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MOBILE ACCESS™—CLOCK SYNTHESIZER, TEMPERATURE SENSOR, 9TCS1085 & PWM FAN CONTROLLER FOR PORTABLE DEVICES

Description

The 9TCS1085 is a highly programmable IC that integrates clock synthesizers with a PWM Fan controller and temperature sensor for hardware thermal protection.

The device has an ultra-low-power 32.768 kHz frequency generator to support Real Time Clocks (RTC). This device can generate the 32.768 kHz frequency up to four years of life powered by a CR2032 coin cell battery. The 9TCS1085 can output computer system clock frequencies of 24, 25, 27 and 48 MHz which reduces the component count on the circuit board.

The fan controller is pulsed width modulated (PWM) used for the temperature proportional speed control. The device is highly configurable through I2C for ease and flexibility of use. The fan controller has three different modes of operation and will work with multiple pole, brushless DC fans. An integrated Start-up Timer ensures reliable motor start-up and turn-on or follows a detected fault condition.

The 9TCS1085 includes temperature monitor function that measures an external diode. The temperature sensor is optimized to be accurate within $\pm 1^{\circ}\text{C}$ between the temperature range of 60°C to 100°C . This device is highly programmable through the use of I²C to set high and low limits for the temperature sensor. The hardware limits drive dedicated ALERT and THERM pins for system shutdown.

The 9TCS1085 is available in a 32-pin QFN package and is available for commercial temperature range.

Applications

- Notebook Computers
- Netbook Computers
- Smartbook Computers
- Consumer Portable Devices
- Embedded Systems
- Networking Equipment (i.e. Routers, Switches)
- Network Area Storage

Features

Thermal Sensor

- One channel temperature sensor
- Both H/W & S/W programmable over/under temperature alarms
- No Calibration required in application
- Diode failure detection
- Support SMBUS Alert
- Accuracy: $\pm 1^{\circ}\text{C}$ ($+60^{\circ}\text{C}$ to $+100^{\circ}\text{C}$); $\pm 2^{\circ}\text{C}$ (0°C to $+ 100^{\circ}\text{C}$)
- Offset register for system calibration
- Series resistor cancellation feature

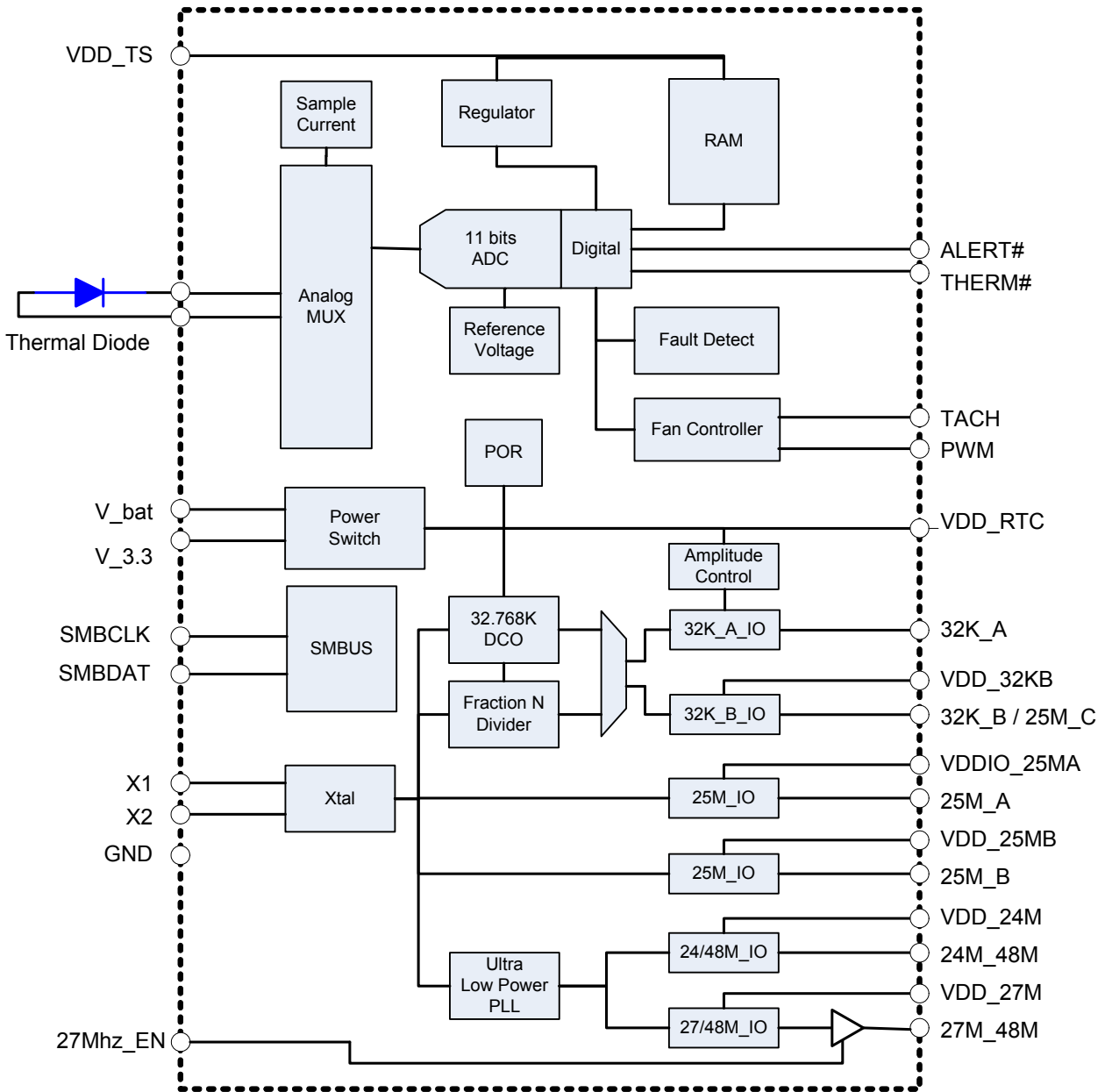
Fan Controller

- High frequency or low frequency PWM outputs for use with 4-wire fans
- TACH inputs to measure fan speed
- OS independent automatic fan speed control based on thermal information
- Dynamic TMIN control mode to optimize system acoustics
- Default startup at 100% PWM for all fans for robust operation

System Clock PLL Synthesizers

- Scalable low voltage VDD I/O (1.5V to 1.05V) to reduce power consumption (applies to 25MHz output)
- Integrated series termination resistors
- Selectable – Single-ended 24MHz/27MHz/48MHz clock output @ VDD3.3V
- 3 – Single ended 25MHz clock outputs (buffer out)
- 32.768 kHz outputs with $< 1.8\mu\text{A}$ power consumption for system RTC circuit

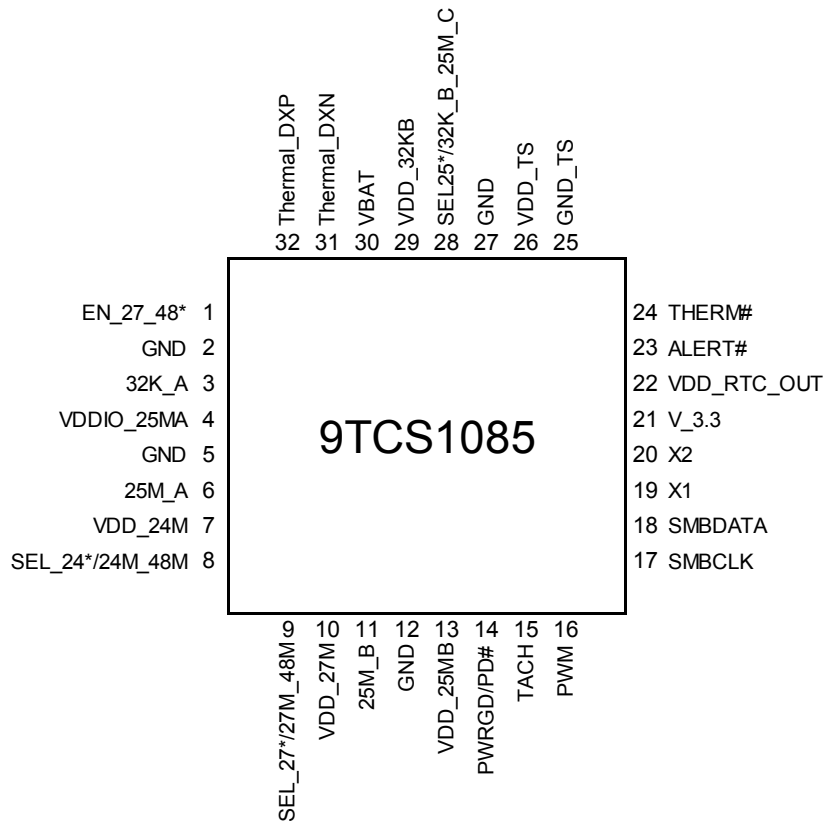
Block Diagram



Preferred drive strengths for single-ended outputs.
 Transmission lines to load do not share series resistors.
 Desktop (Zo=50Ω) and mobile (Zo=55Ω) have the same drive strength.

