

**W83L785TS-S**

**Winbond H/W Monitoring IC**



## W83L785TS-S Data Sheet Revision History

	Pages	Dates	Version	Version on Web	Main Contents
1	n.a.			n.a.	All the version before 0.50 are for internal use.
2					
3					
4					
5					
6					
7					
8					

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## 1. GENERAL DESCRIPTION

The W83L785TS-S is a low-cost, fully integrated temperature sensor that issues an alert signal when the monitored temperature exceeds the threshold. The W83L785TS-S provides 1 remote temperature sensing connected to CPU thermal diode. There is one dedicated **OFFSET/ FAULT\_LIMIT** pin to compensate for the inaccuracy of CPU temperature measurement by adjusting external two serial resistors and setting the temperature fault threshold. When W83L785TS-S begins monitoring, the Watch Dog machine monitors every function and stores the value in registers. If the monitored value exceeds the limit value, the interrupt status will be set to 1. The W83L785TS-S communicates over a two-wire serial interface compatible with SMBus standards.

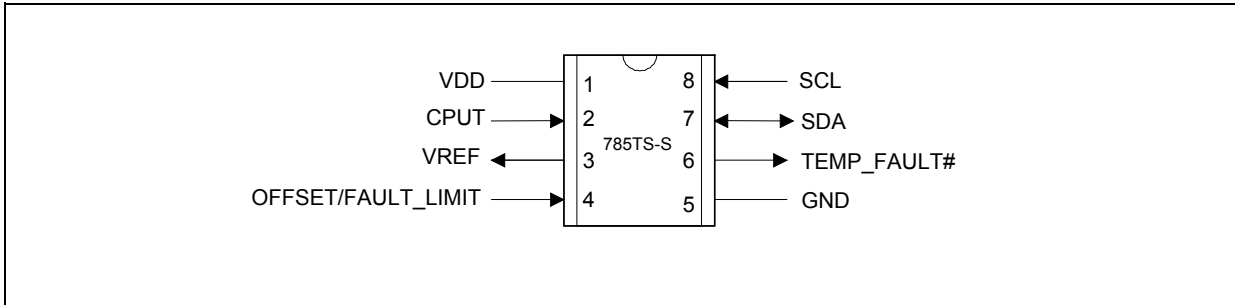
## 2. FEATURES

- Low Cost
- 1 thermal input for remote CPU thermal diode
- WATCHDOG comparison of all monitored values
- Auto Protection When Over Temperature
- I<sup>2</sup>C™ serial bus interface
- 2.7~5.5V Supply
- 8-pin SOP (150mil)

## 3. KEY SPECIFICATIONS

- Monitoring Temperature Range and Accuracy  
- 40°C to +120°C ± 3°C(Max)
- Supply Voltage 2.7V ~ 5.5V
- Operating Supply Current 2 mA typ.
- ADC Resolution 8 Bits

## 4. PIN CONFIGURATION



## 5. PIN DESCRIPTION

- I/O<sub>12t</sub> - TTL level bi-directional pin with 12 mA source-sink capability, open drain output
- I/O<sub>12s</sub> - TTL level and schmitt trigger
- OUT<sub>12</sub> - Output pin with 12 mA source-sink capability
- AOUT - Output pin(Analog)
- OD<sub>12</sub> - Open-drain output pin with 12 mA sink capability
- IN<sub>t</sub> - TTL level input pin
- IN<sub>s</sub> - TTL level input pin and schmitt trigger
- AIN - Input pin(Analog)

PIN NAME	PIN NO.	TYPE	DESCRIPTION
VDD	1	POWER	+3.3 VDD (or 3.3VSB) power supply input.
CPUT	2	AIN	CPU thermal diode input.
VREF	3	AOUT	Reference Voltage.
OFFSET/ FAULT_LIMIT	4	VIN	This pin can be used to change CPUT offset value and set up the temperature_fault limit. by adjusting two external serial resistors.
GND	5	Ground	Ground.
TEMP_FAULT#	6	OD <sub>12</sub>	Active-Low output. This pin will be a logic LOW when CPU temperature exceeds limit.
SDA	7	I/OD <sub>12</sub>	Serial Bus bi-directional Data.
SCL	8	IN <sub>ts</sub>	Serial Bus Clock.

