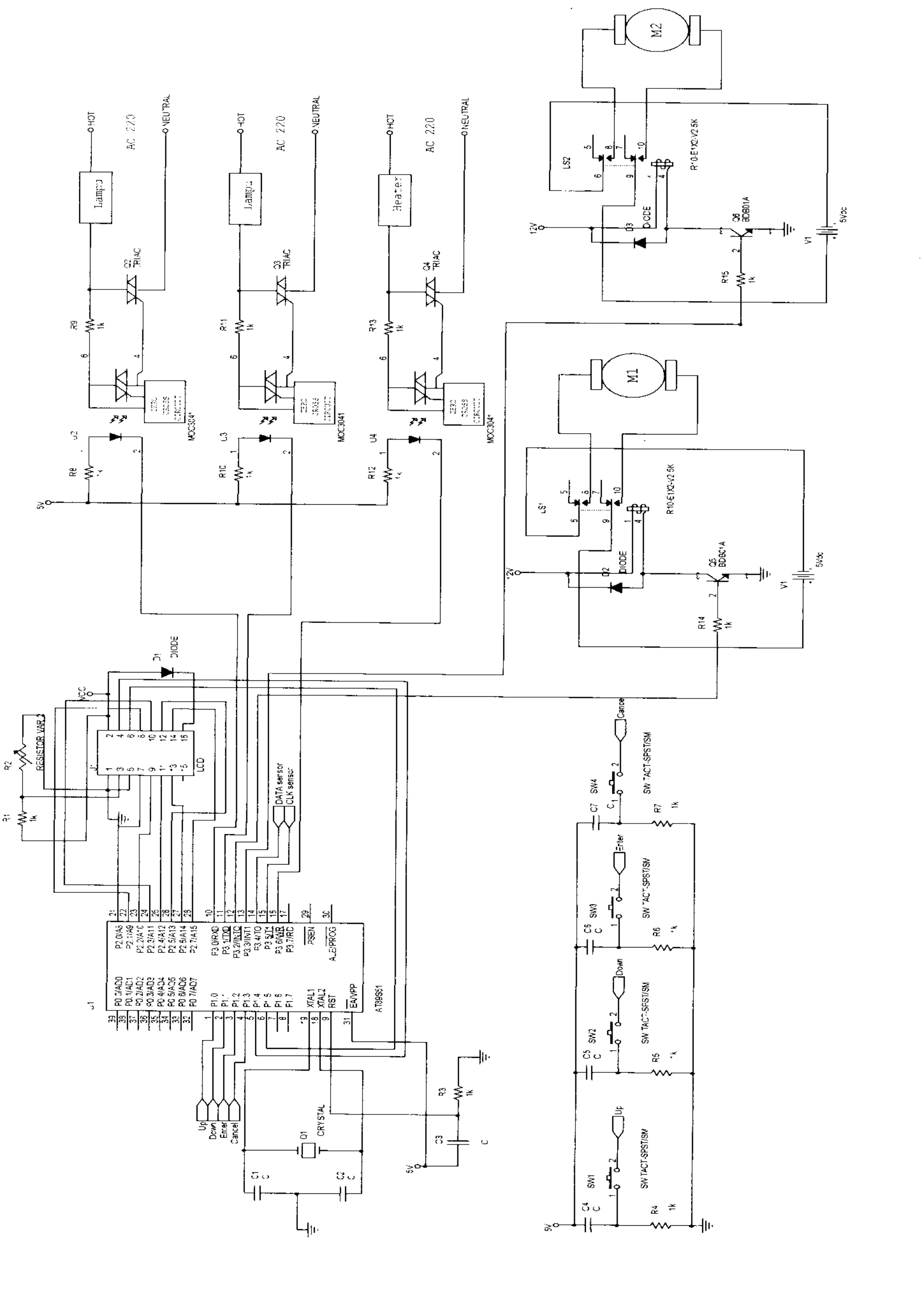
LAMPIRAN

LAMPIRAN A

RANGKAIAN KESELURUHAN



Listing Program

```
#include <at89x51.h>
#include <intrins.h>
#include <math.h>
#include <stdio.h>

typedef union
{ unsigned int i;
  float f;
} value;

enum {TEMP,HUMI};

#definetb_down          P1_0
#definetb_reset         P1_1
#definetb_up            P1_2
#definetb_enter         P1_3
#definers               P1_4
#definee                          P1_5

#define      datalcd      P2

#definelampu_ka         P0_0
#definelampu_ki         P0_1
#definekipas_in         P0_2
#definekipas_out    P0_3
#definepemanas          P0_6

#defineDATA             P3_0
```

```
#defineSCK                P3_1

//program sensor dimulai dari sini
//program sensor dimulai dari sini
//program sensor dimulai dari sini

#define      noACK                   0
#define      ACK              1

#define      STATUS_REG_W   0x06
#define      STATUS_REG_R   0x07
#define      MEASURE_TEMP   0x03
#define      MEASURE_HUMI   0x05
#define      RESET                        0x1e

char s_write_byte(unsigned char value)
{
unsigned char i,error=0;
for (i=0x80;i>0;i/=2)          //shift bit for masking
        {
        if (i & value) DATA=1;        //masking value with i , write to SENSI-
BUS
  else DATA=0;
  SCK=1;                    //clk for SENSI-BUS
  _nop_();_nop_();_nop_();       //pulswith approx. 5 us
  SCK=0;
        }
DATA=1;                    //release DATA-line
SCK=1;                    //clk #9 for ack
error=DATA;                   //check ack (DATA will be pulled down by SHT11)
SCK=0;
```

```
return error;                //error=1 in case of no acknowledge

}

char s_read_byte(unsigned char ack)
{
unsigned char i,val=0;
DATA=1;                      //release DATA-line
for (i=0x80;i>0;i/=2)          //shift bit for masking
        {
        SCK=1;                  //clk for SENSI-BUS
  if (DATA) val=(val | i);      //read bit
  SCK=0;
        }
DATA=!ack;                   //in case of "ack==1" pull down DATA-Line
SCK=1;                       //clk #9 for ack
_nop_();_nop_();_nop_();        //pulswith approx. 5 us
SCK=0;
DATA=1;                      //release DATA-line
return val;
}

void s_transstart(void)
{
DATA=1;     SCK=0;             //Initial state
_nop_();    SCK=1;
_nop_();    DATA=0;
_nop_();    SCK=0;
_nop_();_nop_();_nop_();
SCK=1;      _nop_();
DATA=1;     _nop_();
```

```
SCK=0;
}

void s_connectionreset (void)
{
unsigned char i;
DATA=1; SCK=0;                  //Initial state
for(i=0;i<9;i++)              //9 SCK cycles
        {
        SCK=1;
  SCK=0;
        }
s_transstart();               //transmission start
}

char s_softreset(void)
{
unsigned char error=0;
s_connectionreset();            //reset communication
error+=s_write_byte(RESET);      //send RESET-command to sensor
return error;                   //error=1 in case of no response form the sensor
}

char s_read_statusreg(unsigned char *p_value, unsigned char *p_checksum)
{
unsigned char error=0;
s_transstart();                 //transmission start
error=s_write_byte(STATUS_REG_R); //send command to sensor
*p_value=s_read_byte(ACK);       //read status register (8-bit)
*p_checksum=s_read_byte(noACK);  //read checksum (8-bit)
```

```
return error;                //error=1 in case of no response form the sensor

}

char s_write_statusreg(unsigned char *p_value)
{
unsigned char error=0;
s_transstart();              //transmission start
error+=s_write_byte(STATUS_REG_W);//send command to sensor
error+=s_write_byte(*p_value);   //send value of status register
return error;                //error>=1 in case of no response form the sensor

}

char s_measure(unsigned char *p_value, unsigned char *p_checksum,unsigned
char mode)
{
unsigned error=0;
unsigned int i;
s_transstart();              //transmission start
switch(mode)
        {                //send command to sensor
        case TEMP     : error+=s_write_byte(MEASURE_TEMP); break;
  case HUMI  : error+=s_write_byte(MEASURE_HUMI); break;
  default     : break;
        }
for (i=0;i<65535;i++) if(DATA==0) break; //wait until sensor has finished the
measurement
if (DATA) error+=1;              // or timeout (~2 sec.) is reached
*(p_value)  =s_read_byte(ACK);    //read the first byte (MSB)
*(p_value+1)=s_read_byte(ACK);    //read the second byte (LSB)
```

```
*p_checksum =s_read_byte(noACK);  //read checksum
return error;
}

void calc_sth11(float *p_humidity ,float *p_temperature)
{
const float C1=-4.0;            // for 12 Bit
const float C2=+0.0405;         // for 12 Bit
const float C3=-0.0000028;      // for 12 Bit

float rh=*p_humidity;           // rh:     Humidity [Ticks] 12 Bit
float t=*p_temperature;         // t:      Temperature [Ticks] 14 Bit
float rh_lin;                   // rh_lin:  Humidity linear
float t_C;                      // t_C   :  Temperature [°C]

t_C=t*0.01 - 40;                //calc. temperature from ticks to [°C]
rh_lin=C3*rh*rh + C2*rh + C1;   //calc. humidity from ticks to [%RH]

*p_temperature=t_C;             //return temperature [°C]
*p_humidity=rh_lin;             //return humidity linear [%RH]
}

//program sensor sampai disini
//program sensor sampai disini
//program sensor sampai disini

void tunda()
{
int a;
for (a=0;a<=500;a++);
}
```

```
void tunda2(int loop2)
{
int loop;
loop=0;
while (loop<=loop2)
        {
        loop++;
        TH1=(-50000/256)-1;
        TL1=(-50000%256);
        TF1=0;
        TR1=1;
        while (!TF1);
