Property description

TM7711 is a single channel analog front-end applied to low-frequency measurement of electronic scale. The device can accept the low-level input signal directly from the sensor, and then generate a serial digital output. Utilize Σ-Δ conversion technology to achieve 24 bit lossless code performance. The on-chip digital filter processes the output signal of the modulator, and sends a command through the communication port to adjust the cut-off point and output update rate of the filter, so as to program the first notch of the digital filter. The on-chip digital filter processes the output signal of the modulator, and sends a command through the communication port to adjust the cut-off point and output update rate of the filter, so as to program the first notch of the digital filter. TM7711 only needs 2.6 ~ 5.5V single power supply. TM7711 is a fully differential analog input with a reference input.

TM7711 is an ideal product for high-precision electronic scale system. The special structure ensures that the device has very low power consumption, and a power down mode is built in to reduce standby power consumption The chip also has the advantages of high integration, fast response and strong anti-interference. It can greatly reduce the cost of the whole electronic scale system and improve the performance and reliability of the whole system.

Functional feature

- ADC for 1 pair of fully differential input channels
- On chip direct temperature measurement and digital output
- 24 bit no missing code
- On chip low noise amplifier with a gain of 128
- ± 0.001% nonlinear
- Optional output data rates of 10Hz and 40Hz
- Synchronous suppression of 50Hz and 60Hz power supply interference
- The built-in clock oscillator does not need any external devices
- Simple two-wire serial communication port
- Working voltage range: 2.6 ~ 5.5V
- Operating temperature range: - 40 ~ + 85 ℃
- Packaging form: SOP8 /DIP8 /TSSOP8

Typical Applications

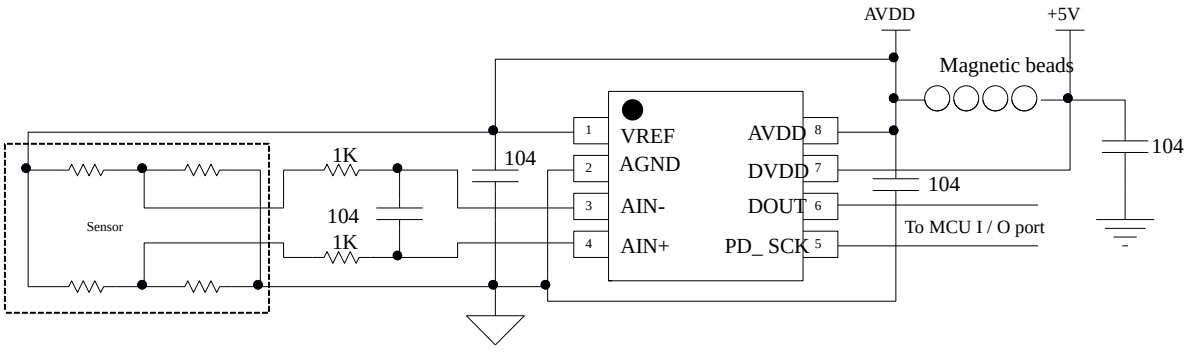


Figure 1 Typical application

Pin information

(TOP VIEW)

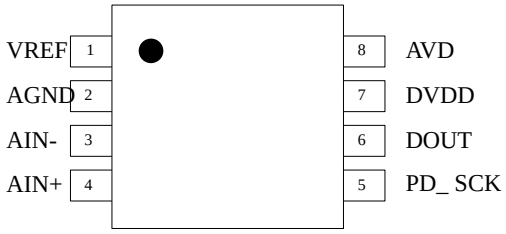


Figure 2 Pin information

Pin function

Table 1 Pin description

Pin	Name	Function
1	VREF	Reference input voltage (1.8V ~ AVDD)
2	AGND	Ground input
3	AIN-	Negative input of differential analog input channel
4	AIN+	Positive input of differential analog input channel
5	PD_ SCK	Power down mode and serial port clock input
6	DOUT	Transmit data output
7	DVDD	Digital power input (2.6 ~ 5.5V)
8	AVDD	Analog power input (2.6 ~ 5.5V), AVDD voltage shall not be higher than DVDD voltage

Absolute maximum rating range

Table 2 Absolute maximum ratings

Parameters			Scope	Unit
VCC	Supply voltage	AVDD,DVDD	-0.4 ~ 6.0	v
VIN	Input voltage range	VREF,AIN+,AIN-,PD_ SCK	-0.4 ~ VCC+0.4V	v
VOUT	Output voltage range	DOUT	-0.4 ~ +6.0	v
Topr	Operating Temperature Range		-40 ~ +85	℃
Tstg	Storage temperature range		-55 ~ +150	℃
ESD	Body mode (HBM)		4000	v
	Machine mode (mm)		300	v

If the device is forced to work under conditions beyond those listed in this table, it may cause permanent damage to the device. This table only lists the limits of working stress and does not mean that the device can work under the conditions listed in the table or other conditions beyond the specified scope of work. Working at the absolute limit for a long time may affect the service life of the device.