## 6. FUNCTIONAL DESCRIPTION

### 6.1 General Description

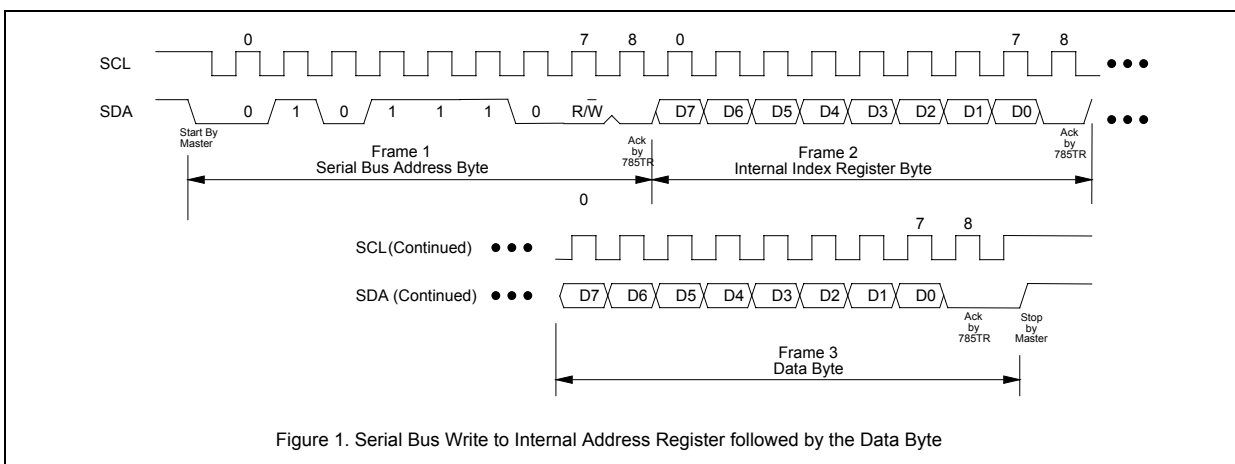
The W83L785TS-S a low-cost, fully integrated temperature sensor issues an alert signal when the monitoring temperature exceeds the threshold. The W83L785TS-S provides 1 remote temperature sensing connected to CPU thermal diode. There is 1 dedicated **OFFSET/ FAULT\_LIMIT** pin to compensate inaccuracy of CPU temperature by adjusting external two serial resistors and set up temperature fault threshold. When W83L785TS-S starts the monitor function on the chip, the Watch Dog machine monitor every function and store the value to registers. If the monitor value exceeds the limit value, the interrupt status will be set to 1.

### 6.2 Access Interface

The W83L785TS-S provides I<sup>2</sup>C Serial Bus to read/write internal registers. In the W83L785TS-S, the I2C address defined value is 0101110.

#### 6.2.1 The first serial bus access timing are shown as follow:

*(a) Serial bus write to internal address register followed by the data byte*





**(b) Serial bus read form internal address register followed by the data byte**

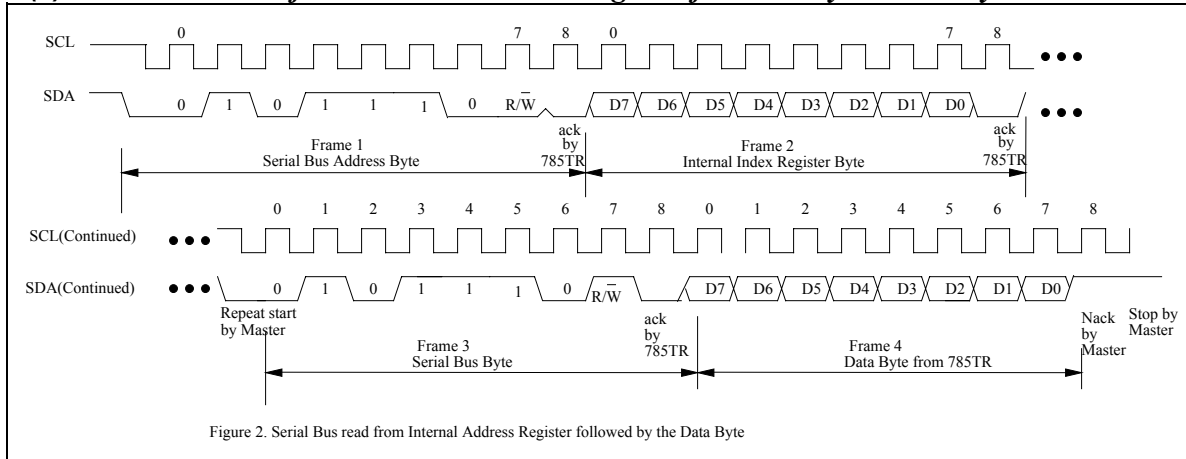


Figure 2. Serial Bus read from Internal Address Register followed by the Data Byte