        }
}

void kirim_p(int dat)
{
rs=0;
datalcd=dat;
e=1;
e=0;
tunda();
}

void initlcd()
{
tunda();
kirim_p(56);kirim_p(56);
kirim_p(56);kirim_p(56);
kirim_p(6);kirim_p(12);
```

```
kirim_p(1);
}

void kirim_k(int dat2)
{
rs=1;
datalcd=dat2;
e=1;
e=0;
tunda();
}

void clear()
{
rs=0;
kirim_p(1);
}

void cursorhome()
{
rs=0;
kirim_p(2);
}

void tampil_suhu_input()
{
kirim_k('M');  kirim_k('A');  kirim_k('S');
kirim_k('U');  kirim_k('K');  kirim_k('K');
kirim_k('A');  kirim_k('N');  kirim_k(' ');
kirim_k('S');  kirim_k('U');  kirim_k('H');
kirim_k('U');  kirim_k(' ');  kirim_k(':');
```

```
}

void tampilan_suhu_awal()
{
kirim_p(192); kirim_k('2');   kirim_k('6');
}

void tampil_suhu()
{
kirim_p(2);             kirim_k('S');   kirim_k('U');   kirim_k('H');
kirim_k('U');   kirim_k(':');    kirim_k(' ');
}

void tampil_rh()
{
kirim_k('K');   kirim_k('E');   kirim_k('L');
kirim_k('E');   kirim_k('M');   kirim_k('B');
kirim_k('A');   kirim_k('B');   kirim_k('A');
kirim_k('N');   kirim_k(':'); kirim_k(' ');
}

void delay_2 ()
        //prosedure delay_2
{
int x,y=0;
ulang8kali:
y++;
for (x=0; x<30000; x++);
if (y<15) goto ulang8kali;
}
```

```
int cek_keypad(int *cekker)
{
int	suhu_satuan,suhu_puluhan,boleh;
lbh_dr_38:

kirim_p(2);
tampil_suhu_input();
kirim_p(192);
tampilan_suhu_awal();

//memberi nilai awal register
suhu_satuan=6;
suhu_puluhan=2;
boleh=0;
do
	{
	// tombol up ditekan
	//
	if (tb_up==0)
		{
		delay_2();
		kirim_p(2);
		tampil_suhu_input();
		kirim_p(192);

		suhu_satuan++;
		// cek apakah satuan sdh lebih dari 10
		if (suhu_satuan>=10)
			{
			suhu_puluhan++;
			suhu_satuan=0;
```

```
            }
        //tampilkan satuan dan puluhan ke LCD
        kirim_k(suhu_puluhan+48);
        kirim_k(suhu_satuan+48);
        }

// tombol down ditekan
//
if (tb_down==0)
        {
        delay_2();
        kirim_p(2);
        tampil_suhu_input();
        kirim_p(192);

        suhu_satuan--;
        // cek apakah satuan sdh kurang lebih dari 0
        if (suhu_satuan<0)
            {
            suhu_puluhan--;
            suhu_satuan=9;
            }
        //tampilkan satuan dan puluhan ke LCD
        kirim_k(suhu_puluhan+48);
        kirim_k(suhu_satuan+48);
        }

// tombol enter ditekan
if (tb_enter==0)
        {
        *cekker=(suhu_puluhan*10)+suhu_satuan;
```

```
                boleh=1;
                delay_2();
                //jika suhu lebih 39 dan kurang dari 25 lompat ke tampilan awal
                if (*cekker >=39) goto lbh_dr_38;
                else if (*cekker <=25) goto lbh_dr_38;
                //jika kondisi terpenuhi program jalan
                else
                        {
                        clear();                kirim_p(2);
                        kirim_k('S');   kirim_k('U');   kirim_k('H');
                        kirim_k('U');   kirim_k(' ');   kirim_k(':');
                        kirim_k(' ');   kirim_k(suhu_puluhan+48);
                        kirim_k(suhu_satuan+48);
                        }
                }
        }
while (boleh==0);
}

void cek_kondisi(int *suhu_inputan, float *suhu_data, float *rh_data)
{
int satuan_suhu,puluhan_suhu,satuan_rh,puluhan_rh,koma_suhu,koma_rh;
if (*suhu_data < 32)
                {
                *suhu_data= *suhu_data - 2 ;
                }
if (*suhu_inputan > *suhu_data)
        {
        lampu_ka=0;
        lampu_ki=0;
        kipas_in=1;
```

```
        kipas_out=0;
        if (*rh_data<=50)      pemanas=0;
        else pemanas=1;
        }
else if (*suhu_inputan == *suhu_data)
        {
        lampu_ka=1;
        lampu_ki=1;
        kipas_in=1;
        kipas_out=0;
        pemanas=1;
        }
else if (*suhu_inputan < *suhu_data)
        {
        lampu_ka=1;
        lampu_ki=1;
        kipas_in=1;
        kipas_out=1;
        pemanas=1;
        }

clear();
tampil_suhu();
if (*suhu_data>=10)
        {
        puluhan_suhu=*suhu_data/10;
        satuan_suhu=*suhu_data-(puluhan_suhu*10);
        koma_suhu=(*suhu_data-((puluhan_suhu*10)+satuan_suhu))*10;
        kirim_k(puluhan_suhu+48);  kirim_k(satuan_suhu+48);
        kirim_k(',');                          kirim_k(koma_suhu+48);
        }
```

```
else
        {
        satuan_suhu=*suhu_data;
        koma_suhu=(*suhu_data-satuan_suhu)*10;
        kirim_k(satuan_suhu+48); kirim_k(',');      kirim_k(koma_suhu+48);
        }
kirim_k(' ');    kirim_k('0'); kirim_k('C');
kirim_p(192);

tampil_rh();
if ( (*rh_data>=10) || (*rh_data<=99))
        {
        puluhan_rh=*rh_data/10;
        satuan_rh=*rh_data-(puluhan_rh*10);
        kirim_k(puluhan_rh+48);     kirim_k(satuan_rh+48);
        }
else
        {
        satuan_rh=*rh_data;
        kirim_k(satuan_rh+48);
        }

kirim_k('%');
}

void main()
{
value humi_val,temp_val;
unsigned char error,checksum;
unsigned int i;
int suhu_input,red,data_suhu,data_rh;
```

```
start:
P0=0x0FF;
P1=0x0FF;
kipas_in=0;
kipas_out=0;
data_rh=0;
data_suhu=0;
initlcd();
clear();
tampil_suhu_input();
tampilan_suhu_awal();
cek_keypad(&suhu_input);

s_connectionreset();

while (1)
        {
        error=0;
        error+=s_measure((unsigned char*) &humi_val.i,&checksum,HUMI);

        error+=s_measure((unsigned char*) &temp_val.i,&checksum,TEMP);

        if(error!=0) s_connectionreset();

        else
                {
                humi_val.f=(float)humi_val.i;

                temp_val.f=(float)temp_val.i;
                calc_sth11(&humi_val.f,&temp_val.f);
```

