OPERATION MANUAL

TH2810B LCR METER

TH2618B CAPACITANCE METER

TH2775B INDUCTANCE METER

NOTICE

Thanks for purchasing and using our product. Please confirm the product set and accessories with shipment list. If there is any unconformity, please contact sales office or Tonghui Company as soon as possible to protect your benefits!

DESCRIPTION

Refer to descriptions of front and rear panels in § 1.6 on P 1-6.

WARNING

To avoid electric shock hazard, please make sure that phase line, zero line and ground line are connected correctly before the instrument is plugged into an outlet. The instrument chassis and cabinet must be connected to a safety earth ground to avoid the cover to be electrified.

WARNING

Take care not to contact the parts with 220V when making maintenance to avoid the hazard of electrical shock. It is absolutely prohibited to perform normal measurement when the cover is removed (except for maintenance and adjustment).

WARNING

Do not plug in or out component or connecting line when the instrument is switched on to avoid unnecessary damage to component or instrument. It is not permitted to turn on or off instrument continuously to avoid causing program inordinate, which will lose proofread and saved data.

ATTENTION

The calibration of the instrument should be done by professional personnel. Should trouble occur in EEPROM 28C64, it must be returned to the company to avoid losing accuracy calibration data.

DECLARATION

We are likely to improve our equipment without extra explanation, including the performance, functions, inner structure, appearance, accessories, and packing.

CONTENTS

Chapter 1 General introduction

This chapter provides brief and concise description of instrument's specifications and functions.

1.1 Brief introduction

As a newly developed instrument, TH2810B Series Component Parameter Testers offer fast, reliable, and versatile testing at a low cost. It can automatically measure component parameters, including inductance (L), capacitance (C), resistance (R), impedance (Z), quality factor (Q), and tangent of dissipation angle (D), etc. This instrument, which merges powerful functions, excellent performances and simple operation into a whole, can satisfy both the need for fast test in factories, and the requirement of high precision and stable measurement in laboratory.

Compared with general component parameter testers, instruments of TH2810B make improvements in the following aspects:

1. To meet requirements in different situations, the instrument has two sets of selection programs, and parameter setup is of many digits and high resolution rate. The instrument can be connected with automatic meter through interfaces to realize automatic measurement.
2. The instrument provides RS232C interface to effectively communicate with computer and make it possible to remotely control and collect data.
3. The instrument applies the design method of invariable resistance of signal source, and it ensures that voltage or current signal in one tested component does not change with the adjustment of range, to avoid being hard to select range for tested component which is at the edge of range.
4. The instrument has the functions of locking key and saving state. It can reduce workers' incorrect operation, and make personalized default state possible.

TH2810B Series Component Parameter Testers include TH2810B LCR meter, TH2618B capacitance meter, and TH2775B inductance meter. And they differ in measurement parameters (referring to Table 1-1 Measurement Parameters Table in § 1.2.2). TH2618B and TH2775B only have some functions of TH2810B, so this manual is applicable to TH2810B and the contents which are only applicable to TH2618B or TH2775B are marked.

1.2 Specifications

1.2.1 Measurement terminals

There are five terminals, namely HD, HS, LS, LD and GND.

1.2.2 Measurement parameters

Model	Parameter
TH2810B	L-Q, C-D, R-D, Z-Q
TH2618B	C-D, R-D
TH2775B	L-Q, R-Q

Table 1-1.Measurement Parameters

L: inductance C: capacitance R: resistance
Z: impedance Q: quality factor D: tangent of dissipation angle
The instrument provides two kinds of equivalent circuits, series connection and parallel connection, in which Z, D and Q have the same values while C, L and R have different values. The conversion relations between the two equivalent circuits are discussed in Table 2-4 Conversion Table of Circuits in Series and Parallel Connections on P 2-11.

1.2.3 Display range

L: 0.01μH ~ 99999H
C: 0.01pF ~ 99999μF
R/Z: 0.0001Ω ~ 99999MΩ
D: 0.0001 ~ 9.999
Q: 0.0001 ~ 9999
Δ%: -9999% ~ 9999%

1.2.4 Measurement accuracy

C: 0.1% (1+Cx/Cmax+Cmin/Cx) (1+Dx) (1+ks+kv+kf);
L: 0.1% (1+Lx/Lmax+Lmin/Lx) (1+1/Qx) (1+ks+kv+kf);
Z: 0.1% (1+Zx/Zmax+Zmin/Zx) (1+ks+kv+kf);
R: 0.1% (1+Rx/Rmax+Rmin/Rx) (1+Qx) (1+ks+kv+kf);
D: ±0.0010 (1+Zx/Zmax+Zmin/Zx) (1+Dx+Dx^2) (1+ks+kv+kf);
Q: ±0.0015 (1+Zx/Zmax+Zmin/Zx) (Qx+1/Qx) (1+ks+kv+kf).
Notes: 1. D and Q are absolute deviations and others are percent deviations, Dx=1/Qx;

2. Those with subscript x mean measurement values of the parameters; those with subscript max mean maximum values and min mean minimum values;

3. ks is the speed factor; kv is the level factor and kf is the frequency factor;

4. In order to gain high measurement accuracy, you should make open and short correction again when the test fixture or conditions are changed.

1.2.4.1 Maximum and minimum values for different ranges

Parameter	Frequency			
	100Hz	**120Hz**	**1kHz**	**10kHz**
Cmax	800μF	667μF	80μF	8μF
Cmin	1500pF	1250pF	150pF	15pF
Lmax	1590H	1325H	159H	15.9H
Lmin	3.2mH	2.6mH	0.32mH	0.032mH
Zmax/ Rmax	1MΩ			
Zmin/ Rmin	1.59Ω			

Table 1-2. Maximum and Minimum Values

1.2.4.2 Deviation factor ks

slow speed: ks =0 fast speed: ks =10

1.2.4.3 Level factor kv

When V=1V, kv =0;
When V = 0.3V, kv = 1;
When V = 0.1V, kv = 4.

1.2.4.4 Frequency factor kf

When f = 100 Hz, 120 Hz or 1 kHz, kf = 0;
When f = 10 kHz, kf = 0.5.

1.2.5 Test signal frequency

Test signal: sine wave
Four frequencies are available: 100Hz, 120 Hz, 1 kHz, 10 kHz
Accuracy: 0.02%.

1.2.6 Test signal level

Three levels are available: 0.1V, 0.3V, 1.0V (effective value)
Accuracy: ±10% (The set value of the measurement level is the value set when test terminals are opened HD and HS should be connected)
Due to the output impedance of the signal source, the actual level applied upon the component under test may be different from the set value.

1.2.7 Output impedance of measurement signal

Output impedance: 30 Ω (default value) and 100 Ω, without requirement of accuracy.

1.2.8 Measurement speed

Fast: around 15 times/sec.;
Slow: around 4.5 times/sec.;
The actual speed differs with different measurement conditions such as frequency, component value, display mode, measurement mode, once, range mode, RS232 interface and so on.
The typical speeds for Fast, Medium and Slow are given under the following measurement conditions:

- Frequency: 1 kHz or 10 kHz;
- Measurement mode: continuous;
- Range mode: Hold;
- Display parameters: C/D;
- RS232 interface: only receiving allowed.

1.2.9 Inputting data range

Parameter	Code	Range
Nominal value	L	0.0001μH～99999H
	C	0.0001pF～99999μF
	R/|Z|	0.0001Ω ～99999MΩ
High or low limit		-9999%～9999%
Dissipation value Quality factor	D/Q	0～99999

Table 1-3. Sorting Setup Range

1.3 Operating environment

1.3.1 Temperature & Humidity

Temperature: 0^0C ~ 40^0C
Humidity: ≤85%RH
Accurate temperature: 18^0C ~ 28^0C
Accurate humidity: ≤80%RH

1.3.2 Power

Voltage: 220V （1±10%）
Frequency: 50Hz（1±5%）
Power: around 25W

1.3.3 Warm-up

After warming up for 10 minutes, the instrument can start to measure.

1.3.4 Notice

- Do not operate the instrument in the conditions of much dust, vibration, strong sun shining, or
- Even the instrument has made special treatment for different signals (especially AC power noise); please operate in the condition of low noise. If unavoidable, please install power filter.
- If the instrument hasn't been used for a long time, please pack with original packing or sealed plastic bag and paper case, and store in the ventilated room with temperature of -10^{0}C ~ 40^{0}C and humidity of≤85％RH.
- If DUT is capacitor, even the instrument has specially-designed anti-shock circuit; the rest electricity in tested capacitor should be given out to be clear before measurement, which is good for the instrument's reliability and safety.