### 6.3 Analog Inputs

#### 6.3.1 Temperature measurement machine

The W83L785TS-S provides a best solution to prevent CPU from being damaged. The temperature data format is 8-bit two-complement for thermal sensor. The 8-bit temperature data can be obtained by reading the register. The format of the temperature data is show in Table 1.

Table 1: The format of the temperature data

Temperature	8-Bit Digital Output	
	8-Bit Binary	8-Bit Hex
+125°C	0111,1101	7Dh
+25°C	0001,1001	19h
+2°C	0000,0010	02h
+1°C	0000,0001	01h
+0°C	0000,0000	00h
-1°C	1111,1111	FFh
-2°C	1111,1110	FEh
-25°C	1110,0111	E7h
-55°C	1100,1001	C9h



**6.3.2 Monitor temperature from thermal diode :**

The W83L785TS-S can monitor the temperature from the thermal diode and issue temperature fault signal to activate system protection when temperature exceeds the threshold. The terminators of thermal diode are connected to power supply ground (GND) and the CPUT1(pin2) in the W83L785TS-S. The resistor R=15K ohms should be connected to VREF to supply the diode bias current

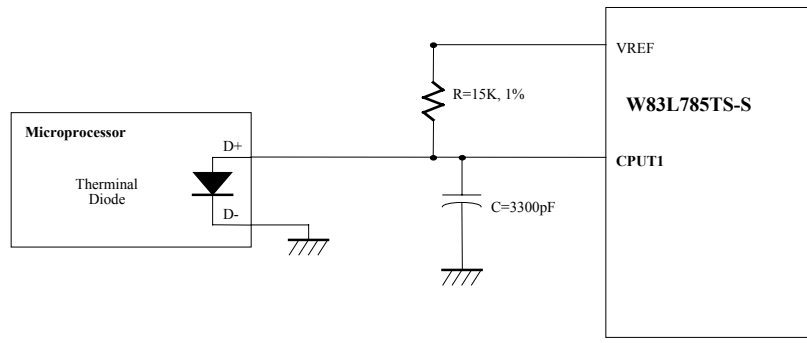


Figure 3

**6.4 OFFSET and Temperature Fault Limit (FAULT\_LIMIT) Setting**

There is one dedicated pin to change the offset value and temperature fault limited value by adjusting external serial resistors. By adjusting external resistors, there are two sets of temperature fault limit to be chosen and they are 85,90°C. As for the application circuit and corresponding resistors value, please see the figure and table as below.

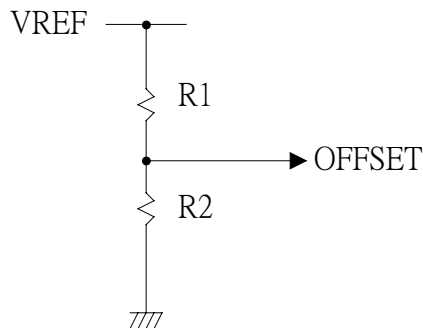


Figure 4: OFFSET Setting

Table 2: The CPU OFFSET value and Temperature Fault Limited Value

	TFAULT LIMIT	OFFSET	R1	R2
0000XXXX	85	0	X	10K
0001XXXX	85	22	91K	9.1K
0010XXXX	85	24	30K	5.6K
0011XXXX	85	26	20K	5.6K
0100XXXX	85	28	13K	5.1K
0101XXXX	85	30	91K	4.7K
0110XXXX	85	32	68K	4.7K
0111XXXX	85	34	18K	16K
1000XXXX	90	0	16K	18K
1001XXXX	90	22	5.1K	7.5K
1010XXXX	90	24	4.7K	9.1K
1011XXXX	90	26	4.7K	12K
1100XXXX	90	28	5.1K	18K
1101XXXX	90	30	3K	16K
1110XXXX	90	32	9.1K	91K
1111XXXX	90	34	10K	X

## 6.5 TEMP\_FAULT#

The W83L785TS-S provides a good protection for temperature sensing. The W83L785TS-S will issue an alert signal when the monitoring temperature exceeds the threshold. Setting pin 6 (TEMP\_FAULT#) to monitor temperature and enable TEMP\_FAULT# function. When monitoring CPUT1 (Pin 2) temperature exceeds temperature fault limit (ex: 90°C) in CR26, or CR27, pin6 TEMP\_FAULT# will be asserted. As figure 5 shows.

