

NCT7511Y

Nuvoton

H/W Monitoring IC

Date: July/2012 Revision: 1.0

Table of Content-

1.	GENERAL DESCRIPTION	1
2.	FEATURES	1
2.1	Temperature Measurement.....	1
2.2	Fan Speed Monitoring and Control	1
2.3	Event Notification.....	1
2.4	General	1
3.	KEY SPECIFICATIONS	2
4.	PIN CONFIGURATION	2
5.	PIN DESCRIPTION.....	3
5.1	PIN TYPE DISCRIPTION.....	3
5.2	PIN DISCRIPTION	3
6.	FUNCTION DESCRIPTION	4
6.1	GENERAL DESCRIPTION	4
6.2	ACCESS INTERFACE	4
6.2.1	Data write to the internal register	4
6.2.2	Data read from the internal register	4
6.3	ADDRESS SETTING.....	5
6.4	TEMPERATURE MONITOR DATA FORMAT	5
6.4.1	The local temperature (on-die) data with 8-bit 2's complement format.....	5
6.4.2	The remote temperature data with 11-bit 2's complement format	5
6.5	FAN_IN Count Calculation	5
6.6	FAN_OUT Duty Cycle Calculation.....	6
6.7	SMART FAN™ IV Control Parameters.....	6
6.7.1	Step Up Time / Step Down Time	6
6.7.2	Fan Output Start-up Value.....	6
6.7.3	Fan Output Nonstop Value	6
6.7.4	Fan Output Stop Time	6
6.8	SMART FAN™ IV.....	7
6.9	ALERT# Output.....	8
6.9.1	ALERT# Output Mechanism	8
6.9.2	ALERT Response Address.....	9
6.10	T_CRIT# Output.....	9
6.11	SHDN_SEL.....	10
6.12	T_CRIT#_SET	10
7.	REGISTER DESCRIPTION	13
7.1	REGISTER MAP	13
7.2	REGISTER DETAIL.....	16
7.2.1	Remote Diode 1 Temperature Readout Register (MSB)	16

7.2.2	Remote Diode 2 Temperature Readout Register (MSB)	16
7.2.3	Local Diode Temperature Readout Register (MSB)	16
7.2.4	Temperature Readout Register (LSB)	16
7.2.5	Fan Count 1 Readout Register (MSB)	17
7.2.6	Fan Count Readout Register (LSB)	17
7.2.7	T_CRIT#_SET Point Register	17
7.2.8	Alert Status Register	17
7.2.9	Diode Fault Alert Status Register	18
7.2.10	Low Alert Status Register	18
7.2.11	High Alert Status Register	18
7.2.12	Fan Alert Status Register	18
7.2.13	T_CRIT# Alert Status Register	19
7.2.14	GPIO Alert Status Register	19
7.2.15	T_CRIT# Real Time Status Register	19
7.2.16	Start Register	19
7.2.17	Mode Selection Register	20
7.2.18	Fan Enable Register	20
7.2.19	Conversion Rate Register	20
7.2.20	Fault Queue Register	20
7.2.21	Alert# High Limit Link to T_CRIT#	21
7.2.22	RTD1 Temperature High Limit Register	21
7.2.23	RTD1 Temperature Low Limit Register	21
7.2.24	RTD2 Temperature High Limit Register	21
7.2.25	RTD2 Temperature Low Limit Register	22
7.2.26	LTD Temperature High Limit Register	22
7.2.27	LTD Temperature Low Limit Register	22
7.2.28	RTD1 T_CRIT# Threshold Register	22
7.2.29	RTD2 T_CRIT# Threshold Register	23
7.2.30	LTD T_CRIT# Threshold Register	23
7.2.31	FANIN1 Limit Low Byte Register	23
7.2.32	FANIN1 Limit High Byte Register	23
7.2.33	ALERT Mask Register Register	24
7.2.34	ALERT Mask Temperature Channel Register	24
7.2.35	ALERT Mask Fan Channel Register	24
7.2.36	T_CRIT# Mask Register	25
7.2.37	GPIO Alert Mask Register	25
7.2.38	GPIO Mode Register	25
7.2.39	GPIO Output Type Register	26
7.2.40	GPIO Input Data Register	26
7.2.41	GPIO Output Data Register	26
7.2.42	Fan Control Output Type Register	26
7.2.43	Fan Control Output Mode Register	27
7.2.44	Fan Control 1 Output Value Register	27
7.2.45	Close-Loop Fan Control RPM mode Register	27

7.2.46	Temperature to Fan mapping Relationships Register	27
7.2.47	Temperature to Fan mapping Relationships Register	28
7.2.48	Fan Control Configuration Register 1	28
7.2.49	Fan Control Configuration Register 2	29
7.2.50	Fan Control Configuration Register 3	29
7.2.51	Fan Control Configuration Register 4	29
7.2.52	Fan 1 Target Register.....	29
7.2.53	Close-Loop Fan Control RPM Mode Tolerance Register	30
7.2.54	FANCTL Step Up Time Register	30
7.2.55	FANCTL Step Down Time Register.....	30
7.2.56	Default Fan Speed Register	30
7.2.57	FANCTL1 PWM Prescaler Register	31
7.2.58	Temperature1 Hysteresis Register	32
7.2.59	Temperature 2 Hysteresis Register	32
7.2.60	Temperature 3 Hysteresis Register	32
7.2.61	FANCTL Start Duty Cycle Register	32
7.2.62	FANCTL Stop Time Register.....	33
7.2.63	SMART FAN™ IV Temperature and PWM Registers Register	33
7.2.64	TD1 Offset Register.....	34
7.2.65	TD2 Offset Register.....	34
7.2.66	Soft Reset Register	34
7.2.67	Vendor ID Register	34
7.2.68	Chip ID Register	35
7.2.69	Device ID Register.....	35
8.	ELECTRICAL CHARACTERISTICS	36
8.1	Absolute Maximum Ratings.....	36
8.2	DC Characteristics	36
8.3	AC Characteristics.....	37
9.	ORDERING INFORMATION.....	38
10.	TOP MARKING SPECIFICATION	38
11.	TAPING SPECIFICATION	39
12.	PACKAGE DRAWING AND DIMENSIONS.....	40
13.	REVISION HISTORY	41

1. GENERAL DESCRIPTION

The NCT7511Y is a Nuvoton Hardware Monitor IC, which can monitor several critical hardware parameters of the systems, including the temperature and fan speeds, to make the system work stably and efficiently.

The NCT7511Y supports one on-die and two remote temperature sensors with SMBus interface. There's a 10-bit analog-to-digital converter (ADC) is built inside NCT7511Y, to convert the monitored temperature value. Both of the remote temperature inputs can be connected to CPU/GPU thermal diode or any diode sensors and thermistor.

The NCT7511Y has 1 fan control groups and two GPIO pins. The SMART FAN™ IV mode of the fan speed control provides 4 sets of temperature setting points, and they can also control the duty cycle of fan outputs. It provides an easy method to implement quiet and cooling solution with maximum safety and flexibility.

Meanwhile, there're two pure hardware event pins ALERT# and T_CRIT# for independent alarm signals, and all threshold values could be set for system protection without timing delay.

2. FEATURES

2.1 Temperature Measurement

- Measure the temperature with high accuracy.
- One local on-die thermal sensor
- Two pairs thermal diode (current mode) temperature channels

2.2 Fan Speed Monitoring and Control

- SMART FAN™ IV mode or Manual mode to control the fan speed
- One fan control output multi-function (PWM/DC mode supported)
- One fan tachometer input multi-function

2.3 Event Notification

- Supports 2 alarm outputs: ALERT# and T_CRIT# signals to activate system protection.
- ALERT# output supports SMBus™ 2.0 ARA function
- T_CRIT# supports Hardware Power-on setting

2.4 General

- Two GPIO pins
- I²C® Compatible System Management bus (SMBus)
- 3.3V±5% V_{CC} operation
- 16-pin QFN (Halogen free)

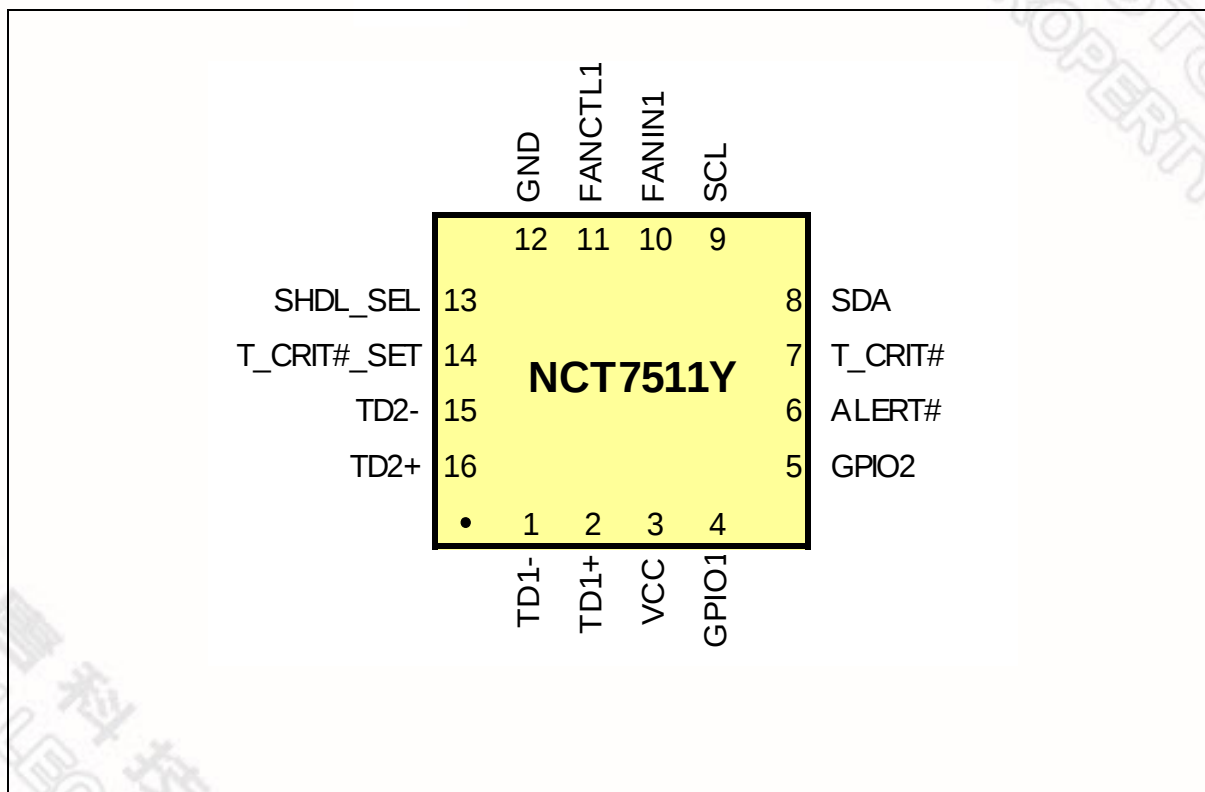
3. KEY SPECIFICATIONS

- Temperature Sensor Accuracy

Remote Diode Sensor Accuracy (25~85°C)	$\pm 1^{\circ}\text{C}$ typ.
On-chip Temperature Sensor Accuracy (25~70°C)	$\pm 2^{\circ}\text{C}$ typ.
Remote Temperature Sensor Resolution	0.125 °C
Local Temperature Sensor Resolution	1 °C
- Supply Voltage 3.3V $\pm$ 5%
- Operating Supply Current TBD
- Operating Temperature Range -40°C ~ 85°C ^{*1}

^{*1} Guaranteed by design from -40~85 degree C, 100% tested at 85 degree C.

