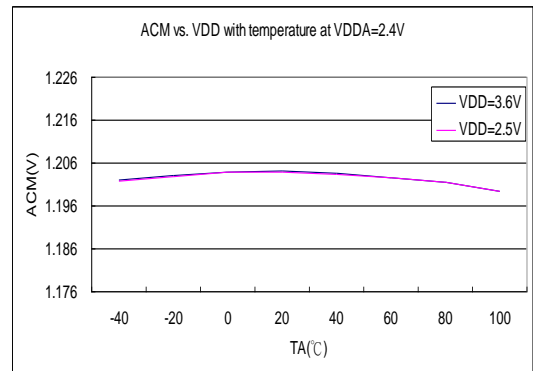


Figure 6.6-6 ACM vs. Temperature (b)

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_{LNOP}	Supply voltage at VDDA	ENVDDA[0]=0		2.4		3.6	V
I_{LNOP}	Operation supply current		OPM[1:0]=xxb		200		μA
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		μV
	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

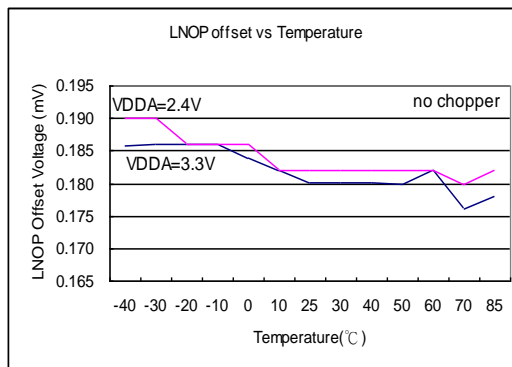


Figure 6.7-1 LNOP Offset Temperature

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)	$V_{DDA} = 2.4\text{V}, V_{VR} = 1.0\text{V}, \Delta\text{SI} = \pm 200\text{mV}$			± 0.003	± 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 ³	ADC_CK=250KHz, OSR[2:0]=010b		23			Bits
G_{SD18}	Temperature drift	INBUF[0]=0b,VRBUF[0]=0b	$T_A = -40^\circ\text{C} \sim 85^\circ\text{C}$		2		ppm/°C
	Gain 1~x16 (INBUF[0]=0b)	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	* ΔAI is external short	Gain=2			1	

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	PGA and Buffer(INBUF,VRBUF)					
	Offset temperature drift with chopper without PGA and Buffer (INBUF,VRBUF).			GAIN=1	2	
				GAIN=2	1	
				GAIN=4	0.5	
				GAIN=16	0.15	
	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	uV/°C
CM _{SD18}	Common-mode rejection	V _{CM} =0.7V to 1.7V, V _{VR} =1.0V, without PGA	V _{SI} =0V, GAIN=1	90	dB	
		V _{CM} =0.7V to 1.7V, V _{VR} =1.0V, without PGA	V _{SI} =0V, GAIN=16	75		
PSRR	DC power supply rejection	V _D DA=3.0V, ΔV _D DA=±100mV, V _{VR} =1.0V, V _{SI} =1.2V, V _{SI} =1.2V,	GAIN=1 PGA=off	75	dB	
			GAIN=16 PGA=8			