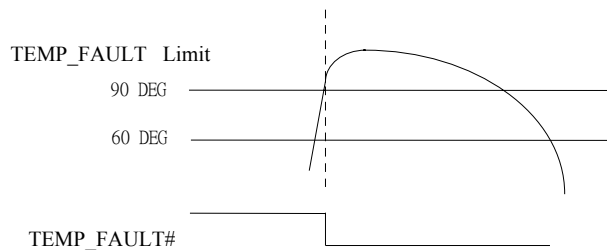


Figure 5. TEMP\_FAULT#



## 7. CONTENT OF DATA REGISTERS

### 7.1 Configuration Register — Index 40h

Power on default [7:0] = 0010,1101 b

Bit	Name	Read/Write	Description
7	INITIALIZATION	Read/Write	A one restores power on default value to all registers except the Serial Bus Address register. This bit clears itself since the power on default is zero.
6	Reserved	Read/Write	Reserved
5	Reserved	Read/Write	Reserved
4	SOFT_PWDN	Read/Write	<b>Software Power Down.</b> If setting to 1, this chip will power down, but I2C interface is still working.
3	Reserved	Read/Write	Reserved
2	En_Temp_FAULT	Read/Write	<b>Enable Temperature Fault Function.</b> When Temperature 1 is out of the Temperature1 Fault Limit value (defined in Index 85), the Pin 6 will go to low level.
1	INT_CLEAR	Read/Write	The device will stop monitoring. It will resume upon clearing of this bit.
0	START	Read/Write	A one enables startup of monitored activities, a zero puts the part in standby mode.

### 7.2 Reserved --Index 41h~4Bh

### 7.3 Winbond Vendor ID (Low Byte) - Index 4Ch (Auto Increase)

Power-on default [7:0] = 1010,0011 b (A3h)

Bit	Name	Read/Write	Description
7:0	VIDL[7:0]	Read Only	Vendor ID Low Byte. Default A3h.

### 7.4 Winbond Vendor ID (High Byte) - Index 4Dh (No Auto Increase)

Power-on default [7:0] = 0101,1100 b (5Ch)

Bit	Name	Read/Write	Description
7:0	VIDH[7:0]	Read Only	Vendor ID High Byte. Default 5Ch



## 7.5 Chip ID -- Index 4Eh

Power on default [7:0] = 0111,0000 b

Bit	Name	Read/Write	Description
7-0	CHIPID[7:0]	Read Only	<b>Winbond Chip ID number.</b> Read this register will return 70h for W83L785TS.

## 7.6 Reserved -- Index 4Fh~51h

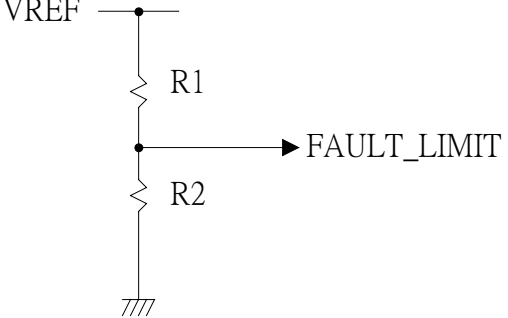
## 7.7 Thermal Sensor 1/2 Type Register -- Index 52h

Power on default [7:0] = 0000-0011 b

Bit	Name	Read/Write	Description
7-2	Reserved	Read/Write	Reserved.
1-0	T1_TYPE[1:0]	Read/Write	Temperature sensor 2 (environment) type. 0x - Thermistor (10K @ 25 °C, $\beta=3435$ ) 11 - Thermal diode.