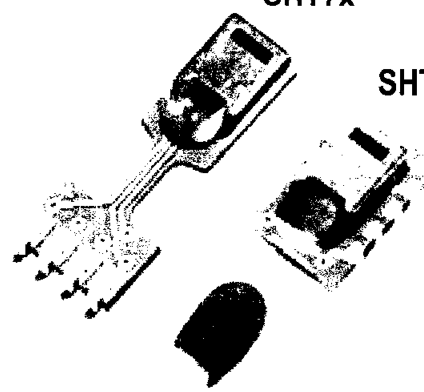
```
            }
        clear();
        cek_kondisi(&suhu_input,&temp_val.f,&humi_val.f);
        for (i=0;i<40000;i++)
        {
        if (tb_reset==0) goto start;
        }
        }
}
```

SHT1x / SHT7x
Humidity & Temperature Sensor

Evaluation Kit Available

SHT7x

SHT1x



- Relative humidity and temperature sensors
- Dew point
- Fully calibrated, digital output
- Excellent long-term stability
- No external components required
- Ultra low power consumption
- Surface mountable or 4-pin fully interchangeable
- Small size
- Automatic power down

SHT1x / SHT7x Product Summary

The SHTxx is a single chip relative humidity and temperature multi sensor module comprising a calibrated digital output. Application of industrial CMOS processes with patented micro-machining (CMOSens® technology) ensures highest reliability and excellent long term stability. The device includes a capacitive polymer sensing element for relative humidity and a bandgap temperature sensor. Both are seamlessly coupled to a 14bit analog to digital converter and a serial interface circuit on the same chip. This results in superior signal quality, a fast response time and insensitivity to external disturbances (EMC) at a very competitive price. Each SHTxx is individually calibrated in a precision humidity chamber. The calibration coefficients are programmed into the OTP memory. These coefficients are used internally during measurements to calibrate the signals from the sensors.

The 2-wire serial interface and internal voltage regulation allows easy and fast system integration. Its tiny size and low power consumption makes it the ultimate choice for even the most demanding applications.

The device is supplied in either a surface-mountable LCC (Leadless Chip Carrier) or as a pluggable 4-pin single-in-line type package. Customer specific packaging options may be available on request.

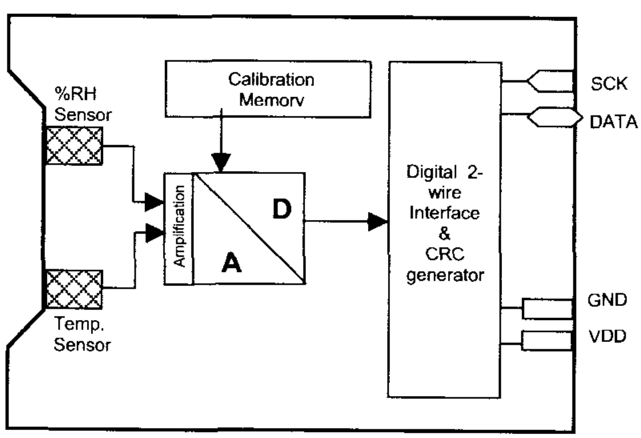
Applications

- HVAC
- Automotive
- Consumer Goods
- Weather Stations
- Humidifiers
- Dehumidifiers
- Test & Measurement
- Data Logging
- Automation
- White Goods
- Medical

Ordering Information

Part Number	Humidity accuracy [%RH]	Temperature accuracy [K] @ 25 °C	Package
SHT10	±4.5	±0.5	SMD (LCC)
SHT11	±3.0	±0.4	SMD (LCC)
SHT15	±2.0	±0.3	SMD (LCC)
SHT71	±3.0	±0.4	4-pin single-in-line
SHT75	±1.8	±0.3	4-pin single-in-line

Block Diagram



Sensor Performance Specifications

arameter	Conditions	Min.	Typ.	Max.	Units
umidity					
esolution (2)		0.5	0.03	0.03	%RH
		8	12	12	bit
epeatability			±0.1		%RH
ccuracy (1) ncertainty	linearized	see figure 1			
terchangeability		Fully interchangeable			
onlinearity	raw data		±3		%RH
	linearized		<<1		%RH
ange		0		100	%RH
esponse time	1/e (63%) slowly moving air		4		s
ysteresis			±1		%RH
ng term stability	typical		< 0.5		%RH/yr
emperature					
esolution (2)		0.04	0.01	0.01	°C
		0.07	0.02	0.02	°F
		12	14	14	bit
epeatability			±0.1		°C
			±0.2		°F
ccuracy		see figure 1			
ange		-40		123.8	°C
		-40		254.9	°F
esponse Time	1/e (63%)	5		30	s

ble 1 Sensor Performance Specifications

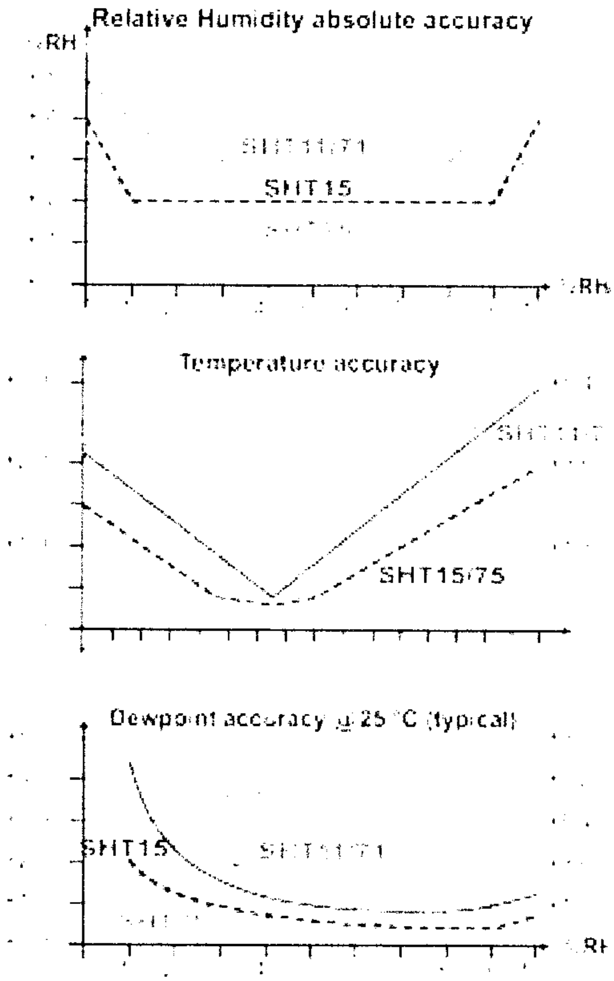
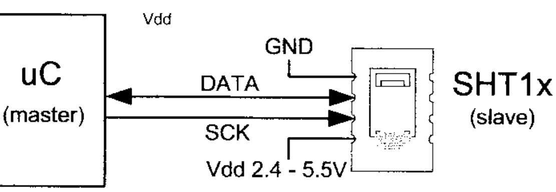


Figure 1 Rel. Humidity, Temperature and Dewpoint accuracies

Interface Specifications



gure 2 Typical application circuit

1 Power Pins

e SHTxx requires a voltage supply between 2.4 and 5.5 V. ter powerup the device needs 11ms to reach its "sleep" ate. No commands should be sent before that time.

wer supply pins (VDD, GND) may be decoupled with a 0 nF capacitor.