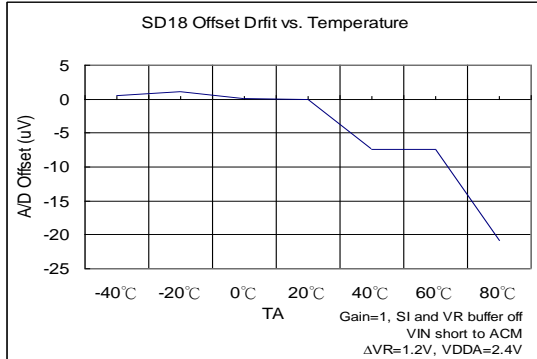


Figure 6.8-1(a) SD18 Offset Temperature Drift

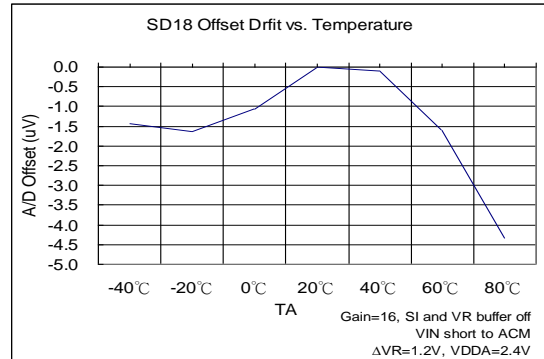


Figure 6.8-1(b) SD18 Offset Temperature Drift

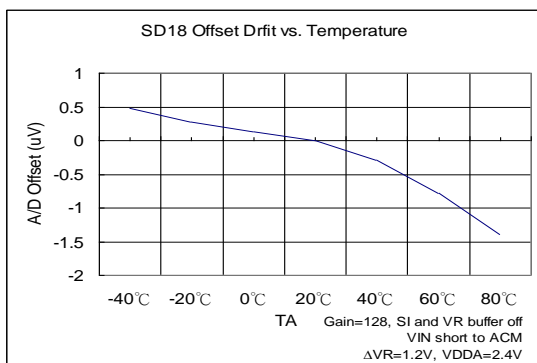


Figure 6.8-1(c) SD18 Offset Temperature Drift

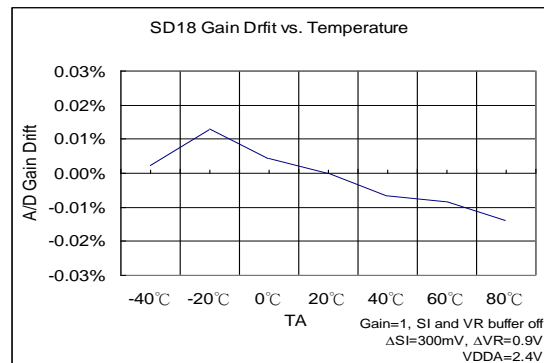


Figure 6.8-2(a) SD18 Gain Drift with Temperature

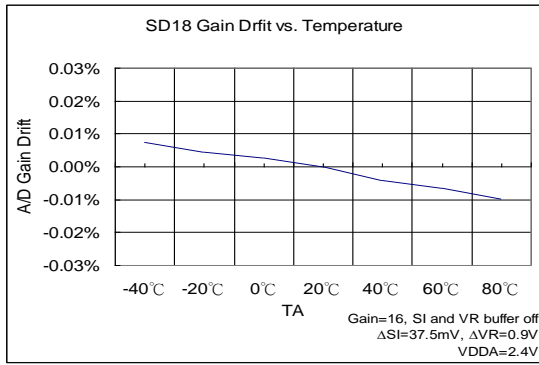


Figure 6.8-2(b) SD18 Gain Drift with Temperature

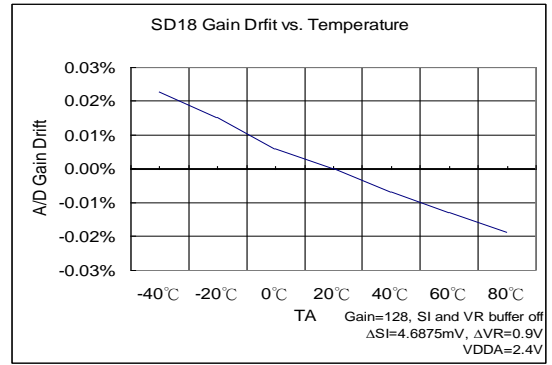


Figure 6.8-2(c) SD18 Gain Drift with Temperature

6.8.3 SD18, Temperature Sensor

$T_A = 25^\circ\text{C}, V_{DD} = 3.0\text{V}, V_{DDA} = 3.3\text{V}$, unless otherwise noted

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

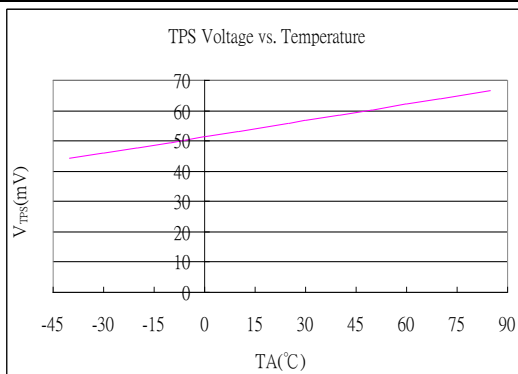


Figure 6.8-3 TPS Output Voltage vs. Temperature Drift

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 provides important input noise specification that aims at SD18. Table 6.8-4(a) and Table 6.8-4(b) lists out the relations of typical noise specification, Gain, Output rate, and maximum input voltage of single end. Test condition configuration and external input signal short, voltage reference: 1.2V and 1024 records were sampled.

ENOB(RMS) with OSR/GAIN at A/D Clock=250Khz, VDDA=2.4V, VREF=1.2V													
Max. Vin(mV) =0.9*VREF ⁽¹⁾	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).