4. PIN CONFIGURATION



5. PIN DESCRIPTION

5.1 PIN TYPE DISCRIPTION

PIN TYPE	PIN ATTRIBUTE
OD ₁₂	Open-drain output pin with 12 mA sink capability
IN _{ts}	TTL level input pin and schmitt trigger
AIN	Input pin (Analog)
OUT ₁₂	Output pin with 12 mA sink/source capability
AOUT	Output pin (Analog)
P	Power or Ground Pin

5.2 PIN DISCRIPTION

PIN NO.	PIN NAME	I/O	FUNCTION
1	TD1-	AIN	Connect to Thermal Diode 1 Cathode.
2	TD1+	AIN	Connect to Thermal Diode 1 Anode.
3	VCC	P	Power supply, Voltage input 3.3V±5%
4	GPIO1	IN _{ts} / OD ₁₂	General purpose I/O function.
5	GPIO2	IN _{ts} / OD ₁₂	General purpose I/O function.
6	ALERT#	OD ₁₂	Alarm output, for interrupt control
7	T_CRIT#	OD ₁₂	T_CRIT# alarm output, for interrupt or shutdown control.
8	SDA	IN _{ts} / OD ₁₂	SMBus bi-directional data.
9	SCL	IN _{ts}	SMBus Clock.
10	FANIN1	IN _{ts}	Fan tachometer input
11	FANCTL1	OUT ₁₂ / AOUT	It can be configured to PWM/DC mode by registers. Default is PWM output. As DC output, 256 steps output voltage scaled to 0~VCC.
12	GND	P	Power supply ground
13	SHDN_SEL	AIN	Selects the hardware shutdown channel and operating mode
14	T_CRIT#_SET	AIN	Voltage input to set the Critical/Thermal Shutdown threshold
15	TD2-	AIN	Connect to Thermal Diode 2 Cathode.

PIN NO.	PIN NAME	I/O	FUNCTION
16	TD2+	AIN	Connect to Thermal Diode 2 Anode.

6. FUNCTION DESCRIPTION

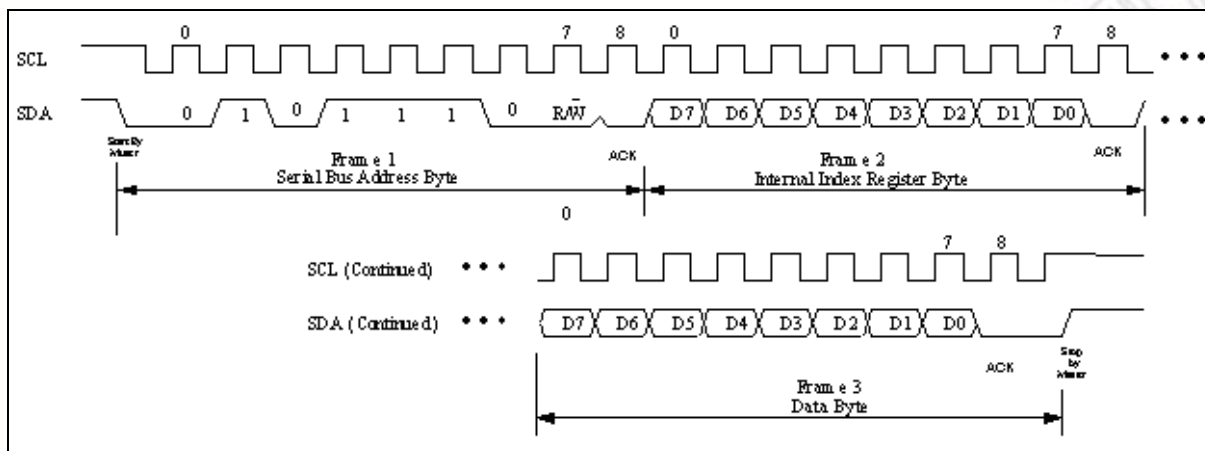
6.1 GENERAL DESCRIPTION

The NCT7511Y is a SMBus™ interface device to provide one on-die temperature sensor, two set of inputs for thermal diode sensors, 1 fan control groups, and two GPIO pins. The NCT7511Y also provides ALERT# and T_CRIT# alarm signals for event notification.

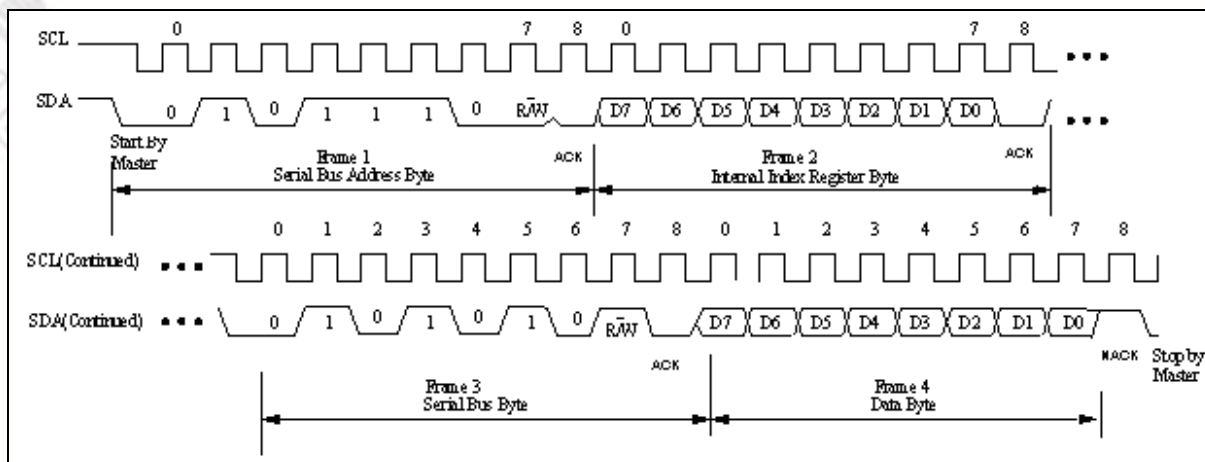
6.2 ACCESS INTERFACE

NCT7511Y provides SMBus to access the internal register, supports SMBus byte write and byte read protocols.

6.2.1 Data write to the internal register



6.2.2 Data read from the internal register



6.3 ADDRESS SETTING

NCT7511Y I2C/SMBus address is 0101110xb (x is R/W bit).

6.4 TEMPERATURE MONITOR DATA FORMAT

6.4.1 The local temperature (on-die) data with 8-bit 2's complement format

TEMPERATURE	8-BIT DIGITAL OUTPUT
+127°C	0111,1111
+25°C	0001,1001
+2°C	0000,0010
+1°C	0000,0001
+0°C	0000,0000
- 1°C	1111,1111
- 2°C	1111,1110
- 25°C	1110,0111
- 128°C	1000,0000

6.4.2 The remote temperature data with 11-bit 2's complement format

TEMPERATURE	8-BIT DIGITAL OUTPUT HIGH BYTE	3-BIT DIGITAL OUTPUT LOW BYTE
+127.875°C	0111,1111	111X,XXXX
+25.750°C	0001,1001	110X,XXXX
+2.250°C	0000,0010	010X,XXXX
+1.125°C	0000,0001	001X,XXXX
+0.000°C	0000,0000	000X,XXXX
- 1.125°C	1111,1110	111X,XXXX
- 2.250°C	1111,1101	110X,XXXX
- 25.750°C	1110,0110	010X,XXXX
- 127.875°C	1000,0000	001X,XXXX

6.5 FAN_IN Count Calculation

The FAN_IN tachometer high byte and low byte are combined to 12-bitCountValue. Real RPM (Rotate per Minute) calculation should follow the formula:

$$FanSpeed(RPM) = \frac{1.35 \times 10^6}{(12 - bitCountValue) \times (FanPoles/4)}$$

In this formula, FanPoles stands for the number of NS pole pairs inside the fan. Normally an N-S-N-S Fan (FanPoles=4) generates 2 pulses after completing one rotation.

6.6 FAN_OUT Duty Cycle Calculation

The NCT7511Y provides 1 set of PWM for fan speed control. The duty cycle of PWM can be programmed by an 8-bit register. The expression of duty cycle can be represented as follow formula:

$$\text{Duty-cycle(\%)} = \frac{\text{Programmed 8-bit Register Value}}{255} \times 100\%$$

6.7 SMART FAN™ IV Control Parameters

In SMART FAN™ IV Mode, there are some Fan control parameters as below descriptions:

6.7.1 Step Up Time / Step Down Time

SMART FAN™ IV is designed for the smooth operation of the fan. The Up Time / Down Time register defines the time interval between successive duty increases or decreases. If this value is set too small, the fan will not have enough time to speed up after tuning the duty and sometimes may result in unstable fan speed. On the other hand, if Up Time / Down Time is set too large, the fan may not work fast enough to dissipate the heat. This register should never be set to 0, otherwise, the fan duty will be abnormal.

6.7.2 Fan Output Start-up Value

From still to rotate, the fan usually needs a higher fan output value to generate enough torque to conquer the restriction force. Thus the Fan Output Start-up Value is used to turn on the fan with the specified output value.

6.7.3 Fan Output Nonstop Value

It takes some time to bring a fan from still to working state. Therefore, Nonstop value are designed with a minimum fan output to keep the fan working when the system does not require the fan to help reduce heat but still want to keep the fast response time to speed up the fan.

6.7.4 Fan Output Stop Time

A time interval is specified to turn off the fan if SMART FAN™ IV continuously requests to slow down the fan which has already reached the Stop time.