2 Serial Interface (Bidirectional 2-wire)

e serial interface of the SHTxx is optimized for sensor adout and power consumption and is not compatible with ; interfaces, see FAQ for details.

2.2.1 Serial clock input (SCK)

The SCK is used to synchronize the communication between a microcontroller and the SHTxx. Since the interface consists of fully static logic there is no minimum SCK frequency.

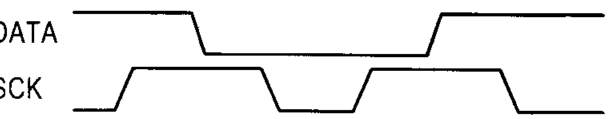
2.2.2 Serial data (DATA)

The DATA tristate pin is used to transfer data in and out of the device. DATA **changes after the falling edge** and is **valid on the rising edge** of the serial clock SCK. During transmission the DATA line must remain stable while SCK is high. To avoid signal contention the microcontroller should only drive DATA low. An external pull-up resistor (e.g. 10 kΩ) is required to pull the signal high. (See Figure 2) Pull-up resistors are often included in I/O circuits of microcontrollers. See Table 5 for detailed IO characteristics.

Each SHTxx is tested to be fully within RH accuracy specifications at 25 °C (77 °F) and 48 °C (118.4 °F)
The default measurement resolution of 14bit (temperature) and 12bit (humidity) can be reduced to 12 and 8 bit through the status register.

.2.3 *Sending a command*

o initiate a transmission, a "Transmission Start" sequence as to be issued. It consists of a lowering of the DATA line hile SCK is high, followed by a low pulse on SCK and ising DATA again while SCK is still high.



igure 3 "Transmission Start" sequence

he subsequent command consists of three address bits nly "000" is currently supported) and five command bits. he SHTxx indicates the proper reception of a command by ılling the DATA pin low (ACK bit) after the falling edge of e 8th SCK clock. The DATA line is released (and goes gh) after the falling edge of the 9th SCK clock.

Command	**Code**
Reserved	0000x
Measure Temperature	**00011**
Measure Humidity	**00101**
Read Status Register	00111
Vrite Status Register	00110
Reserved	0101x-1110x
Soft reset, resets the interface, clears the status register to default values vait minimum 11 ms before next command	**11110**

ıble 2 SHTxx list of commands

2.4 *Measurement sequence (RH and T)*

fter issuing a measurement command ('00000101' for RH, 0000011' for Temperature) the controller has to wait for the easurement to complete. This takes approximately l/55/210 ms for a 8/12/14bit measurement. The exact time aries by up to ±15% with the speed of the internal oscillator. o *signal the completion of a measurement, the SHTxx pulls* own the data line and enters idle mode. The controller **must** ait for this "data ready" signal before restarting SCK to adout the data. Measurement data is stored until readout, therefore the controller can continue with other tasks and readout as convenient.

Two bytes of measurement data and one byte of CRC checksum *will then be transmitted. The uC must* acknowledge each byte by pulling the DATA line low. All values are MSB first, right justified. (e.g. the 5th SCK is MSB for a 12bit value, for a 8bit result the first byte is not used).
Communication terminates after the acknowledge bit of the CRC data. If CRC-8 checksum is not used the controller may terminate the communication after the measurement data LSB by keeping ack high.
The device automatically returns to sleep mode after the measurement and communication have ended.

Warning: To keep self heating below 0.1 °C the SHTxx should not be active for more than 10% of the time (e.g. max. 2 measurements / second for 12bit accuracy).

2.2.5 *Connection reset sequence*

If communication with the device is lost the following signal sequence will reset its serial interface:
While leaving DATA high, toggle SCK 9 or more times. This must be followed by a "Transmission Start" sequence preceding the next command. This sequence resets the interface only. The status register preserves its content.

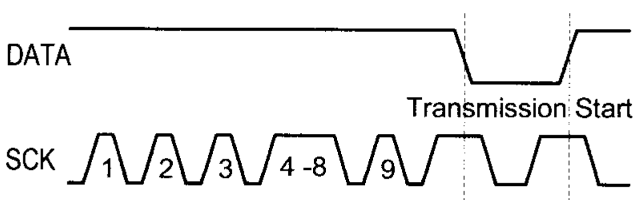
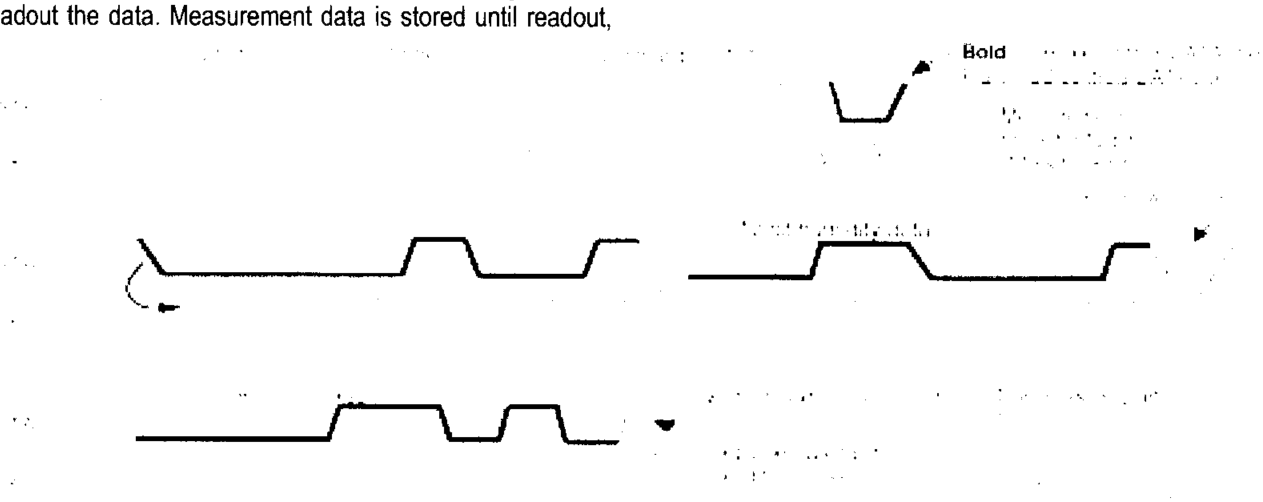


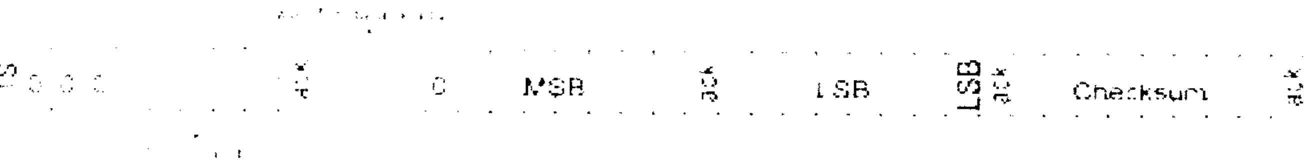
Figure 4 Connection reset sequence

2.2.6 *CRC-8 Checksum calculation*

The whole digital transmission is secured by a 8 bit checksum. It ensures that any wrong data can be detected and eliminated.
Please consult application note "CRC-8 Checksum Calculation" for information on how to calculate the CRC.