1.4 Dimensions and weight

Dimensions: around 350(W) by 110(H) by 340(D) (mm) (without packing)
Weight: around 3.5 kg (without packing)

1.5 Function index

No.	Name	Function Description	Referring to
1	Measurement parameter	to optionally select different measurement parameters (§1.2.2)	§2.2.1 on P2-3
2	Measurement frequency	to select four measurement frequencies (§1.2.5)	§2.2.2 on P2-4
3	Measurement level	to select three measurement levels (§1.2.6)	§2.2.3 on P2-4
4	Measurement mode	to display measurement value in number or percentage of deviation	§2.2.4 on P2-4
5	Range mode	to automatically select range or hold in one range	§2.2.5 on P2-5
6	Measurement speed	Accuracy and stability are lower in fast speed than in slow speed	§2.2.6 on P2-7
7	Clear & proofreading	to clear distribution parameters' effect to measurement	§2.2.7 on P2-8
8	Alarm	to select whether to alarm or	§2.3.1 on P2-10

		not when sorting result is qualified	
9	Trigger	to select trigger mode: continuous or single	§2.3.2 on P2-10
10	Equivalent type	to select circuit's equivalent type: series connection or parallel connection	§2.3.3 on P2-10
11	Serial interface	to select whether to send data outside through RS232 interface	§2.3.4 on P2-11
12	Sorting mode	to select sorting mode: P1 mode or P3 mode	§2.3.5 on P2-16
13	Resistance of signal source	to select output resistance of signal source: 30 Ω or 100 Ω	§2.3.6 on P2-19
14	Key lock	to lock keys and keep operating state	§2.3.7 on P2-19
15	Comparator and output interface HANDLER	to compare and sort comparison values and output sorting result through HANDLER interface to control measurement system's operation structure	§2.3.5 on P2-16 § 3.3.3 on P3-7
16	RS232 interface	to remotely control instrument	§2.3.4 on P2-11 §3.3.4 on P3-8

Table 1-4. Function Index

1.6 Panel

1.6.1 Rear panel description

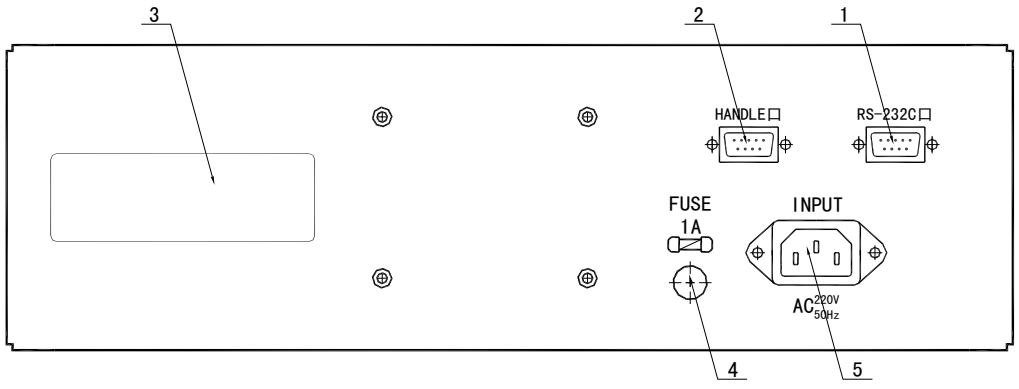


Figure 1-1.Rear Panel Overview

No.	NAME	FUNCTION DESCRIPTION
1	RS-232C serial interface (9-pin)	to provide serial interface between the instrument and peripheral equipments (referring to §2.3.4)
2	HANDLER interface (9-pin)	to provide controlling interface between the instrument and system (referring to §2.3.5.2)
3	Nameplate	to indicate following information: License No., date, serial No. and manufacturer.
4	Fuse	to protect the instrument, 1A
5	LINE input receptacle	to connect with AC power of 220V, 50Hz

Table 1-5. Rear Panel Description

1.6.2 Front Panel Description

The schematic drawing of the front panel can be seen on the next page (taking TH2810B LCR Meter as an example).

No.	NAME	FUNCTION DESCRIPTION
1	Main parameters (or Display A in this manual)	to display the measurement values of C, L, Z and R. Two display modes are available: direct, and percent deviation △%. It can also display information when parameters are being set.
2	Units of main parameters	to indicate the units of main parameter in direct mode
3	Sub parameters (or Display B in this manual)	to display the measurement values of D and Q. It can also display information when parameters are being set.
4		
5	State indication	Refer to §2.1 on P2-1.
6	Frame terminal (GND)	to be used for measurements that requires guarding. The Frame Terminal is tied to the instrument's chassis, and it is connected with the protective earth ground of power supply.
7	Test terminals	to provide 4-terminals for measurement of component: HD (High Drive of current): Test signal is output through HD. Voltage, frequency and waveform of test signal can be measured at HD by voltmeter, frequency meter and oscillograph, etc. HS (High Sense of voltage): sample the high potential of the device under test. LS (Low Sense of voltage): sample the low

		potential of the device under test. LD (Low Drive of current): the current flowing through the device under test is sent to the current measuring part of instrument. HD and HS should be connected to one lead of the device under test and LD and LS should be connected to another lead.
8	Trade mark of Tonghui & model	TH2810B LCR meter
		TH2618B capacitance meter
		TH2775B inductance meter
9	Keyboard	All the function statees of the instrument can be selected and controlled through the 7-button keyboard (referring to §2.1 on P2-1).
10	Sorting indication	to indicate the sorting result
11	Power ON/OFF	Power ON/OFF Switch. In ON position, all operating voltages are applied to the instrument. In OFF position, no operating voltages are applied to the instrument.

Table 1-6. Front Panel Description

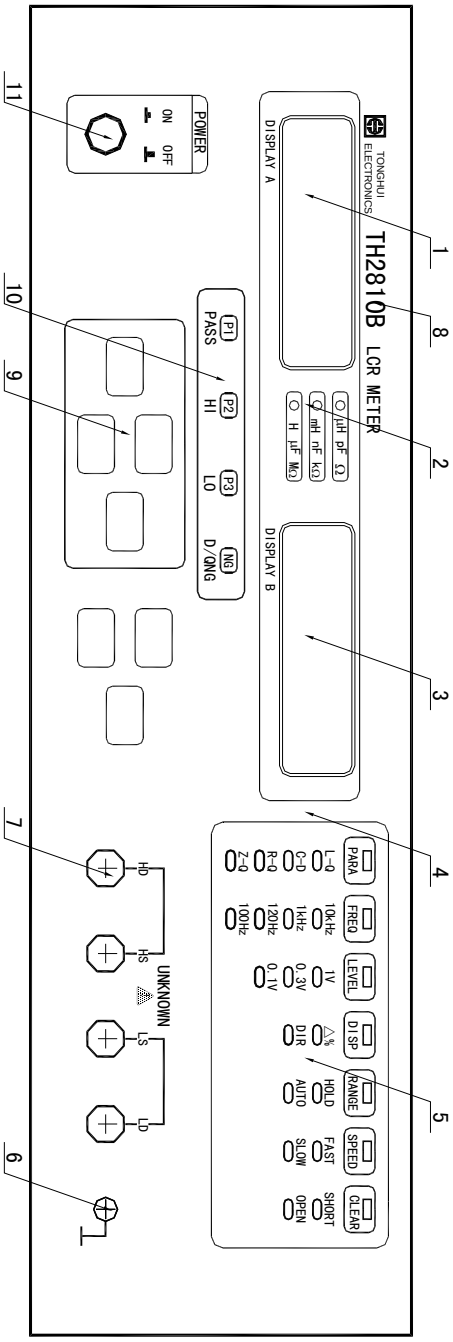


Figure 1-2. Front Panel Overview

Chapter 2 Operation instruction

This chapter provides detailed description of all functions of the instrument and operation instruction.