Range of recommended working conditions

(at - 40 ℃ ~ + 85 ℃) unless otherwise specified

Table 3 Recommended working conditions

Parameters		Test Conditions	TM7711			Unit
			Minimum	Typical value	Maximum	
DC parameter specification table:						
AVDD	Analog part power supply		2.6	5.0	5.5	v
DVDD	Digital part supply voltage		2.6	5.0	5.5	v
VIH	High-level input voltage		0.7×DVDD		DVDD	v
VIL	Low-level input voltage		GND		0.3×DVDD	v
TA	Operating Temperature		-40		+85	℃
TJ	Working temperature range		-40		+125	℃

Serial communication

The serial communication line consists of pin PD_ SCK and DOUT. The communication line is used to output data and select the output data rate and input signal.

When the data output pin DOUT is at high level, it indicates that the A / D converter is not ready to output data. At this time, the serial port clock input signal PD_SCK shall be low level. When DOUT changes from high level to low level, PD_SCK shall input 25 to 27 clock pulses (Figure 3). The rising edge of the first clock pulse will read out the highest bit (MSB) of the output 24 bit data until the 24th clock pulse is completed. 24 bit output data is output bit by bit from the highest bit to the lowest bit. The 25th to 27th clock pulses are used to select the output data rate and input signal for the next A/D conversion, see Table 4. The number of input clock pulses for PD_SCK should not be less than 25 or more than 27, otherwise it will cause a serial communication error.

When the input signal or output data rate of the A/D converter changes, the A/D converter needs 4 data output cycles to be stable. DOUT will change from high level to low level after 4 data output cycles and output valid data.

Table 4 Input selection and output data rate selection

Number of PD_SCK pulses	Input Select	Velocity
25	Differential signal	10Hz
26	Temperature measurement	40Hz
27	Differential signal	40Hz

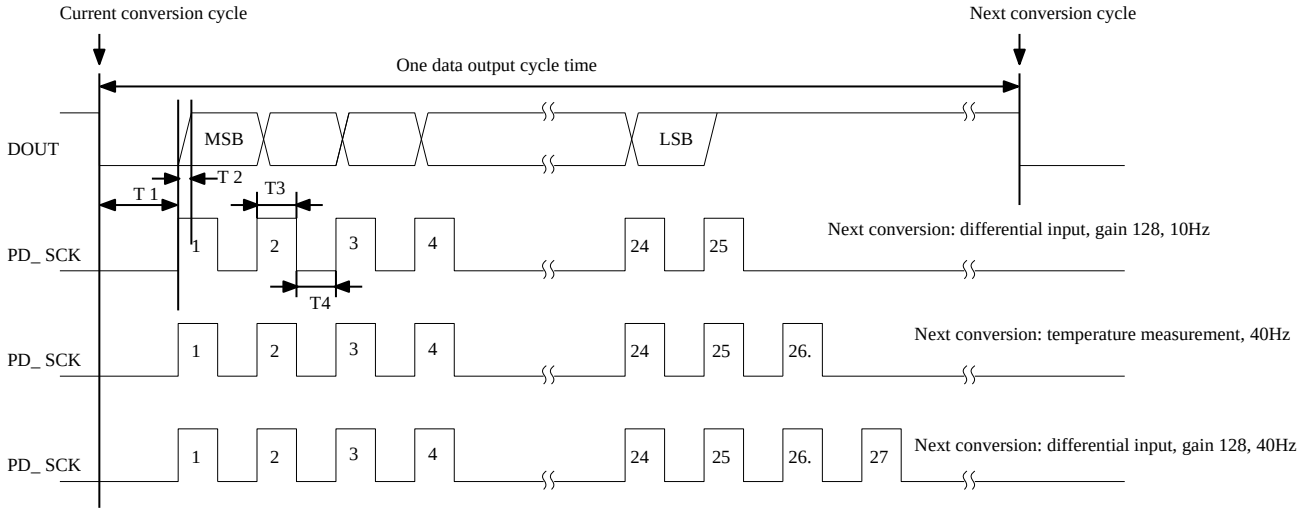


Fig. 3 Timing chart of data output, input channel and gain selection

Table 5 Description of timing communication parameters

Parameters	Description	Minimum value	Typical value	Maximum value	Unit
T 1	Falling edge of DOUT to PD_SCK pulse rising edge	0.1			μs
T2	PD_ SCK pulse rising edge to DOUT data valid			0.1	μs
T3 *	PD_ SCK positive pulse level time	0.2		50	μs
T4	PD_ SCK negative pulse level time	0.2			μs

***Note: PD-SCK positive pulse level time should not exceed the specified maximum value of 50μs, otherwise it will lead to incorrect data of the read out AD result.**

Output noise

Table 6 Shows the noise free bits of TM7711 output. The data given is applicable to the 5V bipolar input range of AVDD and VREF. These data are typical values and are generated when the analog differential input voltage is 0V.