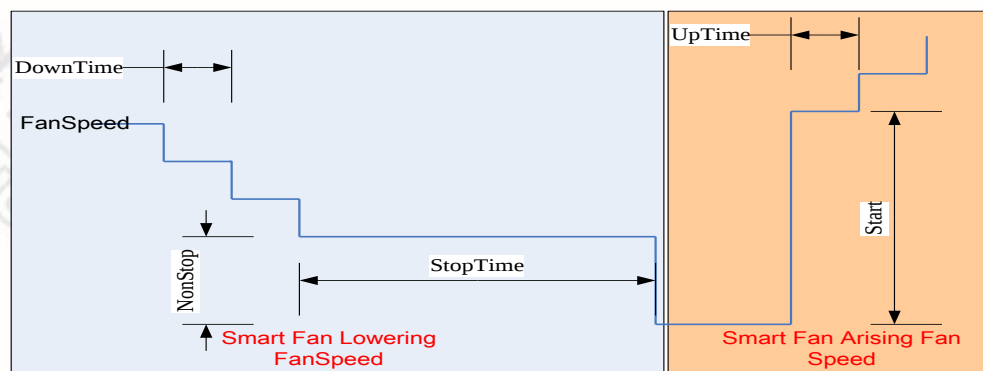


Figure 6-1 SMART FAN™ Control Parameters

6.8 SMART FAN™ IV

SMART FAN™ IV supports Fan Duty Outputs Mode and Close Loop Fan Control (RPM) Mode to control the fan speed.

There're 3 slopes can be obtained by setting FanDuty/RPM1~FanDuty/RPM4 and T1~T4 through the registers. When the temperature rises, FAN Output will calculate the target FanDuty/RPM based on the current slope. For example, assuming Tx is the current temperature and FanDuty/RPM is the target, then the slope:

$$X2 = \frac{(FanDuty3 / RPM3) - (FanDuty2 / RPM2)}{(T3 - T2)}$$

Fan Output:

$$Target\ FanDuty\ or\ RPM = (FanDuty2\ or\ RPM2) + (Tx - T2) \cdot X2$$

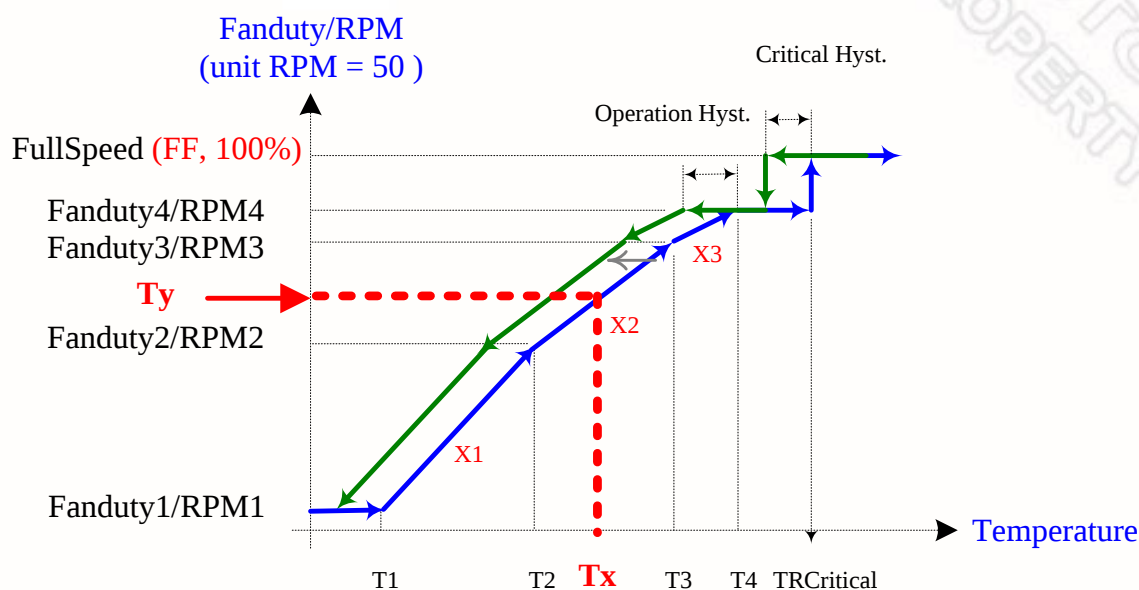
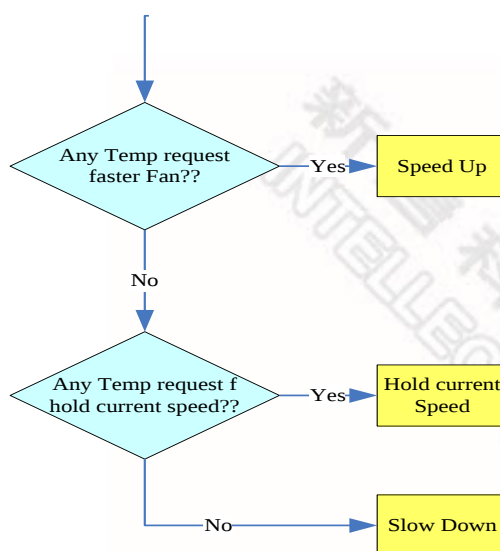


Figure 6-2 SMART FAN™ IV Mechanism

In addition, SMART FAN™ IV can also set up Critical Temperature and Hysteresis. If the current temperature exceeds Critical Temperature, external fan will be forced by maximum FanDuty to meet the largest target FanDuty or RPM, Which is 0xFF. The target FanDuty & RPM value will be determined in accordance to the slope only when the temperature falls below (TCritical – Criticl Hyst.)

NCT7511Y provides 3 temperature source selections to map the fan, the algorithm will make a decision to control the fan as below figure:



6.9 ALERT# Output

The NCT7511Y ALERT# pin is an active-low open-drain output pin which is triggered when measured temperature exceeds the limitation defined in the limit registers. There are three types of ALERT# output mode: the ALERT# output comparator mode, the ALERT# output interrupt mode, and the ALERT# output SMBus ALERT# mode.

6.9.1 ALERT# Output Mechanism

Figure 6-3 shows the mechanism of the ALERT# output. In this mode, the NCT7511Y will set the ALERT mask bit of Configuration Register during a read of the Status Register if any flag in Status Register, except the ADC_Busy flag and Remote Diode Open flag, is set. This prevents further ALERT# triggering until the master has reset the ALERT mask bit (write 0 to Alert_MSK), at the end of the interrupt service routine. The Status Register flags are cleared only upon a read Status Register command from the master and will be re-alerted at the end of the next temperature conversion if the measured temperature still falls outside of the allowed range.

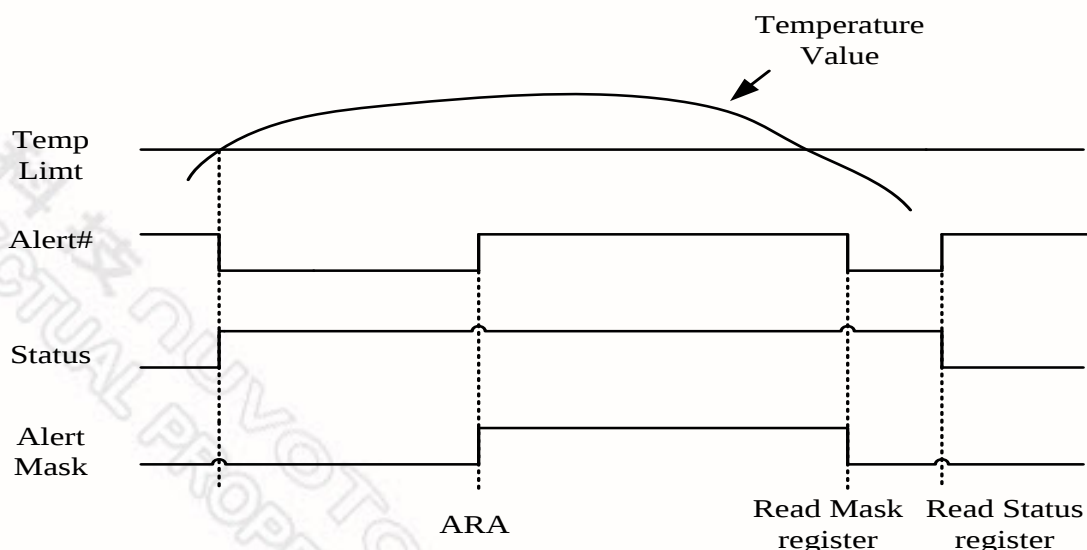


Figure 6-3 ALERT# Output Mechanism

6.9.2 ALERT Response Address

Figure 6-4 shows the mechanism of the SMBus ALERT Response Address (ARA) support on ALERT# output. In this mode, the ALERT# output of the NCT7511Y is connected to the SMBus alert line which has more than one device connected to it. Through such an implementation, SMBus alert mode can assist the master in resolving which slave generates an interrupt. When the measured temperature falls outside of the allowed range, the ALERT# pin will be pulled low and the corresponding alert flags in Status Register will be set to 1. The ALERT mask bit will just be set if there is a read command for Status Register or when ARA occurs from master (Alert Response Address is 0001100x). Meanwhile, the NCT7511Y will generate and return its own address to the master. If the temperature never falls outside of the allowed range, the latched ALERT# pin can release by the reset ALERT mask bit and the latched corresponding alert flags in Status Register can release by reading command for Status Register.

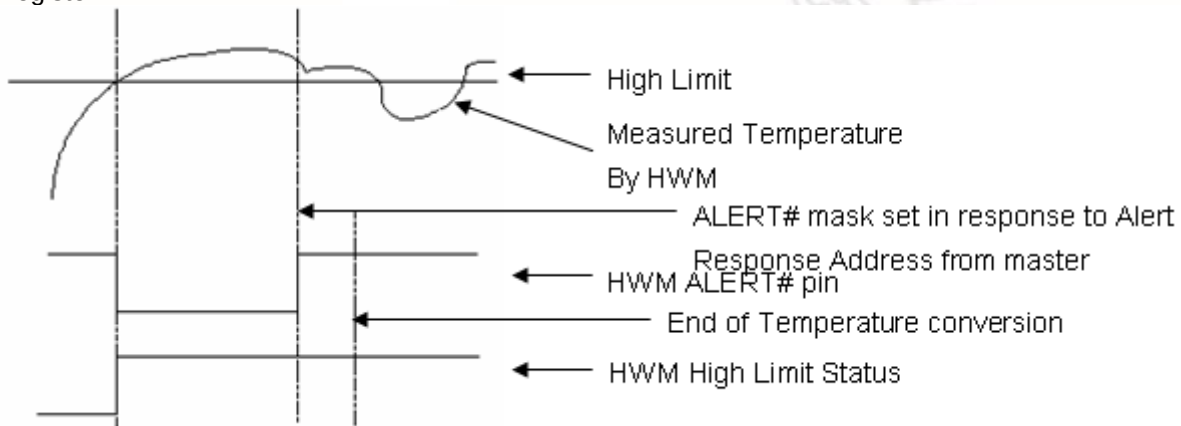


Figure 6-4 SMBus ARA Mechanism

6.10 T_CRIT# Output

T_CRIT# output pulls low when the measured temperature exceeds the critical temperature setting. Once the T_CRIT# output pulls low, it will not be set high until the measured temperature is lower than "T_CRIT# - TH", where TH is Temperature Hysteresis. Status Register will not be reset until it is read and the temperature conversion falls below the T_CRIT# set point. Figure 6-5 shows this mechanism.