D.C.Drive Strength	Number of Loads to Drive	Match Point for N & P Voltage / Current (mA)	Number of Loads Actually Driven.		
			1 Load Rs =	2 Loads Rs=	3 Loads Rs =
	1	0.56 / 33 (17Ω)	33Ω [39Ω]	-	-
	2	0.92 / 66 (14Ω)	39Ω [43Ω]	22Ω [27Ω]	-
	3	1.15 / 99 (11.6Ω)	43Ω [43Ω]	27Ω [33Ω]	15Ω [22Ω]

Pin Assignment



* Internal Pull-Up Resistor
24M/27M/48Mhz outputs require external series resistors on Board.

Power Group

Pin Number		Description
VDD	GND	
4	2	VDDIO_25MA IO power
7	5	VDD_24M power
10	12	VDD_27M power
13	2	VDD_25B Power
21	2	V_3.3 core power
22	27	VDD_RTC_Out
26	25	VDD_TS power
29	27	VDD_32KB Power
30	27	V_bat for DCO and 32KA power

* pin33: thermal pad

Pin Descriptions

PIN	PIN NAME	TYPE	DESCRIPTION
1	EN_27_48*	PWR	Pin10 27_48 output enable/disable. Real time
2	GND	OUT	Ground pin
3	32K_A	OUT	RTC clock 32.768KHz output A
4	VDDIO_25MA	PWR	Power for 25MHz_A output
5	GND	PWR	Ground pin
6	25M_A	OUT	25MHz_A Output
7	VDD_24M	PWR	Power for 24/48 MHz output
8	SEL_24*/24M_48M	I/O	24Mhz Enable Latched Input, programmable Free Running 24/48M clock output. SEL_24 Selects the functionality of the 24_48M output as follows: 1 = 24M output (Default) 0 = 48M output
9	SEL_27*/27M_48M	I/O	27Mhz Enable Latched Input, programmable Free Running 27/48M clock output. SEL_27 Selects the functionality of the 27_48M output as follows: 1 = 27M output (default) 0 = 48M output
10	VDD_27M	PWR	Power for 27/48 MHz output
11	25M_B	OUT	25MHz_B Output
12	GND	PWR	Ground pin
13	VDD_25MB	PWR	Power for LDO and main circuit
14	PWRGD/PD#	IN	This 3.3V LVTTTL input notifies device to sample latched inputs and start up on first high assertion, or
15	TACH	IN	Fan controller TACH signal input
16	PWM	OUT	Fan controller PWM signal output
17	SMBCLK	IN	SMBUS clock
18	SMBDAT	I/O	SMBUS data
19	X1	IN	Crystal input, Nominally 25MHz.
20	X2	OUT	Crystal output, Nominally 25MHz
21	V_3.3	PWR	Power for 32K PLL core, connect to system 3.3V_StandBy
22	VDD_RTC_OUT	OUT	Power for chipset RTC circuit
23	ALERT#	OUT	open drain interrupt output for SMBUS Alert pin
24	THERM#	OUT	open drain interrupt output for external hardware connection
25	GND_TS	PWR	Ground pin for thermal sensor function
26	VDD_TS	PWR	Power for thermal sensor function
27	GND	PWR	Ground pin
28	SEL_25*/32KB_25M_C	I/O	25Mhz_C output select pin, programmable Free Running 32.768Khz or 25Mhz clock output. SEL_25* Selects the functionality of the 32K_25M output as follows: 1 = 25Mhz output (Default) 0 = 32.768Khz output
29	VDD_32KB	PWR	Power for 32.768Khz_B output
30	VBAT	PWR	Power for 32kHz_A output. Connect to coin cell battery
31	Thermal_DNX1	IN	external thermal diode N
32	Thermal_DXP1	IN	external thermal diode P
33	Thermal Pad	PWR	GND

Frequency and Output Selection Tables

Clock Output Selection Table

Pin number	Setting	Output	Remark
8	L	48MHz	
	H	24MHz	default, internal pull high
9	L	48MHz	
	H	27MHz	default, internal pull high
28	L	32.768KHz_B	
	H	25MHz_C	default, internal pull high

Output Selection Table A

Power Supply		VDDIO_Control			Outputs				
V_Bat	V_3.3	VDD_32KB	VDDIO_25A	VDD_25B	32K_A	32K_B	25M_A	25M_B	VDD_RTC
2.3~3.0	0	0	0	0	ON	OFF	OFF	OFF	Vbat
2.3~3.0	3.3 ¹	0	0	0	ON	OFF	OFF	OFF	V3.3
2.3~3.0	3.3 ¹	3.3	0	0	ON	ON	OFF	OFF	V3.3
2.3~3.0	3.3 ¹	3.3	1.05~1.5 ²	0	ON	ON	ON	OFF	V3.3
2.3~3.0	3.3 ¹	3.3	1.05~1.5 ²	3.3	ON	ON	ON	ON	V3.3

Note 1: When V3.3 is applied, XTAL will always be ON. 32K source will switch to an analog PLL. Fan control will be ON.

Note 2: If amplitude greater than 1.5V is required on 25MHz_A output, please contact IDT support.

Output Selection Table B

Power Supply				Outputs			
V_3.3	VDD_24M ¹	VDD_27M	VDD_TS	24_48M	27_48M	Fan Control	Thermal Sensor
3.3	0	0	0	OFF	OFF	ON	OFF
3.3	3.3	0	0	ON	OFF	ON	OFF
3.3	3.3	3.3	0	ON	ON	ON	OFF
3.3	3.3	3.3	3.3	ON	ON	ON	ON

Note 1: When either VDD_24M, VDD_27M or VDD_TS is ON, V_3.3 should be ON.

Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the 9TCS1085. These ratings, which are standard values for IDT commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	Notes
Maximum Supply Voltage	VDDxxx	Core/Logic Supply		3.6	V	1,2
Maximum Supply Voltage	VDDIOxxx	Core/Logic Supply		3.6	V	1,2
Maximum Input Voltage	V _{IH}	3.3V LVCMOS Inputs		3.6	V	1,2,3
Minimum Input Voltage	V _{IL}	Any Input	GND - 0.5		V	1,2
Storage Temperature	T _s	-	-65	150	°C	1,2
Case Temperature	T _{case}	-		115	°C	1,2

¹ Unless otherwise noted, guaranteed by design and characterization, not 100% tested in production.

² Operation under these conditions is neither implied, nor guaranteed.

³ Maximum input voltage is not to exceed maximum VDD

Electrical Characteristics—SMBus Interface

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	Notes
SMBus Voltage	V _{DD}		2.7	3.6	V	1
Low-level Output Voltage	V _{OL} SMB	@ I _{PULLUP}		0.4	V	1
Current sinking at V _{OL} SMB = 0.4 V	I _{PULLUP}	SMB Data Pin	4		mA	1
SCLK/SDATA Clock/Data Rise Time	T _{RI2C}	(Max V _{IL} - 0.15) to (Min V _{IH} + 0.15)		1000	ns	1
SCLK/SDATA Clock/Data Fall Time	T _{FI2C}	(Min V _{IH} + 0.15) to (Max V _{IL} - 0.15)		300	ns	1
Maximum SMBus Operating Frequency	F _{SMBUS}	Block Mode		400	kHz	1

¹ Unless otherwise noted, guaranteed by design and characterization, not 100% tested in production.

AC Electrical Characteristics—Input/Common Parameters

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	Notes
Clk Stabilization	T _{STAB}	From VDD Power-Up or de-assertion of PD# to 1st clock		1.8	ms	1
Tdrive_PD#	T _{DRPD}	Differential output enable after PD# de-assertion		300	us	1

¹ Unless otherwise noted, guaranteed by design and characterization, not 100% tested in production.