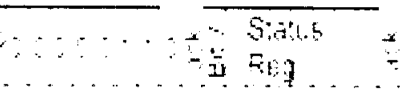
gure 5 Example RH measurement sequence for value "0000'1001 ' 0011'0001"= 2353 = 75.79 %RH (without temperature compensation)



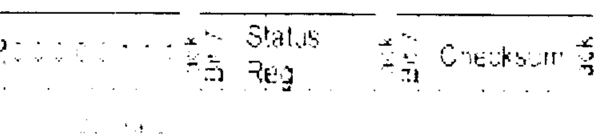
igure 6 Overview of Measurement Sequence (TS = Transmission Start)

.3 Status Register

ome of the advanced functions of the SHTxx are available rough the status register. The following section gives a ief overview of these features. A more detailed description available in the application note “Status Register”



gure 7 Status Register Write



gure 8 Status Register Read

t	Type	Description	Default	
		reserved	0	
	R	End of Battery (low voltage detection) '0' for Vdd > 2.47 '1' for Vdd < 2.47	X	No default value, bit is only updated after a measurement
		reserved	0	
		reserved	0	
		For Testing only, do not use	0	
	R/W	Heater	0	off
	R/W	no reload from OTP	0	reload
	R/W	'1' = 8bit RH / 12bit Temperature resolution '0' = 12bit RH / 14bit Temperature resolution	0	12bit RH 14bit Temp.

ble 3 Status Register Bits

3.1 Measurement resolution

e default measurement resolution of 14bit (temperature) d 12bit (humidity) can be reduced to 12 and 8bit. This is pecially useful in high speed or extreme low power plications.

3.2 End of Battery

e “End of Battery” function detects VDD voltages below 47 V. Accuracy is ±0.05 V

3.3 Heater

on chip heating element can be switched on. It will crease the temperature of the sensor by 5-15 °C (9-27 °F). wer consumption will increase by ~8 mA @ 5 V. plications:

comparing temperature and humidity values before and after switching on the heater, proper functionality of both sensors can be verified.

- In high (>95 %RH) RH environments heating the sensor element will prevent condensation, improve response time and accuracy

Warning: While heated the SHTxx will show higher temperatures and a lower relative humidity than with no heating.

2.4 Electrical Characteristics(1)

VDD=5V, Temperature = 25 °C unless otherwise noted

Parameter	Conditions	Min.	Typ.	Max.	Units
Power supply DC		2.4	5	5.5	V
Supply current	measuring		550		µA
	average	2(2)	28(3)		µA
	sleep		0.3	1	µA
Low level output voltage		0		20%	Vdd
High level output voltage		75%		100%	Vdd
Low level input voltage	Negative going	0		20%	Vdd
High level input voltage	Positive going	80%		100%	Vdd
Input current on pads				1	µA
Output peak current	on			4	mA
	Tristated (off)		10		µA

Table 4 SHTxx DC Characteristics

	Parameter	Conditions	Min	Typ.	Max.	Unit
F_{SCK}	SCK frequency	VDD > 4.5 V			10	MHz
		VDD < 4.5 V			1	MHz
T_{RFO}	DATA fall time	Output load 5 pF	3.5	10	20	ns
		Output load 100 pF	30	40	200	ns
T_{CLx}	SCK hi/low time		100			ns
T_V	DATA valid time			250		ns
T_{SU}	DATA set up time		100			ns
T_{HO}	DATA hold time		0	10		ns
T_R/T_F	SCK rise/fall time			200		ns

Table 5 SHTxx I/O Signals Characteristics

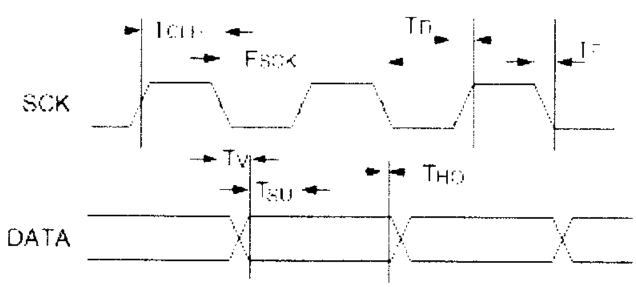


Figure 9 Timing Diagram

Parameters are periodically sampled and not 100% tested
With one measurement of 8 bit accuracy without OTP reload per second
With one measurement of 12bit accuracy per second

Converting Output to Physical Values

.1 Relative Humidity

ɔ compensate for the non-linearity of the humidity sensor nd to obtain the full accuracy it is recommended to convert e readout with the following formula[1]:

$$H_{linear} = c_1 + c_2 \bullet SO_{RH} + c_3 \bullet SO_{RH}^2$$

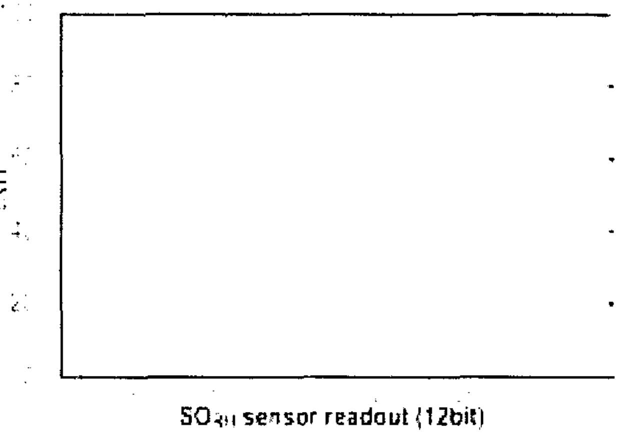
SO_{RH}	c_1	c_2	c_3
12 bit	-4	0.0405	$-2.8 * 10^{-6}$
8 bit	-4	0.648	$-7.2 * 10^{-4}$

able 6 Humidity conversion coefficients

or simplified, less computation intense conversion formulas ee application note "RH and Temperature Non-Linearity ompensation".

alues higher than 99% RH indicate fully saturated air and ust be processed and displayed as 100% RH.

ne humidity sensor has no significant voltage dependency.



gure 10 Conversion from SO_{RH} to relative humidity

.1.1 *Humidity Sensor RH/Temperature compensation*

or temperatures significantly different from 25 °C (~77 °F) e temperature coefficient of the RH sensor should be ɔnsidered:

$$H_{true} = (T_{°C} - 25) \bullet (t_1 + t_2 \bullet SO_{RH}) + RH_{linear}$$

SO_{RH}	t_1	t_2
12 bit	0.01	0.00008
8 bit	0.01	0.00128

able 7 Temperature compensation coefficients

his equals ~0.12 %RH / °C @ 50 %RH

3.2 Temperature

The bandgap PTAT (Proportional To Absolute Temperature) temperature sensor is very linear by design. Use the following formula to convert from digital readout to temperature:

$$Temperature = d_1 + d_2 \bullet SO_T$$

VDD	d_1 [°C]	d_1 [°F]
5V	-40.00	-40.00
4V	-39.75	-39.50
3.5V	-39.66	-39.35
3V	-39.60	-39.28
2.5V	-39.55	-39.23

	d_2 [°C]	d_2 [°F]
14bit	0.01	0.018
12bit	0.04	0.072

Table 8 Temperature conversion coefficients

For improved accuracies in extreme temperatures with more computation intense conversion formulas see application note "RH and Temperature Non-Linearity Compensation".