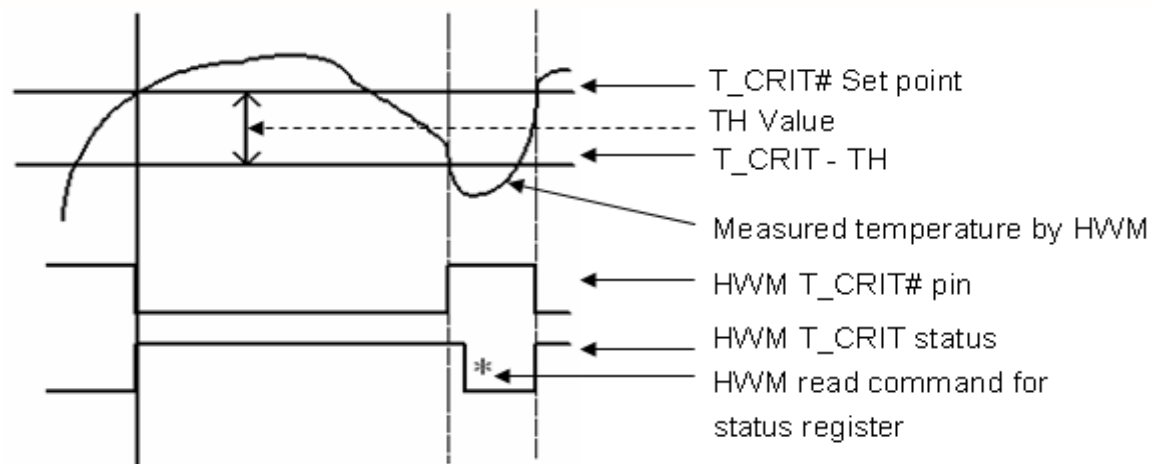


Figure 6-5 T_CRIT# Output Mechanism

6.11 SHDN_SEL

The NCT7511Y has a strapping input pin (SHDN_SEL) allowing for configuration of the hardware Critical/Thermal Shutdown input channel.

The pull-up resistor used on SHDN_SEL pin identifies which configuration setting is used as shown in table.

PULL-UP RESISTOR (Ω)	MODE / SHUTDOWN CHANNEL
4.7K ~ 10K	RTD1

6.12 T_CRIT#_SET

The NCT7511Y's T_CRIT#_SET pin is an analog input pin to set the Critical/Thermal shutdown temperature by trapping voltage when system power on. The thermal shutdown temperature is ranging from 65°C to 127°C as shown in table.

Trapping Temp(HEX)	Trapping Temp(DEC)	Trapping Volt(V)
41	65	1.112
41	65	1.144
41	65	1.176
42	66	1.207
43	67	1.239
44	68	1.271
45	69	1.303
46	70	1.334
47	71	1.366
48	72	1.398
49	73	1.430
4a	74	1.461
4b	75	1.493
4c	76	1.525
4d	77	1.557
4e	78	1.589
4f	79	1.620
50	80	1.652
51	81	1.684
52	82	1.716
53	83	1.747
54	84	1.779
55	85	1.811

Trapping Temp(HEX)	Trapping Temp(DEC)	Trapping Volt(V)
56	86	1.843
57	87	1.875
58	88	1.906
59	89	1.938
5a	90	1.970
5b	91	2.002
5c	92	2.033
5d	93	2.065
5e	94	2.097
5f	95	2.129
60	96	2.160
61	97	2.192
62	98	2.224
63	99	2.256
64	100	2.288
65	101	2.319
66	102	2.351
67	103	2.383
68	104	2.415
69	105	2.446
6a	106	2.478
6b	107	2.510
6c	108	2.542
6d	109	2.573
6e	110	2.605
6f	111	2.637
70	112	2.669
71	113	2.701
72	114	2.732
73	115	2.764
74	116	2.796
75	117	2.828
76	118	2.859
77	119	2.891
78	120	2.923
79	121	2.955

Trapping Temp(HEX)	Trapping Temp(DEC)	Trapping Volt(V)
7a	122	2.986
7b	123	3.018
7c	124	3.050
7d	125	3.082
7e	126	3.114
7f	127	3.145

7. REGISTER DESCRIPTION

7.1 REGISTER MAP

Idx	Register Name	Att	Df	7	6	5	4	3	2	1	0	
1	Read RTD1 MSB	R		MNTRTD1[10:3]								
2	Read RTD2 MSB	R		MNTRTD2[10:3]								
4	Read LTD MSB	R		MNTLTD[10:3]								
5	Read Temp LSB	R		MNTTD_Lsb[2:0]			RSV					
10	Read Fan Count 1MSB	R		MNTFAN1[12:5]								
13	Read Fan Count 1LSB	R		MNTFAN_Lsb[4:0]					RSV			
14	T_CRIT#_SET Point	R		T_CRIT#_SET Point								
16	Interrupt Alert Status Register	R		RSV		TCRIT	GPIO	FAN	High	Low	Fault	
17	Diode Fault Alert Status	R		RSV						STS_DF2	STS_DF1	
18	Low Alert Status	R		RSV				STS_AL4	RSV	STS_AL2	STS_AL1	
19	High Alert Status	R		RSV				STS_AH4	RSV	STS_AH2	STS_AH1	
1A	Fan Alert Status	R		RSV			FAN_TAR1	RSV			FAN_FC1	
1B	T_CRIT# Alert Status	R		RSV				STS_TC4	RSV	STS_TC2	STS_TC1	
1C	GPIO Alert Stuts	R		RSV						STS_GPI02	STS_GPI01	
20	T_CRIT# Real Time Status	R		RSV				LTD_Texc	RSV	RTD2_Texc	RTD1_Texc	
21	START	R/W	01	Msk_Alert	RSV						START	
22	Mode Selection	R/W	55	RSV	EnLTD	RSV		RTD2_MD		RTD1_MD		
24	Fan Enable	R/W	01	RSV							EnFan1	
26	Conversion Rate	R/W	02	RSV						ConvRate[1:0]		
27	Fault Queue	R/W	03	RSV						FaultQueue[1:0]		
28	Alert High link to T_CRIT#	R/W	00	RSV					SYS3	SYS2	SYS1	
30	RTD1 Temp High Limit	R/W	55	RTD1_HL								
31	RTD1 Temp Low Limit	R/W	00	RTD1_LL								
32	RTD2 Temp High Limit	R/W	55	RTD2_HL								
33	RTD2 Temp Low Limit	R/W	00	RTD2_LL								
36	LTD Temp High Limit	R/W	55	LTD_HL								
37	LTD Temp Low Limit	R/W	00	LTD_LL								
3A	RTD1 T_CRIT# Threshold	R/W	64	T_CRIT#_RTD1								
3B	RTD2 T_CRIT# Threshold	R/W	64	T_CRIT#_RTD2								
3D	LTD T_CRIT# Threshold	R/W	64	T_CRIT#_LTD								
49	FANIN1 Limit low Byte	R/W	FF	FANIN1_HL[7:0]								
4C	FANIN1 Limit high byte	R/W	F8	FANIN1_HL[12:8]					RSV			
4F	Alert Mask function	R/W	7F	Msk_Alert	Msk_TC	Msk_GPIO	Msk_TAR_T	Msk_FC	Msk_AH	Msk_AL	Msk_DF	

Idx	Register Name	Att	Df	7	6	5	4	3	2	1	0
50	Alert / SMI Mask Temp Channel	R/W	3F	RSV				Msk_LTD	RSV	Msk_RTD_2	Msk_RTD_1
51	Alert / SMI Mask FAN Channel	R/W	07	RSV							Msk_Fan1
53	T_CRIT# Mask	R/W	BF	Msk_ALL	RSV			Msk_LTD	RSV	Msk_RTD_2	Msk_RTD_1
54	GPIO Alert Mask	R/W	3F	RSV						Msk_GPI_O2	Msk_GPI_O1
56	GPIO mode	R/W	3F	RSV						GPIO2 Mode	GPIO1 Mode
57	GPIO output type	R/W	00	RSV						GPIO2 OB	GPIO1 OB
58	GPIO input data	R		RSV						GPIO2 in	GPIO1 in
59	GPIO output data	R/W	00	RSV						GPIO2 out	GPIO1 out
5E	Fan Control Output Type	R/W	00	RSV							EnDCFAN_1
5F	Fan Control Output Mode	R/W	00	RSV			PWM1_Pol	RSV			PWM1_OD
60	Fan Control 1 Output Value	RW	7F	FANDuty1							
63	Close-Loop Fan Control RPM mode Register	RW	00	RSV		TwoDimension	RSV		RPM_HIGH_EN	RSV	
64	Temperature to Fan mapping Relationships	RW	00	RSV	Temp2FanSelect			RSV	Temp1FanSelect		
65	Temperature to Fan mapping Relationships	RW	00	RSV					Temp3FanSelect		
66	Configuration Register 1	RW	00	Temp2_Share_En	Temp2_Share_Sel			Temp1_Share_En	Temp1_Share_Sel		
67	Configuration Register 2	RW	00	RSV				Temp3_Share_En	Temp3_Share_Sel		
68	Configuration Register 3	RW	00	RSV	Temp2_Sour_Sel			RSV	Temp1_Sour_Sel		
69	Configuration Register 4	RW	00	RSV					Temp3_Sour_Sel		
6A	Fan1_Target	R		Fan1_Target[7:0]							
6D	Close-Loop Fan Control RPM mode Tolerance	RW	00	RSV					Generic_Tol_RPM		
6E	Fanctl Step Up Time	RW	0A	UpTime							
6F	Fanctl Step Down Time	RW	0A	DownTime							
70	DefaultFanSpeed	RW	7F	DefaultFanSpeed							
71	PWM1 Prescalar	RW	84	FanOutDivisor1[7]	FanOutDivisor1[6:0]						
74	Temp1 Hysteresis	RW	53	RSV	Criti_HysT1			RSV	Oper_HysT1		
75	Temp2 Hysteresis	RW	53	RSV	Criti_HysT2			RSV	Oper_HysT2		
76	Temp3 Hysteresis	RW	53	RSV	Criti_HysT3			RSV	Oper_HysT3		
77	Fanctl1 Start Duty Cycle	RW	30	StartDutyCycle							
78	Stop Time of Fanctl1	RW	FF	StopTime							
80	Table 1 Transition Point 1	RW	00	Temp1Table_TR1							
81	Table 1 Transition Point 2	RW	00	Temp1Table_TR2							
82	Table 1 Transition Point 3	RW	00	Temp1Table_TR3							
83	Table 1 Transition Point 4	RW	00	Temp1Table_TR4							