Electrical Characteristics—Input/Supply/Common Parameters

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	Notes
Ambient Operating Temp	T _{ambient}	-	0	70	°C	
Supply Voltage	V _{3.3}	Supply Voltage	3.135	3.465	V	
Supply Voltage	VDD _{xx}	Other Supply Voltages	3.135	3.465	V	
Supply Voltage	VDDIO_25MA	Supply Voltage	0.9975	1.575	V	
Supply Voltage	V _{bat}	Supply Voltage	2.3	3.465	V	
Input High Voltage	V _{IHSE}	Single-ended inputs	2	V _{DD} + 0.3	V	1,4
Input Low Voltage	V _{ILSE}	Single-ended inputs	V _{SS} - 0.3	0.8	V	1,4
Low Threshold Input-High Voltage	V _{IH_FS}	3.3 V +/-5%	0.7	V _{DD} + 0.3	V	1
Low Threshold Input-Low Voltage	V _{IL_FS}	3.3 V +/-5%	V _{SS} - 0.3	0.35	V	1
Input Leakage Current	I _{IN}	V _{IN} = V _{DD} , V _{IN} = GND	-5	5	uA	1,3
Input Leakage Current	I _{INRES}	Inputs with pull or pull down resistors V _{IN} = V _{DD} , V _{IN} = GND	-200	200	uA	1
Output High Voltage	V _{OHSE}	Single-ended outputs, I _{OH} = -1mA	2.4		V	1,2
Output Low Voltage	V _{OLSE}	Single-ended outputs, I _{OL} = 1 mA		0.4	V	1,2
3.3V Operating Supply Current	I _{DD3.3OP}	Full active mode, C _L = Full load, 3.3V Rail		50	mA	1
	I _{DD3.3PD#}	Complete Power-Down, 3.3V Rail		10	mA	1
	I _{DD3.3WOL}	WOL Mode with 25MA running, 3.3V Rail		25	mA	1
	I _{DD3.3RTC}	RTC Mode with 32KA running, 3.3V Rail		0.1	uA	1
VDDIO Operating Supply Current	I _{DDIO_OP}	Full active mode, C _L = Full load, VDDIO Rails		5	mA	1
	I _{DDIO_PD#}	Complete Power-Down, VDDIO Rails		1	mA	1
	I _{DDIO_WOL}	WOL Mode with 25MA running, VDDIO Rails		10	mA	1
	I _{DDIO_RTC}	RTC Mode with only 32KA running, VDDIO Rails		0.5	uA	1
V _{bat} Operating Supply Current	I _{DD_V_bat}	RTC Mode with 32KA running, V _{bat} Rail		1.8	uA	1
Input Frequency	F _i	V _{DD} = 3.3 V	25MHz Typical		MHz	1
Pin Inductance	L _{pin}			7	nH	1
Input Capacitance	C _{IN}	Logic Inputs	1.5	5	pF	1
	C _{OUT}	Output pin capacitance		6	pF	1
	C _{INX}	X1 & X2 pins		6	pF	1

*TA = 0 - 70°C; Supply Voltage V_{3.3} = VDD_{TS} = 3.3 V +/-5%, VDD_{24M} = VDD_{27M} = VDD_{25MB} = 3.3V +/- 5%, VDD_{25MA} = 1.05V +/- 5%, VDD_{32KB} = 3.3V +/- 5%, CL = 5pF with Rs = 27Ω (unless otherwise specified)

¹ Unless otherwise noted, guaranteed by design and characterization, not 100% tested in production.

² Signal is required to be monotonic in this region.

³ Input leakage current does not include inputs with pull-up or pull-down resistors

⁴ 3.3V referenced inputs are: SCLK, SDATA, SEL₂₅, SEL₂₄, SEL₂₇, PWRGD.

AC Electrical Characteristics—Power Management

Output Clock Power Consumption Table

Power Supply		Power Consumption @ 2' transmission line			
V _{bat} / V _{3.3}	Outputs	I _{V_{bat}}	I _{V_{3.3}}	I _{VDD_32KB}	I _{VDD_25M}
2.3~3.3	32K_A	1.8uA	0	0	0
2.3~3.3	32K_A	0	2mA	0	0
2.3~3.3	32K_A+B	0	2mA	1uA	0
2.3~3.3	32K, 25M_A	0	2mA	1uA	1mA
2.3~3.3	32K_A+B,25MA+B	0	2mA	1uA	2mA

Note: When V_{3.3} is applied, XTAL will always be ON. 32K source will switch to an analog PLL.

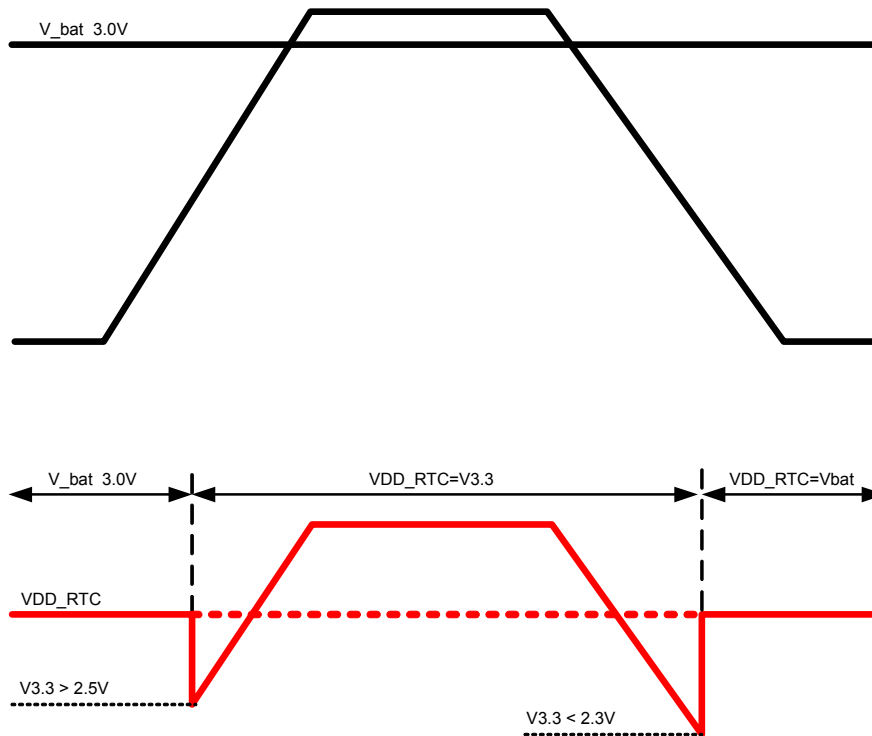
Power Supply		Power consumption @ 2' transmission line			
V _{3.3}	VDD_24/27/TS	I _{V3.3}	I _{VDD_24M}	I _{VDD_27M}	I _{VDD_TS}
3.3	0	2mA	0	0	0
3.3	24Mhz	2mA	3mA	0	0
3.3	24/27Mhz	2mA	3mA	1mA	0
3.3	24/27Mhz+Thermal+Fan	2mA	3mA	1mA	0.8mA

Note: When either VDD_24M, VDD_27M or VDD_TS is ON, V3.3 should be ON

Power Switch (VBAT/V33 -> VDD_RTC)

Integrated power switch detects the VDD_RTC SW to coin cell battery (VBAT) or main power supply (V33).

When there is no V33 (V33=0), the SW will connect the VDD_RTC to VBAT; when V33 goes higher than 2.5V, the VDD_RTC will be switched to V33 with no delay. After V33 goes lower than 2.3V, the VDD_RTC will be switched to VBAT, no delay.



When VDD_RTC = VBAT, the power SW circuit consumes < 100nA.

When VDD_RTC = V33, the power consumption on VBAT needs to be "0".

Electrical Characteristics—USB48MHz

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	NOTES
Long Accuracy	ppm	see Tperiod min-max values	-100	100	ppm	1,2
Clock period	T _{period}	48.00MHz output nominal	20.8313	20.8354	ns	1,2
Output High Voltage	V _{OH}	I _{OH} = -1 mA	2.4		V	1
Output Low Voltage	V _{OL}	I _{OL} = 1 mA		0.4	V	1
Output High Current	I _{OH}	V _{OH} @MIN = 1.0 V	-33		mA	1
		V _{OH} @MAX = 3.135 V		-33	mA	1
Output Low Current	I _{OL}	V _{OL} @ MIN = 1.95 V	30		mA	1
		V _{OL} @ MAX = 0.4 V		38	mA	1
Rising Edge Slew Rate	t _{SLR}	Measured from 0.8 to 2.0 V	0.5	2.5	V/ns	1
Falling Edge Slew Rate	t _{SLR}	Measured from 2.0 to 0.8 V	0.5	2.5	V/ns	1
Duty Cycle	d _{t1}	V _T = 1.5 V	45	55	%	1
Jitter, Cycle to cycle	t _{jyc-cyc}	V _T = 1.5 V		350	ps	1

*TA = 0 - 70°C; Supply Voltage V_{3.3} = VDD_{TS} = 3.3 V +/-5%, VDD_{24M} = VDD_{27M} = VDD_{25MB} = 3.3V +/- 5%, VDD_{25MA} = 1.05V +/- 5%, VDD_{32KB} = 3.3V +/- 5%, CL = 5pF with Rs = 27Ω (unless otherwise specified)

¹Guaranteed by design and characterization, not 100% tested in production.