Table 6 TM7711 output noise (5V voltage)

Data updating rate	Noiseless bit
10Hz	17bits
40 Hz	16bits

Analog Input

(1) Channel analog input range:

TM7711 includes one analog input pair, i.e.AIN+, AIN-. The input pair provides a differential input channel that can process single and bipolar input signals. It should be noted that the bipolar input signal is referenced to the AIN terminal.

The analog differential input voltage range is ± 0.5 × (VREF/128) V, the absolute value of analog input voltage is between AGND+0.9V and AVDD-1.3V.

(2) Datum input:

VREF provides reference input for TM7711. The reference voltage input range is 1.8V to AVDD.

Update rate of system clock and AD data

(1) System clock:

The system clock of TM7711 is provided for the internal oscillator. It is a high-precision oscillator with ultra-low dependence on VDD and temperature.

(2) AD data update rate:

TM7711 provides optional 10Hz and 40Hz output data rates, which can be simply selected through the communication port.

Output data

The output data code of TM7711 is binary complement, ranging from 800000H (minimum) to 7FFFFFH (maximum).

Temperature Measurement

The digital temperature sensor inside the TM7711 chip can be directly used to read the temperature in the chip, that is temperature in the system. Its effective (stable) digits are 15. The typical temperature measurement accuracy is 20.4 readings (15 bits) per degree (℃). The temperature measurement range is -40 ℃ ~ 85 ℃. When using digital temperature sensor, it should be noted that the temperature sensor in the chip has large zero point and gain difference between the chip and the chip. If it is used to measure absolute temperature, both zero point and gain need to be corrected. If the measured temperature is used for system temperature related performance compensation, the zero point and gain do not need to be corrected, as long as the linearity of temperature measurement meets the requirements.

Reset and power down mode

When the chip is powered on, the power on automatic reset circuit in the chip will reset the chip automatically.

The pin PD-SCK input is used to control the power off of the TM7711. When PD_ SCK is at low level, and the chip is in normal working state. If PD_ SCK changes from low level to high level and remains at high level for more than 60 μs, TM7711 enters the power down mode (see Figure 4). When PD_ SCK returns to the low level, the chip will enter the normal working state again. After the chip returns to the normal working state from the power-off state, if the conversion rate and input signal selection before power-off are to be maintained, the power-off cannot be carried out in the current data conversion cycle when the number of clock pulses changes, but after the next data conversion cycle after the number of clock pulses changes.

After the chip enters the normal working state from the reset or power-off state, the A/D converter needs 4 data output cycles to be stable. DOUT will change from high level to low level after 4 data output cycles and output valid data.

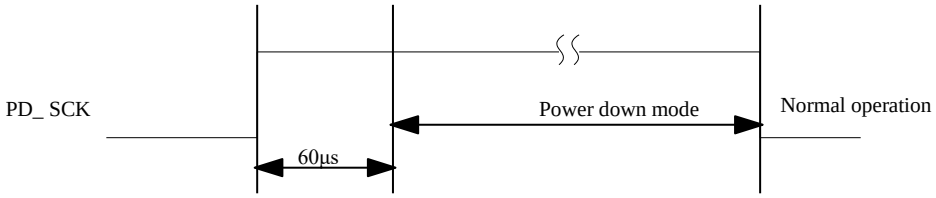


Figure 4 Power down control

Power waste

The power consumption of TM7711 in various states is shown in table 7 below.