## 7.8 Temperature 1 Fault Limit -- Index 53h

Power on trapping

Bit	Name	Read/Write	Description
7-0	TEMP1_LM	Read/Write	<p><b>Temperature sensor 1 Limit Value.</b></p>  <p>Use two resistors to divide an four section to represent different temperature fault limit value and offset limit value. The table is shown as following.</p> <p>ADCVAL[7]: are represented as Fault Limit Value</p>



## 7.9 Reserved --Index 54h~84h

## 7.10 Temperature 1 OFFSET Register-- Index 85h

Power on trapping

**ADCVAL<7> == FAULT\_LIMIT1; ADCVAL<6:4> == OFFSET1**

FAULT_LIMIT	Offset Temperature	ADC Value	R1	R2
85	0	0000_xxxx	X	10K
85	22	0001_xxxx	91K	9.1K
85	24	0010_xxxx	30K	5.6K
85	26	0011_xxxx	20K	5.6K
85	28	0100_xxxx	13K	5.1K
85	30	0101_xxxx	91K	4.7K
85	32	0110_xxxx	68K	4.7K
85	34	0111_xxxx	18K	16K
90	0	1000_xxxx	16K	18K
90	22	1001_xxxx	5.1K	7.5K
90	24	1010_xxxx	4.7K	9.1K
90	26	1011_xxxx	4.7K	12K
90	28	1100_xxxx	5.1K	18K
90	30	1101_xxxx	3K	16K
90	32	1110_xxxx	9.1K	91K
90	34	1111_xxxx	10K	X

## 8. VALUE RAM AND LIMIT VALUE

### 8.1 Value RAM — Index 20h- 3Fh

Index A7-A0	Description
20-26h	Reserved
27h	Temperature 1 reading
28-3Fh	Reserved

## 9. SPECIFICATIONS

### 9.1 Absolute Maximum Ratings

PARAMETER	RATING	UNIT
Power Supply Voltage	-0.5 to 7.0	V
Input Voltage	3.3 to 5.5	V
Operating Temperature	0 to +70	°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.

### 9.2 DC Characteristics

( $T_a = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $V_{DD} = 3.3\sim 5\text{V}$ ,  $V_{SS} = 0\text{V}$ )

PARAMETER	SYM	MIN	TYP.	MAX.	UNIT	CONDITIONS
<b>I/O<sub>12t</sub> - TTL level bi-directional pin with source-sink capability of 12 mA</b>						
Input Low Voltage	VIL			0.8	V	
Input High Voltage	VIH	2.0			V	
Output Low Voltage	VOL			0.4	V	I <sub>OL</sub> = 12 mA
Output High Voltage	VOH	2.4			V	I <sub>OH</sub> = - 12 mA
Input High Leakage	ILIH			+10	μA	VIN = VDD
Input Low Leakage	ILIL			-10	μA	VIN = 0V
<b>I/O<sub>12ts</sub> - TTL level bi-directional pin with source-sink capability of 12 mA and schmitt-trigger level input</b>						
Input Low Threshold Voltage	Vt-	0.5	0.8	1.1	V	VDD = 5 V
Input High Threshold Voltage	Vt+	1.6	2.0	2.4	V	VDD = 5 V
Hysteresis	VTH	0.5	1.2		V	VDD = 5 V
Output Low Voltage	VOL			0.4	V	I <sub>OL</sub> = 12 mA
Output High Voltage	VOH	2.4			V	I <sub>OH</sub> = - 12 mA
Input High Leakage	ILIH			+10	μA	VIN = VDD
Input Low Leakage	ILIL			-10	μA	VIN = 0V