Idx	Register Name	Att	Df	7	6	5	4	3	2	1	0
84	Table 1 Critical Point	RW	00	Temp1Table_TRCritical							
85	Table 1 Y-axis Transition Point 1	RW	00	Temp1Table_FL1							
86	Table 1 Y-axis Transition Point 2	RW	00	Temp1Table_FL2							
87	Table 1 Y-axis Transition Point 3	RW	00	Temp1Table_FL3							
88	Table 1 Y-axis Transition Point 4	RW	00	Temp1Table_FL4							
90	Table 2 Transition Point 1	RW	00	Temp2Table_TR1							
91	Table 2 Transition Point 2	RW	00	Temp2Table_TR2							
92	Table 2 Transition Point 3	RW	00	Temp2Table_TR3							
93	Table 2 Transition Point 4	RW	00	Temp2Table_TR4							
94	Table 2 Critical Point	RW	00	Temp2Table_TRCritical							
95	Table 2 Y-axis Transition Point 1	RW	00	Temp2Table_FL1							
96	Table 2 Y-axis Transition Point 2	RW	00	Temp2Table_FL2							
97	Table 2 Y-axis Transition Point 3	RW	00	Temp2Table_FL3							
98	Table 2 Y-axis Transition Point 4	RW	00	Temp2Table_FL4							
A0	Table 3 Transition Point 1	RW	00	Temp3Table_TR1							
A1	Table 3 Transition Point 2	RW	00	Temp3Table_TR2							
A2	Table 3 Transition Point 3	RW	00	Temp3Table_TR3							
A3	Table 3 Transition Point 4	RW	00	Temp3Table_TR4							
A4	Table 3 Critical Point	RW	00	Temp3Table_TRCritical							
A5	Table 3 Y-axis Transition Point 1	RW	00	Temp3Table_FL1							
A6	Table 3 Y-axis Transition Point 2	RW	00	Temp3Table_FL2							
A7	Table 3 Y-axis Transition Point 3	RW	00	Temp3Table_FL3							
A8	Table 3 Y-axis Transition Point 4	RW	00	Temp3Table_FL4							
C1	TD1 Offset	R/W	00	RSV		Offset_TD1					
C2	TD2 Offset	R/W	00	RSV		Offset_TD2					
FC	SOFT RESET	W		INIT		RSV					
FD	Vendor ID	R		Vendor ID							
FE	ChipID	R		ChipID							
FF	Device ID	R		Version ID							

7.2 REGISTER DETAIL

7.2.1 Remote Diode 1 Temperature Readout Register (MSB)

Location : Index 01h

Type : Read Only

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	MNTRTD1[10:3]							
FUNC.	MNTRTD1[10:3] : Readout of RTD1 MSB.							

7.2.2 Remote Diode 2 Temperature Readout Register (MSB)

Location : Index 02h

Type : Read Only

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	MNTRTD2[10:3]							
FUNC.	MNTRTD2[10:3] : Readout of RTD2 MSB.							

7.2.3 Local Diode Temperature Readout Register (MSB)

Location : Index 04h

Type : Read Only

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	MNTLTD[10:3]							
FUNC.	MNTLTD[10:3] : Readout of LTD MSB.							

7.2.4 Temperature Readout Register (LSB)

Location : Index 05h

Type : Read Only

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	MNTTD_LSB[2:0]			RSV				
FUNC.	MNTTD_LSB[2:0] : Readout of RTD and LTD LSB.							

7.2.5 Fan Count 1 Readout Register (MSB)

Location : Index 10h

Type : Read Only

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	MNTFAN1[12:5]							
FUNC.	MNTFAN1[12:5] : Readout of Fan Count 1 MSB.							

7.2.6 Fan Count Readout Register (LSB)

Location : Index 13h

Type : Read Only

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	MNTFAN_LSB[4:0]					RSV		
FUNC.	MNTFAN_LSB[4:0] : Readout of Fan Count LSB.							

7.2.7 T_CRIT#_SET Point Register

Location : Index 14h

Type : Read Only

Power on default value : refer to the section 5.12 T_CRIT#_SET

BIT	7	6	5	4	3	2	1	0
NAME	T_CRIT#_SET Point							
FUNC.	T_CRIT#_SET Point : Temperature point of T_CRIT#_SET power on strapping.							

7.2.8 Alert Status Register

Location : Index 16h

Type : Read Only

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV		T_CRIT#	GPIO	FAN	High	Low	Fault
FUNC.	T_CRIT# : 1 indicates the T_CRIT# event asserts. GPIO : 1 indicates the GPIO event asserts. FAN : 1 indicates the Fan event asserts, corresponds to Index[1Ah]. High : 1 indicates the High event asserts, corresponds to Index[19h] Low : 1 indicates the Low event asserts, corresponds to Index[18h]. Fault : 1 indicates the Fault event asserts, corresponds to Index[17h].							

7.2.9 Diode Fault Alert Status Register

Location : Index 17h

Type : Read Only

Power on default value :00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV						STS_DF2	STS_DF1
FUNC.	STS_DF2 : 1 indicates the TD2 fault. STS_DF1 : 1 indicates the TD1 fault.							

7.2.10 Low Alert Status Register

Location : Index 18h

Type : Read Only

Power on default value :00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV				STS_AL4	RSV	STS_AL2	STS_AL1
FUNC.	STS_AL4 : 1 indicates the LTD over low limit. STS_AL2 : 1 indicates the RTD2 over low limit. STS_AL1 : 1 indicates the RTD1 over low limit.							

7.2.11 High Alert Status Register

Location : Index 19h

Type : Read Only

Power on default value :00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV				STS_AH4	RSV	STS_AH2	STS_AH1
FUNC.	STS_AH4 : 1 indicates the LTD over high limit. STS_AH2 : 1 indicates the RTD2 over high limit. STS_AH1 : 1 indicates the RTD1 over high limit.							

7.2.12 Fan Alert Status Register

Location : Index 1Ah

Type : Read Only

Power on default value :00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV			FAN_TA R1	RSV			FAN_FC 1
FUNC.	FAN_TAR3 : 1 indicates the FAN1 is driven to fully speed over 3 minutes. FAN_FC1 : 1 indicates the FAN1 over limit.							

7.2.13 T_CRIT# Alert Status Register

Location : Index 1Bh

Type : Read Only

Power on default value :00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV				STS_TC4	RSV	STS_TC2	STS_TC1
FUNC.	STS_TC4 : 1 indicates the LTD T_CRIT# asserts. STS_TC2 : 1 indicates the RTD2 T_CRIT# asserts. STS_TC1 : 1 indicates the RTD1 T_CRIT# asserts.							

7.2.14 GPIO Alert Status Register

Location : Index 1Ch

Type : Read Only

Power on default value :00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV						STS_GPIO2	STS_GPIO1
FUNC.	STS_GPIO2 : 1 indicates the GPIO2 event asserts. STS_GPIO1 : 1 indicates the GPIO1 event asserts.							

7.2.15 T_CRIT# Real Time Status Register

Location : Index 20h

Type : Read Only

Power on default value :00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV				LTD_Texc	RSV	RTD2_Texc	RTD1_Texc
FUNC.	LTD_Texc : 1 indicates the LTD over the shutdown threshold. RTD2_Texc : 1 indicates the RTD2 over the shutdown threshold. RTD1_Texc : 1 indicates the RTD1 over the shutdown threshold.							

7.2.16 Start Register

Location : Index 21h

Type : Read/Write

Power on default value : 01h

BIT	7	6	5	4	3	2	1	0
NAME	MSK_ALERT	RSV						START
FUNC.	MSK_ALERT : 1 indicates the ALERT# output is masked. START : 1 indicates the ADC is operating.							

7.2.17 Mode Selection Register

Location : Index 22h

Type : Read/Write

Power on default value : 55h

BIT	7	6	5	4	3	2	1	0
NAME	RSV	EnLTD	RSV		RTD2_MD		RTD1_MD	
FUNC.	EnLTD : 1 indicates the LTD function enabled. RTD2_MD : 00=Closed , 01=Current mode , 10=RSV , 11=RSV RTD1_MD : 00=Closed , 01=Current mode , 10=RSV , 11=RSV							

7.2.18 Fan Enable Register

Location : Index 24h

Type : Read/Write

Power on default value : 01h

BIT	7	6	5	4	3	2	1	0
NAME	RSV							EnFan1
FUNC.	EnFan1 : 1 indicates the FANIN1 enabled.							

7.2.19 Conversion Rate Register

Location : Index 26h

Type : Read/Write

Power on default value : 02h

BIT	7	6	5	4	3	2	1	0
NAME	RSV						ConvRate[1:0]	
FUNC.	ConvRate[1:0] : 00=1Hz , 01=2Hz , 10= 4Hz , 11=Free Run.							

7.2.20 Fault Queue Register

Location : Index 27h

Type : Read/Write

Power on default value : 03h

BIT	7	6	5	4	3	2	1	0
NAME	RSV						FaultQueue[1:0]	
FUNC.	FaultQueue[1:0] : Fault Queue of Thermal Shutdown , 00=1 , 01=2 , 10=3 , 11=4 .							

7.2.21 Alert# High Limit Link to T_CRIT#

Location : Index 28h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV					SYS3	SYS2	SYS1
FUNC.	SYS3 : 1 indicates the External Diode3 channel high limit will be linked to T_CRIT# SYS2 : 1 indicates the External Diode2 channel high limit will be linked to T_CRIT# SYS1 : 1 indicates the External Diode1 channel high limit will be linked to T_CRIT#							

7.2.22 RTD1 Temperature High Limit Register

Location : Index 30h

Type : Read/Write

Power on default value : 55h

BIT	7	6	5	4	3	2	1	0
NAME	RTD1_HL							
FUNC.	RTD1_HL : RTD1 Temperature High Limit setting for ALERT# .							

7.2.23 RTD1 Temperature Low Limit Register

Location : Index 31h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RTD1_LL							
FUNC.	RTD1_LL : RTD1 Temperature Low Limit setting for ALERT#.							

7.2.24 RTD2 Temperature High Limit Register

Location : Index 32h

Type : Read/Write

Power on default value : 55h

BIT	7	6	5	4	3	2	1	0
NAME	RTD2_HL							
FUNC.	RTD2_HL : RTD2 Temperature High Limit setting for ALERT#.							