Table 7 Power consumption table

Operating voltage VDD	**Chip status**	Total chip current I_{vdd} **(typical value)**
3V	Normal operation	1080μA
3V	Power down (standby) mode	0.5μA
5V	Normal operation	1200μA
5V	Power down (standby) mode	0.5μA

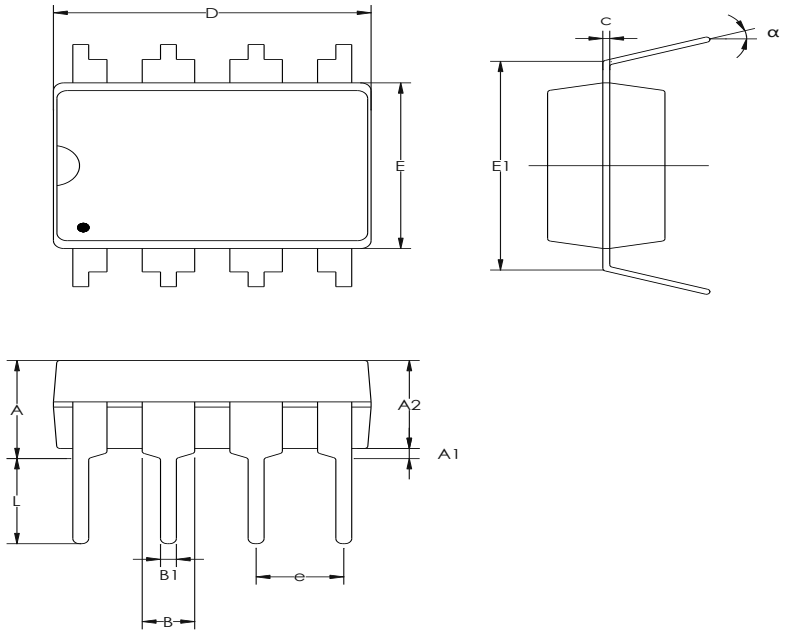
Reference Procedure

C language: (for reference only)

```
/* TM7711. h header file*/
#ifndef _ TM7711_ H_
#define _ TM7711_ H_
#define CH1_ 10HZ 0x01
#define CH1_ 40HZ 0x02
#define CH2_ TEMP 0x03
#define CH1_ 10HZ_ CLK 25
#define CH1_ 40HZ_ CLK 27
#define CH2_ TEMP_ CLK 26
unsigned long Read_ TM7711(unsigned char next_select);
#endif
/* TM7711. C) procedure documents*/
#include "TM7711.h"
#Include "global. H" / / define the port
#Include "delay. H" / / delay subroutine
unsigned long Read_ TM7711(unsigned char next_select)
{   unsigned char i = 0;
    unsigned long data_ temp = 0;
    for(i = 0;i < 24;i++)
    {       SET_ SCK_ H(); // At global H file, set SCK pin to output high level.
    data_ temp <<= 1;
    delay_ us(5); // Delay 5 microseconds. Customize this function according to different MCU
    If (read_port & (1 < < pin_dout)) / / judge whether dout is high.
                data_ temp |= 1;
    SET_ SCK_ L();// At global h file, set SCK pin to output high level.
    }
    Switch (next_select) / / determine the next data update rate or switch channels
    {       case CH1_ 10HZ:
                SET_ SCK_ H();
                delay_ 1us();
                SET_ SCK_ L();
                break;
    case CH1_ 40HZ:
                SET_ SCK_ H();
                delay_ 1us();
                SET_ SCK_ L();
                delay_ 1us();
                SET_ SCK_ H();
                delay_ 1us();
                SET_ SCK_ L();
                delay_ 1us();
                SET_ SCK_ H();
                delay_ 1us();
                SET_ SCK_ L();
                break;
    case CH2_ TEMP:
                SET_ SCK_ H();
                delay_ 1us();
                SET_ SCK_ L();
                delay_ 1us();
                SET_ SCK_ H();
                delay_ 1us();
                SET_ SCK_ L();
                break;
    default:
                break;
    }
    return(data_temp); // Return the data read from TM7711
}
```

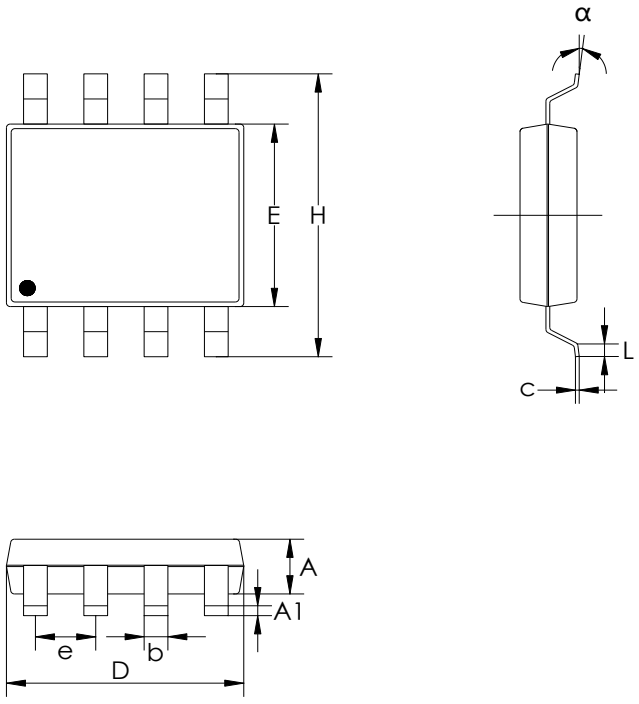
Packaging diagram

DIP8:



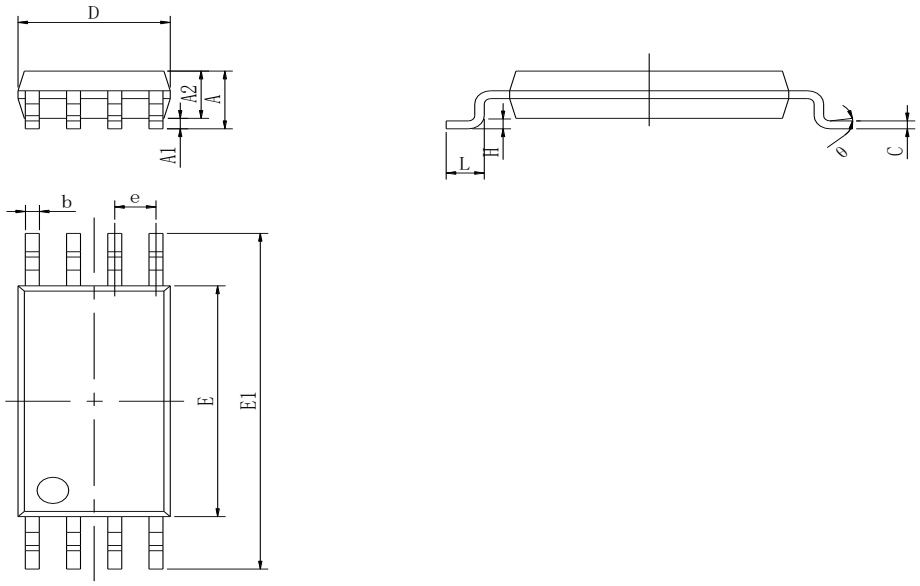
	inches			millimeters		
label	**Minimum**	**Standard**	**Max.**	**Minimum**	**Standard**	**Maximum**
A			0.170			4.31
A1	0.015			0.38		
A2	0.124	0.134	0.144	3.15	3.4	3.65
B	0.015	0.018	0.020	0.38	0.46	0.51
B1	0.050	0.060	0.070	1.27	1.52	1.77
c	0.008	0.010	0.012	0.20	0,25	0.30
D	0.352	0.362	0.372	8.95	9.20	9.45
E	0.242	0.252	0.262	6.15	6.40	6.65
E1		0.300			7.62	
e		0.100			2.54	
L	0.118	0.130	0.142	3.00	3.30	3,60
α	0°		15°	0°		15°

SOP8：



	inches			millimeters		
label	**Minimum**	**Standard**	**Maximum**	**Minimum**	**Standard**	**Maximum**
A	0.051	0.059	0.067	1.30	1.50	1.70
A1	0.002	0.006	0.010	0.06	0.16	0.26
b	0.012	0.016	0.022	0.30	0.40	0.55
c	0.006	0.010	0.014	0.15	0,25	0.35
D	0.186	0.194	0.202	4.72	4.92	5.12
E	0.148	0.156	0.163	3.75	3.95	4.15
e		0.050			1.27	
H	0.224	0.236	0.248	5.70	6.00	6.30
L	0.018	0.026	0.033	0.45	0.65	0.85
α	0°		8°	0°		8°

TSSOP8：



	inches		millimeters	
Label	**Minimum**	**Maximum**	**Minimum**	**Maximum**
D	0.011	0.012	0.29	0.31
E	0.169	0.177	4.3	4.5
B	0.007	0.012	0.19	0,3
c	0.004	0.008	0.09	0.2
E1	0.252(BSC)		6.40(BSC)	
A		0.047		1.2
A2	0.031	0.039	0.8	1.0
A1	0.002	0.006	0.05	0.15
e	0.026(BSC)		0.65(BSC)	
L	0.017	0.029	0.45	0.75
H	0.01(TYP)		0.25(TYP)	
θ	0°	8°	0°	8°

Revision History

Version	Date of issuance	Introduction to revision
Ver1. 0	2011-7-25	The first edition is issued.
V1.1	2012-03-29	Revision and distribution
V1.2	2018-02-27	Revision and distribution
V1. 3	2020-04-15	Revision and distribution