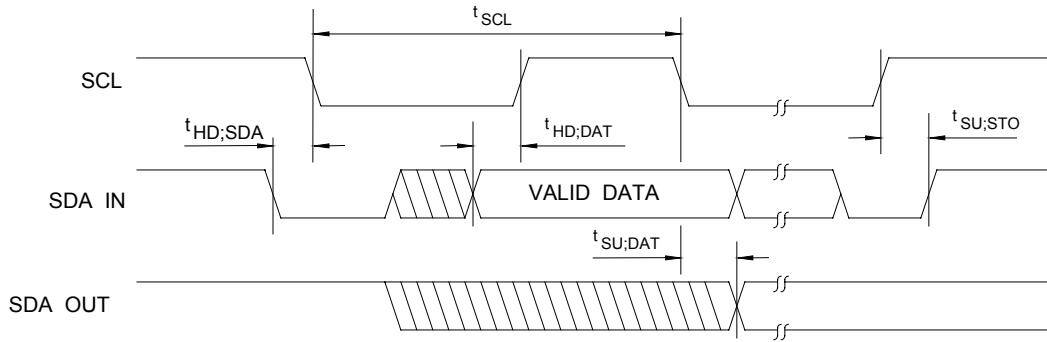


Preliminary

## 9.2 DC Characteristics, continued

<i>PARAMETER</i>	<i>SYM.</i>	<i>MIN.</i>	<i>TYP.</i>	<i>MAX.</i>	<i>UNIT</i>	<i>CONDITIONS</i>	
<b>OUT<sub>12t</sub> - TTL level output pin with source-sink capability of 12 mA</b>							
Output Low Voltage	VOL			0.4	V	I <sub>OL</sub> = 12 mA	
Output High Voltage	VOH	2.4			V	I <sub>OH</sub> = -12 mA	
<b>OD<sub>8</sub> - Open-drain output pin with sink capability of 8 mA</b>							
Output Low Voltage	VOL			0.4	V	I <sub>OL</sub> = 8 mA	
<b>OD<sub>12</sub> - Open-drain output pin with sink capability of 12 mA</b>							
Output Low Voltage	VOL			0.4	V	I <sub>OL</sub> = 12 mA	
<b>OD<sub>48</sub> - Open-drain output pin with sink capability of 48 mA</b>							
Output Low Voltage	VOL			0.4	V	I <sub>OL</sub> = 48 mA	
<b>IN<sub>t</sub> - TTL level input pin</b>							
Input Low Voltage	VIL			0.8	V		
Input High Voltage	VIH	2.0			V		
Input High Leakage	ILIH			+10	μA	VIN = VDD	
Input Low Leakage	ILIL			-10	μA	VIN = 0 V	
<b>IN<sub>ts</sub> - TTL level Schmitt-triggered input pin</b>							
Input Low Threshold Voltage	V <sub>t-</sub>	0.5	0.8	1.1	V	VCC = 5 V	
Input High Threshold Voltage	V <sub>t+</sub>	1.6	2.0	2.4	V	VCC = 5 V	
Hysteresis	V <sub>TH</sub>	0.5	1.2		V	VCC = 5 V	
Input High Leakage	ILIH			+10	μA	VIN = VCC	
Input Low Leakage	ILIL			-10	μA	VIN = 0 V	

### 9.3 AC Characteristics



Serial Bus Timing Diagram

#### Serial Bus Timing

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
SCL clock period	$t_{SCL}$	10		uS
Start condition hold time	$t_{HD;SDA}$	4.7		uS
Stop condition setup-up time	$t_{SU;STO}$	4.7		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





Preliminary

## 10. HOW TO READ THE TOP MARKING

The top marking of W83L785TS-S



Left: Winbond logo

1st line and 2nd line: Type number W83L785TS-S, S means SOP (Thickness = 150mil).