²All Long Term Accuracy and Clock Period specifications are guaranteed assuming that REFOUT is at 25.000000MHz

Electrical Characteristics—24MHz

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	NOTES
Long Accuracy	ppm	see Tperiod min-max values	-100	100	ppm	1,2
Clock period	T _{period}	24.00MHz output nominal	41.6625	41.6708	ns	1,2
Output High Voltage	V _{OH}	I _{OH} = -1 mA	2.4		V	1
Output Low Voltage	V _{OL}	I _{OL} = 1 mA		0.4	V	1
Output High Current	I _{OH}	V _{OH} @MIN = 1.0 V	-33		mA	1
		V _{OH} @MAX = 3.135 V		-33	mA	1
Output Low Current	I _{OL}	V _{OL} @ MIN = 1.95 V	30		mA	1
		V _{OL} @ MAX = 0.4 V		38	mA	1
Rising Edge Slew Rate	t _{SLR}	Measured from 0.8 to 2.0 V	0.5	4	V/ns	1
Falling Edge Slew Rate	t _{SLR}	Measured from 2.0 to 0.8 V	0.5	4	V/ns	1
Duty Cycle	d _{t1}	V _T = 1.5 V	45	55	%	1
Jitter, Cycle to cycle	t _{jyc-cyc}	V _T = 1.5 V		350	ps	1

*TA = 0 - 70°C; Supply Voltage V_{3.3} = VDD_{TS} = 3.3 V +/-5%, VDD_{24M} = VDD_{27M} = VDD_{25MB} = 3.3V +/- 5%, VDD_{25MA} = 1.05V +/- 5%, VDD_{32KB} = 3.3V +/- 5%, CL = 5pF with Rs = 27Ω (unless otherwise specified)

¹Guaranteed by design and characterization, not 100% tested in production.

²All Long Term Accuracy and Clock Period specifications are guaranteed assuming that REFOUT is at 25.000000MHz

Electrical Characteristics—25MHz

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	NOTES
Long Accuracy	ppm	see Tperiod min-max values	-100	100	ppm	1,2
Clock period	T _{period}	25.00MHz output nominal	39.99600	40.00400	ns	1,2
Output High Voltage	V _{OH}	I _{OH} = -1 mA	2.4		V	1
Output Low Voltage	V _{OL}	I _{OL} = 1 mA		0.4	V	1
Output High Current	I _{OH}	V _{OH} @ MIN = 1.0 V	-29		mA	1
		V _{OH} @ MAX = 3.135 V		-23	mA	1
Output Low Current	I _{OL}	V _{OL} @ MIN = 1.95 V	29		mA	1
		V _{OL} @ MAX = 0.4 V		27	mA	1
Rising Edge Slew Rate	t _{SLR}	Measured from 0.8 to 2.0 V	0.5	4	V/ns	1
Falling Edge Slew Rate	t _{SLR}	Measured from 2.0 to 0.8 V	0.5	4	V/ns	1
Duty Cycle	d _{t1}	V _T = 1.5 V	40	60	%	1
Jitter, Cycle to cycle	t _{jcy-cyc}	V _T = 1.5 V		500	ps	1

*TA = 0 - 70°C; Supply Voltage V_{3.3} = VDD_{TS} = 3.3 V +/-5%, VDD_{24M} = VDD_{27M} = VDD_{25MB} = 3.3V +/- 5%, VDD_{25MA} = 1.05V +/- 5%, VDD_{32KB} = 3.3V +/- 5%, CL = 5pF with Rs = 0Ω (unless otherwise specified)

¹Guaranteed by design and characterization, not 100% tested in production.

²All Long Term Accuracy and Clock Period specifications are guaranteed assuming that REFOUT is at 25.000000MHz

Electrical Characteristics—27MHz

Long Accuracy	ppm	see Tperiod min-max values	-50	50	ppm	1,2
Clock period	T _{period}	27.000MHz output nominal	37.0365	37.0376	ns	1,2
Output High Voltage	V _{OH}	I _{OH} = -1 mA	2.4		V	1
Output Low Voltage	V _{OL}	I _{OL} = 1 mA		0.4	V	1
Output High Current	I _{OH}	V _{OH} @ MIN = 1.0 V	-29		mA	1
		V _{OH} @ MAX = 3.135 V		-23	mA	1
Output Low Current	I _{OL}	V _{OL} @ MIN = 1.95 V	29		mA	1
		V _{OL} @ MAX = 0.4 V		27	mA	1
Rising Edge Slew Rate	t _{SLR}	Measured from 0.8 to 2.0 V	1	4	V/ns	1
Falling Edge Slew Rate	t _{FLR}	Measured from 2.0 to 0.8 V	1	4	V/ns	1
Duty Cycle	d _{t1}	V _T = 1.5 V	45	55	%	1
Jitter, Cycle to cycle	t _{jcy-cyc}	Cycle to Cycle, V _T = 1.5 V		200	ps	1

*TA = 0 - 70°C; Supply Voltage V_{3.3} = VDD_{TS} = 3.3 V +/-5%, VDD_{24M} = VDD_{27M} = VDD_{25MB} = 3.3V +/- 5%, VDD_{25MA} = 1.05V +/- 5%, VDD_{32KB} = 3.3V +/- 5%, CL = 5pF with Rs = 27Ω (unless otherwise specified)

¹Guaranteed by design and characterization, not 100% tested in production.

²All Long Term Accuracy and Clock Period specifications are guaranteed assuming that REFOUT is at 25.000000MHz

Electrical Characteristics–32KHz_A (Low Voltage Output)

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	Notes
Long Accuracy	ppm	see Tperiod min-max values	32.768	Typical	kHz	1,2
Output High Voltage	V _{OH}	32K_A Output	0.8	1.2	V	1
Output Low Voltage	V _{OL}	32K_A Output		0.3	V	1
Initial Frequency Error	32K _{INI}	0C to 70C		+/-10	ppm	1
				0.86	sec/day	1
RTC Frequency Error	32K _{RTC_7D}	7-day measurement		8	sec	1
Rising Edge Slew Rate	t _{SLR}	Measured from 20% to 80%	0.03 typ		V/ns	1
Falling Edge Slew Rate	t _{FLR}	Measured from 80% to 20%	0.03 typ		V/ns	1
Duty Cycle	d _{t1}	VT = V _{bat} /2	40	60	%	1

*TA = 0 - 70°C; Supply Voltage V_{3.3} = VDD_{TS} = 3.3 V +/-5%, VDD_{24M} = VDD_{27M} = VDD_{25MB} = 3.3V +/- 5%, VDD_{25MA} = 1.05V +/- 5%, VDD_{32KB} = 3.3V +/- 5%, CL = 2pF with Rs = 0Ω (unless otherwise specified)

¹Guaranteed by design and characterization, not 100% tested in production.

²All Long Term Accuracy and Clock Period specifications are guaranteed assuming that REFOUT is at 25.000000MHz

Electrical Characteristics–32KHz_B

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	Notes
Long Accuracy	ppm	see Tperiod min-max values	32.768	Typical	kHz	1,2
Output High Voltage	V _{OH}	32K_B Output	0.9975	3.465	V	1
Output Low Voltage	V _{OL}	32K_B Output		0.3	V	1
Initial Frequency Error	32K _{INI}	0C to 70C		+/-10	ppm	1
				0.86	sec/day	1
Rising Edge Slew Rate	t _{SLR}	Measured from 20% to 80%	0.3	2	V/ns	1
Falling Edge Slew Rate	t _{FLR}	Measured from 80% to 20%	0.3	2	V/ns	1
Duty Cycle	d _{t1}	VT = V _{bat} /2	40	60	%	1

*TA = 0 - 70°C; Supply Voltage V_{3.3} = VDD_{TS} = 3.3 V +/-5%, VDD_{24M} = VDD_{27M} = VDD_{25MB} = 3.3V +/- 5%, VDD_{25MA} = 1.05V +/- 5%, VDD_{32KB} = 3.3V +/- 5%, CL = 2pF with Rs = 0Ω (unless otherwise specified)

¹Guaranteed by design and characterization, not 100% tested in production.

²All Long Term Accuracy and Clock Period specifications are guaranteed assuming that REFOUT is at 25.000000MHz

Recommended 25MHz Crystal Specification

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	NOTES
Frequency Accuracy	F _{accr}	@25C		+/-10	ppm	1
Frequency Error over temperature	F _{errt}	-10C ~ 70C		+/-10	ppm	1
Frequency Aging	F _{aging}	1 year		+/-1	ppm	1
Driver Level	DL			100	uW	1
Crystal Load Capacitance	CL	Parallel Resonance	8pF Typical		pF	1

*TA = 0 - 70°C; Supply Voltage V_{3.3} = VDD_{TS} = 3.3 V +/-5%, VDD_{24M} = VDD_{27M} = VDD_{25MB} = 3.3V +/- 5%, VDD_{25MA} = 1.05V +/- 5%, VDD_{32KB} = 3.3V +/- 5% (unless otherwise specified)

¹Guaranteed by design and characterization, not 100% tested in production.