Table 6.8-4(a) SD18 ENOB Table

RMS Noise(uV) with OSR/GAIN at A/D Clock=250Khz, VDDA=2.4V, VREF=1.2V													
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

Table 6.8-4(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) = $2 \times \text{VREF} / \text{Gain}$.

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

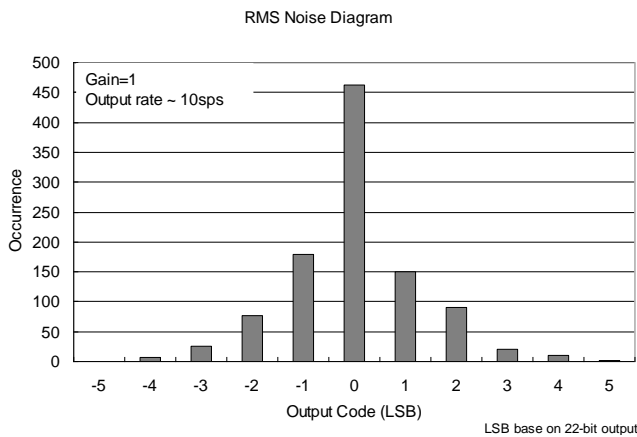


Figure 6.8-4(a) RMS Noise Diagram

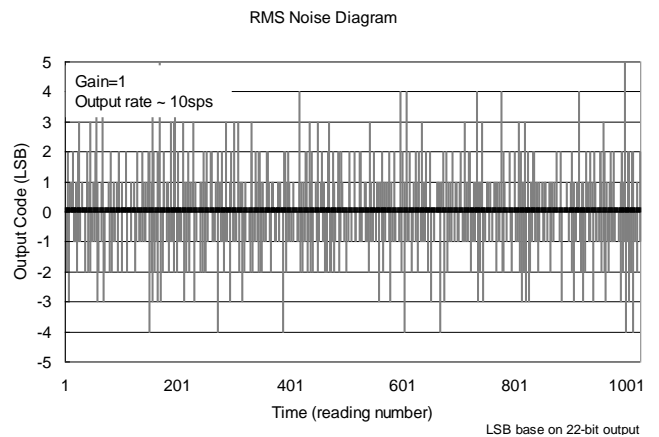


Figure 6.8-4(b) Output Code Diagram

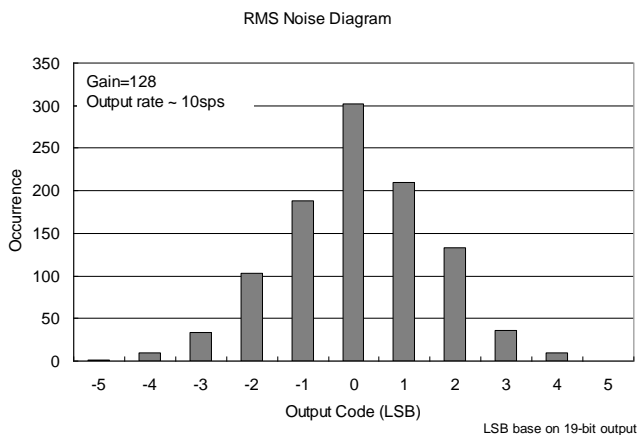


Figure 6.8-4(c) RMS Noise Diagram

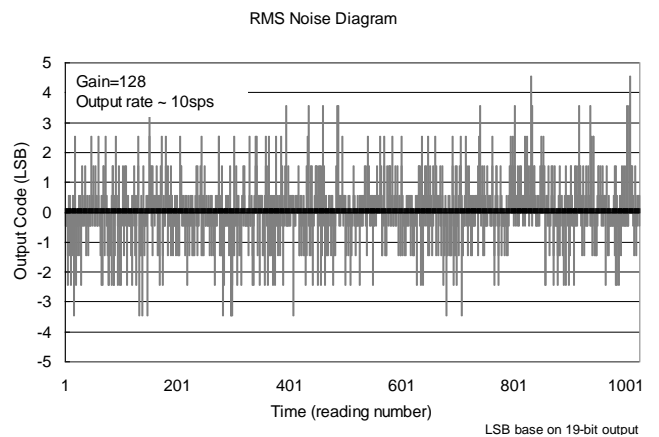


Figure 6.8-4(d) Output Code Diagram

7. Ordering Information

Device No. ¹	Package Type	Pins	Package Drawing		Code ²	Shipment Packing Type	Unit Q'ty	Material Composition	MSL ³
			D	000					
HY11P24-D000	Die	-	D	000	000	-	140	Green ⁴	-
HY11P24-L044	LQFP	44	L	044	000	Tray	160	Green ⁴	MSL-3
HY11P24-L048	LQFP	48	L	048	000	Tray	250	Green ⁴	MSL-3

¹ **Device No.:** Model No. – Package Type Description – Code (Blank Code/ Standard/ Customized Programming Code)

Ex: Your customized programming code is 008 and you require die shipment.