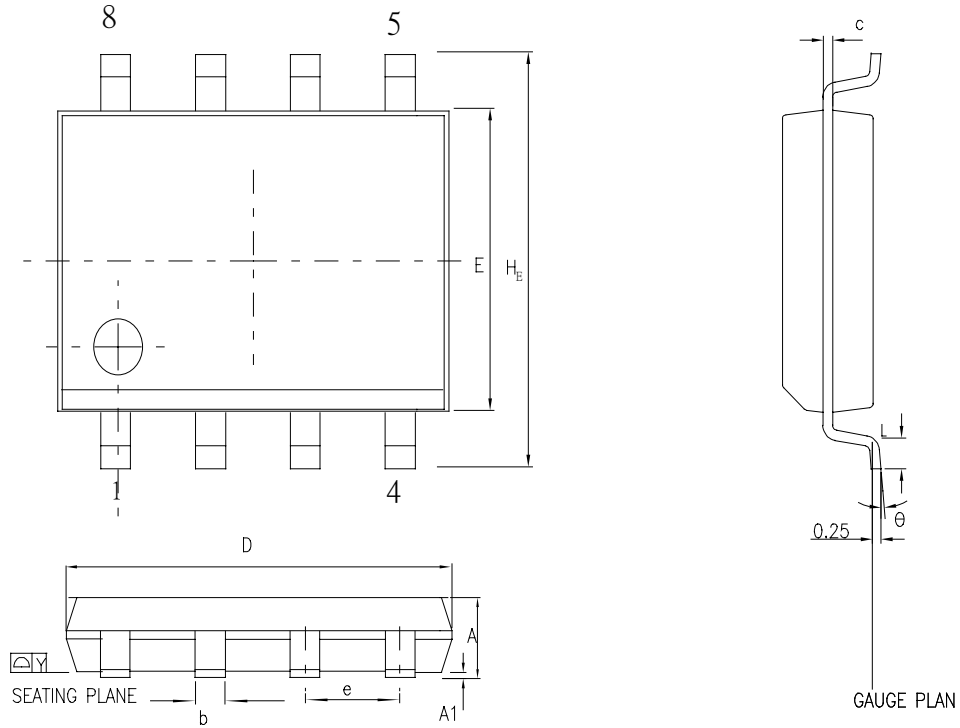
3rd line: Date code 212 O A

2 12: packages made in 2002, week 12

O: assembly house ID; A means ASE, O means OSE, G means Greatek

A: IC revision; A means version A, B means version B

### 11. PACKAGE AND DIMENSIONS



Control dimensions are in millimeters .

SYMBOL	DIMENSION IN MM		DIMENSION IN INCH	
	MIN.	MAX.	MIN.	MAX.
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
b	0.33	0.51	0.013	0.020
c	0.19	0.25	0.008	0.010
E	3.80	4.00	0.150	0.157
D	4.80	5.00	0.188	0.196
e	1.27 BSC		0.050 BSC	
H <sub>E</sub>	5.80	6.20	0.228	0.244
Y	0.10		0.004	
L	0.40	1.27	0.016	0.050
θ	0	10	0	10

8L SOP-150mil



**Preliminary**

# W83L785TS-S

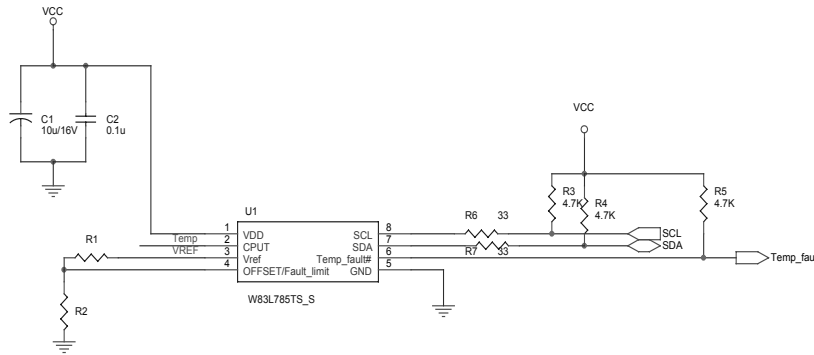


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I2C ADDRESS 0x5CH

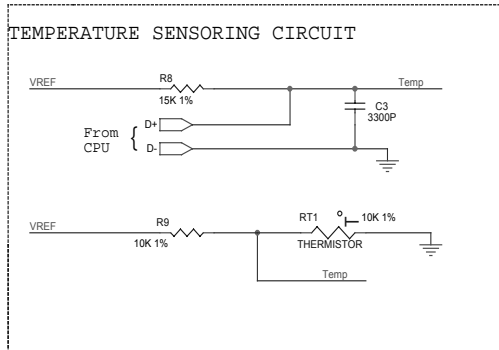
Ver 0.3 pin6 Temp\_fault# change to Temp\_fault

Ver 0.4 W83L785TR\_S change to W83L785TS\_S



OFFSET/FAULT\_LIMIT

	TEMP_FAULT	OFFSET	R1	R2
0000XXXX	85	0	X	10K
0001XXXX	85	22	91K	9.1K
0010XXXX	85	24	30K	5.6K
0011XXXX	85	26	20K	5.6K
0100XXXX	85	28	13K	5.1K
0101XXXX	85	30	91K	4.7K
0110XXXX	85	32	68K	4.7K
0111XXXX	85	34	18K	16K
1000XXXX	90	0	16K	18K
1001XXXX	90	22	5.1K	7.5K
1010XXXX	90	24	4.7K	9.1K
1011XXXX	90	26	4.7K	12K
1100XXXX	90	28	5.1K	18K
1101XXXX	90	30	3K	16K
1110XXXX	90	32	9.1K	91K
1111XXXX	90	34	10K	X



WINBOND ELECTRONICS CORP.

Title		W83L785TS_S Application Circuit
Size	Document Number	Rev
B	W83L785TS.SCH	0.4
Date:	Wednesday, February 27, 2002	Sheet 1 of 1

Publication Release Date: April 2002  
Revision 0.5