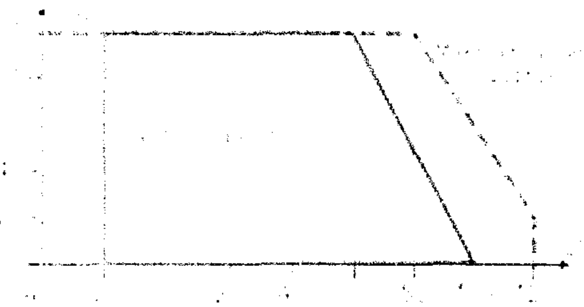
3.3 Dewpoint

Since humidity and temperature are both measured on the same monolithic chip, the SHTxx allows superb dewpoint measurements. See application note "Dewpoint calculation" for more.

[1] Vhere SO_{RH} is the sensor output for relative humidity

Applications Information

.1 Operating and Storage Conditions



gure 11 Recommended operating conditions

onditions outside the recommended range may temporarily fset the RH signal up to ±3 %RH. After return to normal onditions it will slowly return towards calibration state by self. See 4.3 "Reconditioning Procedure" to accelerate this ocess. Prolonged exposure to extreme conditions may ccelerate ageing.

.2 Exposure to Chemicals

hemical vapors may interfere with the polymer layers used r capacitive humidity sensors. The diffusion of chemicals to the polymer may cause a shift in both offset and ensitivity. In a clean environment the contaminants will owly outgas. The reconditioning procedure described elow will accelerate this process. High levels of pollutants ay cause permanent damage to the sensing polymer.

.3 Reconditioning Procedure

ne following reconditioning procedure will bring the sensor ack to calibration state after exposure to extreme conditions chemical vapors.

)-90 °C (176-194°F) at < 5 %RH for 24h (baking) followed by
)-30 °C (70-90°F) at > 74 %RH for 48h (re-hydration)

.4 Temperature Effects

ne relative humidity of a gas strongly depends on its mperature. It is therefore essential to keep humidity ensors at the same temperature as the air of which the lative humidity is to be measured.

the SHTxx shares a PCB with electronic components that ve off heat it should be mounted far away and below the eat source and the housing must remain well ventilated.

o reduce heat conduction copper layers between the HT1x and the rest of the PCB should be minimized and a it may be milled in between (see figure 13).

.5 Membranes

membrane may be used to prevent dirt from entering the ousing and to protect the sensor. It will also reduce peak oncentrations of chemical vapors. For optimal response mes air volume behind the membrane must be kept to a inimum. For the SHT1x package Sensirion recommends e SF1 filter cap for optimal IP67 protection.

4.6 Light

The SHTxx is not light sensitive. Prolonged direct exposure to sunshine or strong UV radiation may age the housing.

4.7 Materials Used for Sealing / Mounting

Many materials absorb humidity and will act as a buffer, increasing response times and hysteresis. Materials in the vicinity of the sensor must therefore be carefully chosen. Recommended materials are: All Metals, LCP, POM (Delrin), PTFE (Teflon), PE, PEEK, PP, PB, PPS, PSU, PVDF, PVF

For sealing and gluing (use sparingly): High filled epoxy for electronic packaging (e.g. glob top, underfill), and Silicone. Outgassing of these materials may also contaminate the SHTxx (cf. 4.2). Store well ventilated after manufacturing or bake at 50°C for 24h to outgas contaminants before packing.

4.8 Wiring Considerations and Signal Integrity

Carrying the SCK and DATA signal parallel and in close proximity (e.g. in wires) for more than 10cm may result in cross talk and loss of communication. This may be resolved by routing VDD and/or GND between the two data signals.

Please see the application note "ESD, Latchup and EMC" for more information.

Power supply pins (VDD, GND) should be decoupled with a 100 nF capacitor if wires are used.

4.9 Qualifications

Extensive tests were performed in various environments. Please contact SENSIRION for detailed information.

Environment	Norm	Results(1)
Temperature Cycles	JESD22-A104-B **-40 °C / 125 °C, 1000 cy**	Within Specifications
HAST Pressure Cooker	JESD22-A110-B **2.3 bar 125 °C 85 %RH**	Reversible shift by +2 %RH
High Temperature and Humidity	JESD22-A101-B **85 °C 85 %RH 1250h**	Reversible shift by +2 %RH
Salt Atmosphere	DIN-50021ss	Within Spec.
Condensing Air	-	Within Spec.
Freezing cycles fully submerged	**-20 / +90 °C, 100 cy** 30min dwell time	Reversible shift by +2 %RH
Various Automotive Chemicals	DIN 72300-5	Within Specifications

Table 9 Qualification tests (excerpt)

4.10 ESD (Electrostatic Discharge)

ESD immunity is qualified according to MIL STD 883E, method 3015 (Human Body Model at ±2 kV)).

Latch-up immunity is provided at a force current of ±100 mA with T_{amb} = 80 °C according to JEDEC 17. See application note "ESD, Latchup and EMC" for more information.

(1) The temperature sensor passed all tests without any detectable drift. Package and electronics also passed 100%

Package Information

1 SHT1x (surface mountable)

in	Name	Comment
	GND	Ground
	DATA	Serial data, bidirectional
	SCK	Serial clock, input
	VDD	Supply 2.4 - 5.5 V
	NC	Remaining pins must be left unconnected

ble 10 SHT1x Pin Description

1.1 Package type

e SHT1x is supplied in a surface-mountable LCC eadless Chip Carrier) type package. The sensors housing nsists of a Liquid Crystal Polymer (LCP) cap with epoxy ob top on a standard 0.8 mm FR4 substrate. The device is e of Pb, Cd and Hg. (Fully ROHS, WEEE compliant) evice size is 7.42 x 4.88 x 2.5 mm (0.29 x 0.19 x 0.1 inch) eight 100 mg

e production date is printed onto the cap in white numbers the form wwy. e.g. "351" = week 35, 2001.

1.2 Delivery Conditions

e SHT1x are shipped in 12mm tape at 100pcs or 400pcs. HT10 at 2000pcs only). Reels are individually labelled with rcode and human readable labels. The lot numbers allow l traceability through production, calibration and test.

gure 12 Tape configuration and unit orientation

1.3 Soldering Information

andard reflow soldering ovens may be used. For details ease see application note "soldering procedure".

For manual soldering contact time must be limited to 5 seconds at up to 350 °C.
After soldering the devices should be stored at >74 %RH for at least 24h to allow the polymer to rehydrate.
Please consult the application note "Soldering procedure" for more information.

5.1.4 Mounting Examples

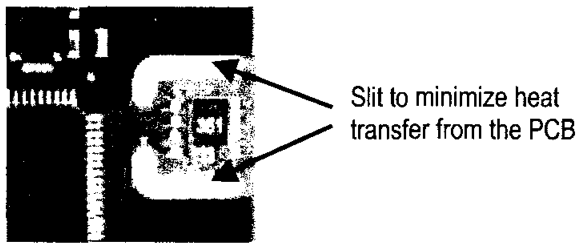


Figure 13 SHT1x PCB Mounting example

The SF1 membrane filter cap is available for optimal IP67 protection. When mounted through a housing the interior can be protected from the environment while still allowing high quality humidity measurements (see example below).