7.2.25 RTD2 Temperature Low Limit Register

Location : Index 33h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RTD2_LL							
FUNC.	RTD2_LL : RTD2 Temperature Low Limit setting for ALERT#.							

7.2.26 LTD Temperature High Limit Register

Location : Index 36h

Type : Read/Write

Power on default value : 55h

BIT	7	6	5	4	3	2	1	0
NAME	LTD_HL							
FUNC.	LTD_HL : LTD Temperature High Limit setting for ALERT#.							

7.2.27 LTD Temperature Low Limit Register

Location : Index 37h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	LTD_LL							
FUNC.	LTD_LL : LTD Temperature Low Limit setting for ALERT#.							

7.2.28 RTD1 T_CRIT# Threshold Register

Location : Index 3Ah

Type : Read/Write

Power on default value : 64h

BIT	7	6	5	4	3	2	1	0
NAME	TCRIT_RTD1							
FUNC.	TCRIT_RTD1 : RTD1 Temperature Threshold of T_CRIT#.							

7.2.29 RTD2 T_CRIT# Threshold Register

Location : Index 3Bh

Type : Read/Write

Power on default value : 64h

BIT	7	6	5	4	3	2	1	0
NAME	TCRIT_RTD2							
FUNC.	TCRIT_RTD2 : RTD2 Temperature Threshold of T_CRIT#.							

7.2.30 LTD T_CRIT# Threshold Register

Location : Index 3Dh

Type : Read/Write

Power on default value : 64h

BIT	7	6	5	4	3	2	1	0
NAME	TCRIT_LTD							
FUNC.	TCRIT_LTD : LTD Temperature Threshold of T_CRIT#.							

7.2.31 FANIN1 Limit Low Byte Register

Location : Index 49h

Type : Read/Write

Power on default value : FFh

BIT	7	6	5	4	3	2	1	0
NAME	FANIN1_HL[7:0]							
FUNC.	FANIN1_HL[7:0] : FANIN1 Limit Low Byte.							

7.2.32 FANIN1 Limit High Byte Register

Location : Index 4Ch

Type : Read/Write

Power on default value : F8h

BIT	7	6	5	4	3	2	1	0
NAME	FANIN1_HL[12:8]					RSV		
FUNC.	FANIN1_HL[12:8] : FANIN1 Limit High Byte.							

7.2.33 ALERT Mask Register Register

Location : Index 4Fh

Type : Read/Write

Power on default value : 7Fh

BIT	7	6	5	4	3	2	1	0
NAME	RSV	MSK_TC	MSK_GPIO	MSK_TART	MSK_FC	MSK_AH	MSK_AL	MSK_DF
FUNC.	MSK_TC : 1 indicates the ALERT# from T_CRIT# event will be masked . MSK_GPIO : 1 indicates the ALERT# from GPIO event will be masked . MSK_TART : 1 indicates the ALERT# from TART event will be masked . MSK_FC : 1 indicates the ALERT# from FAN event will be masked . MSK_AH : 1 indicates the ALERT# from High ALERT event will be masked . MSK_AL : 1 indicates the ALERT# from Low ALERT event will be masked . MSK_DF : 1 indicates the ALERT# from Diode Fault event will be masked .							

7.2.34 ALERT Mask Temperature Channel Register

Location : Index 50h

Type : Read/Write

Power on default value : 3Fh

BIT	7	6	5	4	3	2	1	0
NAME	RSV				MSK_LTD	RSV	MSK_RTD2	MSK_RTD1
FUNC.	MSK_LTD : 1 indicates the ALERT# from LTD event will be masked . MSK_RTD2 : 1 indicates the ALERT# from RTD2 event will be masked . MSK_RTD1 : 1 indicates the ALERT# from RTD1 event will be masked .							

7.2.35 ALERT Mask Fan Channel Register

Location : Index 51h

Type : Read/Write

Power on default value : 07h

BIT	7	6	5	4	3	2	1	0
NAME	RSV							MSK_FAN1
FUNC.	MSK_FAN1 : 1 indicates the ALERT# from FAN1 event will be masked .							

7.2.36 T_CRIT# Mask Register

Location : Index 53h

Type : Read/Write

Power on default value : BFh

BIT	7	6	5	4	3	2	1	0
NAME	MSK_ALL	RSV			MSK_LT D4	RSV	MSK_RT D2	MSK_RT D1
FUNC.	MSK_ALL : 1 indicates the T_CRIT# from ALL event will be masked . MSK_LTD : 1 indicates the T_CRIT# from LTD event will be masked . MSK_RTD2 : 1 indicates the T_CRIT# from RTD2 event will be masked . MSK_RTD1 : 1 indicates the T_CRIT# from RTD1 event will be masked .							

7.2.37 GPIO Alert Mask Register

Location : Index 54h

Type : Read/Write

Power on default value : 3Fh

BIT	7	6	5	4	3	2	1	0
NAME	RSV						MSK_GP IO2	MSK_GP IO1
FUNC.	MSK_GPIO2 : 1 indicates the ALERT# from GPIO2 event will be masked . MSK_GPIO1 : 1 indicates the ALERT# from GPIO1 event will be masked .							

7.2.38 GPIO Mode Register

Location : Index 56h

Type : Read/Write

Power on default value : 3Fh

BIT	7	6	5	4	3	2	1	0
NAME	RSV						GPIO2 Mode	GPIO1 Mode
FUNC.	GPIO2 Mode : 0= Input , 1= Output. GPIO1 Mode : 0= Input , 1= Output.							

7.2.39 GPIO Output Type Register

Location : Index 57h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV						GPIO2 OB	GPIO1 OB
FUNC.	GPIO2 Output Type : 0= Push Pull , 1= Open Drain. GPIO1 Output Type : 0= Push Pull , 1= Open Drain.							

7.2.40 GPIO Input Data Register

Location : Index 58h

Type : Read Only

Power on default value :00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV						GPIO2 IN	GPIO1 IN
FUNC.	GPIO2 IN : Input data register of GPIO2. GPIO1 IN : Input data register of GPIO1.							

7.2.41 GPIO Output Data Register

Location : Index 59h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV						GPIO2 OUT	GPIO1 OUT
FUNC.	GPIO2 OUT : Output data register of GPIO2. GPIO1 OUT : Output data register of GPIO1.							

7.2.42 Fan Control Output Type Register

Location : Index 5Eh

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV							EnDCFA N1
FUNC.	EnDCFAN1 : 0 indicates the FANCTL1 output is PWM type. 1 indicates the FANCTL1 output is DC type.							

7.2.43 Fan Control Output Mode Register

Location : Index 5Fh

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV			PWM1_P OL	RSV			PWM1_O D
FUNC.	PWM1_POL : 1 indicates the FANCTL1 PWM output is inverted. PWM1_OD : 0 indicates the FANCTL1 PWM output is push pull. 1 indicates the FANCTL1 PWM output is open drain.							

7.2.44 Fan Control 1 Output Value Register

Location : Index 60h

Type : Read/Write for Manual mode , Read only for Smart Fan control

Power on default value : 7Fh

BIT	7	6	5	4	3	2	1	0
NAME	FANDuty1							
FUNC.	FANDuty1 : FANCTL1 output value.							

7.2.45 Close-Loop Fan Control RPM mode Register

Location : Index 63h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV		TwoDimension	RSV		RPM_HIGH_EN	RSV	
FUNC.	TwoDimension : Close_Loop Fan Control Enable Bit5 : 1 indicated the FAN1 group enables Close-Loop Fan Control RPM mode RPM_HIGH_EN : Changing default unit of all RPM setting from 50 RPMs to 100 RPMs. It benefits to control ultra high RPM fan Bit2 : 1 indicated the FAN1 group support ultra high RPM fan							

7.2.46 Temperature to Fan mapping Relationships Register

Location : Index 64h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV	Temp2FanSelect			RSV	Temp1FanSelect		
FUNC.	Temp2FanSelect ,							

	Temp1FanSelect : Enable FANCTL3 – FANCTL1 Smart Fan. 0 = FANCTL has no relation with this temperature source. FANCTL is controlled by Manual mode. (Default) 1 = Applies SmartFan control for SMART FAN™ IV on FANCTL and this temperature.
--	--

7.2.47 Temperature to Fan mapping Relationships Register

Location : Index 65h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV					Temp3FanSelect		
FUNC.	Temp3FanSelect : Enable FANCTL3 – FANCTL1 Smart Fan.							
	0 = FANCTL has no relation with this temperature source. FANCTL is controlled by Manual mode. (Default)							
	1 = Applies SmartFan control for SMART FAN™ IV on FANCTL and this temperature.							

7.2.48 Fan Control Configuration Register 1

Location : Index 66h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	Temp2_Share_En	Temp2_Share_Sel			Temp1_Share_En	Temp1_Share_Sel		
FUNC.	Temp2_Share_En : Enable temperature2 sharing table function. Temp2_Share_Sel : Select which temperature2 source could share control table in SMART FAN™ IV Temp1_Share_En : Enable temperature1 sharing table function. Temp1_Share_Sel : Select which temperature1 source could share control table in SMART FAN™ IV Refer to the <u>Sharing Table</u>.							

Sharing Table.

BIT [2-0]	Share_Sel Condition
000 _{BIN}	Mapping to Remote 1 temperature.
001 _{BIN}	Mapping to Remote 2 temperature.
011 _{BIN}	Mapping to Local temperature.
110 _{BIN}	Mapping to Programmable temperature 1.
111 _{BIN}	Mapping to Programmable temperature 2.

7.2.49 Fan Control Configuration Register 2

Location : Index 67h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV				Temp3_Share_En	Temp3_Share_Sel		
FUNC.	Temp3_Share_En : Enable temperature3 sharing table function. Temp3_Share_Sel : Select which temperature3 source could share control table in SMART FAN™ IV Refer to the <u>Sharing Table</u> .							

7.2.50 Fan Control Configuration Register 3

Location : Index 68h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV	Temp2_Source_Sel			RSV	Temp1_Source_Sel		
FUNC.	Temp2_Source_Sel : Temperature 2 source selection. Temp1_Source_Sel : Temperature 1 source selection. Refer to the <u>Sharing Table</u> .							

7.2.51 Fan Control Configuration Register 4

Location : Index 69h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV					Temp3_Source_Sel		
FUNC.	Temp3_Source_Sel : Temperature 3 source selection. Refer to the <u>Sharing Table</u> .							