2.1 Keyboard and functions introduction

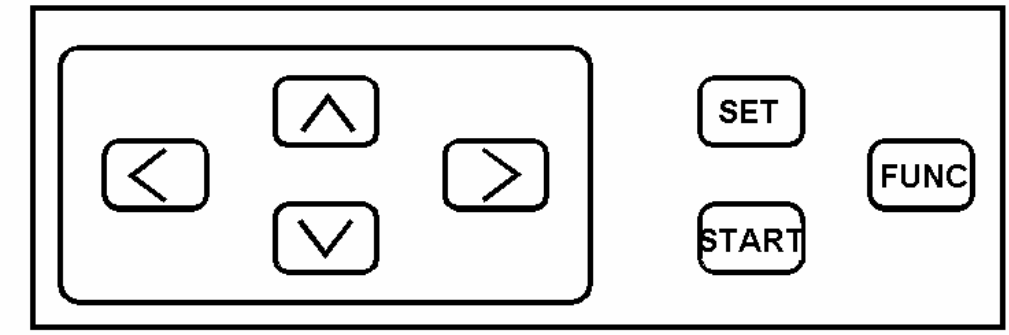


Figure 2-1.Keyboard Overview

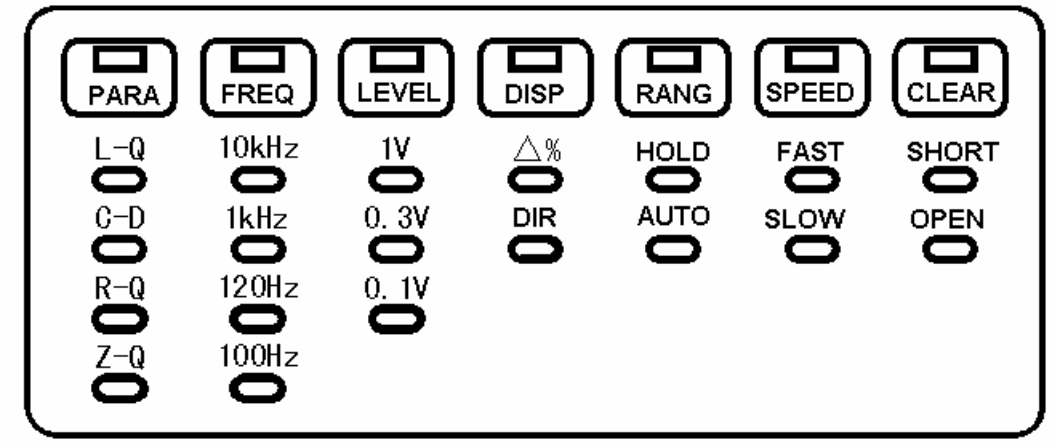


Figure 2-2.Status Indicator

TH2810B has 7 keys, and all of them have different functions in different conditions without direct definition. Each menu will be discussed in this chapter: The normal state is "measurement" state without pressing "FUNC" or "SET" key; and after pressing "FUNC" key, it is "inner function" state; and "parameter setup" state after pressing "SET" key. And the conversion of these states is shown in next figure.

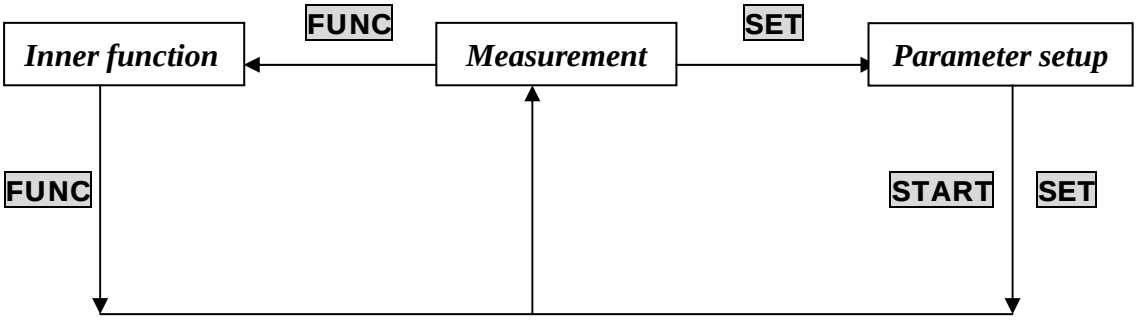


Figure 2-3. Status Conversion and Keys

Note: some characters are displayed on display window, while some corresponding letters show in parenthesis in the manual. And the correspondence of letters and characters is shown in the following table:

AbCcdELNOoqrSUZ
AbCcdELNOoqrSUZ

For example: When performing short correction, CLEAr SH is displayed, indicating "CLEAr SH".

When setting reference value, 25 is displayed, indicating "ZS", not "25".

1. "measurement" state: Functions are directly indicated on panel, as shown in Figure 2-2, and corresponding seven commonly-used functions can be controlled by operating the following cursor keys, [△], [▽], [◁], [▷], [START].

A. Measurement parameter: L/Q, C/D, R/Q, Z/Q, Z/D
B. Measurement frequency: 10 kHz, 1 kHz, 120 Hz, 100 Hz
C. Test signal level: 1.0V, 0.3V, 0.1V
D. Display mode: DIR (Direct) and △% (Percent deviation) in display A
E. Range mode: HOLD & AUTO
F. Measurement speed: FAST & SLOW
G. Clear (CLEAr): SHORT & OPEN

2. "inner function" state: seven inner functions are available:

A. Alarm (1--bEE): OFF & ON
B. Trigger (measurement mode) (2--ONE): OFF (continuous) & ON (single)
C. Equivalent mode (3--EqU): series (SEr) & parallel (PAr)
D. Sending is allowed through serial interface (4--rSC): OFF (only receiving allowed) & ON (both receiving and sending allowed)
E. Sorting mode (5--Sor): P1 & P3
F. Signal source resistance (6--rES): 30Ω & 100Ω
G. Key lock (7--Loc): OFF & ON

3. "parameter setup" state: sorting parameters and limits can be set.

A. Reference value setup: LS, CS, RS, ZS
B. High limit of dissipation setup (d^-), or low limit of quality factor setup (q_-)
C. High limit of Bin 1 ($P1^-$)
D. Low limit of Bin 1 ($P1_-$)

The following parameters are only displayed in P3 mode

E. High limit of Bin 2 ($P2^{-}$)
F. Low limit of Bin 2 ($P2_{-}$)
G. High limit of Bin 3 ($P3^{-}$)
H. Low limit of Bin 3 ($P3_{-}$)

And it is introduced how to realize each function as follows.

2.2 Function conversion in "measurement" state

Function indications in "measurement" state are shown in Figure 2-2 on P2-1. All functions can be set through the four cursor keys, ∧, ∨, <, and >. Functions in each state include items of function and parameter. For example, "measurement parameter" and "measurement frequency" are function items; "L/Q", "C/D", "R/Q", "Z/Q" are parameters corresponding to "measurement parameter"; and "100 Hz", "120 Hz", "1 kHz", "10 kHz" are parameters corresponding to "measurement frequency". Operate < and > cursor keys to select some function item and the corresponding indicator lamp is on; and then operate ∧ and ∨ cursor keys to select parameters in the function and the corresponding indicator lamp is on.

The default functions in "measurement" state are shown in Table 2-1.

function	parameter	frequency	level	display	range	speed	clear
parameter	C-D[NOTE]	1kHz	1.0V	direct	auto	slow	open

Table 2-1.The Default Functions in "measurement" State

NOTE: The default parameter of TH2775B is L-Q.

2.2.1 Measurement parameters

The optional measurement parameters of TH2810B are shown in Table 1-1.Measurement parameters table on P1-2.

L/Q: inductance L & quality factor Q;
C/D: capacitance C & tangent of dissipation angle D;
R/Q: resistance R & quality factor Q;
R/D: resistance R & tangent of dissipation angle D;
Z/Q: impedance Z & quality factor Q.

Parameters L, C, R, and Z are displayed in Display A, and D and Q in Display B. The parameter units are as follows:

L: μH, mH and H, 1 H=10^3 mH=10^6 μH;
C: pF, nF and μF, 1 μF=103 nF=106 pF;
R, Z: Ω, kΩ and MΩ, 1 MΩ=103 KΩ=106 Ω

Z, D and Q have the same measurement values in series or parallel equivalent circuit, while L, C and R have different measurement values in different equivalent circuits. The relation of the two equivalent circuit modes is shown in Table 2-4 Conversion between circuits of series and parallel connection on P2-11.

Z displayed in Display A is always positive (≥0). C, L and R may have negative values. When measuring C & D, the negative value of C means that the component under test has the characteristics of an inductor. When measuring L&Q, the negative value of L means that the component under test has the characteristics of a capacitor. In theory, the resistance of has the positive value. However, in some cases, value of R may be negative, which is generated due to excess correction. In order to eliminate the negative value of R, correct corrections are needed.
Sub parameter D is the reciprocal of Q, that is, D=1/Q.

2.2.2 Measurement frequency

Different components need signals with different measurement frequencies to measure. For example, electrolytic capacitor usually needs 100 Hz and120 Hz to measure, and metalized film capacitor needs 1 kHz or 10 KHz. It depends on real-world needs.
TH2810B provides four measurement frequencies: 100 Hz, 120 Hz, 1 kHz, and 10 kHz.

2.2.3 Test signal level

TH2810B provides three test signal levels available: 1 V, 0.3 V, and 0.1 V.
An inductor's inductance value may differ widely depending on the current through the inductor due to the permeability of its core material. Usually, high test level is used for normal test of components (such as capacitor, resistor and some kind of inductor), and low test level is used for those components which work in the circuit of low level (such as semiconductor device, output impedance of battery, inductor and nonlinear impedance component). For some devices, the measurement values differ widely depending on the measurement level, for example inductor components. And the voltage level actually applied across the device may be different with the set value, refer to §2.3.6 Signal source resistance.