Electrical Characteristics—Thermal Sensor Controller

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	Notes
Local Sensor Accuracy		0C<TA<60C		2	C	1
		60C<TA<100C		1	C	1
Resolution				1	C	1
Remote Sensor Accuracy	Raccu	0C<TA<60C		2	C	1
		60C<TA<100C		1	C	1
Resolution	Rs			1	C	1
Conversion Rate	CR		16	1/64	Sec	1

*TA = 0 - 70°C; Supply Voltage V_{3.3} = VDD_TS = 3.3 V +/-5%, VDD_24M = VDD_27M = VDD_25MB = 3.3V +/- 5%, VDD_25MA = 1.05V +/- 5%, VDD_32KB = 3.3V +/- 5% (unless otherwise specified)

¹Guaranteed by design and characterization, not 100% tested in production.

Electrical Characteristics—Fan Controller

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNITS	Notes
PWM frequency	PWM		25	27	kHz	1
PWM Duty Cycle	DUTY			100	%	1
Tachometer Range	TACH		1	4	POLE	1

*TA = 0 - 70°C; Supply Voltage V_{3.3} = VDD_TS = 3.3 V +/-5%, VDD_24M = VDD_27M = VDD_25MB = 3.3V +/- 5%, VDD_25MA = 1.05V +/- 5%, VDD_32KB = 3.3V +/- 5% (unless otherwise specified)

¹Guaranteed by design and characterization, not 100% tested in production.

General SMBus Serial Interface Information for 9TCS1085

How to Write

- Controller (host) sends a start bit
- Controller (host) sends the write address
- IDT clock will **acknowledge**
- Controller (host) sends the beginning byte location = N
- IDT clock will **acknowledge**
- Controller (host) sends the byte count = X
- IDT clock will **acknowledge**
- Controller (host) starts sending Byte N through Byte N+X-1
- IDT clock will **acknowledge** each byte **one at a time**
- Controller (host) sends a Stop bit

Index Block Write Operation			
Controller (Host)		IDT (Slave/Receiver)	
T	starT bit		
Slave Address			
WR	WRite		
			ACK
Beginning Byte = N			ACK
Data Byte Count = X			ACK
Beginning Byte N		X Byte	ACK
O			O
O			O
O			O
Byte N + X - 1			ACK
P	stoP bit		

Read Address	Write Address
D3 _(H)	D2 _(H)

How to Read

- Controller (host) will send a start bit
- Controller (host) sends the write address
- IDT clock will **acknowledge**
- Controller (host) sends the beginning byte location = N
- IDT clock will **acknowledge**
- Controller (host) will send a separate start bit
- Controller (host) sends the read address
- IDT clock will **acknowledge**
- IDT clock will send the data byte count = X
- IDT clock sends Byte N+X-1
- IDT clock sends **Byte 0 through Byte X (if X_(H) was written to Byte 8)**
- Controller (host) will need to acknowledge each byte
- Controller (host) will send a not acknowledge bit
- Controller (host) will send a stop bit

Index Block Read Operation			
Controller (Host)		IDT (Slave/Receiver)	
T	starT bit		
Slave Address			
WR	WRite		
			ACK
Beginning Byte = N			ACK
RT	Repeat starT		
Slave Address			
RD	ReaD		
			ACK
ACK			Data Byte Count=X
ACK		X Byte	Beginning Byte N
O			O
O			O
O			O
ACK			Byte N + X - 1
N	Not acknowledge		
P	stoP bit		

Byte0	Name	Control Function	Type	0	1	PWD
Bit7	ALERT_TH1	CH1 Diode ALERT High Temperature Limit	RW	-	SIGN	0
Bit6					64C	1
Bit5					32C	1
Bit4					16C	1
Bit3					8C	1
Bit2					4C	1
Bit1					2C	1
Bit0					1C	1

Note: Register readback uses 2's Complement

Byte1	Name	Control Function	Type	0	1	PWD
Bit7	Reserved	Reserved	RW	-	-	0
Bit6					-	1
Bit5					-	1
Bit4					-	1
Bit3					-	1
Bit2					-	1
Bit1					-	1
Bit0					-	1

Note: Register readback uses 2's Complement

Byte 2 Reserved Register

Byte3	Name	Control Function	Type	0	1	PWD
Bit7	ALERT_TL1	CH1 Diode ALERT Low Temperature Limit	RW	-	SIGN	1
Bit6					64C	0
Bit5					32C	0
Bit4					16C	0
Bit3					8C	0
Bit2					4C	0
Bit1					2C	0
Bit0					1C	1

Note: Register readback uses 2's Complement

Byte 4~5 Reserved Register

Byte6	Name	Control Function	Type	0	1	PWD
Bit7	CH1_EN	Enable Temp-Sensor Channel1	RW	Disable	Enable	0
Bit6	Reserved	Reserved	RW	-	-	0
Bit5	Reserved	Reserved	RW	-	-	1
Bit4	Reserved	Reserved	RW	-	-	0
Bit3	Consecutive ALERT	Consecutive ALERT Report	RW	00 = 1	01 = 2	0
Bit2			RW	10 = 3	11 = 4	0
Bit1	Average_Fact	Average the converted temperature	RW	00 = 1	01 = 4	0
Bit0			RW	10 = 8	11 = 16	0

Byte7	Name	Control Function	Type	0	1	PWD
Bit7	THERMAL1	CH1 Diode THERMALTemperature Limit	RW	-	Reserved	0
Bit6					64C	1
Bit5					32C	1
Bit4					16C	1
Bit3					8C	1
Bit2					4C	1
Bit1					2C	1
Bit0					1C	1

Byte 8~9 Reserved Register

Byte10	Name	Control Function	Type	0	1	PWD
Bit7	D_A1	CH1 Gain (Slope) Coefficient	RW	-	1.28C	1
Bit6			RW		0.64C	0
Bit5			RW		0.32C	0
Bit4			RW		0.16C	0
Bit3	D_B1	CH1 Offset Coefficient	RW	-	4C	1
Bit2			RW		2C	0
Bit1			RW		1C	0
Bit0			RW		0.5C	0

Byte 11 Reserved Register

Byte12	Name	Control Function	Type	0	1	PWD
Bit7	Reserved	Reserved	RW	-	-	0
Bit6	Reserved	Reserved	RW	-	-	0
Bit5	MASK1	MASK Channel1 ALERT	RW	Non-Mask	Mask	0
Bit4	THERMAL_HYS	THERMAL Limit Hysteresis	RW	-	16C	0
Bit3			RW		8C	0
Bit2			RW		4C	1
Bit1			RW		2C	0
Bit0			RW		1C	0

Byte13	Name	Control Function	Type	0	1	PWD
Bit7	Reserved	Reserved	R	-	-	0
Bit6	Reserved	Reserved	R	-	-	0
Bit5	Reserved	Reserved	R	-	-	0
Bit4	Reserved	Reserved	R	-	-	0
Bit3	CH1 High	Channel 1 ALERT High Alarm	R	Non-Flag	Flag	0
Bit2	CH1 Low	Channel 1 ALERT Low Alarm	R	Non-Flag	Flag	0
Bit1	CH1 Fault	Channel 1 Diode Fault (Open)	R	Non-Flag	Flag	0
Bit0	Reserved	Reserved	R	-	-	0

Byte14	Name	Control Function	Type	0	1	PWD
Bit7	BUSY	ADC is converting	R	Non-Flag	Flag	0
Bit6	HIGH	One of the Channels ALERT High	R	Non-Flag	Flag	0
Bit5	LOW	One of the Channels ALERT Low	R	Non-Flag	Flag	0
Bit4	FAULT	One of the EXT-Channel Open/Short	R	Non-Flag	Flag	0
Bit3	Reserved	Reserved	R	-	-	0
Bit2	CH1_THERMAL	Channel1 THERMAL Alarm	R	Non-Flag	Flag	0
Bit1	Reserved	Reserved	R	-	-	0
Bit0	Reserved	Reserved	R	-	-	0

Byte15	Name	Control Function	Type	0	1	PWD
Bit7	Fault_Clear	Clear all the Alarm Flag	RW	No Clear	Clear	0
Bit6	One-Shot	One-Shot Temperature Conversion	RW	Disable Oneshot	Do OneShot	0
Bit5	DYN_AVE_EN	Enable Dynamic average	RW	Disable Dynamic Average	Enable Dynamic Average	0
Bit4	Conv. Rate 3		RW	See Detail From Convert Ratio Table		0
Bit3	Conv. Rate 2		RW			0
Bit2	Conv. Rate 1		RW			1
Bit1	Conv. Rate 0		RW			0
Bit0	Reserved	Reserved	RW	-	-	0