7.2.52 Fan 1 Target Register

Location : Index 6Ah

Type : Read only

Power on default value : 8Ch

BIT	7	6	5	4	3	2	1	0
NAME	Fan1_Target							
FUNC.	Fan1_Target : RPM mode FANCTL1 Target Register							

7.2.53 Close-Loop Fan Control RPM Mode Tolerance Register

Location : Index 6Dh

Type : Read/Write

Power on default value : 0Ah

BIT	7	6	5	4	3	2	1	0
NAME	RSV					Generic_Tol_RPM		
FUNC.	Generic_Tol_RPM : Tolerance of RPM mode, unit 50 RPM.							

7.2.54 FANCTL Step Up Time Register

Location : Index 6Eh

Type : Read/Write

Power on default value : 0Ah

BIT	7	6	5	4	3	2	1	0
NAME	UpTime							
FUNC.	UpTime : In SMART FAN™ IV mode, this register determines the amount of time FANOUT takes to increase its value by one step. The units are intervals of 0.1 second. The default time is 1 second.							

7.2.55 FANCTL Step Down Time Register

Location : Index 6Fh

Type : Read/Write

Power on default value : 0Ah

BIT	7	6	5	4	3	2	1	0
NAME	DownTime							
FUNC.	DownTime : In SMART FAN™ IV mode, this register determines the amount of time FANOUT takes to decrease its value by one step. The units are intervals of 0.1 second. The default time is 1 second.							

7.2.56 Default Fan Speed Register

Location : Index 70h

Type : Read/Write

Power on default value : 7Fh

BIT	7	6	5	4	3	2	1	0
NAME	DefaultFanSpeed							
FUNC.	DefaultFanSpeed : (Default Fan Speed at Power-on). Specifies the fan duty at next power on.							

7.2.57 FANCTL1 PWM Prescaler Register

Location : Index 71h

Type : Read/Write

Power on default value : 84h

BIT	7	6	5	4	3	2	1	0
NAME	CLKSEL	Divisor[6:0]						
FUNC.	CLKSEL : Clock source select. Divisor : Clock frequency Divisor. Refer the Divisor table.							

The clock source selected by CLKSEL will be divided by the divisor and used as a fan PWM output frequency.

If CLKSEL equals **1**, then the output clock is simply equal to **125/ (Divisor[6:0]+1) KHz**

MappedDivisor depends on **Divisor[6:0]** and is described in the table below.

Divisor[6:0]	Mapped Divisor	Output Frequency	Divisor[6:0]	Mapped Divisor	Output Frequency
0000000	1	125KHz			
0000001	2	62.5KHz			
0000010	3	41.6KHz			
0000011	4	31.2KHz			
0000100	5	25KHz	0001111	16	7.8KHz
0000101	6	20.8KHz	0011111	32	3.9KHz
0000110	7	17.8KHz	0111111	64	1.9KHz
0000111	8	15.6KHz	1111111	128	976Hz

If CLKSEL equals **0**, then the output clock is simply equal to **1000/ Mapped Divisor Hz**

MappedDivisor depends on **Divisor[3:0]** and is described in the table below.

Divisor[3:0]	Mapped Divisor	Output Frequency	Divisor[3:0]	Mapped Divisor	Output Frequency
0000	1	1000Hz	1000	12	83Hz
0001	2	500Hz	1001	16	62.5Hz
0010	3	333Hz	1010	32	31.25Hz
0011	4	250Hz	1011	64	15.6Hz
0100	5	200Hz	1100	128	7.8Hz
0101	6	166Hz	1101	256	3.9Hz
0110	7	142Hz	1110	512	1.9Hz
0111	8	125Hz	1111	1024	0.97Hz

7.2.58 Temperature1 Hysteresis Register

Location : Index 74h

Type : Read/Write

Power on default value : 53h

BIT	7	6	5	4	3	2	1	0
NAME	RSV	Criti_HysT1			RSV	Oper_HysT1		
FUNC.	Criti_HysT1 : Hysteresis value of SMART FAN™ IV Critical Temperature Oper_HysT1 : Hysteresis value of SMART FAN™ IV Operating Temperature							

7.2.59 Temperature 2 Hysteresis Register

Location : Index 75h

Type : Read/Write

Power on default value : 53h

BIT	7	6	5	4	3	2	1	0
NAME	RSV	Criti_HysT2			RSV	Oper_HysT2		
FUNC.	Criti_HysT2 : Hysteresis value of SMART FAN™ IV Critical Temperature Oper_HysT2 : Hysteresis value of SMART FAN™ IV Operating Temperature							

7.2.60 Temperature 3 Hysteresis Register

Location : Index 76h

Type : Read/Write

Power on default value : 53h

BIT	7	6	5	4	3	2	1	0
NAME	RSV	Criti_HysT3			RSV	Oper_HysT3		
FUNC.	Criti_HysT3 : Hysteresis value of SMART FAN™ IV Critical Temperature Oper_HysT3 : Hysteresis value of SMART FAN™ IV Operating Temperature							

7.2.61 FANCTL Start Duty Cycle Register

Location : Index 77h

Type : Read/Write

Power on default value :30h

BIT	7	6	5	4	3	2	1	0
NAME	StartDutyCycle							
FUNC.	StartDutyCycle : control the FANCTL1-FANCTL3 fan output start-up value.							

7.2.62 FANCTL Stop Time Register

Location : Index 78h

Type : Read/Write

Power on default value : FFh

BIT	7	6	5	4	3	2	1	0
NAME	StopTime							
FUNC.	StopTime : control the FANCTL1-FANCTL3 fan stop time. Unit in 0.1sec. Ranges from 0.1sec to 25.5sec. If set to 0, the fan will never stop.							

7.2.63 SMART FAN™ IV Temperature and PWM Registers Register

Location : Table 1 Address 80h ~ 88h

Location : Table 2 Address 90h ~ 98h

Location : Table 3 Address A0h ~ A8h

Type : Read/Write

Power on default value: refer to below tables

TABLE	NAME	ADDRESS	DEFAULT	TYPE
Table1	Transition Point : T1	80 _{HEX}	19 _{HEX}	Read/Write
	Transition Point : T2	81 _{HEX}	23 _{HEX}	Read/Write
	Transition Point : T3	82 _{HEX}	23 _{HEX}	Read/Write
	Transition Point : T4	83 _{HEX}	37 _{HEX}	Read/Write
	Critical Point	84 _{HEX}	3C _{HEX}	Read/Write
	Y-axis Transition Point : PWM1	85 _{HEX}	8C _{HEX}	Read/Write
	Y-axis Transition Point : PWM2	86 _{HEX}	8C _{HEX}	Read/Write
	Y-axis Transition Point : PWM3	87 _{HEX}	C8 _{HEX}	Read/Write
	Y-axis Transition Point : PWM4	88 _{HEX}	E6 _{HEX}	Read/Write
Table2	Transition Point : T1	90 _{HEX}	19 _{HEX}	Read/Write
	Transition Point : T2	91 _{HEX}	23 _{HEX}	Read/Write
	Transition Point : T3	92 _{HEX}	23 _{HEX}	Read/Write
	Transition Point : T4	93 _{HEX}	37 _{HEX}	Read/Write
	Critical Point	94 _{HEX}	3C _{HEX}	Read/Write
	Y-axis Transition Point : PWM1	95 _{HEX}	8C _{HEX}	Read/Write
	Y-axis Transition Point : PWM2	96 _{HEX}	8C _{HEX}	Read/Write
	Y-axis Transition Point : PWM3	97 _{HEX}	C8 _{HEX}	Read/Write
	Y-axis Transition Point : PWM4	98 _{HEX}	E6 _{HEX}	Read/Write
Table3	Transition Point : T1	A0 _{HEX}	19 _{HEX}	Read/Write
	Transition Point : T2	A1 _{HEX}	23 _{HEX}	Read/Write
	Transition Point : T3	A2 _{HEX}	23 _{HEX}	Read/Write

TABLE	NAME	ADDRESS	DEFAULT	TYPE
	Transition Point : T4	A3 _{HEX}	37 _{HEX}	Read/Write
	Critical Point	A4 _{HEX}	3C _{HEX}	Read/Write
	Y-axis Transition Point : PWM1	A5 _{HEX}	8C _{HEX}	Read/Write
	Y-axis Transition Point : PWM2	A6 _{HEX}	8C _{HEX}	Read/Write
	Y-axis Transition Point : PWM3	A7 _{HEX}	C8 _{HEX}	Read/Write
	Y-axis Transition Point : PWM4	A8 _{HEX}	E6 _{HEX}	Read/Write

7.2.64 TD1 Offset Register

Location : Index C1h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV		Offset_TD1					
FUNC.	Offset_TD1 : TD1 function offset register .							

7.2.65 TD2 Offset Register

Location : Index C2h

Type : Read/Write

Power on default value : 00h

BIT	7	6	5	4	3	2	1	0
NAME	RSV		Offset_TD2					
FUNC.	Offset_TD2 : TD2 function offset register .							

7.2.66 Soft Reset Register

Location : Index FCh

Type : Write Only

Power on default value : FFh

BIT	7	6	5	4	3	2	1	0
NAME	INIT	RSV						
FUNC.	INIT : Write 1 to reset the NCT7511Y.							

7.2.67 Vendor ID Register

Location : Index FDh

Type : Ready Only

Power on default value : 50h

BIT	7	6	5	4	3	2	1	0
-----	---	---	---	---	---	---	---	---

NAME	Vendor ID
FUNC.	Vendor ID of NCT7511Y is 50h

7.2.68 Chip ID Register

Location : Index FEh

Type : Ready Only

Power on default value : C3h

BIT	7	6	5	4	3	2	1	0
NAME	Chip ID							
FUNC.	Chip ID of NCT7511Y is C3h							

7.2.69 Device ID Register

Location : Index FFh

Type : Ready Only

Power on default value : 2xh

BIT	7	6	5	4	3	2	1	0
NAME	Device ID							
FUNC.	Device ID of NCT7511Y is 2xh (x=0,1,2...)							

8. ELECTRICAL CHARACTERISTICS

8.1 Absolute Maximum Ratings

PARAMETER	RATING	UNIT
Power Supply Voltage	3.3V $\pm$ 5%	V
Input Voltage	-0.3 to +3.6	V
Operating Temperature	-40 to +85	° C
Storage Temperature	-55 to +150	° C

Note: Exposure to conditions beyond those listed under Absolute Maximum Ratings may adversely affect the life and reliability of the device.