2.2.4 Display mode

TH2810B provides two modes: direct and △% (percentage deviation).

2.2.4.1 Direct

In DIR mode, the measurement values displayed in Display A have their corresponding units. The following units are used by the instrument:
L: μH, mH and H, 1 H=10^3 mH=10^6 μH;
C: pF, nF and μF, 1 μF=10^3 nF=10^6 pF;
R, Z: Ω, kΩ and MΩ, 1 MΩ=10^3 KΩ=10^6 Ω
In DIR mode, when DUT hasn't been connected, in the state of L, R, and Z, there should be a large variable number displaying in Display A, which is even beyond display range to be no display. And D/Q value in Display B is a variable number.

2.2.4.2 △%

The formula is: $$\Delta\% = \frac{X_x - X_n}{X_n} \times 100\%$$, in which Xx is measured value, and Xn is the set nominal value.

Because it takes a while to complete deviation calculation at the time of measurement, the measurement speed slows a little.

Nominal value must be set before deviation measurement, because the absolute deviation is the difference between the measured value of the component and a previously set nominal value. And it has both magnitude and unit. Please refer to §2.4 Parameter setup method to set nominal value.

In this mode, positive and negative values display in percentage mode with the least resolution of 0.01%.

Incorrectly set nominal value leads to invalid △% display. If nominal value is set to be 0, △% will become infinite, which is beyond display range to make no display in Display A.

2.2.5 Range mode

2.2.5.1 Range definition and its range

TH2810B has five basic ranges and one extensional range. There is a cross between two neighboring ranges. When measurement range is set to AUTO, the instrument will judge if the optimum measurement range is selected after each measurement. If the range is the optimum range, the instrument calculates and displays the measurement value; otherwise the instrument should adjust the measurement range and measure again. So in AUTO mode, more time will be added to select the optimum measurement range and adjust the measurement range.

Range No.	Range	Range up	Range down
0	100kΩ	↑ 95kΩ	↓ 90kΩ
1	10kΩ	↑ 9.5kΩ	↓ 9kΩ
2	1kΩ	↑ 950Ω	↓ 900Ω
3	100Ω	↑ 95Ω	↓ 90Ω
4	31.6Ω	↑ 12Ω	↓ 11Ω
5	(extensional)10Ω		

Table 2-2.Range No., Range Resistance and Range Adjustment

From Table 2-2, there is a cross of 5% between two neighboring ranges, instead of an absolute dividing limit. And the cross can avoid range's frequent jumpiness when the impedance is right at the dividing limit, and the range doesn't vary. For example, Zx = 920 kΩ, it will be measured in Range 2 or Range 3.

According the test frequency, capacitance, or inductance, the range of the capacitor or the inductor can be calculated.

For example: C = 0.22 μF, D = 0.0010, measurement frequency f = 10 kHz, then

$$Z_X = R_X + \frac{1}{j2\pi fC_X}$$

$$|Z_X| \approx \frac{1}{2\pi fC_X} = \frac{1}{2\pi \times 10 \times 10^3 \times 0.22 \times 10^{-6}} = 72.37\Omega$$

From Table 2-3, the optimum range of this capacitor is Range 4.

2.2.5.2 Range Hold

When the components to be measured have the same nominal, we can set the range mode to HOLD to increase the measurement speed. When in HOLD mode, the instrument will not spend any time selecting the range. Perform the following steps to select the optimum range:

1. Press $\boxed{<}$ or $\boxed{>}$ key to select the function of RANGE;
2. Make sure that the range mode is in AUTO state;
3. Connect one of the components to the fixture;
4. Set the range mode to HOLD using $\boxed{\wedge}$ or $\boxed{\vee}$ key after the measurement value is stable.

If the impedance of DUT is out of the effective measurement range of the held range, TH2810B's measurement accuracy does not meet its specification. So make sure that the optimum range is selected when using the range hold function.

2.2.6 Measurement speed

TH2810B provides two measurement speeds: fast and slow. When the range is set to AUTO, measurement time needs to increase range adjustment time, and when the range is not correct, range adjustment time and another measurement time need to be increased.

Measurement Time

The measurement time consists of two main parts: integration time and calculation time.

The sum of integration time and calculation time determine the measurement speed.

The calculation time is about 25 ms;

Integration time in fast speed: approx. 30 ms;
Integration time in slow speed: approx. 180ms;
So approximate speeds can be calculated:
Fast speed: approx. 15times/sec.
Slow speed: approx. 4.5times/sec.

2.2.7 Clear (Correction)

In order to maintain high measurement accuracy, SHORT and LOAD corrections for correcting the stray admittance, the residual impedance, and the other errors can be performed. OPEN clear and SHORT clear are provided by TH2817. When TH2810B performs OPEN/SHORT correction, all ranges with different measurement speeds, frequencies, levels are cleared once. And all the clear parameters are saved in nonvolatile RAM inside the instrument. It's not necessary to clear "0" again when restarting instrument. When measurement environment changes, such as temperature, humidity, test fixture, and space between down-leads, another OPEN/SHORT correction should be performed.

- OPEN correction

1. Press $\lhd$ or $\rhd$ key to select the function of CLEAR;
2. Press $\wedge$ or $\vee$ key to select OPEN parameters, and "CLEAr" and "OP" are displayed. If clear operation is not needed, press $\lhd$ or $\rhd$ key to exit.
3. Make sure the test terminals are absolutely open.
4. Press START key to perform open correction. Then, the function item automatically alters to PARAMETER to exit.

- SHORT correction

1. Press $\lhd$ or $\rhd$ key to select the function of CLEAR;
2. Press $\wedge$ or $\vee$ key to select SHORT parameters, and "CLEAr" and "SH" are displayed. If clear operation is not needed, press $\lhd$ or $\rhd$ key to exit.
3. Use TH26010 short-circuit slice or conducting line of low resistance to make the test terminals absolutely short.
4. Press START key to perform short correction. Then, "CLEAR" parameter alters to "OPEN", and the function item automatically alters to PARAMETER to exit.

Note: When performing open or short correction, if the test terminals are not absolutely open or short as the manual describes, "FAIL" will be displayed in Display A, and the instrument makes short time alarm, which tells that because correction fails in this condition, the instrument can't save all the correction data and it will exit.

In order to make reliable correction, following rules should be observed:

1. Keep the same condition of the conducting line with that when the correction is performed;

2. When short correction is performed, shorting plate supplied by the instrument or conducting line of low resistance, should be used to make test terminals short. Don't directly connect HD and HS, LD and LS. Keep HD and HS, LD and LS not being directly connected after inserting conducting line of low

resistance when test fixtures are used to make short. And HS and LS can be directly connected.

Note: If the test terminals are not absolutely open or short, the instrument's operation performance is probably affected by incorrect clear parameters after correction.

2.3 Conversion of "inner function" state

There are seven functions in "inner function" state shown in Table 2-3.

Function	Parameter		
Name	**Display A**	**Name**	**Display B**
Alarm	1—bEE	off	OFF
		on	ON
Trigger (measurement mode)	2—ONE	off (continuous)	OFF
		on (single)	ON
Equivalent mode	3—EqU	series connection	SEr
		parallel connection	PAr
Serial interface	4—rSC	off – only receiving	OFF
		0n – receiving & sending	ON
Sorting mode	5—Sor	P3	P3
		P1	P1
Signal source resistance	6—rES	30Ω	30
		100Ω	100
Key lock	7—Loc	off -- unlocked	OFF
		on -- locked	ON

Table 2-3 Parameters in "inner function" State

Note: Parameter setup in shadow is default state.
As Figure 2-3 on P2-2 shows, at the state of "measurement", press FUNCTION key once to enter the state of "inner function". Perform the following steps to set function parameters:

1. After selecting "inner function" state, selected function is shown in Display A, and parameter of the function in B;
2. Use $\langle$ or $\rangle$ key to select some function item;
3. Use $\wedge$ or $\vee$ key to select parameter of the function;
4. Repeat the above operations to select parameters of all functions;

5. Press FUNCTION key to exit.

2.3.1 Alarm

The default setting is "OFF", which means no alarm.
When "ON" is selected, and the sorting result is "P1" or "PASS", the beeper alarms.
Only if the sorting parameter is correctly set to get correct sorting result signal, correct alarm signal can be obtained.

2.3.2 Trigger (continuous/single)

The default setting is "OFF", which means continuous measurement. In this mode, the instrument continuously measures and calculates display value. And after one measurement, another measurement immediately starts.
If "ON" is selected, which means single measurement, the instrument doesn't start one measurement until getting 'START" signal. The signal can be obtained through either START key on front panel or HANDLER interface, RS-232C interface.