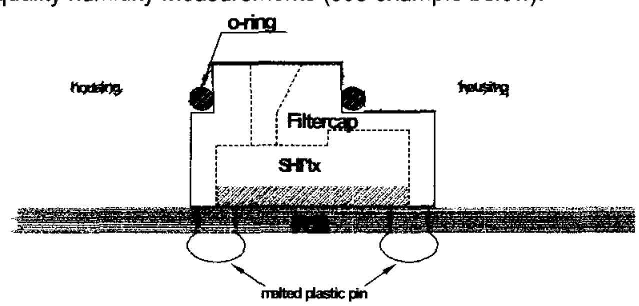
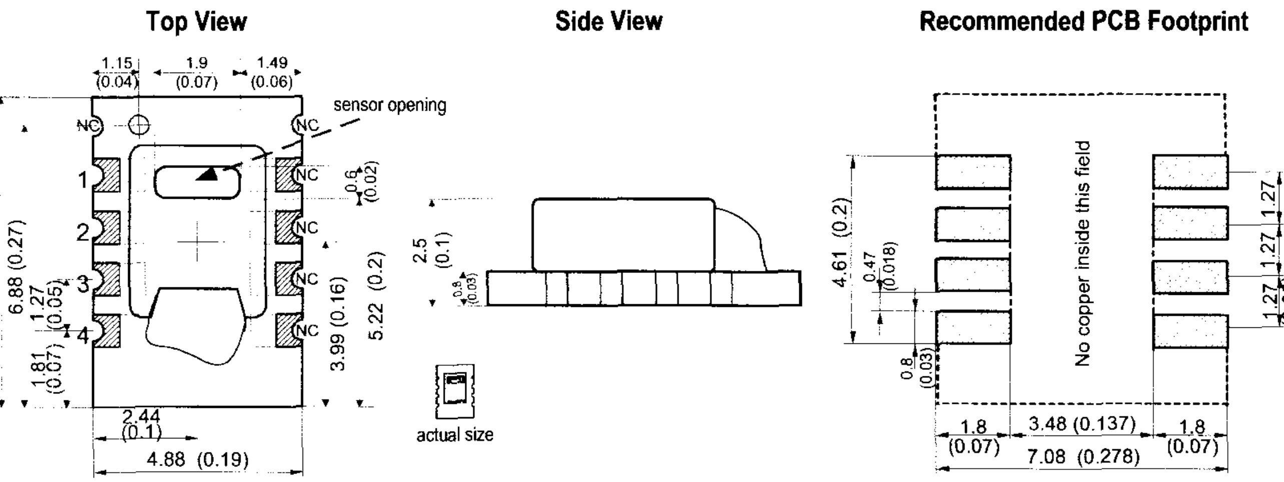


Figure 14 SF1 IP67 filter cap mounting example



gure 15 SHT1x drawing and footprint dimensions in mm (inch)

.2 SHT7x (4-pin single-in-line)

Pin	Name	Comment
1	*SCK*	*Serial clock input*
2	*VDD*	*Supply 2.4 - 5.5 V*
3	*GND*	*Ground*
4	*DATA*	*Serial data bidirectional*

able 11 SHT7x Pin Description

.2.1 Package type[1]

he device is supplied in a single-in-line pin type package. he sensor housing consists of a Liquid Crystal Polymer .CP) cap with epoxy glob top on a standard 0.6 mm FR4 ıbstrate. The device is Cd and Hg free.

he sensor head is connected to the pins by a small bridge minimize heat conduction and response times. The gold ated back side of the sensor head is connected to the GND n.

100nF capacitor is mounted on the back side between DD and GND.

ll pins are gold plated to avoid corrosion. They can be oldered or mate with most 1.27 mm (0.05") sockets

.g.: Preci-dip / Mill-Max 851-93-004-20-001 or similar

otal weight: 168 mg, weight of sensor head: 73 mg

he production date is printed onto the cap in white numbers the form wwy. e.g. "351" = week 35, 2001.

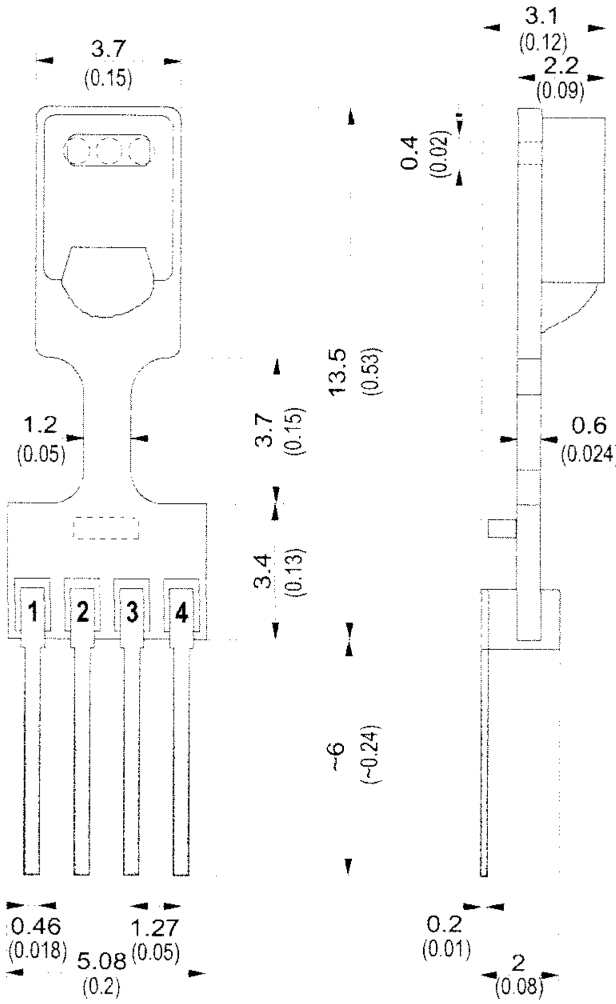
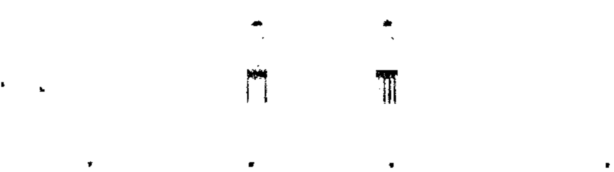


Figure 17 SHT7x dimensions in mm (inch)

.2.2 Delivery Conditions

he SHT7x are shipped in 32 mm tape. These reeled parts standard option are shipped with 500 units per 13 inch ameter reel. Reels are individually labelled with barcode nd human readable labels.



gure 16 Tape configuration and unit orientation

.2.3 Soldering Information[2]

tandard wave SHT7x soldering ovens may be used at aximum 235 °C for 20 seconds.

or manual soldering contact time must be limited to 5 econds at up to 350 °C.

fter wave soldering the devices should be stored at 74 %RH for at least 24 h to allow the polymer to rehydrate.

ease consult the application note "Soldering procedure" for ore information.

[1] Other packaging options may be available on request.

[2] For maximum accuracy do not solder SHT75!

Revision history

)ate	Version	Page(s)	Changes
ebruary 2002	Preliminary	1-9	First public release
une 2002	Preliminary		Added SHT7x information
/larch 2003	Final v2.0	1-9	Major remake, added application information etc. Various small modifications
	V2.01	1-9	Typos, Graph labeling
uly 2004	V2.02	1-9	Improved specifications, added SF1 information, improved wording
\pril 2005	V2.03	1-2	Added SHT10 information
/lay 2005	V2.04	1-9	Changed company address

he latest version of this document and all application notes can be found at:

Important Notices

.1 Warning, personal injury

o not use this product as safety or emergency stop evices or in any other application where failure of the roduct could result in personal injury. Failure to omply with these instructions could result in death or erious injury.

hould buyer purchase or use SENSIRION AG products for any ıch unintended or unauthorized application, Buyer shall demnify and hold SENSIRION AG and its officers, employees, ıbsidiaries, affiliates and distributors harmless against all claims, ɔsts, damages and expenses, and reasonable attorney fees ising out of, directly or indirectly, any claim of personal injury or eath associated with such unintended or unauthorized use, even such claim alleges that SENSIRION AG was negligent regarding e design or manufacture of the part.