Byte16	Name	Control Function	Type	0	1	PWD
Bit7	TEMP <10:3>	MSB of Temperature	R	-	SIGN	0
Bit6			R		64	0
Bit5			R		32	0
Bit4			R		16	0
Bit3			R		8	0
Bit2			R		4	0
Bit1			R		2	0
Bit0			R		1	0

Byte17	Name	Control Function	Type	0	1	PWD
Bit7	Reserved	Reserved	R	-	-	0
Bit6	Reserved	Reserved	R	-	-	0
Bit5	Reserved	Reserved	R	-	-	0
Bit4	Reserved	Reserved	R	-	-	0
Bit3	Reserved	Reserved	R	-	-	0
Bit2	TEMP<2:0>	LSB of Temperature	R	-	0.5	0
Bit1			R		0.25	0
Bit0			R		0.125	0

Byte 18~21 Reserved Register

Byte22	Name	Control Function	Type	0	1	PWD
Bit7	TACH_MEASURE<7:0>	LSB of TACH Measurement	R	-	128	0
Bit6			R		64	0
Bit5			R		32	0
Bit4			R		16	0
Bit3			R		8	0
Bit2			R		4	0
Bit1			R		2	0
Bit0			R		1	0

Byte23	Name	Control Function	Type	0	1	PWD
Bit7	Reserved	Reserved	R	-	-	0
Bit6	Reserved	Reserved	R	-	-	0
Bit5	Reserved	Reserved	R	-	-	0
Bit4	TACH_MEASURE<12:8>	MSB of TACH Measurement	R	-	4096	0
Bit3			R		2048	0
Bit2			R		1024	0
Bit1			R		512	0
Bit0			R		256	0

Byte24	Name	Control Function	Type	0	1	PWD
Bit7	Mode Select	Select the FAN Operating Mode	RW	00 - Direct Drive Mode	01 - Thermal Trigger Mode	1
Bit6			RW	10 - Dynamic PWM Mode	11 - Reserved	0
Bit5	Freq_Sel	Select the PWM frequency	RW	00 - 25KHz	01 - 22KHz	0
Bit4			RW	10 - 27KHz	11 - Reserved	0
Bit3	Edge	FAN Type Selection	RW	00 - 1Pole FAN	01 - 2 Poles FAN	0
Bit2			RW	10 - 3 Poles FAN	11 - 4 Poles FAN	1
Bit1	Error Range	TACH Detect Tolerant Error Rang	RW	00 - 0	01 - 32	0
Bit0			RW	10 - 64	11 - 128	1

Byte25	Name	Control Function	Type	0	1	PWD
Bit7	Spin-Up Time	The Time For Spin-Up	RW	00 - 250ms	01 - 500ms	0
Bit6			RW	10 - 1s	11 - 2s	1
Bit5	Spin-Up Duty	PWM Duty-Cycle For Spin-Up	RW	000 - 30%, 001 - 35%, 010 - 40%, 011 - 45%, 100 - 50%, 101 - 55%, 110 - 60%, 111 - 65%		1
Bit4			RW			1
Bit3			RW			0
Bit2	Spin-Up cnt	Time Out Times For Spin-Up	RW	00 - 3	01 - 4	0
Bit1			RW	10 - 5	11 - 6	1
Bit0	Reserved	Reserved	RW	-	-	0

Byte26	Name	Control Function	Type	0	1	PWD
Bit7	Duty_Cycle<10:3>	MSB of PWM Duty-Cycle Setting	RW	-	1	0
Bit6			RW		1/2	0
Bit5			RW		1/4	0
Bit4			RW		1/8	0
Bit3			RW		1/16	0
Bit2			RW		1/32	0
Bit1			RW		1/64	0
Bit0			RW		1/128	0

Byte27	Name	Control Function	Type	0	1	PWD
Bit7	Duty_Cycle<2:0>	LSB of PWM Duty-Cycle Setting	RW	-	1/256	0
Bit6			RW		1/512	0
Bit5			RW		1/1024	0
Bit4	Update Time	TACH Detect Update Time	RW	000 - 100ms, 001 - 200ms, 010 - 300ms, 011 - 400m, 100 - 500ms, 101 - 600ms, 110 - 700ms, 111 - 800ms		0
Bit3			RW			1
Bit2			RW			1
Bit1	T_Hys	Temperature Hysteresis For FAN's Trigger Point	RW	00 - 2C	01 - 5C	0
Bit0			RW	10 - 10C	11 - 15C	1

Byte28	Name	Control Function	Type	0	1	PWD
Bit7	TL_FAN	First Temperature Trigger Point of FAN	RW	-	Reserved	0
Bit6			RW		64C	1
Bit5			RW		32C	1
Bit4			RW		16C	1
Bit3			RW		8C	1
Bit2			RW		4C	1
Bit1			RW		2C	1
Bit0			RW		1C	1

Byte29	Name	Control Function	Type	0	1	PWD
Bit7	TH_FAN	Second Temperature Trigger Point of FAN	RW	-	Reserved	0
Bit6			RW		64C	1
Bit5			RW		32C	1
Bit4			RW		16C	1
Bit3			RW		8C	1
Bit2			RW		4C	1
Bit1			RW		2C	1
Bit0			RW		1C	1

Byte30	Name	Control Function	Type	0	1	PWD
Bit7	TACH_MAX	The Maximum Limit of TACH Number	RW	-	4096	1
Bit6			RW		2048	1
Bit5			RW		1024	1
Bit4			RW		512	1
Bit3			RW		256	1
Bit2			RW		128	1
Bit1			RW		64	1
Bit0			RW		32	1

Byte31	Name	Control Function	Type	0	1	PWD
Bit7	TACH_MIN	The Minimum Limit of TACH Number	RW	-	512	0
Bit6			RW		256	0
Bit5			RW		128	0
Bit4			RW		64	0
Bit3			RW		32	0
Bit2			RW		16	0
Bit1			RW		8	0
Bit0			RW		4	0

Byte32	Name	Control Function	Type	0	1	PWD
Bit7	TACH_S1<12:5>	MSB TACH threshold of Static Mode(T>TL_FAN)	RW	-	4096	0
Bit6			RW		2048	0
Bit5			RW		1024	0
Bit4			RW		512	0
Bit3			RW		256	0
Bit2			RW		128	0
Bit1			RW		64	0
Bit0			RW		32	0

Byte33	Name	Control Function	Type	0	1	PWD
Bit7	TACH_S1<4:0>	LSB TACH threshold of Static Mode(T>TL_FAN)	RW	-	16	0
Bit6			RW		8	0
Bit5			RW		4	0
Bit4			RW		2	0
Bit3			RW		1	0
Bit2	Reserved	Reserved	RW	-	-	0
Bit1	FAN_SEL	Temperature Selection For FAN	RW	00 - enable, 01~11 disable		1
Bit0			RW			0

Byte34	Name	Control Function	Type	0	1	PWD
Bit7	TACH_S2<12:5>	MSB TACH threshold of Static Mode(T>TH_FAN)	RW	-	4096	0
Bit6			RW		2048	0
Bit5			RW		1024	0
Bit4			RW		512	0
Bit3			RW		256	0
Bit2			RW		128	0
Bit1			RW		64	0
Bit0			RW		32	0

Byte35	Name	Control Function	Type	0	1	PWD
Bit7	TACH_S2<4:0>	LSB TACH threshold of Static Mode(T>TH_FAN)	RW	-	16	0
Bit6			RW		8	0
Bit5			RW		4	0
Bit4			RW		2	0
Bit3			RW		1	0
Bit2	FAN MASK	Mask Fan Fault	RW	0=normal	1=masked	0
Bit1	SEL_ALERT	Select the ALERT Source	RW	00 - ALERT=Temp-Sensor Alert	01 - ALERT=FAN Fault	0
Bit0			RW	10 - ALERT=Temp-Senso Alert or FAN Fault	10 - ALERT=Temp-Senso Alert and FAN Fault	0

Byte36	Name	Control Function	Type	0	1	PWD
Bit7	PWM Step	The PWM DutyCycle Incremental/Decremental Step	RW	-	128	0
Bit6			RW		64	0
Bit5			RW		32	0
Bit4			RW		16	0
Bit3			RW		8	1
Bit2			RW		4	0
Bit1			RW		2	0
Bit0			RW		1	0

Byte37	Name	Control Function	Type	0	1	PWD
Bit7	Reserved	Reserved	R	-	-	0
Bit6	Reserved	Reserved	R	-	-	0
Bit5	Reserved	Reserved	R	-	-	0
Bit4	Reserved	Reserved	R	-	-	0
Bit3	Reserved	Reserved	R	-	-	0
Bit2	Reserved	Reserved	R	-	-	0
Bit1	FAN_Fault1	FAN TACH measurement is < Minimum limit (Too Fast)	R	Non-Flag	Flag	0
Bit0	FAN_Fault2	FAN TACH measurement is > Maximum limit (Too Slow)	R	Non-Flag	Flag	0