The device No. will be HY11P24-D000-008

Ex: You request blank code in die package.

The device No. will be HY11P24-D000

Ex: You request blank code in LQFP 44 package.

The device No. will be HY11P24-L044

And please clearly indicate the shipment packing type when placing orders.

Ex: Your customized programming code is 009 and you require products in LQFP48 package.

The device No. will be HY11P24-L048-009.

And please clearly indicate the shipment packing type when placing orders.

² **Code:**

“001”~ “999” is standard or customized programming code. Blank code does not have these numbers.

³ **MSL:**

The Moisture Sensitivity Level ranking conforms to IPC/JEDEC J-STD-020 industry standard categorization. The products are processed, packed, transported and used with reference to IPC/JEDEC J-STD-033.

⁴ **Green (RoHS & no Cl/Br):**

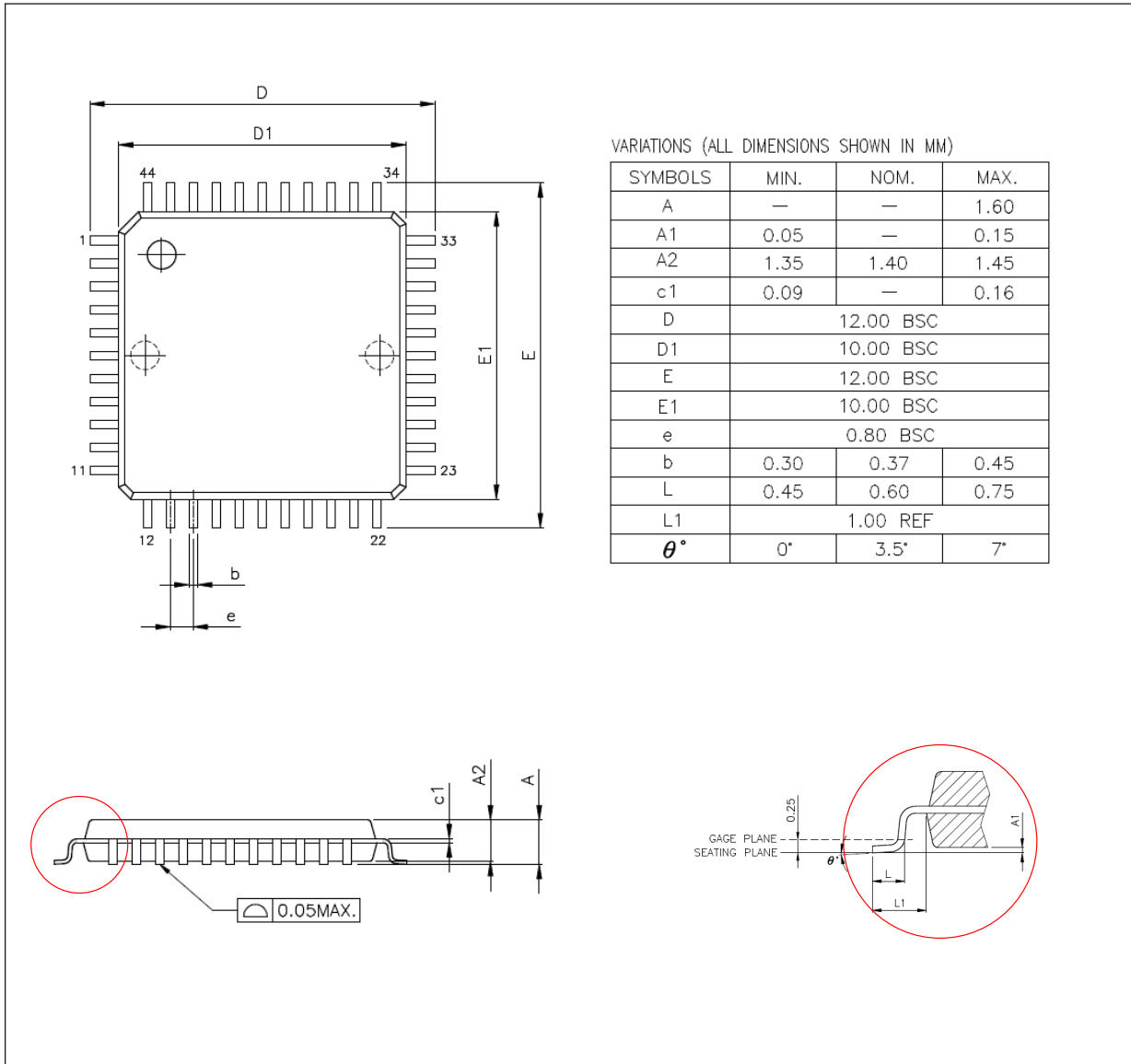
HYCON products are Green products that compliant with RoHS directive and are Halogen free (Br/Cl<0.1%).