.2 ESD Precautions

he inherent design of this component causes it to be sensitive to ectrostatic discharge (ESD). To prevent ESD-induced damage nd/or degradation, take normal ESD precautions when handling is product.

ee application note "ESD, Latchup and EMC" for more formation.

7.3 Warranty

SENSIRION AG makes no warranty, representation or guarantee regarding the suitability of its product for any particular purpose, nor does SENSIRION AG assume any liability arising out of the application or use of any product or circuit and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters can and do vary in different applications. All operating parameters, including "Typical" must be validated for each customer applications by customer's technical experts.

SENSIRION AG reserves the right, without further notice, to change the product specifications and/or information in this document and to improve reliability, functions and design.

leadquarters and Sales Office

ENSIRION AG
aubisrütistr. 50
H-8712 Stäfa ZH
witzerland

Phone: + 41 (0)44 306 40 00
Fax: + 41 (0)44 306 40 30
e-mail: info@sensirion.com

Sensirion humidity sensors are available from:

find your local representative at:

RUMAH SAKIT ADI HUSADA - UNDAAN WETAN
Jln. Undaan Wetan 40 - 44 SURABAYA [illegible]
Tlp. (031) - 532-1256, 031-5020 [illegible]
Fax. (031) - 532-1081

Surabaya ; 01 Agustus 2005

No. : 246 /RSAH-Um/VIII/2005
Hal : Persetujuan pengambilan data

Kepada Yth :

Ketua Jurusan Teknik Elektro
Universitas Katolik Widya Mandala

Jl. Kalijudan no. 37

S u r a b a y a

Dengan hormat.

Berkenaan dengan permohonan untuk mencari data [illegible] bator oleh mahasiswa teknik elektro UWM an. Hadisuyoto Pos[illegible] (5103006051) untuk keperluan penyusunan skripsi sebagai [illegible] saudara [illegible] melalui surat no. : 0.28/WM08.1/T/2005 tanggal 19 Juli 2005 maka pada prinsip [illegible] menyetujui permohonan tersebut

Untuk pelaksanaan lebih lanjut kepada mahasiswa saudara agar menemui Manajer Perawatan R.S Adi Husada Undaan Wetan, pada hari Rabu tanggal 10 Agustus 2005 jam 10.00 WIB di R.S Adi Husada Undaan Wetan jl. Undaan Wetan 40-44 Surabaya

Demikian kami sampaikan dan atas perhatian [illegible] kami ucapkan terima kasih.

R.S ADI HUSADA UNDAAN WETAN

dr. EDHY LISTIYO, MARS
Direktur

Tembusan kepada Yth. :

1. Manajer Perawatan
2. Mahasiswa Ybs.
3. Arsip

Sekretariat.doc

Menemui
Ibu Made Puryasi
Ruangan A2
Tgl 18/8/05
(Andy [illegible])

RUMAH SAKIT KATOLIK
St. Vincentius A Paulo
Jl. Diponegoro no. 51- Surabaya 60008, Indonesia
Telp. (031) 5677562 (hunting), 5687846, 5663895
Fax. : (031) 5674748 ; Email : rkzsby@mitra.net.id

Surabaya, 12 Agustus 2005

Nomor : 028/VIII/2005
Perihal : *Pemberian ijin tempat pengambilan data*

Yth. Ketua Jurusan
Jurusan Teknik Elektro
Fakultas Teknik
Universitas Widya Mandala
Jalan Kalijudan 37
S u r a b a y a 60114

Dengan hormat,

Membalas surat tertanggal 19 Juli 2005 Nomor 0128/WM06.1/T/2005 mengenai permohonan ijin tempat mencari data sehubungan dengan pelaksanaan tugas akhir bagi Mahasiswa Fakultas Teknik Jurusan Teknik Elektro Unika Widya Mandala Surabaya.

Dengan ini kami sampaikan bahwa Direksi RSK dapat memberikan ijin kepada:

Nama	:	Hadisuyoto Poging Yustisia
NIM	:	5103099051
Judul Proposal	:	Perancangan dan pembuatan prototype pengaturan suhu pada Inkubator
Unit Kerja	:	Sie Teknik

Untuk melaksanakan pengambilan data dan mendapatkan beberapa informasi yang berkaitan dengan inkubator di Rumah Sakit Katolik St.Vincentius a Paulo Surabaya.

Sebelum pengambilan data dimohon mahasiswa berhubungan dengan *Sdr.Bram Dewanto / Kasie Teknik pes.288.*

Terima kasih atas kepercayaan dan perhatiannya pada rumah sakit kami.

Hormat kami,

IUS A. PAULO S.K. ABAYA AKIT

Sr. Maria Widjaja SSpS
Direktur Umum & Adm.Keu.

...n:
...ust.Service
...eknik
...iklat
...wa bersangkutan

DEPARTEMEN PENDIDIKAN NASIONAL
UNIVERSITAS AIRLANGGA
FAKULTAS KEDOKTERAN
BAGIAN ILMU KESEHATAN ANAK
Telgr. : FDO UNA
Jl. Mayjen Prof. Dr. Moestopo 6-8 Surabaya Telp. 5020089-5020079-5020062 Ps : 1680 Telp. 5501681 Fax. 5501680 Kode Pos . 6028

No. : 814/J03.1.17/KA.6/2005
Lamp. : -
Hal : Permohonan ijin penelitian.

28 Juli 2005

Kepada Yth.
Kepala Bidang Litbang
RSU Dr. Soetomo
Surabaya

Menjawab surat Saudara no : 070/488/304/L:itb/VII/2005 tanggal 25 Juli 2005 perihal tersebut pada pokok surat, dengan ini diberitahukan bahwa pada prinsipnya kami tidak keberatan dan dapat memberikan ijin mahasiswa Jurusan Teknik Elektro Fakultas Teknik Univ. Katolik Widyamandala Surabaya a.n. :

Hadisuyoto Poging Yustisia
NPM : 5103099051

untuk meminjam data guna penyusunan skripsi di Bagian/SMF Ilmu Kesehatan Anak FK Unair/RSU Dr. Soetomo.
Adapun sebagai pembimbing kami adalah : Risa Etika, dr,SpA.

Demikian untuk diketahui, atas perhatian Saudara kami ucapkan terima kasih.

Ketua,

Prof. H. Bambang Permono, dr,SpA(K)
NIP. 130350722

Tembusan :
1. Kepala IRNA Anak
2. Koordinator Penelitian IKA
3. Risa Etika, dr,SpA
4. Hadisuyoto Poging Yustisia

Biodata

Nama Lengkap : Hadisuyoto Poging Yustisia

Temapat / TanggalLahir : Surabaya / 8 Desember 1980

Alamat : Kedurus II / 96 A Surabaya

Telepon : (031) 7664811

Riwayat Pendidikan:

1. SDK SantoYosef Surabaya Th.1987 - 1993
2. SMPK Santo Yosef Surabaya Th.1993 - 1996
3. SMUN 4 Surabaya Th.1996 – 1999
4. UNIKA Widya Mandala Surabaya Jurusan Teknik Elektro Th.1999 - 2005