2.3.3 Equivalent model

The default model is serial connection ("SEr").
The real-world capacitor, resistor and inductor are not ideal, but component of complex impedance in the form of serial connection or parallel connection. The instrument calculates necessary values according to equivalent circuit connected in series or parallel. And different result will be obtained in different circuits, differing in different components.
The following description gives some practical guide lines for selecting the equivalent circuits:
1. Real-world equivalent circuit can be selected following the manufacturer's recommendation. If there is no recommendation to be followed, we select the circuit mode according to the variation of D under two different frequencies. If the dissipation factor of a capacitor increases with the increase of the test frequency, series circuit mode will be selected. In formulas in following table, D in series connection is in direct ratio with frequency. If the dissipation factor decreases with the increase of the test frequency, parallel circuit should be used, and D in parallel connection is in inverse ratio with frequency. For inductor, the situation is just in the opposite side.
2. Judge according to the actual application in circuits. If a capacitor is used as a coupling capacitor, series circuit mode is the best choice; if a capacitor is used in a LC oscillator then parallel circuit model can be selected.
3. Select the equivalent circuits according to the following rules:
Component with low impedance (such as large capacitor and small inductor) is usually measured in series circuit mode;
Component with high impedance (such as small capacitor and large inductor) is

usually measured in parallel circuit mode;
Normally, when |Zx| < 10Ω, the series circuit mode is selected;
When |Zx| >10kΩ, the parallel circuit mode is selected;
When 10Ω<|Zx| <10kΩ, follow the manufacturer's recommendation.
Two equivalent circuits can be conversed through some formula, and Q and D don't change in different circuits, as shown in table 2-4, where s means series connection, p means parallel connection.
Q=Xs/Rs, D=Rs/Xs, Xs=1/2πFCs=2πFLs

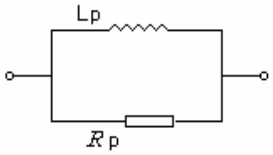
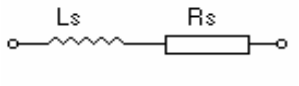
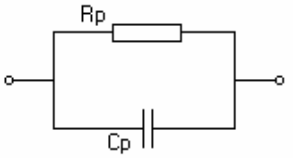
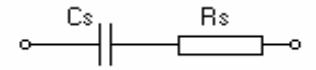
Circuit model		Dissipation (D)	Equivalent model conversion
L		D=2πFLp/Rp=1/Q	Ls=Lp/(1+D²) Rs=RpDP2P/(1+D²)
		D=Rs/2πFLs=1/Q	Lp=(1+D²)Ls Rp=(1+D²)Rs/D²
C		D=1/2πFCpRp=1/Q	Cs=(1+D²)Cp Rs=RpDP2P/(1+D²)
		D=2πFCsRs=1/Q	Cp=Cs/(1+D²) Rp=Rs(1+D²)/D²

Table 2-4 Circuit Model Conversion

2.3.4 Serial interface

The default setting is "OFF", which means that serial interface is always in the state of receiving command (unilateralism). When it is set to "ON", the instrument sends measurement state and result through interface at the same time. If "4-rSC ON" is selected, RS-232C interface is opened, which means that it is allowed to send measurement result through serial interface (bidirectional). TH2810B's serial interface meets the RS-232C DB-9 standard. The serial interface adopts
asynchronous serial communication bus with fixed baud rate of 19200 bit, the logic level of ±8V and the maximum transmission distance of 15m. The data format is as follows:

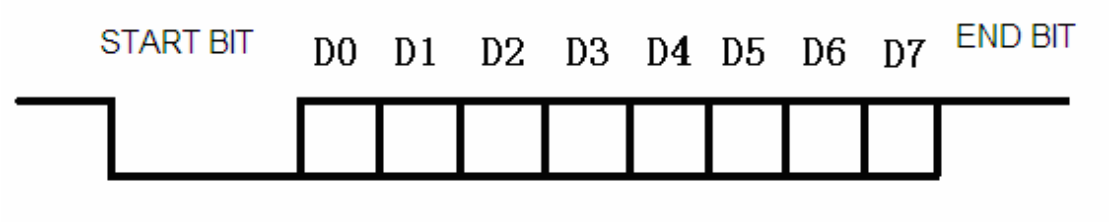
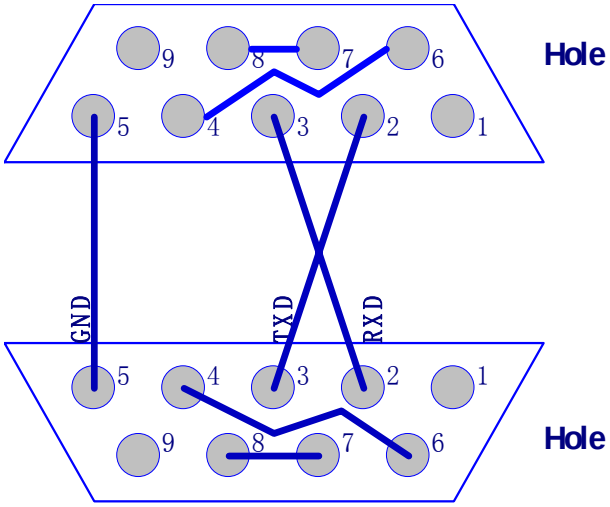


Figure 2-5 Data Format Transmitting through RS232C Serial Interface



RS232C interface cable

Pin 2: RXD pin, sending terminal
Pin 3: TXD pin, receiving terminal
Pin 5: GND, instrument ground

Figure 2-6 RS232C Serial Interface's Connection with Cable

Information transmitted through RS-232C interface is ASCII code. The output information is listed in Table 2-5 (TH2810B → computer).

No.	Function	Symbol	Description		
1	start character recognition	{	no special meaning		
2	display of main and sub parameters	0, 1, 2, 3		main parameter	sub parameter
			0[note 1]	Inductance (L)	quality factor (Q)
			1[note 2]	capacitance (C)	dissipation (D)
			2	resistance (R)	quality factor (Q)
			3	impedance (Z)	quality factor (Q)
3	frequency	0, 1, 2, 3	0: 10kHz 1: 1kHz 2: 120Hz 3: 100Hz		
4	level	0, 1, 2	0: 1V 1: 0.3V 2: 1V		
5	display mode	0, 1	0: percentage deviation 1: direct		
6	range	0, 1	0: hold 1: auto		

7	speed	0, 1	0: fast 1: slow			
8	clear	0, 1	0: short 1: open			
9	beeper	0, 1	0: on 1: off			
10	trigger mode	0, 1	0: continuous 1: single			
11	equivalent model	0, 1	0: serial connection 1: parallel connection			
12	serial interface	0, 1	0: off (only receiving) 1: on (receiving and sending)			
13	sorting mode	0, 1	0: P1 1: P3			
14	impedance	0, 1	0: 30Ω 1:100Ω			
15~20	main parameter data	0~9, ".", "-"	from high digit to low digit			
21~26	sub parameter data	0~9, ".", "-"	from high digit to low digit			
27	unit of main parameter or %	0, 1, 2, %		L-Q	C-D	R/Z-Q
			0	uH	pF	Ω
			1	mH	nF	kΩ
			2	H	uF	MΩ
			%	percentage deviation		
28	sorting output	0, 1, 2, 3, 4, 5		P3	P1	
			0	NG (not qualified)	D/QNG (sub parameter is more than limit)	
			1	P1 (first-class)	PASS (pass)	
			2	P2 (second-class)	HI (more than high limit)	
			3	P3 (third-class)	LO (less than low limit)	
			4		D/QNG & HI	
			5		D/QNG & LO	
29	current range	0, 1, 2, 3, 4, 5	five following ranges: 0: 100kΩ 1: 10kΩ 2: 1kΩ 3: 100Ω 4: 31.6Ω 5v10Ω			
30	end bit	}	no special meaning			

Table 2-5 Format of Serial Data Transfer

Note 1: In Th2618B: resistance (R) & dissipation (D)
Note 2: In Th2775B: resistance (R) & quality factor (Q)
The control command of TH2810B serial interface is listed in Table 2-6 (computer →TH2810B, in the form of ASCII code).
In the following table, each command can only be sent alone, and you are not allowed to send more than two commands once. Each command starts with { and ends with }. Command with wrong format can't change corresponding function, and will be dealt with as invalid command by the instrument. It's

suggested that limit parameter and nominal value be input according to the format requirement after the instrument is adjusted, in order to avoid being dealt with as invalid command.