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8. Package Information

8.1 LQFP44(L044)

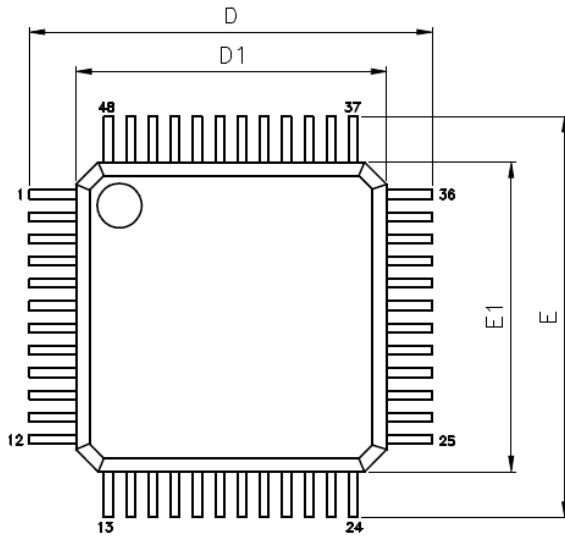


JEDEC MS-026 compliant

HY11P24

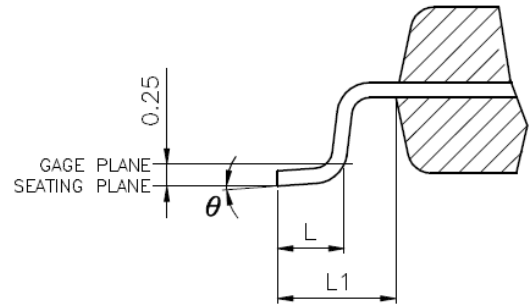
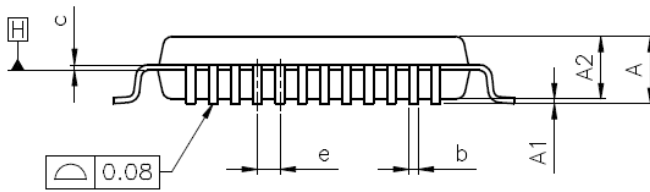
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8.2 LQFP48(L048)



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		
θ	0°	3.5°	7°



JEDEC MS-026 compliant

9. Revision History

Major differences are stated thereafter:

Version	Page	Revision Summary
V01	ALL	First edition
V02		With reference to documentation: DS-HY11P24-V02_TC
	4	Features revision
	6~8	Chapter 2.2 LQFP44 Pinout I/O Description revision
	10~11	Chapter 3 Application Circuit revision
	13~14	Chapter 5 Register List revision
	17~28	Chapter 6.3~6.8 revision
V03	4	Features revision
	7	Chapter 2.2 LQFP44 Pinout I/O Description revision
	22~23	Chapter 6.6 Power System revision
V04	4	Revised features content
	5	Add in Note 3 description
	10~11	Revised application circuit, added in RC circuit of RST
	12	Revised Internal Block Diagram
	20	Delete Detect V_{DD} voltage error description
V08	4	Revised features content
	6	Add in chapter 2.2 LQFP48 Pin Diagram
	13	Revised chapter 4.2 Development Tool Related Operating Instruction serial numbers
	14	Add in chapter 4.3 SD18 Network
	17	Chapter 6 Electrical Characteristics Revision
	24	Revise Power System Temperature Drift Spec
	25	The background color of Figure 6.6-5 and Figure 6.6-6 revision
	31~32	Add in chapter 6.8.4 SD18 Noise Performance
	33	Chapter 7 Ordering information revision
	35	Add in package information-Chapter 8.2 LQFP48(L048)
V09	5~6	Magnified the Pin Diagrams
	7	Added in the Pin Name, CPAI7
	11~14	Added in 4.4 LQFP48 Pinout I/O Description
	19	Added in Low Noise OPAMP Network
	20	Added in Enhance Comparator Network