Byte38	Name	Control Function	Type	0	1	PWD
Bit7	TACH_AIM_OUT	Targeted TACH Readback	R	-	-	0
Bit6			R	-	-	0
Bit5			R	-	-	0
Bit4			R	-	-	0
Bit3			R	-	-	0
Bit2			R	-	-	0
Bit1			R	-	-	0
Bit0			R	-	-	0

Byte 39~ 40 Reserved Register

Byte41	Name	Control Function	Type	0	1	PWD
Bit7	STOP_27M_48M	Stop 27M_48M output	RW	Stopped	Run	1
Bit6	STOP_24M_48M	Stop 24M_48M output	RW	Stopped	Run	1
Bit5	EN_STOP25M_C	Enable pin for 25M_C after at PWRGD=0	RW	Free-Run	Stoppable	1
Bit4	EN_STOP25M_B	Enable pin for 25M_B after at PWRGD=0	RW	Free-Run	Stoppable	1
Bit3	EN_STOP25M_A	Enable pin for 25M_A after at PWRGD=0	RW	Free-Run	Stoppable	0
Bit2	STOP_25M_C	Stop 25M_C output	RW	Stopped	Run	1
Bit1	STOP_25M_B	Stop 25M_B output	RW	Stopped	Run	1
Bit0	STOP_25M_A	Stop 25M_A output	RW	Stopped	Run	1

Byte42	Name	Control Function	Type	0	1	PWD
Bit7	BYTE COUNT Register Bit[7:0]	MSB	RW	-	-	0
Bit6		-	RW	-	-	0
Bit5		-	RW	-	-	0
Bit4		-	RW	-	-	1
Bit3		-	RW	-	-	1
Bit2		-	RW	-	-	1
Bit1		-	RW	-	-	1
Bit0		LSB	RW	-	-	1

Byte 43 ~ Byte 46 Reserved Registers

Byte47	Name	Control Function	Type	0	1	PWD
Bit7	REV_ID	Revision ID	RW	-	-	0
Bit6			RW	-	-	0
Bit5			RW	-	-	0
Bit4			RW	-	-	0
Bit3	VENDOR_ID	Vendor ID (IDT=0001)	RW	-	-	0
Bit2			RW	-	-	0
Bit1			RW	-	-	0
Bit0			RW	-	-	1

Byte 48 ~ Byte 63 Reserved Registers

Byte64	Name	Control Function	Type	0	1	PWD
Bit7	LCKBYPASSB	PLL Lock Bypassb	RW	Bypass	Not Bypas	1
Bit6	REF COUNT<6:0>	PLL M Counter	RW	-	-	0
Bit5			RW	-	-	0
Bit4			RW	-	-	1
Bit3			RW	-	-	1
Bit2			RW	-	-	0
Bit1			RW	-	-	0
Bit0			RW	-	-	1

Byte65	Name	Control Function	Type	0	1	PWD
Bit7	VCO COUNT<9:2>	PLL N COUNTER	RW	-	-	0
Bit6			RW	-	-	0
Bit5			RW	-	-	0
Bit4			RW	-	-	1
Bit3			RW	-	-	1
Bit2			RW	-	-	0
Bit1			RW	-	-	1
Bit0			RW	-	-	1

Byte 66 Reserved Register

Byte67	Name	Control Function	Type	0	1	PWD
Bit7	SL<1:0>(25MHzB)	25M_B Slew Rate Control	RW	00 = 0.5V/ns	01 = 1.0V/ns	0
Bit6			RW	10 = 1.0V/ns	11 = 1.5V/ns	1
Bit5	SL<1:0>(25MHzA)	25M_A Slew Rate Control	RW	00 = 1.0V/ns	01 = 1.5V/ns	0
Bit4			RW	10 = 1.5V/ns	11 = 2.0V/ns	1
Bit3	SL<1:0>(27MHz)	27M Slew Rate Control	RW	00 = 1.0V/ns	01 = 1.5V/ns	0
Bit2			RW	10 = 1.5V/ns	11 = 2.0V/ns	1
Bit1	SL<1:0>(24MHz)	24M Slew Rate Control	RW	00 = 1.0V/ns	01 = 1.5V/ns	0
Bit0			RW	10 = 1.5V/ns	11 = 2.0V/ns	1

All reserved bits and reserved bytes in this SMBus table should not be overwritten at any instance. Writing to these reserved bits and bytes may cause unexpected behavior. IDT does not warrant any application issue going forward if continuing to overwrite these reserve bits and bytes.

Frequency Generator 32.768 kHz

Recommended 25MHz Quartz Crystal Specifications

SMD 25MHz AT cut crystal and maximum driver level at 100μW, for example TXC.

VBAT Battery Recommendations and Connection Considerations

Recommended to use coin cell battery CR2032, CR2025 or equivalent.

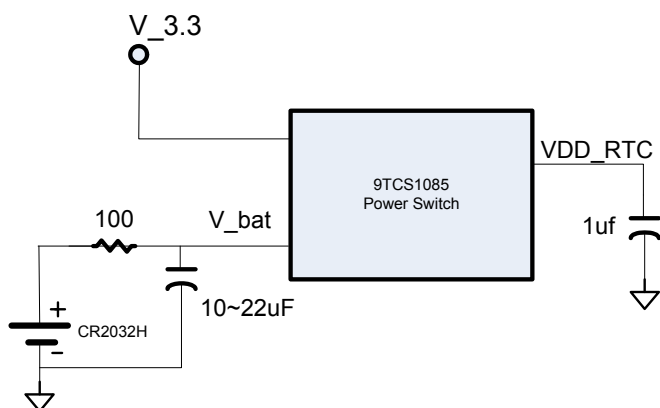
The normal coin cell battery storage capacity is 170 mAh to 220mAh and the average total RTC circuit current required 5uA, the battery life will be at least:

$$170,000 \mu\text{Ah} / 5 \mu\text{A} = 34,000 \text{ hours} = 3.88 \text{ years}$$

The RTC circuit (PCH) usually consumes 3μA power, thus the 32.768kHz clock generator circuit needs be less than 2μA. The 9TCS1085 32.768kHz generator averaged operation current is less than 2μA.

The coin cell battery with 9TCS1085 VBAT power pin connection required a 100 ohm and 22μF ceramic capacitor current limitation and noise filtering. The RC needs to be added to the battery to limit the current spikes effects.

The VDD_RTC connect to the Intel ICH chip and the 9TCS1085 provide seamless power switching between main V_3.3 and V_bat.



32.768K Clocks Operation

The 9TCS1085 32.768K clock output operates in two modes:

1. When the system is not power ON, V_3.3 is not ready and 9TCS1085 is powered with the coin cell battery. The 32kHz comes from the DCO with the digital calibration to keep the accuracy.

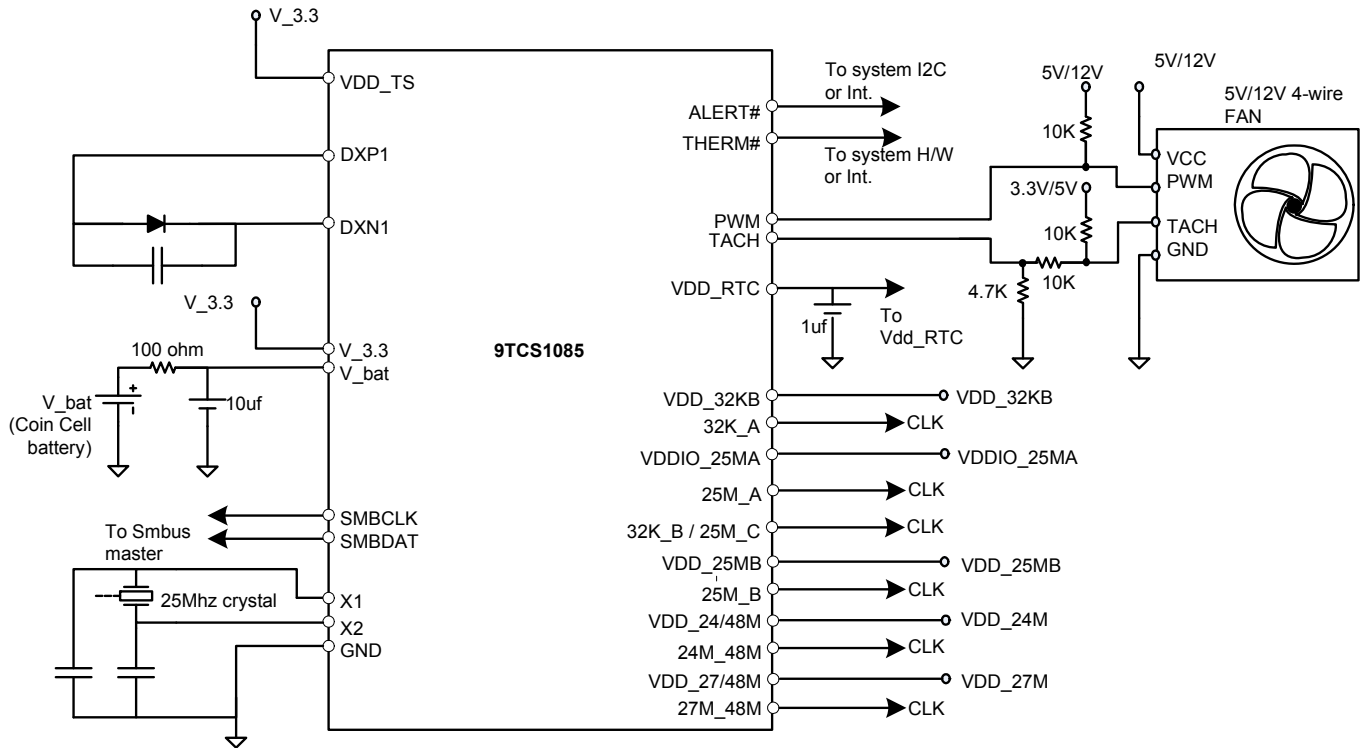
2. After V_3.3 is ready, the 9TCS1085 creates a seamless switch power from V_bat to V_3.3 and the calibration will go to full speed: this will happen every 2~3ms to keep the accuracy and the 32K source will be switched to 25MHz oscillator with Fraction-N divider to get the 0ppm.