No.	Command code Note 0	Characters	Function
1 Note 1	A0	2	measurement parameter & series connection and parallel connection: L-Q
2 Note 2	A1	2	measurement parameter & series connection and parallel connection: C-D
3	A2	2	measurement parameter & series connection and parallel connection: R-Q
4	A3	2	measurement parameter & series connection and parallel connection: Z-Q
5	B0	2	measurement frequency: 10 kHz
6	B1	2	measurement frequency: 1 kHz
7	B2	2	measurement frequency: 120 Hz
8	B3	2	measurement frequency: 100 Hz
9	C0	2	measurement level: 1 V
10	C1	2	measurement frequency: 0.3 V
11	C2	2	measurement frequency: 0.1 V
12	D0	2	display mode: △%
13	D1	2	display mode: direct
14	E0	2	range: holding at current range
15	E1	2	range: auto
16	E2	2	range: holding at 0 (100 kΩ)
17	E3	2	range: holding at 1 (10 kΩ)
18	E4	2	range: holding at 2 (1 kΩ)
19	E5	2	range: holding at 3 (100 Ω)
20	E6	2	range: holding at 4 (31.6 Ω)
21	E7	2	range: holding at 5 (10 Ω)
22	F0	2	measurement speed: fast
23	F1	2	measurement speed: slow
24	G0	2	short correction
25	G1	2	open correction
26	H0	2	alarm: (ON) to turn on beeper
27	H1	2	alarm: (OFF) to turn off beeper
28	I0	2	trigger: (Off) continuous
29	I1	2	trigger: (Off) single
30	J0	2	equivalent model: (SER) serial

<table>
<tr><td></td><td></td><td></td><td>connection</td></tr>
<tr><td>31</td><td>J1</td><td>2</td><td>equivalent model: (PAR) parallel connection</td></tr>
<tr><td>32</td><td>K0</td><td>2</td><td>RS232A□: (OFF) only receiving</td></tr>
<tr><td>33</td><td>K1</td><td>2</td><td>RS232A□: (ON) receiving and sending</td></tr>
<tr><td>34</td><td>L0</td><td>2</td><td>sorting mode: P1</td></tr>
<tr><td>35</td><td>L1</td><td>2</td><td>sorting mode: P3</td></tr>
<tr><td>36</td><td>M0</td><td>2</td><td>signal source resistance: 30Ω</td></tr>
<tr><td>37</td><td>M1</td><td>2</td><td>signal source resistance: 100Ω</td></tr>
<tr><td>38</td><td>NX=$X_1X_2BX_3X_4X_5X_6X_7$</td><td>≤10</td><td>NX: related set parameters
Parameter values and units are after "=".
The regulations are as follows:
N1: nominal value N2: Q/D limit value
N3: first-class high limit N4: first-class low limit
N5: second-class high limit N6: second-class low limit
N7: third-class high limit N8: third-class low limit
Data format is as follows after being received and adjusted:
1. N1: X1: ASCII code (0~9);
X_2~X_6: ASCII code (0~9 and point);
X_7: ASCII code (0~2) (unit code)
Definition of X_7 is as follows:
<table>
<tr><td>X_7's ASCII code</td><td>C</td><td>L</td><td>Z, Q</td></tr>
<tr><td>30H</td><td>pF</td><td>μH</td><td>Ω</td></tr>
<tr><td>31H</td><td>nF</td><td>mH</td><td>KΩ</td></tr>
<tr><td>32H</td><td>μF</td><td>H</td><td>MΩ</td></tr>
</table>
2. N2: X1: ASCII code (0~9);
X_2~X_6: ASCII code (0~9 and point);
3. N3~N8:
X_1: ASCII code (+, -);
X_2: ASCII code (0~9);
X_3~X_6: ASCII code (0~9 and point);
X_7: ASCII code (%)</td></tr>
<tr><td></td><td colspan="2">Example and notes: (symbols used to express in the examples, and ASCII code should be used in real-world program)
1. N1=122 will be automatically adjusted to N1=12.0002 (7 characters) after being received by the instrument, and the last bit is unit code. When resistance is measured, the nominal value is 12 MΩ. That is, N1 starts with number (the first one from 0~9), the rest being numbers (0~9) and point, and ends with unit code. The number of total characters should be less than 7 after automatic adjustment.
2. N2=12 will be automatically adjusted to N2=12.000 (6 characters) after being received by the instrument, that is, N2 (Q/D limit value) starts with number (the first one from 0~9), and the rest are number 0~9 and point. The number of total characters should be less than 6 after automatic adjustment.
3. N3=1% will be automatically adjusted to N3=+1.000% (7 characters) after being received by the instrument, that is, N3~N8 (limit value) starts with symbols or numbers. If starting with symbol, the second character should be number, the rest being number 0~9 and point, and ends with %. The total characters should be less than 7 after automatic adjustment.</td><td></td></tr>
</table>

39	NX=? Note 3	4	The instrument sends corresponding setting value once after receiving the command that setting value is inquired. Sending format: {NX=$X_1X_2X_3X_4X_5X_6X_7$}. Refer to command 38 Data format regulation after being received and adjusted.
40	P0	2	start, the same function as START key.

Table 2-6. Format of Serial Command

Note 0: "Command code" should be in the form of ASCII code in the real-world program. Such as, {0} can be recognized by its ASCII code, 7B41307D.
Note 1: In TH2618B: resistance (R) & dissipation (D).
Note 2: In TH2775B: resistance (R) & quality factor (Q).
Note 3: Defined reference command of NX is 38.
The controller sends continuous command program: sending command 1 —> the function of making sure that data the instrument sends back are received has been altered correctly —> sending command 2 again. Recycle these operations till all the functions are correctly altered.

2.3.5 Sorting mode

Th2810B provides two sorting modes: P3 (default mode) and P1, which are valid in both direct and Δ% display modes.

2.3.5.1 Sorting procedure

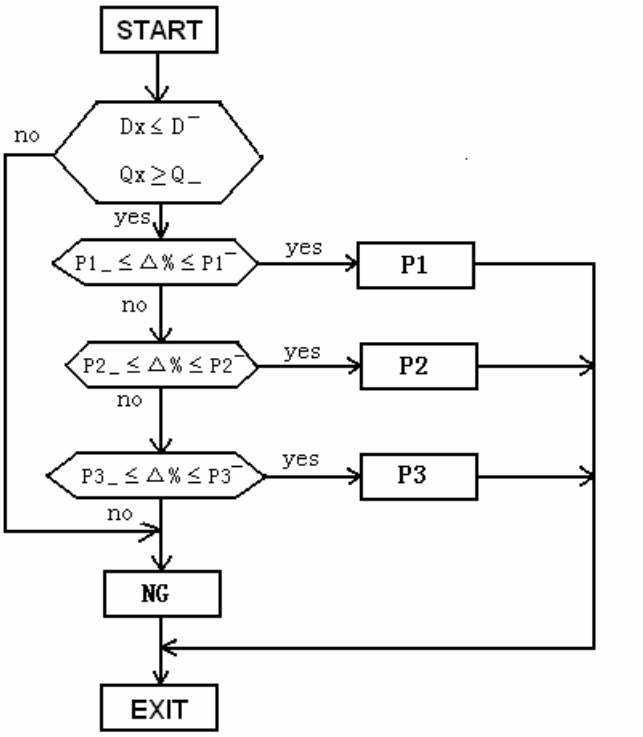


Figure 2-7 Sorting Procedure in P3 Mode

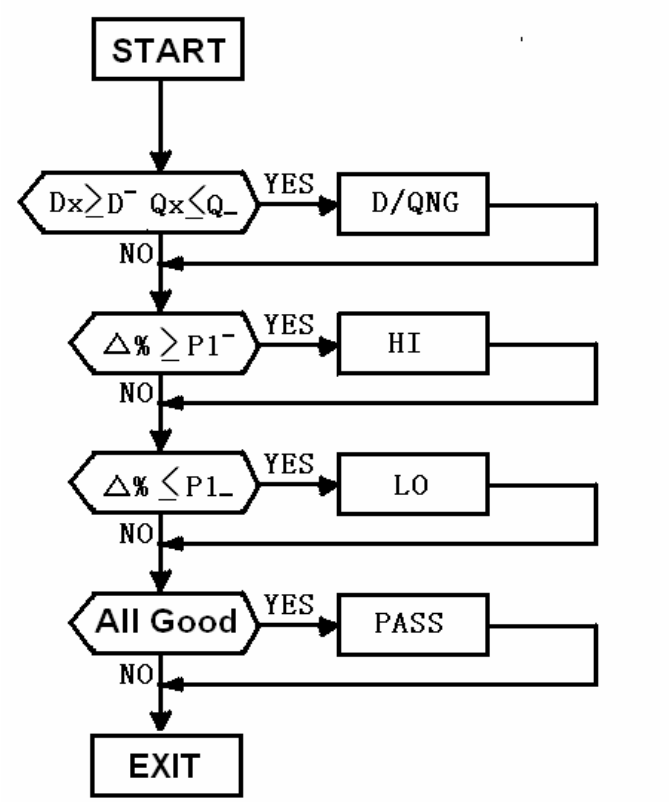


Figure 2-8 Sorting Procedure in P1 Mode

As shown in above figures, P3 sorting mode is suitable for sorting multi-bin, where only one of P1, P2, P3 and NG signals is valid. When one of P1, P2, P3 signals is valid, sub parameter must be qualified; and when NG signal is qualified, probably main parameter or sub parameter is not qualified.