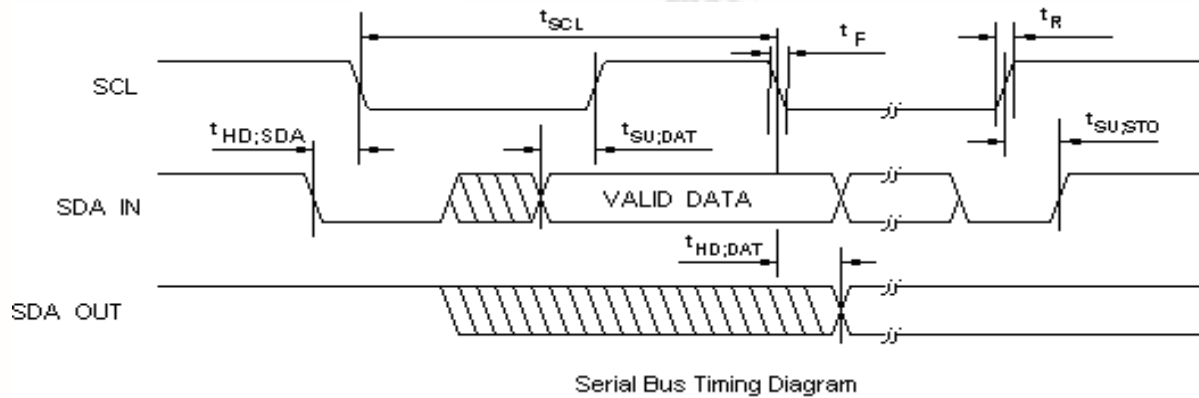
8.2 DC Characteristics

(Ta = 0° C to 70° C, VDD = 3.3V $\pm$ 5%, GND = 0V)

PARAMETER	SYM.	MIN.	TYP.	MAX.	UNIT	CONDITIONS
OD ₁₂ – Open-drain output pin with source-sink capability of 12 mA						
Output Low Voltage	V _{OL}			0.4	V	I _{OL} = 12 mA
OUT ₁₂ - Output buffer pin with source-sink capability of 12 mA						
Output Low Voltage	V _{OL}			0.4	V	I _{OL} = 12 mA
Output High Voltage	V _{OH}	2.4			V	I _{OH} = -12 mA
IN _{ts} - TTL level Schmitt-triggered input pin						
Input Low Voltage	V _{IL}			0.8	V	VDD = 3.3V
Input High Voltage	V _{IH}	2.0			V	VDD = 3.3V
Input High Leakage	I _{LIH}			+10	μA	VIN=3.3V
Input Low Leakage	I _{LIL}			-10	μA	VIN=0V

8.3 AC Characteristics

SMBus Interface



PARAMETER	SYMBOL	MIN.	MAX.	UNIT
SCL clock period	t_{SCL}	2.5		uS
Start condition hold time	$t_{HD;SDA}$	1.5		uS
Stop condition setup-up time	$t_{SU;STO}$	1		uS
DATA to SCL setup time	$t_{SU;DAT}$	120		nS
DATA to SCL hold time	$t_{HD;DAT}$	5		nS
SCL and SDA rise time	t_R		1.0	uS
SCL and SDA fall time	t_F		300	nS

9. ORDERING INFORMATION

PART NUMBER	PACKAGE	SUPPLIED AS	PRODUCTION FLOW
NCT7511Y	QFN16	E shape: Tray T shape: 4,000 units/T&R	Commercial, 0°C to +70°C

10. TOP MARKING SPECIFICATION



1st Line : Nuvoton Logo

2nd Line : Part number- **NCT7511Y**

3rd Line : Assembly tracking code

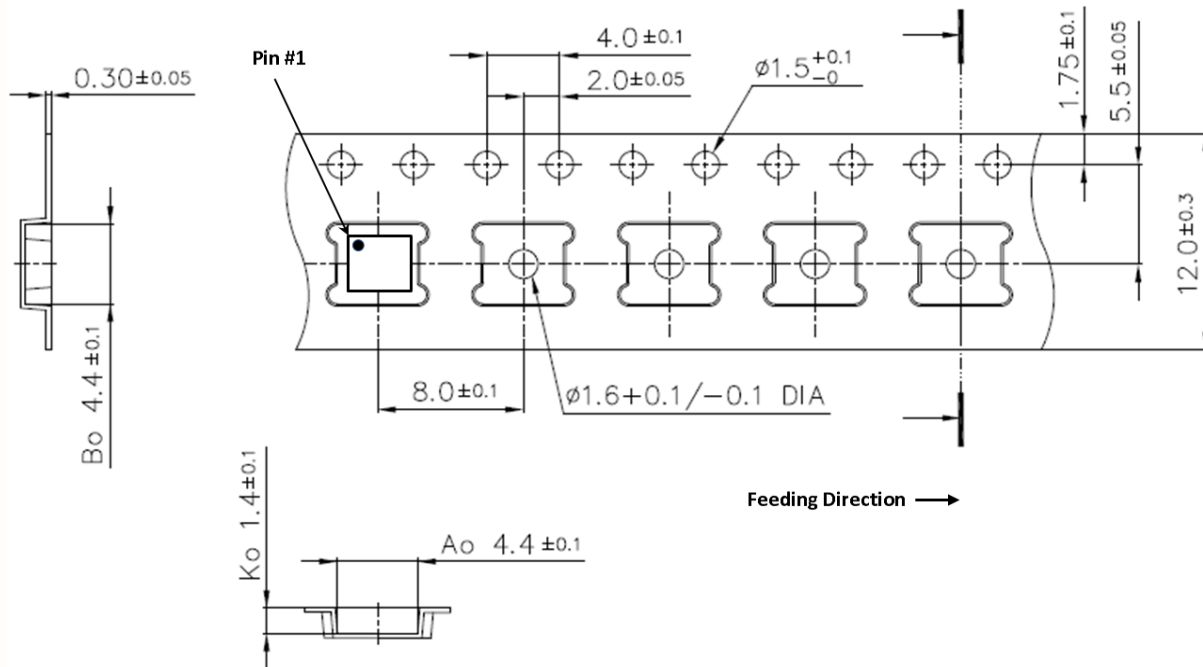
1 13: packages made in year 2011, week 13

T : Assembly house code

A : IC version

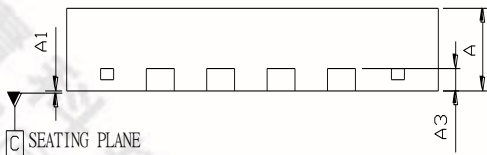
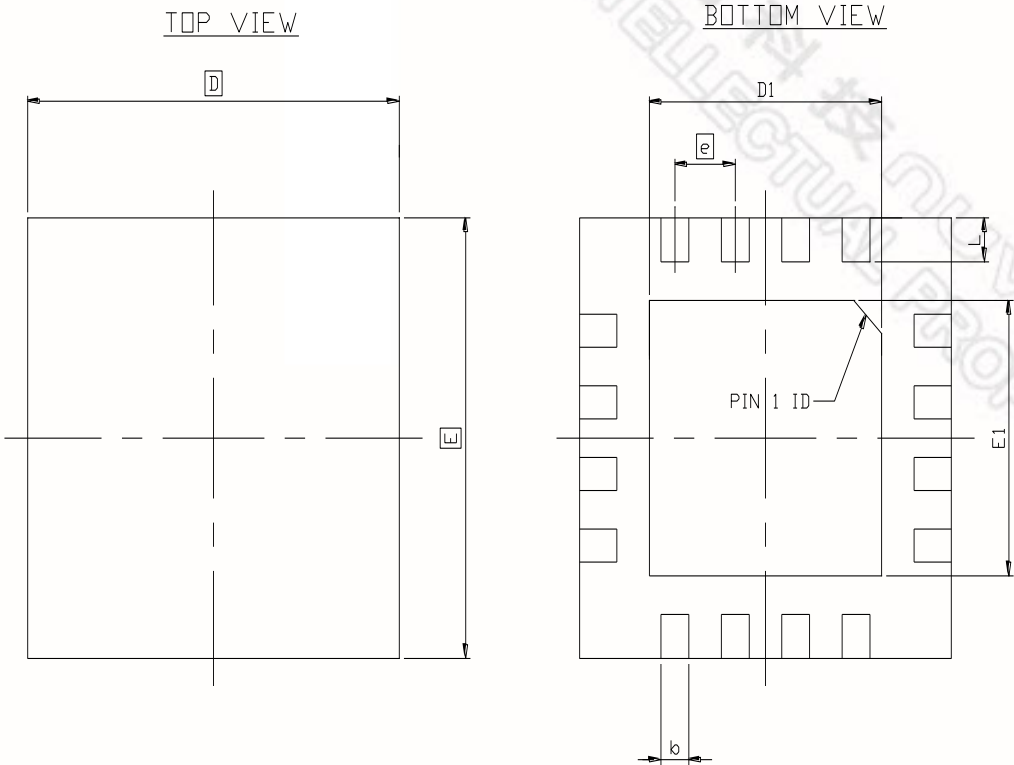
BA : Nuvoton internal use code

11. TAPING SPECIFICATION



12. PACKAGE DRAWING AND DIMENSIONS

QFN16 4x4 MM2



SYMBOL	DIMENSION (MM)			DIMENSION (MIL)		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.7	0.75	0.8	27.56	29.53	31.50
A1	0	0.02	0.05	0	0.79	1.97
A3	0.203 REF			8.00 REF		
b	0.25	0.30	0.35	9.84	11.81	13.78
D	3.85	4.00	4.15	151.57	157.48	163.39
D1	2.40	2.50	2.60	94.49	98.43	102.36
E	3.85	4.00	4.15	151.57	157.48	163.39
E1	2.40	2.50	2.60	94.49	98.43	102.36
e	0.65 BSC			25.59 BSC		
L	0.40 BSC			15.75 BSC		
y	0	—	0.08	0	—	3

13. REVISION HISTORY

VERSION	DATE	PAGE	DESCRIPTION
0.1	05/2010	N.A.	Preliminary version.
0.3	07/2010		Add register definition and feature description
0.31	08/2010		Add Package information
0.32	12/2010		Add more feature description
0.33	01/2011		Modify the description and correct the typo
0.4	05/2011		Remote EEPROM function, and modify the description and correct the typo
0.5	01/2012		Add RPM mode
1.0	07/2012	38	Add taping spec

Important Notice

Nuvoton Products are neither intended nor warranted for usage in systems or equipment, any malfunction or failure of which may cause loss of human life, bodily injury or severe property damage. Such applications are deemed, "Insecure Usage".

Insecure usage includes, but is not limited to: equipment for surgical implementation, atomic energy control instruments, airplane or spaceship instruments, the control or operation of dynamic, brake or safety systems designed for vehicular use, traffic signal instruments, all types of safety devices, and other applications intended to support or sustain life.

All Insecure Usage shall be made at customer's risk, and in the event that third parties lay claims to Nuvoton as a result of customer's Insecure Usage, customer shall indemnify the damages and liabilities thus incurred by Nuvoton.

Please note that all data and specifications are subject to change without notice.
All the trademarks of products and companies mentioned in this datasheet belong to their respective owners.