32.768K DCO uses a 25MHz crystal oscillator for calibration reference, thus the 25MHz oscillator must be fine tuned in order to get the best 32.768kHz accuracy.

RTC Routing Guidelines

Single	face impedanc	Length	Notes
X1	50 ohm	6 inches	
X2	50 ohm	6 inches	

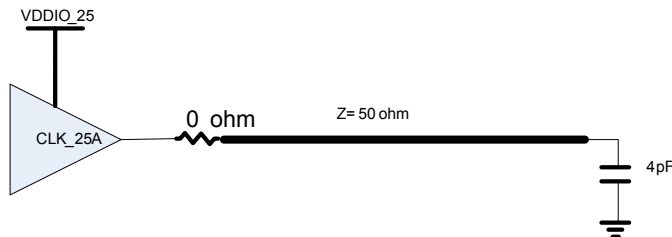
Reference Schematic For VBAT and VDD_RTC



Frequency Synthesizer – 24/48/27/25 MHz

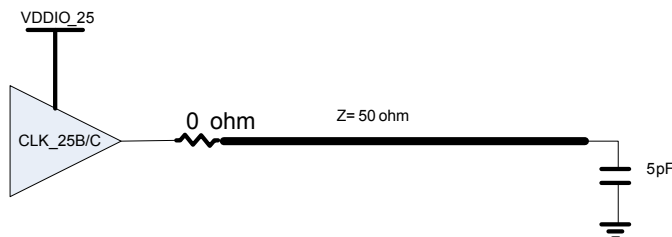
The 9TCS1085 includes a low power PLL to generate 24/27/48 MHz clock outputs. The PLL uses an external 25MHz crystal for reference clock input, thus all 25MHz clock outputs are through a fanout buffer directly for optimal performance. Fine tuning on the external crystal cap load is required to get an accurate 25MHz reference clock.

25MHz_A Connection Recommendations



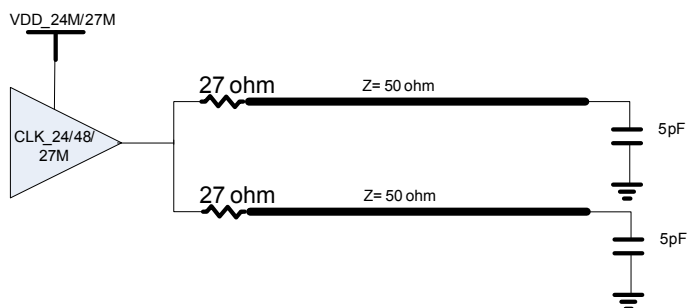
- VDDIO_25A range is from 1.05V to 3.3V.
- Optimize range is 1.05V to 1.5V.
- Pull up strength is 50 ohm@VDDIO_25A=1.5V
- Pull down strength is 50 ohm.
- No on-board 33 ohm series resistor is required.

25MHz_B/C Connection Recommendations



- VDD_25B/C range is from 1.05V to 3.3V.
- Optimized for 3.3V VDDIO.
- Pull up strength is 50 ohm@VDD_25B/C=3.3V
- Pull down strength is 50 ohm.
- No on-board 33 ohm series resistor is required.

24/27/48MHz Connection Recommendations



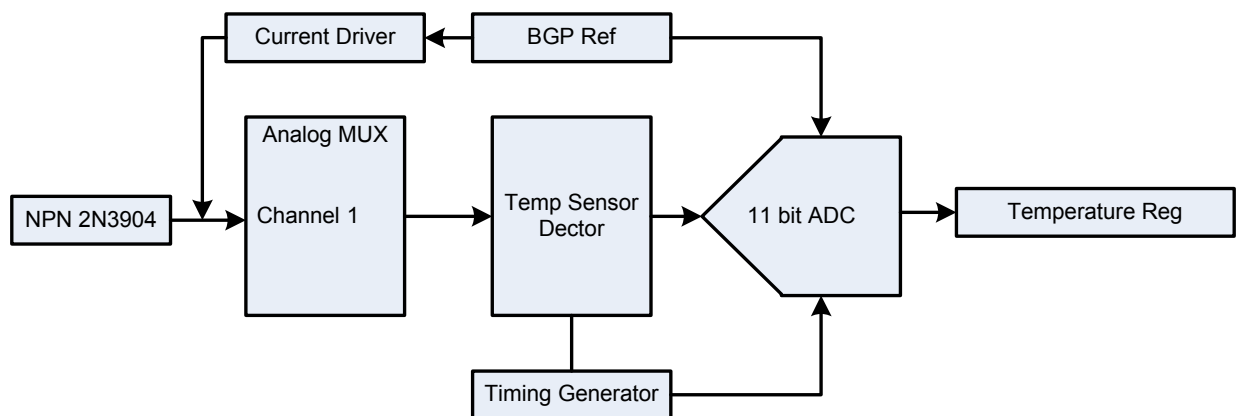
- Default 2X push-pull IO drive strength for 24/48/27MHz.
- On board 27 ohm series resistor for each path.
- Rising/falling slew rate: 1v/ns~4v/ns
- 2 bits (3 steps) I2C for the Slew Rate.

Thermal Sensor

The thermal sensor in the 9TCS1085 is a low power and highly accurate temperature sensor. It is optimized to operate between 60°C to 100°C with an external thermal diode connection input. There are diode faults and temperature alerts for the thermal sensor; Moreover, the thermal sensor has the capability to go into standby mode for power savings.

The temperature sensor's analog to digital converter (ADC) has 11 bits of resolution. One LSB is equal to 0.125°C. The accuracy of the temperature sensor is $\pm 1^\circ\text{C}$ between 60°C to 100°C.

The 9TCS1085 temperature sensor has the ability to cancel the series resistance on the remote diode inputs. Parasitic resistances to the DXP and DXN inputs seen in series with the remote diode are caused by PCB trace resistance along with the overall length, bulk parasitic resistance in the remote temperature transistor junctions, and series resistance in the CPU. This resistance appears as a temperature offset in the thermal sensor measurement and is approximately $+0.7^\circ\text{C}$ per Ohm. The 9TCS1085 has the ability to cancel up to 100Ω of series resistance.



The thermal sensor in 9TCS1085 outputs the measured temperature from a beta compensated temperature reading from an external diode. The temperature sensor architecture uses an on-chip ADC as shown to convert the analog temperature into an 11-bit digital code. Using averaging techniques along with the ADC architecture allows accurate temperature measurements. The ability to have programmable conversion rates and adjustable averaging schemes allow the user the flexibility to balance accuracy versus conversion speed per the system requirements.

The temperature measurement relies on the characteristics of a semiconductor junction operating at a fixed current level. Forcing a fixed current through the temperature diodes and detecting the changes in VBE, the forward voltage of the diode, the temperature proportionality can be determined.

External Thermal Diode Selection

The 9TCS1085 supports the following temperature diodes:

- Typical remote substrate transistor (i.e. CPU substrate PNP intrinsic diode)
- Discrete PNP transistor diode (i.e. 2N3906)
- Discrete NPN transistor diode (i.e. 2N3904)