2.3.5.2 Handler interface

Refer to §2.4 Parameter setting method to set main and sub parameters and nominal value. Then insert the DUT, and the sorting result can be obtained through the following methods:

- Observe sorting instruction information on panel to tell whether the component is qualified or not. There are four indicator lamps, which have corresponding results:

In the state of P3: P1: first-class product P2: second-class product
P3: third-class product NG: not qualified
In the state of P1: PASS: qualified
HI: main parameter is more than high limit
LO: main parameter is less than low limit
D/QNG: sub parameter is not qualified

- If alarm is on (refer to §2.3.1 Alarm), the beeper in the instrument makes alarm when P1 (PASS) signal is output.
- Handler interface: the precondition is that the instrument must be set to single mode (refer to §2.3.2). Through this interface, TH2810B can synchronously work with one component's auto measurement system. An outer "START" signal is received through the interface to start measuring, and four sorting result signals and two synchronous controlling signals are sent out to control outer machine's movement structure.

Handler interface is on the rear panel, and its signals are as follows (definitions in P1 sorting state in brackets):

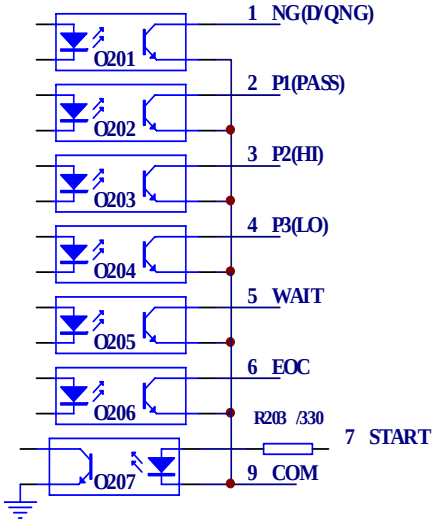


Figure 2-9 Pin of Handler Interface

Note:

Because light coupling output signal is opto-isolated circuit, resistance must be pulled up so that signal can be output. Current of 25 mA can be absorbed when the signal is low asserted.

When one sorting result signal is valid, corresponding light coupling output terminal is connected. For example: if P1 is valid, light coupling O202 is connected, and P1 is low asserted.

Value of R203 (default 330Ω) should drive O207 into saturation, with the input current of 12mA. If power is 24V, R203 = power/12mA = 24V/12mA = 2 kΩ. User can change R203 on main PCB, or serially connect a resistance of 2 kΩ between outer switch and Pin 7 START. And if power is 12V,

the resistance of 1 kΩ should be applied.
Definitions of pins are as follows:

1. Sorting result (NG/DQNG, P1/PASS, P2/HI, P3/LO): output, low-asserted.
2. WAIT (busy): output, high-asserted. This signal can be used to control outer machine's operation of dealing with equipment. When the signal is valid, the instrument is in the state of measurement and calculation.
3. EOC (A/D completion): output, high-asserted. When this signal is output, the DUT's measurement (A/D conversion) has completed, but probably the calculation is still in procession. When the output is low, it must be ensured that test terminal and the DUT keep good connection. And when it's high, it's allowed to move next DUT to test terminal to prepare for next measurement.
4. START (start): input, rising edge and it's valid when the maintaining time of high level is more than 2.5ms. This signal is supplied to HANDLER's input terminal from outside.
5. COM: interface's grounding terminal.

Figure 2-10 shows the timing diagram of the Handler interface. (A, B and C are the three component measured. Component A is sorted to Bin P1, B is sorted to P1 and C is sorted to P2.)

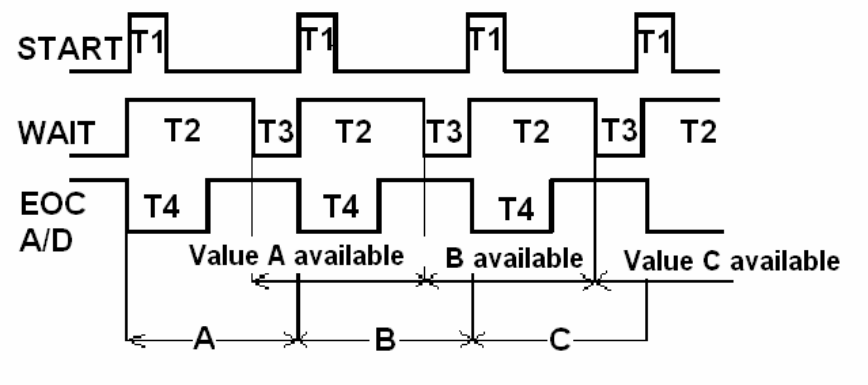


Figure 2-10.The Timing Diagram of Handler Interface

T1: T1 is the pulse width of START which must be more than 2.5ms. When START goes high, the instrument starts a measurement. START signal should return low before the WAIT signal goes low; otherwise the next START signal will not be effective. If there in no external START signal, the START key on the front panel can also be used.
T2: During the time of T2 the instrument performs A/D conversion, correction, calculation, and comparison. The value of T2 depends on the measurement speed. At the end of T2, the comparison results are outputted to the component handler.
T3: This is the period when last measurement is finished and the next measurement has not been started. The handler is free to position the next component for measurement.
T4: Instrument performs A/D conversion during the time of T4.
The comparison output signals are effective until the signals are output next

time, as shown in Figure 2-10.

2.3.6 Signal source resistance

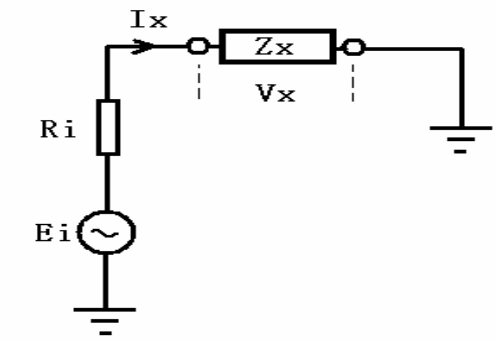


Figure 2-11 Equivalent diagram of signal source output

There are two resistances available: 30Ω (default) and 100Ω.

In Figure 2-11, Ei: signal source voltage Ei; Ri: signal source resistance; Zx: the DUT, Vx is its voltage and Ix current.

Then, Vx=Ei Zx/(Ri+Zx)

Ix= Vx/ Zx= Ei/(Ri+Zx)

When Zx<<Ri，Ix= Ei/ Ri

The level across the DUT and floating current, are related to the instrument's level (refer to §2.2.3 Test signal level), signal source resistance, and the DUT's impedance.

When measuring some components that are sensitive to signal's value, such as magnetic-core inductor, ceramic capacitor. To compare consistency between each other, signal should be approximate, when the instrument's signal source resistance should be well known.

2.3.7 Key lock

The default state is "OFF", indicating the keys can be operated, and initialization state is default.

To avoid operator's improper operation, the instrument provides the function of key lock. In this state, all the keys are invalid except unlock key 'FUNCTIN". And the instrument can't be enabled until the function of key lock is cancelled.

2.3.7.1 Entering key lock

1. The instrument is in the state of normal measurement.
2. Press the following keys in order: FUNCTION, ＜, △, FUNCTION. When "7-Loc ON" is displayed, exit to the state of "MEASURE". And the instrument has been in the state of key lock.

When the instrument is in the state of key lock, all the keys are not available. And if the instrument is turned off in the state of key lock, it will keep the state when it's turned on next time, and measurement state and setting parameters as well.

2.3.7.2 Exiting key lock

When the instrument is in the state of key lock, press the following keys in order: FUNCTION, △, FUNCTION. And when "7-Loc OFF" is displayed, exit to the state of "MEASUREMENT". The instrument returns to normal state.

2.3.7.3 Notices in the state of key lock

When the instrument is in the state of key lock, all the keys are not available. Do not think that the instrument is defective. Please operate as §2.3.7.2 says, to return to the normal state.

2.3.8 Safeguard

TH2810B has RAM inside, which stores some parameters so that they would lose easily. And the parameters can be stored in RAM are as follows:

1. Measurement frequency, short & open correction parameters at the time of measuring level;
2. Nominal value and limits;
3. State values at the time of key lock.

2.4 Parameter setup

1. Press LIMIT once in the state of "MEASUREMENT" to enter "parameter setup".
2. Parameter symbol is displayed in Display B, and the set value of last time is display in Display A and unit, with one digit flickering, which is modification digit (△, ▽ are operated to move point if the value is decimal, and could be used to select the unit if unit indicator is flickering.)
3. Operate < and > to flickering digit, and change the value through △ and ▽ keys.
4. Press LIMIT to modify the next parameter, or press START to store the value and exit to the state of "MEASUREMENT".
5. Repeat the above operations until completing setting all the parameters.

Note: High and low limits are set in the mode of percentage deviation. (Refer to §2.2.4.2 △ %). And the limit's first number means sign ("0" for positive, and "1" for negative). For example, capacitance with nominal value of 100pF is sorted, and the range is 97pF – 105pF, then the range in △ % is -3% - 5%.

No.	Name	Display A	Display B	Note
1	nominal value	5-digit number + 1-digit decimal point + 1-digit unit	Inductance (LS), capacitance (CS), resistance (rS), impedance (ZS)	Positive always
2	high limit of dissipation or low limit of quality factor	5-digit number + 1-digit decimal point	Dissipation (d-), quality factor (q-)	
3	high limit of pin 1	first-digit sign + 4-digit number + 1-digit	P1-	
4	low limit of pin 1		P1-	
5	high limit of pin 2		P2-	only

6	Low limit of pin 2	decimal point (all the numbers are input in the mode of △ %)	P2-	necessary at 3-pin sorting
7	high limit of pin 3		P3-	
8	low limit of pin 3		P3-	

Table 2-7 Limit parameters

Chapter 3 Component measurement

This chapter provides description of instrument operation and lists some measurement examples.

3.1 Unpacking and inspection

3.1.1 Notices

1. After unpacking, please verify with packing list.
2. Read Operation Manual in details before operating the instrument, especially some notes and notices; or operate the instrument under instruction of professional personnel.
3. Power
   The instrument adopts the power supply of 220VAC±10%/50Hz±5%. Before switching on the power supply, make sure that line voltage is correct. Neutral, Line and Earth should be connected correctly as shown in Figure 3-1:

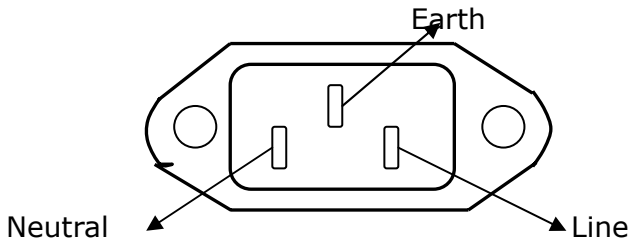


Figure 3-1 Power Supply Receptacle

   For protection from electrical shock, the power cable ground must not be defeated. The power plug must be plugged into an outlet that provides a protective earth ground connection.
   Then outlet can't be shared with those devices consuming large power to avoid interference or damage of the instrument.
4. The instrument should be operated under the environment conditions specified in the manual. Always keep the instrument and the test terminals away from electrical and magnetic field to avoid influence of the measurement accuracy.
5. Allow the instrument to warm up a minimum of 10 minutes before starting any of the performance tests.
6. Turn off the power supply and draw out the plug, when instrument is not in use, or when covers need to be removed for troubleshooting.

3.1.2 Common component measurement

1. Switch on the power supply correctly. And the instrument's default

measurement status is shown in table 3-1.

outer function	**parameter**	**frequency**	**level**	**display**	**range**	**speed**	**clear**
parameter	C-D[note]	1kHz	1.0V	direct	auto	slow	open
inner function	**alarm**	**trigger**	**equivalent**	**serial interface**	**sorting mode**	**source resistance**	**Key lock**
parameter	off	off	serial connection	receiving only	3-pin sorting	30Ω	off

Table 3-1 Default status

Note: TH2775B's default parameter is L-Q.

2. Select measurement parameter: L/Q, C/D, R/Q, Z/Q or R/D (only for TH2618B).
3. If necessary, select equivalent mode, referring to §2.3.3 on P2-19. NOTE 1
4. Select measurement frequency and test signal level.
5. If necessary, select suitable signal source resistance, referring to §2.3.6 on P2-19. NOTE 2
6. Connect test fixtures or cables. Test fixture TH26001 and 4-terminal Kelvin test cable TH26004 are equipped along with the equipment. Test fixture Th26005 is optional for meter with little space between components, and TH26009 is for SMD component.
7. Perform a short correction, using a shorting bar to test fixture or cable.
8. Perform an open correction without the shorting bar. NOTE 3
9. Connect the component to the test terminals and the measurement values are displayed in Display A and B.

Note 1: When the DUT's Q or D is large enough, even close to 1, the measurement values in serial and parallel connections differ a lot.
For example, a capacitance in serial model is Cs = 0.1μF, and dissipations respectively are D1 = 0.0100, D2 = 0.1000 and D3 = 1.0000, then according to fourmula $Cp=Cs/(1+D^2)$, capacitances in parallel model are:
Cp1 = 0.09999μF
Cp2 = 0.09901μF
Cp3 = 0.05μF
You can find that, when D<0.01, the difference between Cs and Cp is very small, but while D>0.01, the difference will be very obvious. For example, when D = 0.1, the difference between Cs and Cp in percentage is approx. 1%, while D = 1, the difference in percentage will be approx. 100%.
Note 2: At the time of measuring component which is sensitive to signal, such as core inductor, ceramic capacitor, it should be compared with the same signal to keep the consistency. In this case, not only test signal level should be selected, but also signal source resistance.
For example, a ceramic capacitor is measured by HP4284A to be of the parameter of 0.1μF, but it's measured to be 0.11μF by TH2810B at the same

level. The reason is that HP4284A's signal source resistance is 100Ω, while TH2810B's is 30Ω. According to §2.3.6 on P2-19, we know that voltage on the DUT is different even their level is the same. So change TH2810B's resistance to 100Ω, and the same measurement value will be got.
Note 3: Refer to §2.2.7 on P2-8 to perform correction. Improper correction will lead to instrument's inaccurate result, even out of work. And the common improper operations are: a) At the time of short or open correction, the DUT is connected; b) Connect HD, HS and LD, LS together to perform short correction.

3.2 Connection of Component

3.2.1 Measurement of Capacitor

Do not apply DC voltage or current to the test terminals. Doing so will damage the instrument. Before you measure a capacitor, be sure the capacitor is fully discharged.

3.2.2 Connecting the Component

TH2810B has four test terminals and the outer shields of each terminal are connected with the instrument ground, the outer shield can be looked as the fifth terminal. Descriptions of the five terminals are as follows:
HD: high drive terminal of current;
LD: low drive terminal of current;
HS: high sense terminal of voltage;
LS: low sense terminal of voltage;
⊥: Ground.
The ground shields are used reduce influence of stray capacitance and electromagnetic disturbance. HD, HS and LD, LS should be connected at the lead of the component under test in order to reduce the influence of cable resistance and contact resistance especially in D measurement. At the time of measuring low impedance, the drive terminals and sense terminals should be connected to leads of component separately so as to avoid the influence of lead resistance.
In other words, HD, HS and LD, LS cannot be connected before connecting to the component otherwise measurement error will be caused.
If contact resistance and leads resistance R_{lead} are far less than the impedance tested (for example $R_{lead} < Zx/1000$, and the accuracy required is 0.1%), then HD, HS and LD, LS can be connected together before connecting to the component under test (two-terminal measurement).
Test fixture is recommended when high accuracy is required. Kelvin test cables have better performance when measurement frequency is less than 10 kHz but it can hardly meet the accuracy requirement when frequency is larger than 10 kHz, because different positions of test leads will directly influence the stray

capacitance and inductance between the test terminals.
Therefore, test fixture is recommended for high frequency measurement. If the test cable must be used, try you best not to move the cable during the corrections and measurements.

Chapter 4 Packing and Warranty

4.1 Packing

The contents are listed as follows:

Description	Quantity
1) TH2810B/TH2618B/TH2775B	1
2) TH26011 Kelvin Test Fixture	1
3) TH26004-1 5-terminal Test Cable	1
3) TH26010 Shorting Bar	1
4) Three-Wire Power Cable	1
5) Fuse (1A)	2
6) Operation Manual	1
7) Quality Certificate	1
8) Test Report	1
9) Warranty Card	1

And the following are optional:

TH2810B-HANDLER Interface Cable	TH2810B-RS232C Interface Cable
TH12011/2/3- RS232C Interface Software	TH26004 5-terminal Test Cable
TH26005&TH26006 Axial Test Fixture	TH26007 Core Test Fixture
TH26008 SMD Test Fixture	TH26009 SMD Kelvin Test Tweezers

Check the contents when you received the instrument. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the power-on self-tests, please contact our company or business department immediately.

4.2 Warranty

The period of warranty: the period of warranty will start from the date the instrument is delivered. The period of warranty is two years. The warranty card is needed when the instrument needs to be repaired. The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer.