KT600
OSCILLAGRAPH

USERS MANUAL

Safety Warning and Precautions

- **Please read this users manual carefully before using the instrument.**
- **Operation of the instrument requires knowledge about automobile test and repair and certain understanding about electric control system of the tested automobile.**
- **Test under good ventilation; otherwise please extend vehicle pipeline to outdoor.**
- **No smoking during operation of the tool.**
- **Battery fluid of automobile contains sulfuric acid which is corrosive to skins. Direct contact of battery fluid to skin should be avoided when operation, and special attention should be paid to your eyes.**
- **Engine has higher temperature when running, and contact to water tank, exhaust pipe and other parts with high temperature should be avoided.**
- **Before starting engine, apply hand brake and block front wheel specially, and place the gear lever to P gear or Neutral to avoid bodily wound when starting engine.**
- **If battery is used as power supply, it is imperative that red alligator clip connects to positive and black alligator clip to negative.**
- **When instrument is used in engine compartment, all power supply cables, pens and tools should be away from belt or other moving parts.**
- **Do not wear watch, ring or large clothes when working in engine compartment.**
- **Always wear approved safety glasses during all automobile tests.**

CONTENTS

Preface

SHENZHEN WEICON INDUSTRIAL CO., LTD. (hereafter called as WEICON) launches new Kingtec KT600 automobile diagnostic system (shortened as KT600) to meet the needs of customers. While maintaining the advantages of excellent performance of Kingtec instrument and quick upgraded services, KT600 experiences technical improvements and has better appearance. It has more stable testing performance, and its test on vehicle model and range of test system are upgraded constantly. It has more powerful oscillographic function while providing auxiliary functions such as automobile dictionary.

Customers having Kingtec instruments can easily upgrade your instruments through the website of WEICON. Please visit WWW.WEICON.COM.CN for more details.

The users manual is for the purpose of correct use of the instrument in a quick way, and its main contents contain equipment introductions, precautions for equipment use, register method, equipment connection, operation method, upgrade method, etc. Be sure to read this manual carefully before using the instrument.

The users manual only contains operation and use method for oscillograph. Refer to KT600 user's manual and repair manual for repair and diagnosis of specific automobile.

If you still have doubts after reading the manual, please contact distributor timely or directly dial the service telephone number of WEICON: +086-0755-83476767.

I. Equipment Introductions

Kingtec KT600 oscillograph, special for automobile, is solely developed by SHENZHEN WEICON INDUSTRIAL CO., LTD. It can collect in real-time the waveform of sensors of ignition, fuel injection, and electric control system, and can precisely diagnose sensor failures through analysis of waveform of sensors. It can diagnose, through the analysis of ignition waveform, not only the failure of elements of ignition system such as spark plug, high voltage line and ignition coil, but possible failure of air intake system and fuel system, providing scientific basis for operation conditions of failure diagnosis of automobile.

1.1 Basic Functions

- The development of Kingtec KT600 oscillograph function realizes real-time display of secondary ignition waveform for the first time in China. Equipped with leading 32-bit CPU for main control+high speed digital processing chip, KT600 can process signal in real time under high sampling frequency of up to 20MHZ.
- High speed five-channel automobile special oscillograph, with storage function for reference waveform;
- Analysis of primary and secondary ignition waveform for automobile; with multiple waveform display modes such as longitudinal, three-dimensional, array and single cylinder modes, with ignition breakdown voltage, dwell angle and combustion time, etc. displayed. Precise ignition synchronization, automatic testing of ignition signal pole; no matter distributor ignition, independent ignition and double end ignition, they can all be tested reliably, equivalent to a hand engine analyzer.
- Universal oscillograph functions;
- Recorder function
- Engine analyzer function (optional)

1.2 Technical Features

- Adoption of four-layer circuit board technology of International Industrial Standard allows powerful stability and anti-interference ability of product;
- The first domestic special oscillograph for automobile that displays real waveform in real time;
- Design of no need to insert card allows easier operation;
- Unique self-diagnosis function for hardware of equipment;

- Quick software upgrade through Internet;
- Special online data stream waveform display and back play makes it possible to capture precisely tiny change of data stream.
- Equipped with leading 32-bit CPU for main control+high speed digital processing chip to provide fast processing speed;
- Adoption of programmable VLSI (very large scale integrated circuit) design make hardware design more stable and reliable, and make possible online hardware upgrade;

1.3 Equipment Configuration and Parameters

1.3.1 Main Unit

Item	Index
Voltage of power	12V DC
Operating temperature	-30˚C~+50˚C
Relative humidity	Less than 90%
Serial port	Standard RS232（ps/2 port）
USB port	USB1.1 for main unit port
RJ45 network port	10M
CF card port	CF card for plug and play

1.3.2 Performance Parameter of Oscillograph

Item	Index
Number of channel	5 /3 channels
Sampling frequency	20MHz
Sampling precision	Double 8 bits
Voltage range	20mV~20v/div
Scanning time	2．50uS~2S/ div

1.3.3 Hardware Configuration

System hardware	Index
CPU	32-bit embedded chip
Main frequency	80MHz
Flash memory	Very large capacity FLASH, rewritable
External memory	CF card, expandable discretionally
Display	6.4 inch LCD touch true color screen
Printer	Thermal sensitive micro-printer

1.4 Equipment Structure

1.4.1 KT600 Main Unit

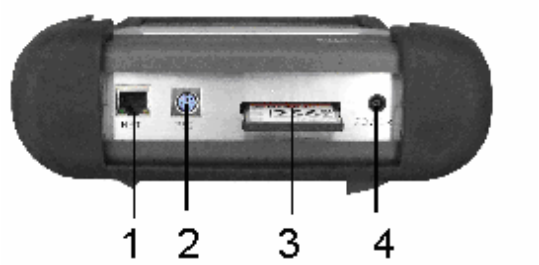
■ Front view

#	Item	Description
1	Touch screen	TFT640×480 6.4 inch touch true color screen
2	ESC	Return to previous menu, exit
3	OK	Enter menu, confirm the selected item
4	⏻	Power switch
5	[▲] [▼] [►] [◄]	TFT640×480 6.4 inch touch true color screen
6	F4 F1 F2 F3	Return to previous menu, exit

■ Back view

#	Item	Description
1	Stylus pen	Operate touch screen
2	Printer/Battery	Printer&Battery in this box
3	Button	Button for changing printing paper
4	Serial number	S/N in the label is the body number of the instrument
5	Hand holding	Human-oriented depression design,in favor of hand hold
6	Button	Button for exchanging diagnosis box with oscillograph box

■ View of upper interface



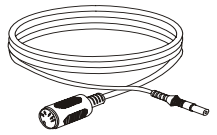
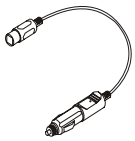
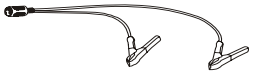
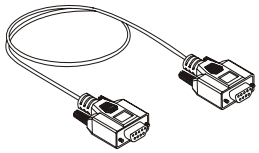
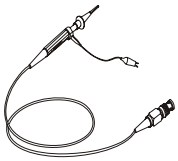
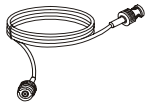
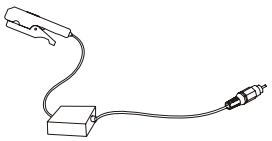
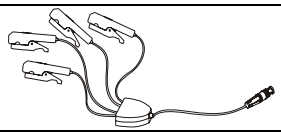
#	Item	Description
1	Network port	Insertion of network cable directly for online upgrade
2	PS/2	For external connection with keyboard and mouse, or used as serial port and USB port through switcher
3	CF card	CF card socket
4	Power	Connection to this port to provide power supply for main

■ View of lower port (taking oscillographic box as example)

#	Item	Description
1	CH1	Oscillographic channel 1
2	CH2	Oscillographic channel 2
3	CH3	Oscillographic channel 3/trigger channel (in three-channel oscillographic card)
4	CH4	Oscillographic channel 4
5	CH5	Trigger channel

1.4.2 Accessories

Accessories of special KT600 oscillograph for automobile include connecting cable for oscillograph test, power cable, self-diagnostic connector, etc., and accessories of KT600 include all accessories of K60 and KT600.

Picture	Name	Function
	Extension lead for power supply	Provide power supply for main unit, can connect to auto cigar igniter or auto alligator clip.
	Connector for auto cigar igniter	Used to connect extension line for power supply and auto cigar igniter to provide power supply for main unit.
	Auto alligator clip	Used to connect extension line for power supply and auto battery to provide power supply for main unit.
	Serial communication cable	Used to connect RS-232 serial port of main unit and serial port of PC to realize connection or software upgrade.
	Test probe	Used to connect Channel 1, 2, 4 and 5 for input, with ground line, X1 or X10 attenuation
	Extension lead for oscillograph	Can connect Channel CH1, CH2, CH4 and CH5, its main function is to extend input signal line.
	Inductive pickup	Connect Channel CH3 (CH5), can test engine speed, and consider that the high voltage line clipped is the high voltage line of the first cylinder.
	Capacitive pickup	Can connect Channel CH1 and CH2 to induce secondary ignition signal.
	Connecting line for oscillograph	Can extend grounding line or signal line for convenient connection.

II. Basic Function and Operation

2.1 Overview of Main Menu

As shown in Fig.2-1, press [ENTER] button to enter the next menu until you select tested item when you select the item to be tested in KT600 menu using UP or DOWN directional button. Press [EXIT] button to return to previous menu.

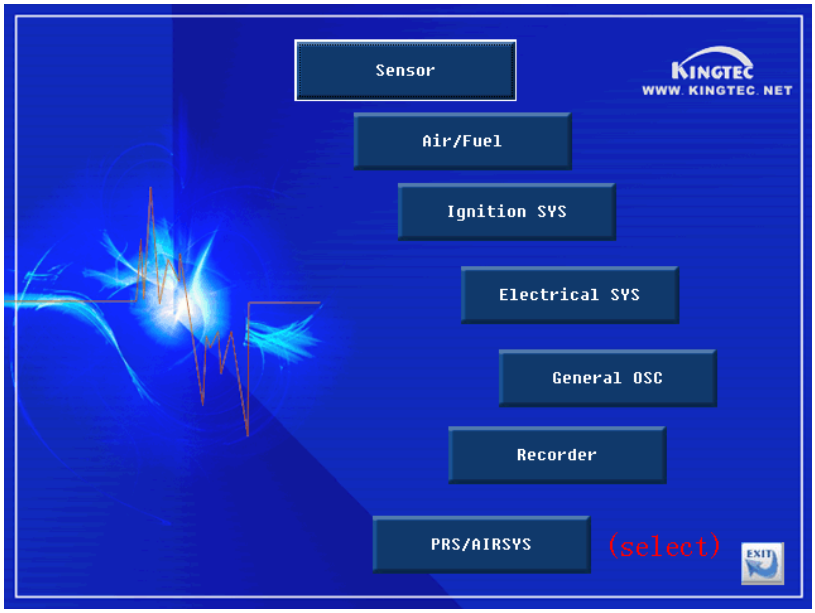


Fig. 2-1

2.2 Adjusting Method for Universal Oscillograph

Generally, the waveform display of special oscillograph for automobile does not need adjustment. When conducting tests other than the standard menus displayed in special oscillograph for automobile, you can select universal oscillograph function and you need to master specific adjustment method. The adjustment method is the same if there is similar menu during test process of special oscillograph for automobile.

Select universal oscillograph and press [ENTER] to confirm, as shown in Fig.2-2. There are 10 options on the screen: channel, period, level, amplitude value, position, start/stop, storage and four function options. Press LEFT and RIGHT directional button to adjust the selected item.

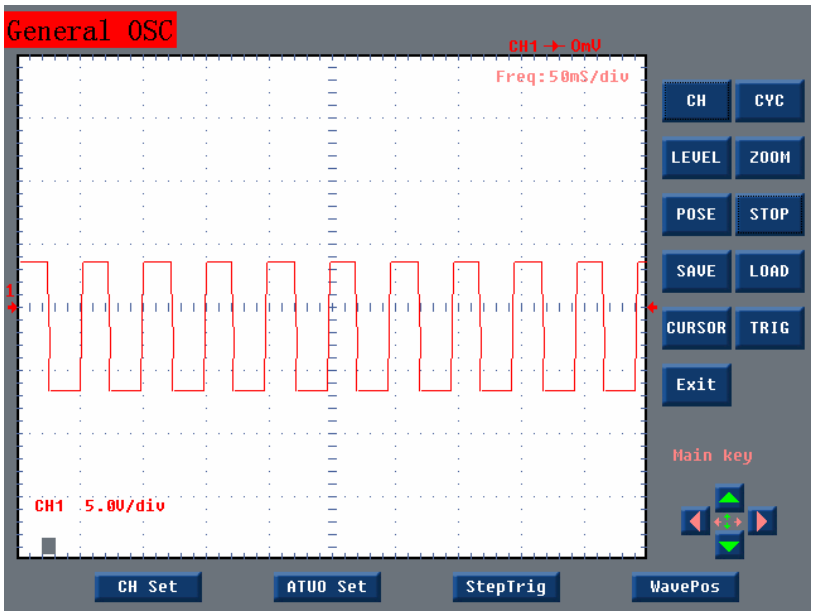


Fig. 2-2

2.2.1 Channel Adjustment

Pressing function button can select any combination of Channel 1 (CH1), Channel 2 (CH2), Channel 3 (CH3) and Channel 4 (CH4), as shown in Fig.2-3.

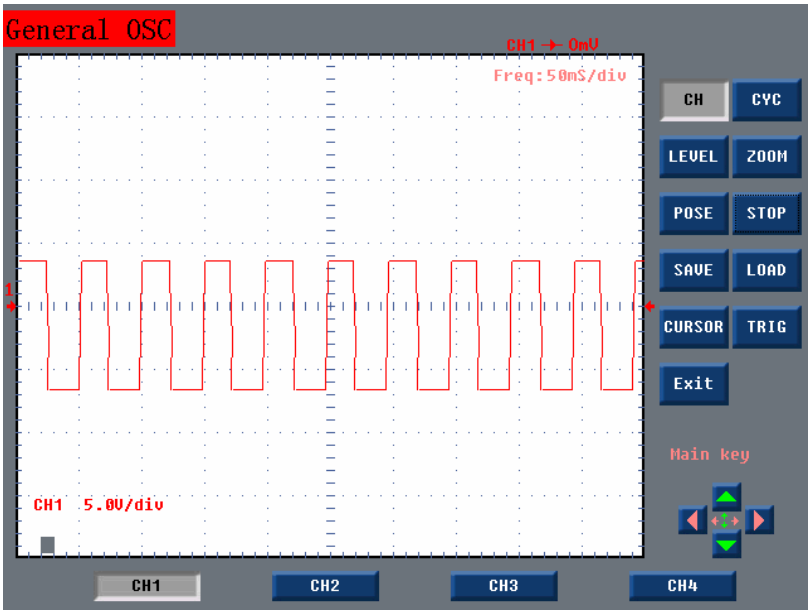


Fig. 2-3

2.2.2 Period Adjustment

When period adjustment is selected, pressing UP and DOWN button can change

the time of each single grid. If 10ms/grid is set when machine is started, it changes to 5ms/grid when DOWN button is pressed down, and waveform gets sparse; it changes to 20ms/grid when UP button is pressed down, and waveform gets dense.

2.2.3 Level Adjustment

When trigger level of longitudinal axis is adjusted, waveform's position in screen will change when different trigger level is selected for the same waveform. If the value of trigger level exceeds the limit value of waveform, waveform will move about and not be steady in screen.

2.2.4 Amplitude Adjustment

Pressing UP and DOWN button can adjust amplitude value of longitudinal waveform, 1:500, 1:200, 1:100, 1:200, 1:0.5, 1:1.0, 1:2.5, 1:5,1:10 and 1:20 can be selected for KT600.

2.2.5 Position Adjustment

Selection of position adjustment can adjust display position of waveform upward or downward.Press UP button to move waveform upward and DOWN button to move downward.

2.2.6 Trigger Mode Adjustment

Selection of trigger mode can adjust the starting trigger point of waveform at high frequency (<50ms/grid), and use of function button can select trigger mode: rising edge trigger, falling edge trigger, level trigger, as shown in Fig.2-4.

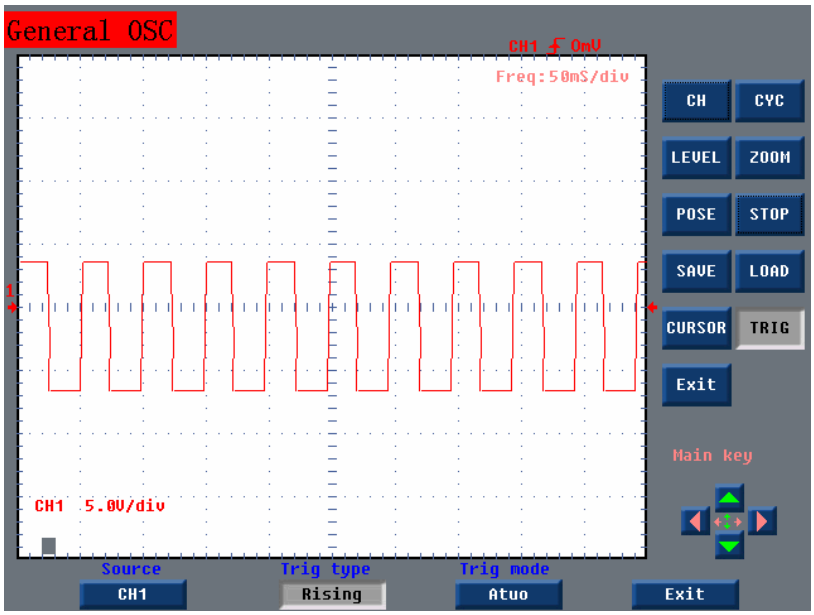


Fig. 2-4

2.2.7 Storage and Loading of Waveform

When universal oscillograph is selected, if you want to store current waveform, you must select STOP first to freeze current waveform, and then select STORE and press CONFIRM button. Press function button to select storage area. Four waveforms can be stored in each interface. Press START/STOP again to re-display current waveform.

If you want to load waveform, you must select STOP first to freeze current waveform, select LOAD, press function button to select storage area, and then press [ENTER] to confirm to load the waveform stored in current area, as shown in Fig.2-5.

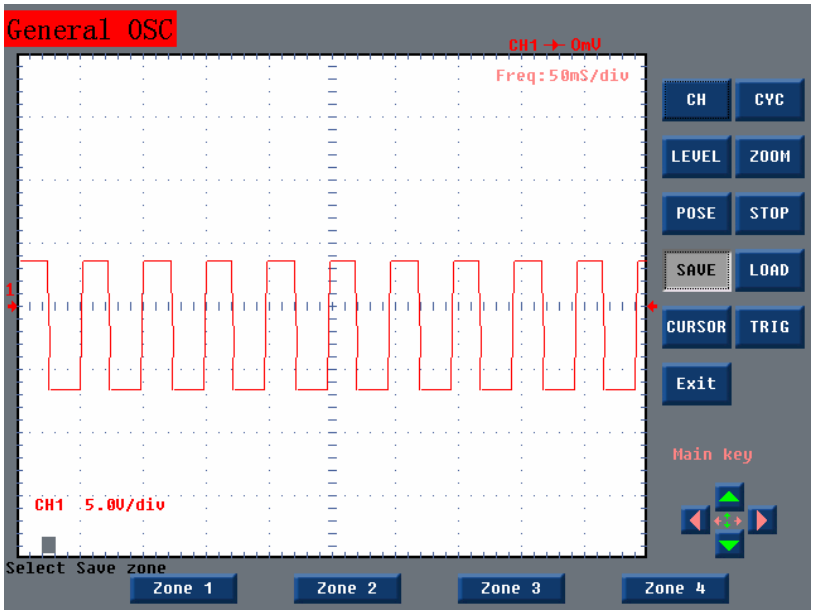


Fig. 2-5

2.2.8 Selection and Adjustment of Signal Source Parameters of Sensor

In sensor menu, you can select and adjust the parameters of channel to be observed by selecting SIGNAL SOURCE PARAMETER, as shown in Fig.2-6.

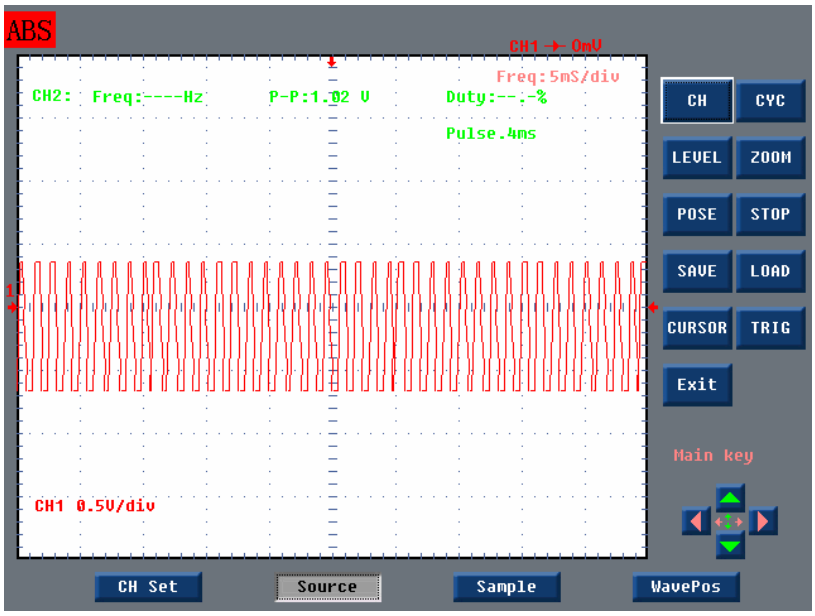


Fig. 2-6

2.2.9 Selection and Adjustment of Pressure/Temperature System (Optional)

In the menu of pressure/temperature system, you can observe speed and current waveform directly, as shown in Fig.2-7.

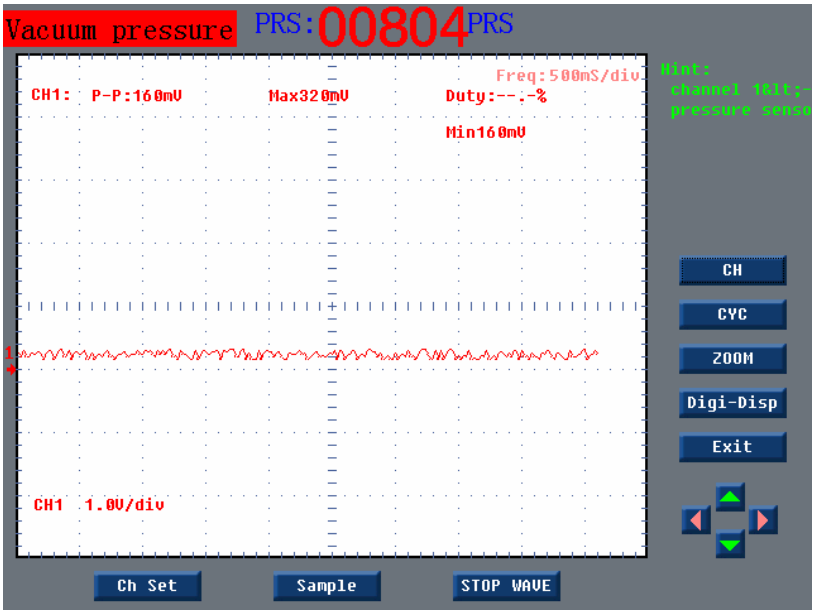


Fig. 2-7

2.2.10 Selection and Adjustment of Pressure/Temperature System (Optional)

In the menu of pressure/temperature system, you can observe current value directly

by selecting number display, as shown in Fig.2-8.

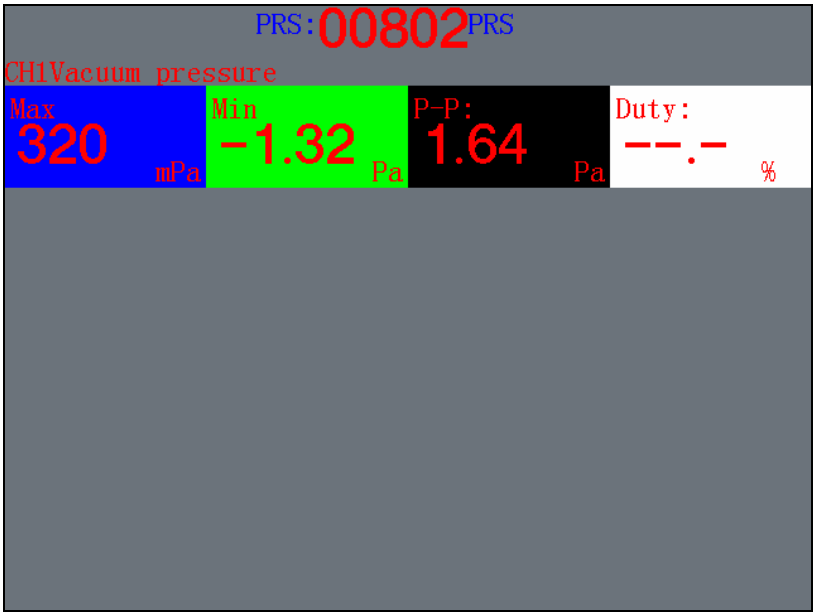


Fig. 2-8

III. Sensor Test and Application

This chapter introduces waveform test method and waveform analysis of common sensors in electric control system of automobile, its purpose is to help learn use method of instrument, but it is not suitable for all vehicle models. Generally, we provide common typical index, please refer to repair manual for specific vehicle model.

3.1 Manifold Absolute Pressure Sensor (MAP)

Manifold absolute pressure sensor provides engine control unit (ECU) with engine load signal, which generally is frequency-modulated square wave signal or voltage level signal (depending on manufacturer) and is used to change mixing ratio of fuel and other output value after being processed by ECU.

When engine load increases, manifold pressure increases, or manifold pressure is low. Damaged MAP sensor may affect air-fuel ratio when engine accelerates or decelerates, and may affect ignition timing and other computer output values.

3.1.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding, pierce test probe into the trigger signal line of manifold absolute pressure sensor (MAP).

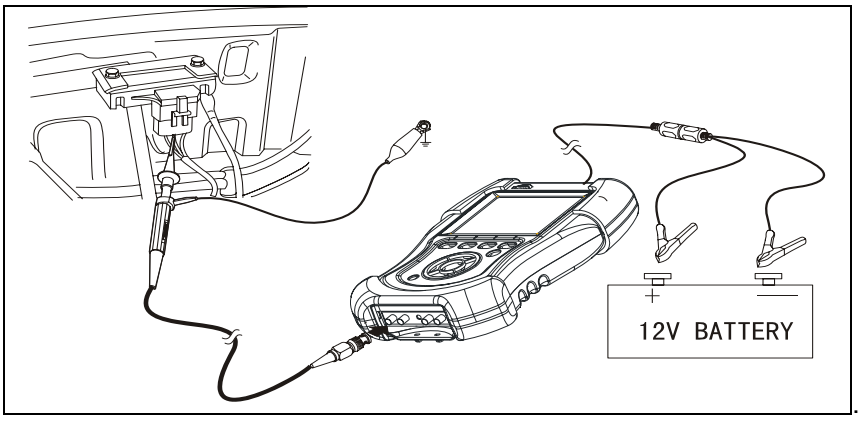


图 3-1

3.1.2 Test conditions

- Switch on automobile ignition switch, do not start engine. Use manual vacuum pump to simulate vacuum and connect it to vacuum input port of manifold absolute pressure sensor.
- Monitor signal from idle to acceleration with engine running.

3.1.3 Test step

1. Connect equipment according to Fig.3-1, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select SENSOR, and press [ENTER] button to enter selection menu for automobile sensor;
4. Select MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP), press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions;
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform into CF card for reference when repair is needed. You can also store it as reference waveform and compare it with tested waveform.

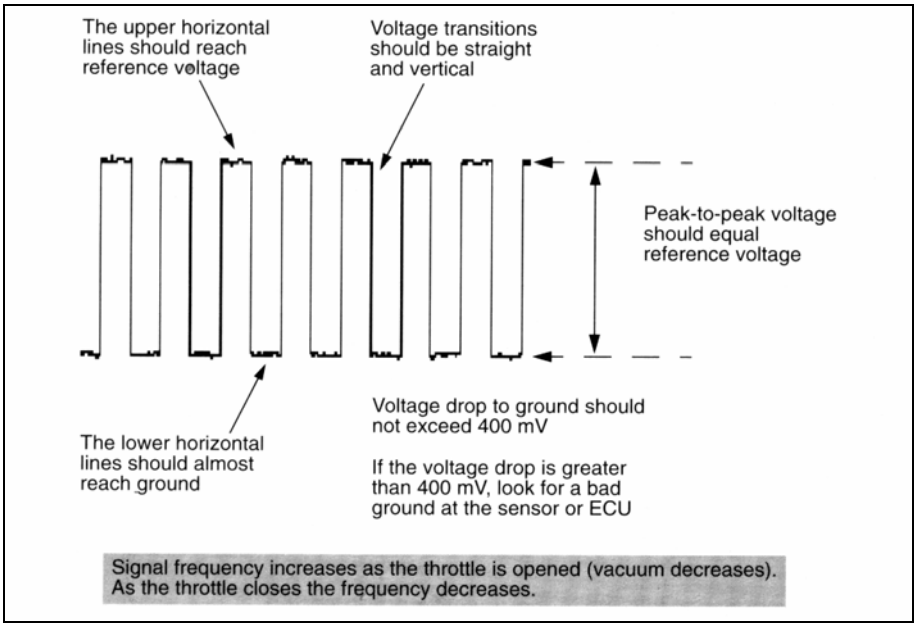
3.1.4 Waveform Analysis

Generally, analog quantity output is common except that the output of manifold absolute pressure sensor in FORD is digital signal. Manifold pressure sensor of analog quantity produces a voltage to ground signal of about 0V in high degree of vacuum, and produces a high voltage to ground signal in low degree of vacuum (approaching atmospheric pressure). Refer to repair manual since different manufacturers may have different indexes.

Digital MAP sensors are mounted on many FORD and LINCOLN vehicles. Output waveform in digital quantity should be pulse with amplitude value of 5V, at the same time, shape is correct, waveform is steady, square angle of rectangle is correct and rising edge is vertical. Frequency and its corresponding degree of vacuum shall comply with the values given in repair materials.

Generally, reference diagrams of waveforms of digital and analog MAP sensors are shown in Fig.3-2.

Manifold Absolute Pressure Sensor (MAP) Digital



Manifold Absolute Pressure Sensor (MAP) Analog

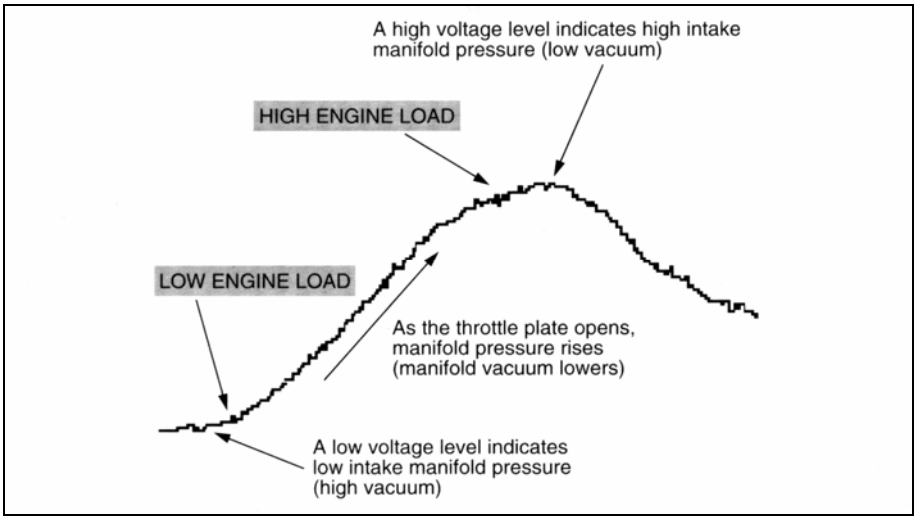


Fig. 3-2

3.2 Oxygen Sensor-Zirconium and Titanium Type

Oxygen sensor provides an output voltage which indicates oxygen content in exhaust gas, and this voltage, after being processed by ECU, can adjust fuel supply of engine to change air-fuel ratio. Zirconium dioxide type sensor, like a battery, can provide high output voltage (caused by rich mixing gas) and low output voltage (caused by lean mixing gas); Zirconium dioxide type sensor can change resistance when oxygen content in exhaust gas changes, which, as a result, causes low output voltage (caused by rich mixing gas) and high output voltage (caused by lean mixing gas).

3.2.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding, pierce test probe into the trigger signal line of oxygen sensor. Connecting diagram is shown as Fig.3-3.

3.2.2 Test conditions

- Start engine to heat oxygen sensor to over 315˚C, with engine in closed-loop state;
- Increase engine speed from idle.

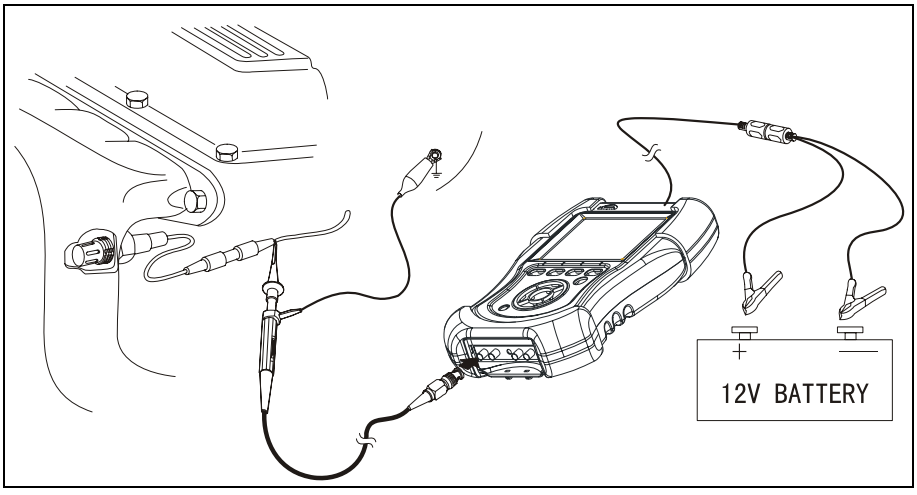


Fig. 3-3

3.2.3 Test step

1. Connect equipment according to Fig.3-3, switch on power supply switch of KT600;
2. Start engine to heat oxygen sensor to over 315˚C, with engine in closed-loop state;
3. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPHIC ANALYZER, and press [ENTER] button to confirm;
4. In the menu of special oscillograph for automobile, select SENSOR, and press [ENTER] button to enter selection menu for automobile sensor;
5. Select OXYGEN SENSOR-ZIRCONIUM AND TITANIUM TYPE, press [ENTER] button to confirm, and waveform will be displayed on the screen;
6. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform into CF card for reference when repair is needed.

3.2.4 Waveform Analysis

Now, oxygen sensors installed on ordinary electronic control vehicles are of zirconium dioxide type, and the voltage range of output signal is 0~1V, while the output signal of some zirconium dioxide type oxygen sensors is variable voltage signal of 5V, for instance, some Cherokee vehicles of old types. Please pay attention to the differences when testing. Reference waveform of ordinary zirconium type oxygen sensor is shown in Fig.3-4.

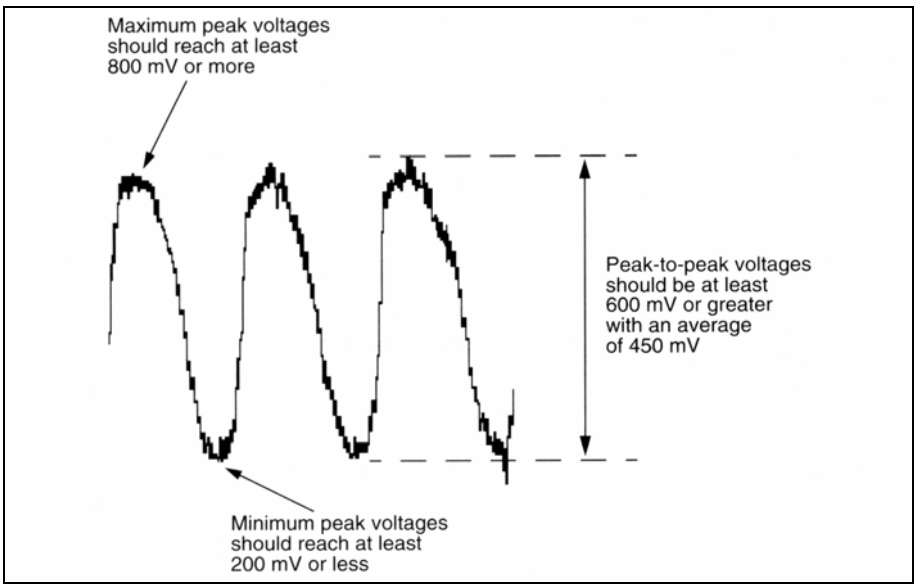


Fig.3-4

3.3 Double Oxygen Sensor

Two oxygen sensors provide output voltage of oxygen content in exhaust gas before and after catalyst. The front sensor signal is used as feedback signal for mixed control, and the rear sensor signal is used to test catalyst efficiency for ECU. Since catalyst efficiency may decrease due to long time use and the amplitude of rear sensor signal increases, the ability of catalyst converter to convert deleterious gas can be determined by the voltage difference between the two sensors.

3.3.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect two test probes to Channel 1 and Channel 2 (CH1 and CH2 port) of KT600, and then connect the small alligator clip on one of the test probes to the negative of battery or grounding, pierce test probes into the trigger signal line of front and rear oxygen sensors. Connecting diagram is shown as Fig.3-5.

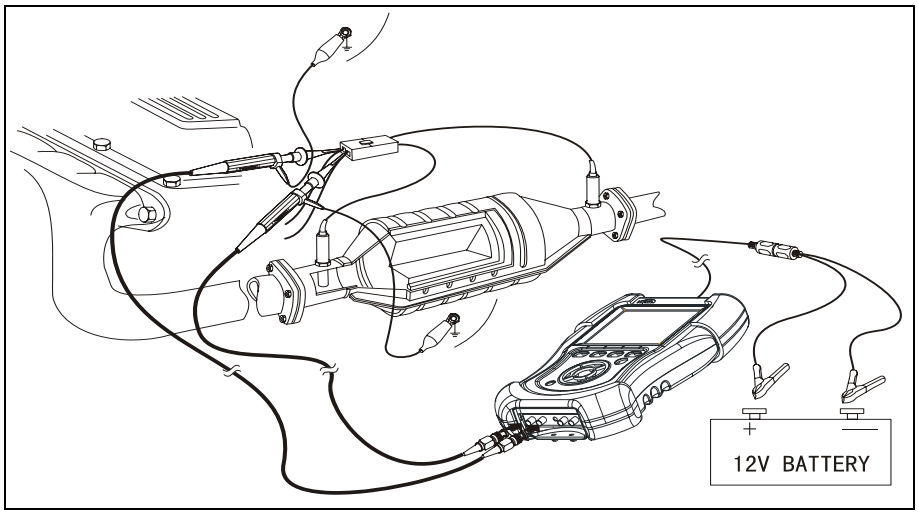


Fig. 3-5

3.3.2 Test conditions

- Start engine to heat oxygen sensor to over 315˚C, with engine in closed-loop state;
- Increase engine speed from idle.

3.3.3 Test step

1. Connect equipment according to Fig.3-5, switch on power supply switch of KT600;
2. Start engine to heat oxygen sensor to over 315˚C, with engine in closed-loop state;
3. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
4. In the menu of special oscillograph for automobile, select SENSOR and press [ENTER] button to enter selection menu for automobile sensor;
5. Select DOUBLE OXYGEN SENSOR, press [ENTER] button to confirm, and waveform will be displayed on the screen;
6. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

3.3.4 Waveform Analysis

When testing waveform of double oxygen sensor, we can judge, through the waveform of front and rear oxygen sensors, whether the ability of three-way catalyst device to convert deleterious gas is lost. Generally speaking, the bigger the amplitude value of two waveforms is, it indicates that three-way catalyst device has perfect function; if amplitude value is basically the same, it indicates that it has lost its function. See Fig.3-6 for schematic diagram.

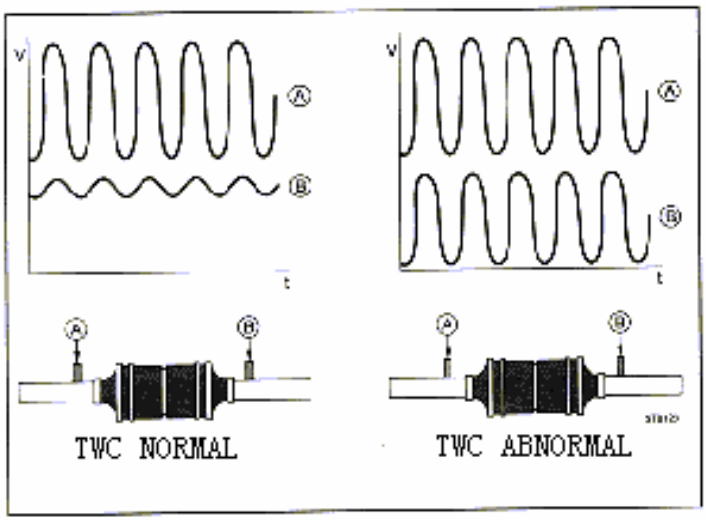


Fig. 3-6

3.4 Temperature Sensor

They are mainly water temperature sensor and air intake temperature sensor, and most temperature sensors adopt negative temperature coefficient (NTC) thermistor made of semi-conducting materials. When temperature changes, its resistance is expected to experience a large change. When temperature rises, resistance decreases; when temperature decreases, resistance increases.

3.4.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding, pierce test probe into the trigger signal line of temperature sensor. Connecting diagram is shown as Fig.3-7.

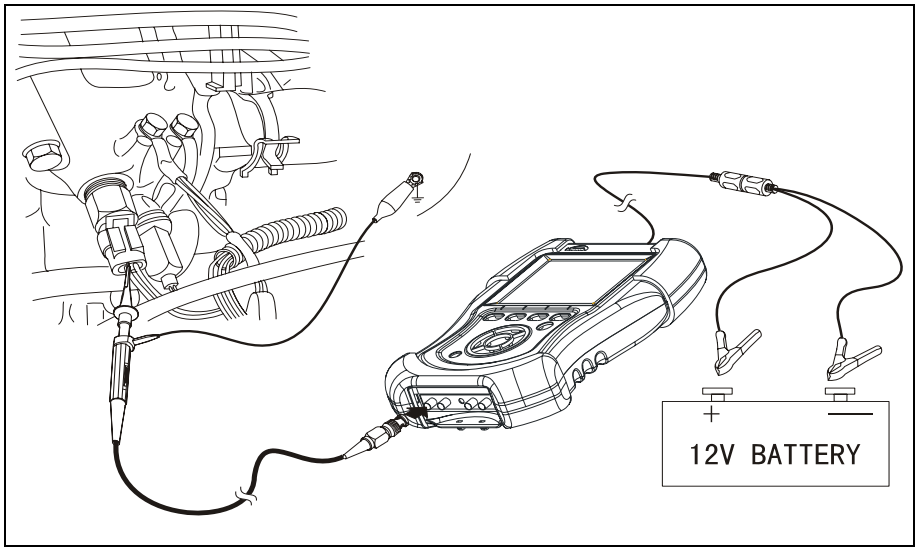


Fig. 3-7

3.4.2 Test conditions

- Switch on ignition switch, do not start engine. Securely connect temperature sensor, and measure the output voltage of temperature sensor with engine in non-running state;
- Start engine, observe voltage falling of temperature sensor when engine gets

heated;

- You may also disconnect sensor and use multimeter to measure resistance value.

3.4.3 Test step

1. Connect equipment according to Fig.3-7, switch on power supply switch;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select SENSOR and press [ENTER] button to enter selection menu for automobile sensor;
4. Select TEMPERATURE SENSOR, press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions;
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

3.4.4 Waveform Analysis

You can get precise voltage range of sensor response by referring to standard manual from manufacturer. Generally, the voltage of sensor should be 3~5V (fully cold state) when engine is not started, and it should have correspondingly variable output voltage signal under different temperature conditions. When temperature sensor circuit is open, voltage increases till it reaches the peak (5V) of reference voltage; when temperature sensor is short to ground, voltage decreases till it reaches the peak of grounding voltage. Refer to Fig.3-8 for temperature characteristics of common thermistor type coolant and air intake temperature sensor, subject to manufacturer's manual.

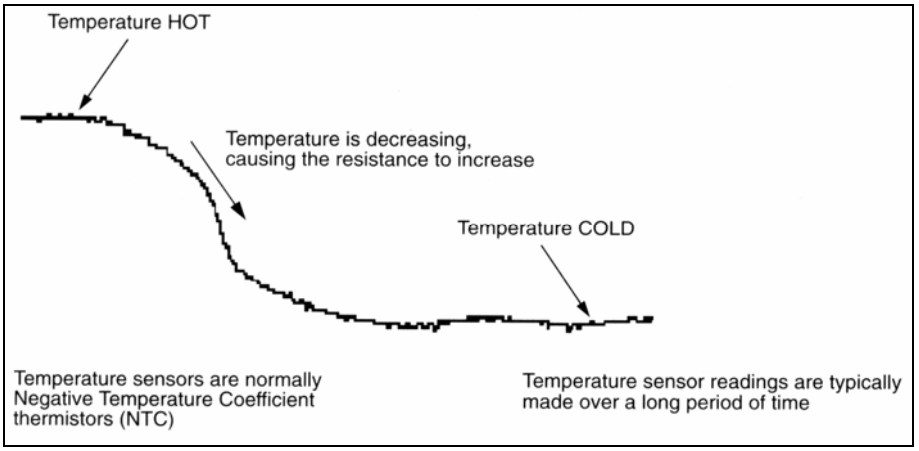


Fig. 3-8

3.5 Throttle Position Sensor

Throttle position sensor (TPS) is common failure source on computer board of modern automobile. TPS informs computer of opening degree of throttle, open or closed state and open/close speed, or working conditions where engine works. When TPS resistance changes, the voltage signal it sends to computer changes consequently.

Common throttle position sensors include two types: one is potentiometer type sensor. When its shaft changes, it will cause resistance to change (potentiometer), and will provide a direct current voltage. TPS is a variable resistance fixed on throttle shaft, which provides a direct current voltage as an input signal for ECU.

The other is switch type sensor. After the signal from this kind of sensor is input to ECU, computer is informed of controlling idle (switch closed, throttle closed), or of not controlling idle (because accelerator pedal is pressed to make switch on), and ECU is informed of throttle open position when the other switch is switched on. Such linear throttle position sensor is installed on throttle shaft, with two movable contacts rotating with the same shaft. One contact is for measuring opening angle of throttle, and the other contact is for measuring closing angle of throttle. Be sure to connect circuit correctly when testing sensor.

3.5.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding, pierce test probe into the TPS signal line. Connecting diagram is shown as Fig.3-9.

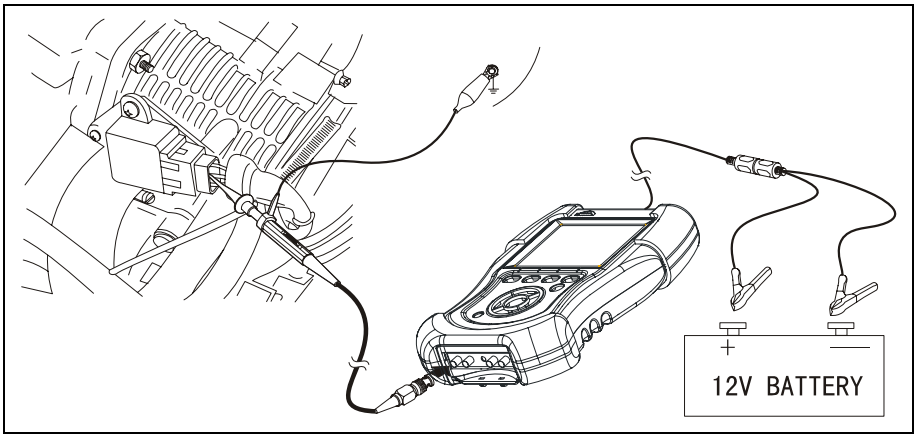


Fig. 3-9

3.5.2 Test conditions

Switch on ignition switch, do not start engine, turn throttle to fully open position, and then turn to fully closed position, or opposition.

3.5.3 Test step

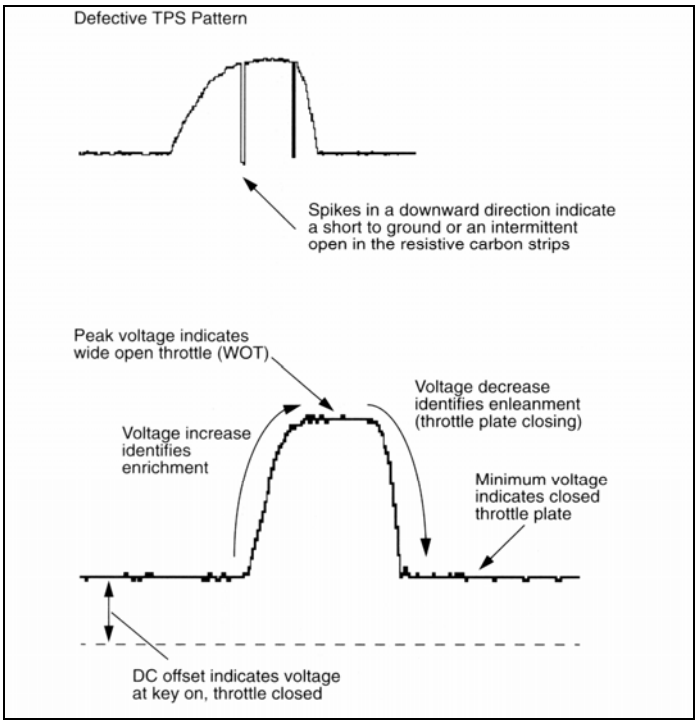
1. Connect equipment according to Fig.3-9, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select SENSOR and press [ENTER] button to enter selection menu for automobile sensor;
4. Select TPS, press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions;
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

3.5.4 Waveform Analysis

Potentiometer type TPS is normally a variable potentiometer. Referring to repair manual from manufacturer, you can get precise voltage range of TPS. Waveform should be free from any breakpoint, cuspate peak TO GROUND or large wave break. The normally closed contact of switch type TPS constitutes idle switch. When throttle is in idle position, normally closed contact is in closed state; normally open contact indicates that throttle opens to full load. Refer to Fig.3-10 for waveform of two throttle sensors.

Result Display:

Throttle Position Sensor (Potentiometer)



Throttle Position Sensor- Switch Type

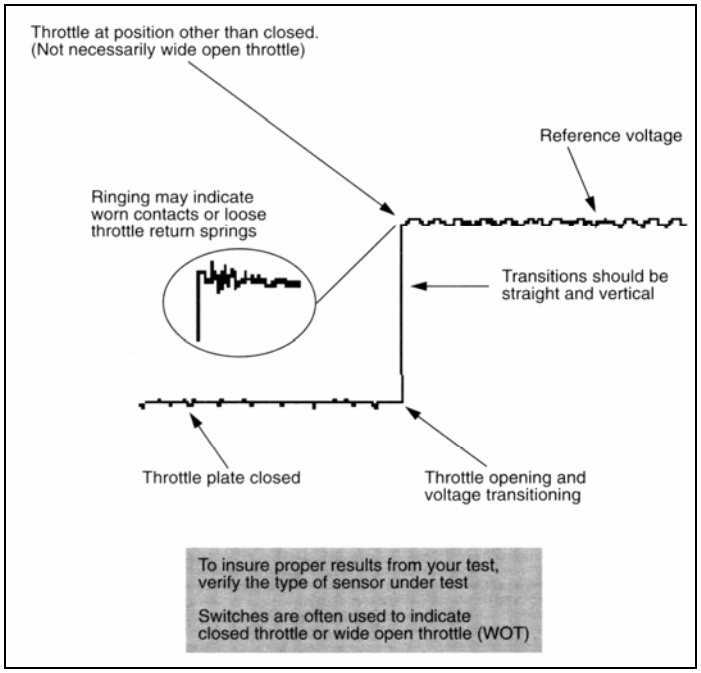


Fig. 3-10

3.6 Crankshaft/Camshaft Position Sensor

It can be used to test waveform for electromagnetic sensor, Hall effect sensor and photoelectric sensor. Electromagnetic sensor (variable magnetoresistive sensor) does not need external power supply, and has two shielded lines connected to magnetostatic coil. When trigger wheel passes the magnetic field formed by coil and static magnet, small voltage signal is produced. Trigger wheel is made of steel with low magnetic resistance. Crankshaft position sensor (CPS), ABS wheel sensor and automobile speed sensor are all examples of variable magnetic resistance. Output voltage and frequency change with vehicle speed.

Hall effect sensor has a current passing a semiconductor placed very close to a variable magnetic field. Magnetic field change occurs when crankshaft or distributor shaft rotates. Hall effect sensor is used in CPS and distributor, and the amplitude of its output voltage is constant, its frequency changes with speed.

Photoelectric sensor uses a rotary disc to separate LED light source from optical pickup unit. With a small hole in the disc, pickup unit can receive light emitted from the light source. A pulse is sent each time pickup unit receives light when the disc rotates and meets the small hole. The result of voltage change can be used as reference signal for other system, and the amplitude of its output voltage is constant, while its frequency changes with speed.

Camshaft sensor is normally installed in ignition distributor, and sensor sends electric pulse to coil module to provide data indicating camshaft and valve position.

3.6.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding, pierce test probe into the CPS signal line. Connecting diagram is shown as Fig.3-11.

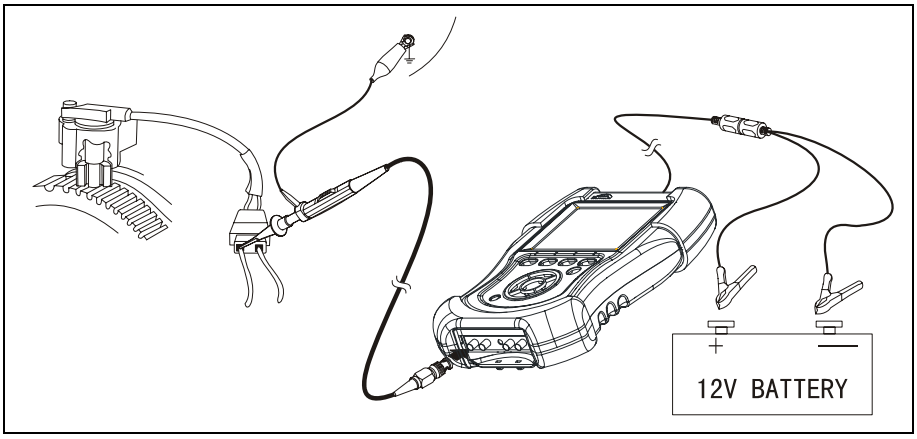


Fig. 3-11

3.6.2 Test conditions

- Check sensor for signal output. If there is no signal output, it is possible that sensor is damaged or lines are poorly connected;
- If that engine cannot be started is determined, connect the instrument according to diagram and then start engine;
- If engine can be started, connect the instrument according to diagram and then start engine; conduct test in idle and relatively high speed state.

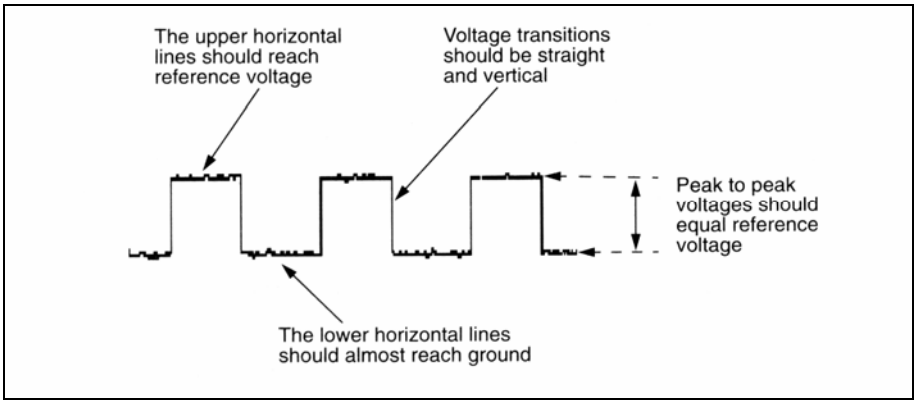
3.6.3 Test step

1. Connect equipment according to Fig.3-11, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select SENSOR and press [ENTER] button to enter selection menu for automobile sensor;
4. Select CRANKSHAFT/CAMSHAFT POSITION SENSOR, press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions;
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

3.6.4 Waveform Analysis

Result Display:

Crankshaft Position Sensor (Hall Effect)



Crankshaft Position Sensor (Magnetic)

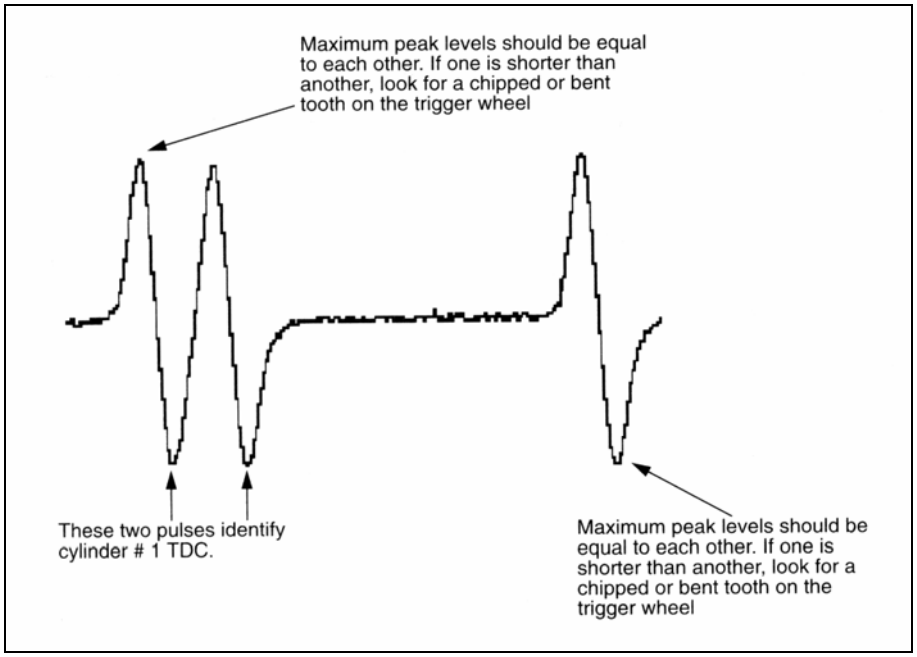


Fig. 3-12

3.7 Ride height (Position) Sensor

All kinds of position sensors produce a direct current voltage output according to the movement of variable resistance (potentiometer) shaft. Position sensor is a variable resistance connected between frame and rear axle or installed in support system. As an input signal for ECU, variable direct current voltage is used to control vehicle height. Some manufacturers use photoelectric or Hall effect sensor, corresponding sensors can be selected for test.

3.7.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding, pierce test probe into the signal line of ride height sensor. Connecting diagram is shown as Fig.3-13.

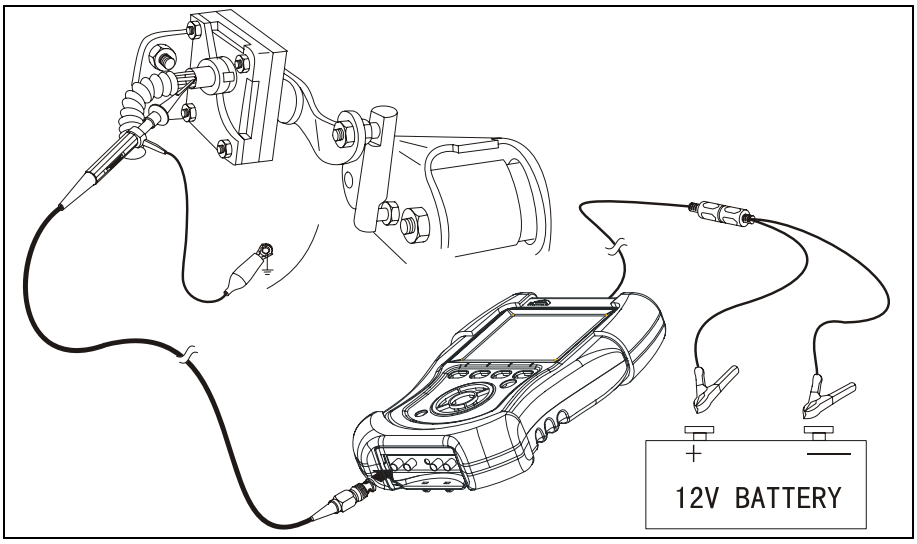


Fig. 3-13

3.7.2 Test conditions

- Switch on ignition switch, do not start engine, separate rotational shaft (fixed on the rear shaft) from sensor, and turn the shaft from stop end to the other end to measure the whole travel;
- Switch on ignition switch, do not start engine, carefully disconnect the connecting line from sensor, and then measure sensor resistance to make sure whether

there is open or short circuit in the sensor;

- Re-install the rotational shaft to the rear shaft, and adjust ride height sensor according to the indexes specified in manufacturer manual.

3.7.3 Test step

1. Connect equipment according to Fig.3-13, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select SENSOR and press [ENTER] button to enter selection menu for automobile sensor;
4. Select RIDE HEIGHT (POSITION) SENSOR, press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions;
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

3.7.4 Waveform Analysis

Refer to Fig.3-14 for waveform characteristics of ride height (position) sensor, and different vehicle models may have different indexes, subject to manufacturer's manual.

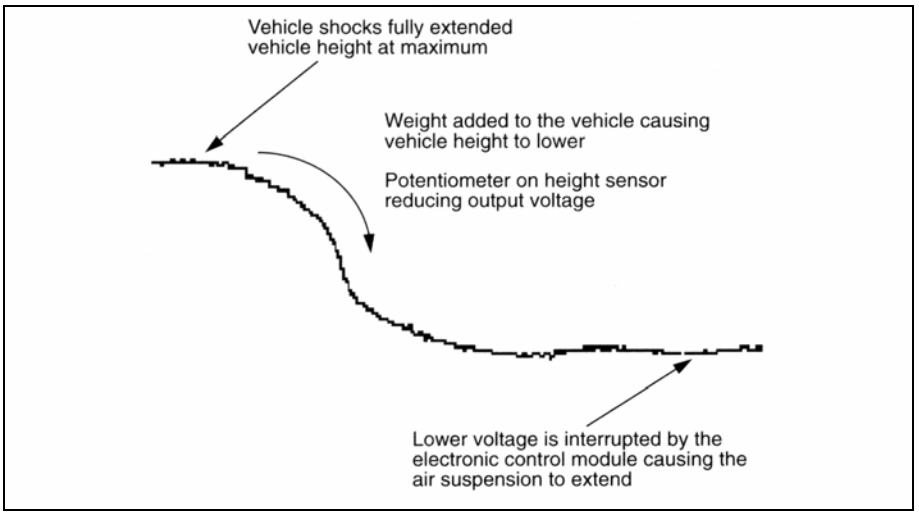


Fig. 3-14

3.8 Vehicle Speed Sensor (VSS)

The output signal of vehicle speed sensor is proportional to vehicle speed. With this signal, ECU controls torque converter lockup clutch, shift point of electric control transmission and other functions. The sensors used include electromagnetic, Hall effect and photoelectric type.

3.8.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding, pierce test probe into the signal line of ride height sensor. Connecting diagram is shown as Fig.3-15.

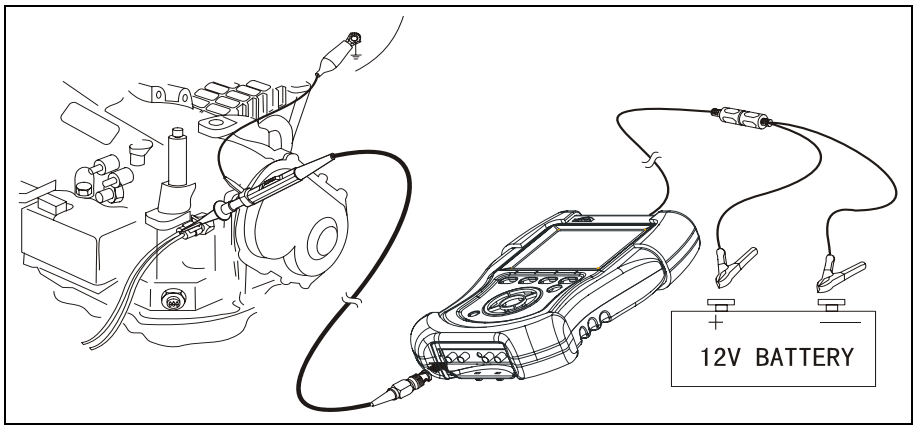


Fig. 3-15

3.8.2 Test conditions

- Lift vehicle body to make driving wheel hang in the air and be able to rotate freely;
- Connect equipment according to Fig.3-15, start engine and apply driving gear;
- Monitor the output signal of vehicle speed sensor at low speed and gradually increase the speed of driving wheel.

3.8.3 Test step

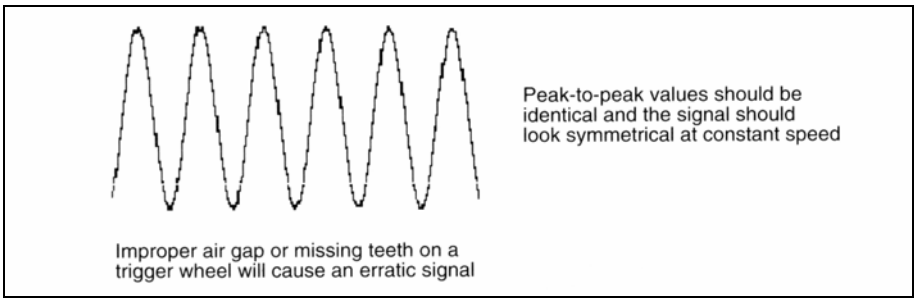
1. Connect equipment according to Fig.3-15, switch on power supply switch of KT600;

2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select SENSOR and press [ENTER] button to enter selection menu for automobile sensor;
4. Select VEHICLE SPEED SENSOR, press [ENTER] to confirm. Select ELECTROMAGNETIC, HALL EFFECT or PHOTOELECTRIC according to the type of sensor to be tested, press [ENTER] to confirm, and waveform will be displayed on the screen depending on test conditions;
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

3.8.4 Waveform Analysis

Generally, if the amplitude of waveform of electromagnetic vehicle speed sensor is too low, check whether the air gap between trigger wheel and pickup unit is too big; if waveform is not steady, check whether trigger wheel or shaft deforms; if there is one twisted waveform, check whether certain tooth of the trigger wheel deforms or is damaged. It is basically the same case with Hall effect sensor which produces square wave. Refer to Fig.3-16 for waveform characteristics of electromagnetic and photoelectric vehicle speed sensor

Vehicle Speed Sensor (Magnetic)



Vehicle Speed Sensor (Optical)

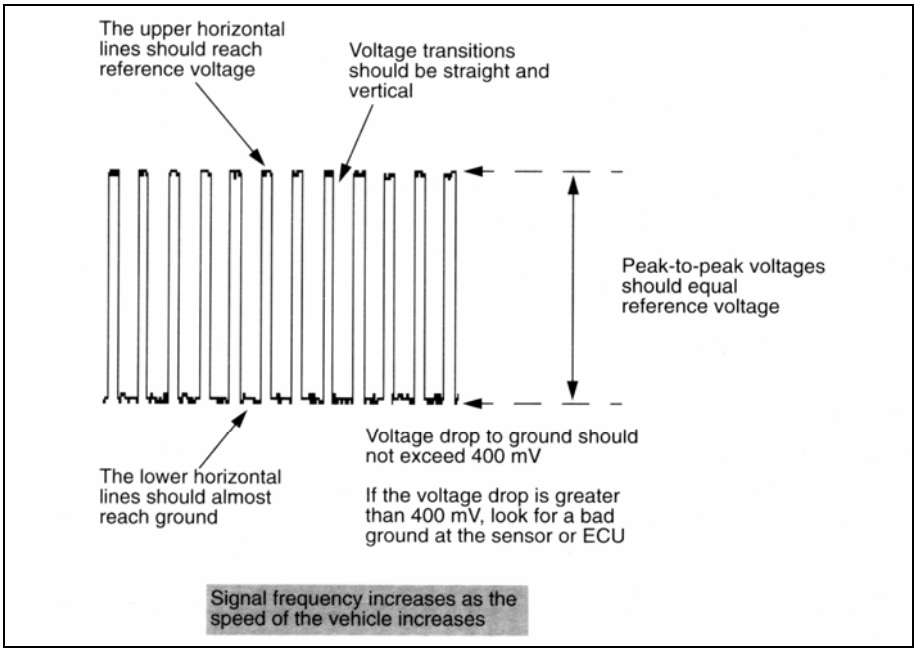


Fig. 3-16

3.9 Anti-lock Braking Speed Sensor

ABS control unit controls vehicle speed at braking by comparing the frequency (instead of voltage) from vehicle speed sensor, and making use of this signal. The frequency is proportional to vehicle speed and increases when vehicle speed increases.

3.9.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding, pierce test probe into the signal line of anti-lock braking speed sensor. Connecting diagram is shown as Fig.3-17.

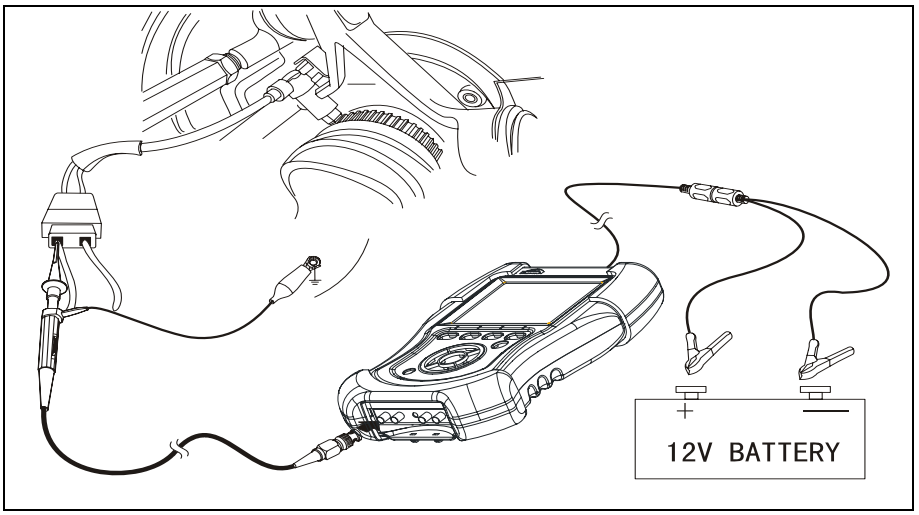


Fig. 3-17

3.9.2 Test conditions

- Lift vehicle body to make driving wheel hang in the air and be able to rotate freely;
- Switch off ignition switch, disconnect connecting line from ABS speed sensor, connect the instrument to ABS speed sensor, and then rotate wheel;
- Or start engine, pierce test probe into the back of ABS speed sensor joint, place transmission to driving gear and slowly accelerate driving; as for non-driving wheel, refer to the above mentioned method of switching off ignition switch.

3.9.3 Test step

1. Connect equipment according to Fig.3-17, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select SENSOR and press [ENTER] button to enter selection menu for automobile sensor;
4. Select ABS SPEED SENSOR, press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions;
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

3.9.4 Waveform Analysis

Refer to Fig.3-18 for waveform characteristics of ABS speed sensor.

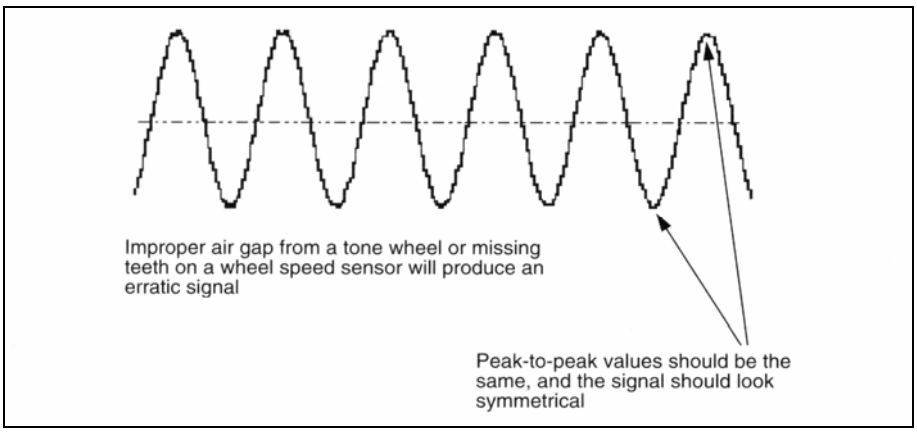


Fig. 3-18

IV. Air/fuel

This chapter mainly introduces how to test main elements intake system, exhaust system and fuel supply system, for instance, air flow sensor, fuel injection driver, etc.

4.1 Air Flow Sensor

Analog air flow sensor: This kind of air flow sensor uses a preheated thin metal element to measure the air flow into the air intake manifold. This element is heated to 77℃ and its temperature will decrease and consequently its resistance will decrease when air passes it, which causes current to increase and voltage to decrease. This signal is regarded by computer as a change of voltage reduction (increment of air flow causes voltage reduction), and also as an indication of air flow.

Digital air flow sensor: This kind of air flow sensor takes 5V sent by computer as reference and sends back frequency signal equivalent to air amount of engine. Output signal is a square wave, its amplitude is fixed at 0-5V, and signal frequency changes between 30-150Hz. Low frequency represents small amount of air flow while high frequency indicates large amount of air flow.

4.1.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding, pierce test probe into the signal line of air flow sensor. Connecting diagram is shown as Fig.4-1.

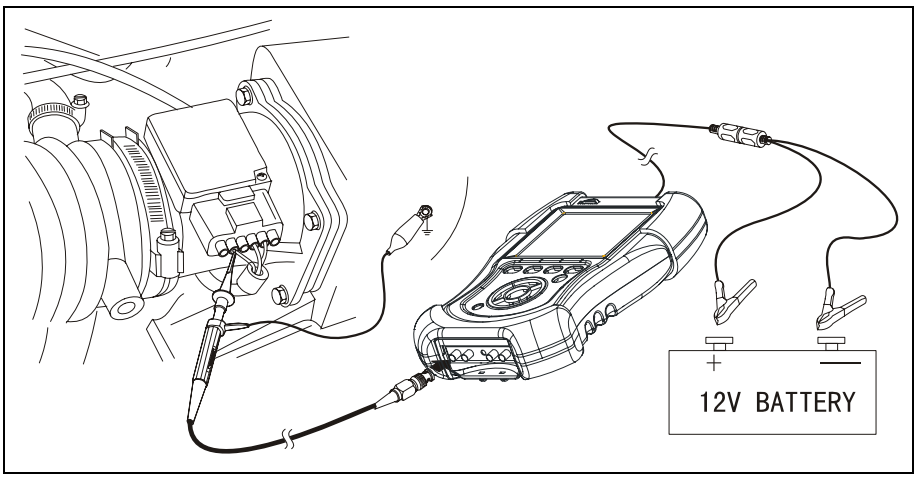


Fig. 4-1

4.1.2 Test conditions

- Connect equipment, start engine and run it at idle, slowly accelerate and observe display result;
- Use screwdriver handle to tap the sensor when testing and temporary delay and unsteady acceleration will be caused if the connecting line inside the sensor is loose.

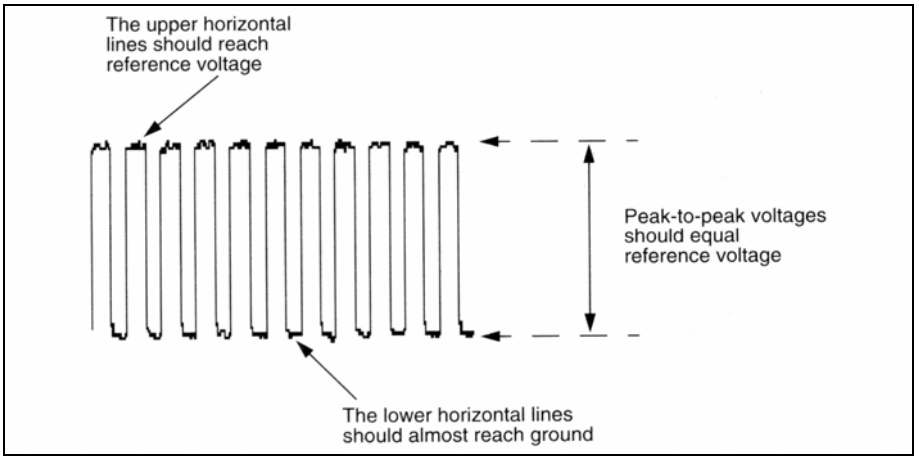
4.1.3 Test step

1. Connect equipment according to Fig.4-1, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select AIR/FUEL and press [ENTER] button to enter selection menu for air/fuel;
4. Select AIR FLOW SENSOR, and press [ENTER] to confirm, and waveform will be displayed on the screen by selecting analog or digital type according to the type of air flow sensor and testing conditions;
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

4.1.4 Waveform Analysis

Refer to Fig.4-2 for waveform characteristics of two air flow sensors.

Mass Air Flow Meter (Digital)



Mass Air Flow Meter (Analog)

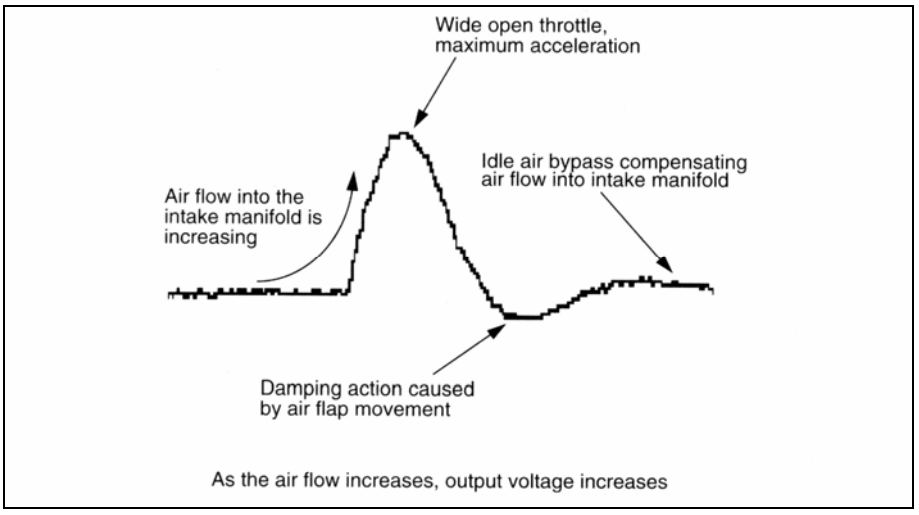


Fig. 4-2

4.2 Exhaust Gas Recirculation (EGR)

EGR valve position sensor is a variable resistance connected to EGR valve. EGR valve position sensor provides a direct current voltage which changes with the movement of knob on the variable resistance (potentiometer). Variable direct current voltage is used as input signal by computer to indicate working conditions of EGR.

When engine has excessive combustion temperature and air-fuel ratio is lean, EGR system dilutes air fuel ratio and limits formation of NOx. Gasoline engine EGR

should work at middle acceleration and cruise speed between 50-120Km/h. Computer makes use of method of providing power supply or cutting off solenoid coil, or uses pulse width modulated solenoid, to switch on or switch off solenoid coil to achieve the goal of controlling vacuum.

4.2.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding, pierce test probe into the EGR valve signal line. Connecting diagram is shown as Fig.4-3.

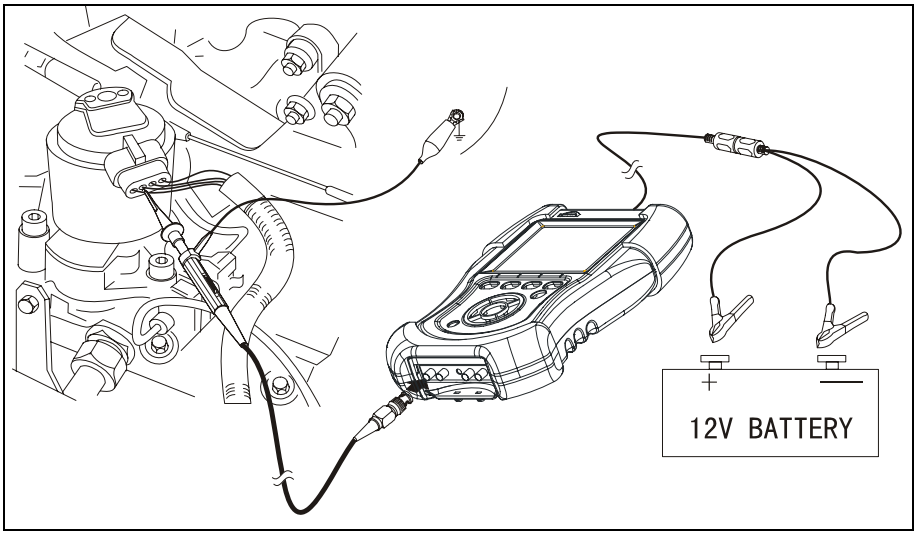


Fig. 4-3

4.2.2 Test conditions

- Start engine, connect KT600 to EGR valve, and slowly increase engine speed to cruise speed.

  Note: Most EGR valves only start when engine is at load state. Therefore, it is possible to use road test or make use of horsepower tester to assist test.
  Warning: Only conduct the following tests when engine is at cold state to avoid burn.

- Ignition switch is at switch-on position, engine stops, insert probe into position sensor on the top of EGR valve, and carefully (cold engine) lift EGR from chassis. If EGR diaphragm has obstacle or is not easily accessible, it is possible to move

EGR valve when vehicle is at load state;

- Switch off ignition switch, disconnect sensor, and then carefully lift EGR valve from chassis. Some position sensors can be disconnected from EGR valve so as to make sensor terminal accessible;
- Apply potentiometer test function of common sensors when testing position sensor.

4.2.3 Test step

1. Connect equipment according to Fig.4-3, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select AIR/FUEL and press [ENTER] button to enter selection menu for air/fuel;
4. Select EGR, press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions;
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

4.2.4 Waveform Analysis

Most vehicles start exhaust gas recirculation control when they travel or accelerate. EGR system does not work when engine runs at idle and decelerates since control signal is cut off. Peak height of waveform reduces when failure occurs, which indicates that vacuum solenoid coil of EGR is short; if no control signal is found, it indicates that failure occurs to PCM or EGR control conditions for PCM does not meet, or there is something wrong with the circuit of EGR system.

4.3 Fuel Injection (FI)

Electronically-controlled fuel injection is controlled by computer and also affected by many working factors, including water temperature, engine load and oxygen sensor signal in closed-loop work.

Fuel injection time can be expressed in pulse width in ms, representing the amount of fuel injected into the cylinder. Wide pulse indicates more fuel injected under the same injection pressure. ECU provides a path for nozzle through a driving triode. When triode is through, current passes from nozzle and triode to ground, which makes nozzle open There are three kinds of fuel injection system currently, and

each has its own fuel injection control method. All nozzles have a method of limiting current, because large current will damage nozzle.

Peak value keeping type In nozzle circuit, nozzle is actually powered by two different circuits. When two circuits work for nozzle at the same time, nozzle is supplied with high starting current and opens quickly; after nozzle opens, one of the circuits is cut off, and the other circuit continues to work to keep the nozzle open till the end of injection time. In the circuit, one resistance is used to reduce the current passing through nozzle. When the second circuit is cut off, nozzle closes, and fuel injection ends. The method for measuring opening time is to locate the falling edge of opening pulse and the rising edge representing the second circuit is cut off.

Throttle injection system is designed to take the place of carburetor, and pulse width represents working or opening time of nozzle. ECU controls pulse width according to engine working and driving conditions.

The triode of traditional (saturated switch type) nozzle provides nozzle with fixed current. Some nozzles use resistance to control current, and other nozzles have high internal impedance, with only one injection pulse.

Nozzles of pulse width modulation type have high starting current to quickly open nozzle. After nozzle opens, pulse switch-on begins at grounding end to cut current off to extend opening time of nozzle, and limit the current passing through nozzle at the same time.

4.3.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect inductive pickup to Channel CH5/(CH3) and to high voltage line of one cylinder, place attenuation switch in front of test probe to X10 position, and then connect the small alligator clip on test probe to the negative of battery or grounding, pierce test probe into the signal line of nozzle. Connecting diagram of multi-point fuel injection is shown as Fig.4-4, and connecting diagram of single point fuel injection is shown as Fig.4-5.

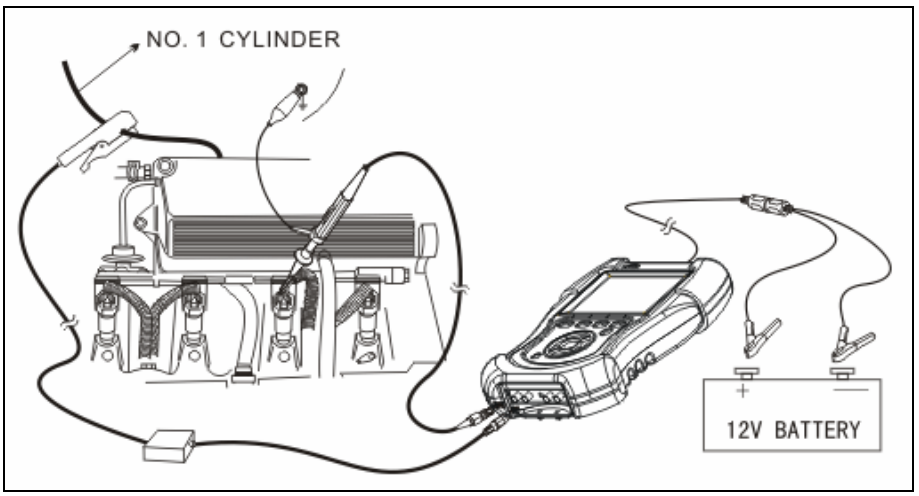


Fig. 4-4

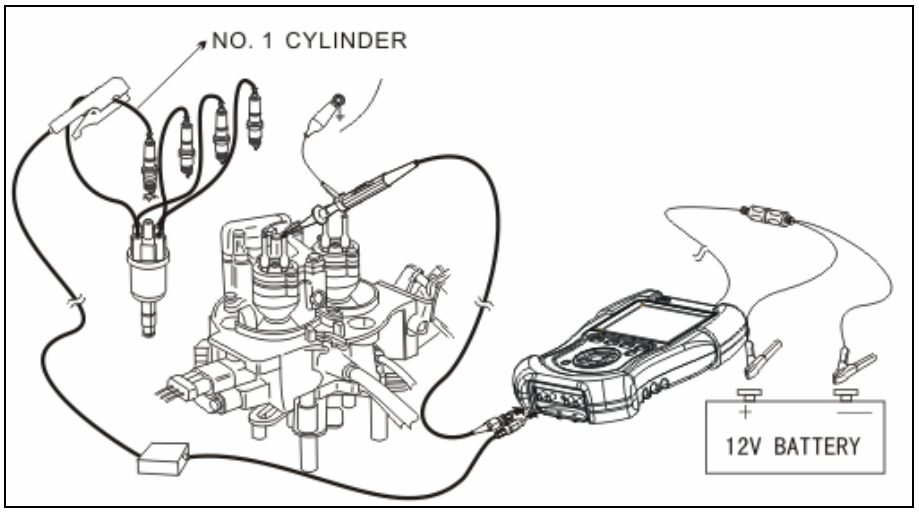


Fig. 4-5

Note: Inductive pickup measures speed signal of engine. If engine speed is not displayed in KT600, re-clip the high voltage line after turning it 180˚C.

4.3.2 Test conditions

- Start engine after connecting equipment. Start test from idle, slowly increase engine speed and observe nozzle signal at the same time.
- Change output signal of MAP sensor or oxygen sensor to increase engine load.
- Another method is to disconnect oxygen sensor, which will decrease the voltage signal sent to ECU, and ECU will increase injection pulse width, but this method may lead to occurrence of DTC.
- Connect signal end of oxygen sensor to positive (+) of battery to increase the

voltage signal sent to ECU, and ECU will decrease injection pulse width.

4.3.3 Test step

- Connect equipment according to Fig.4-4 or Fig.4-5, switch on power supply switch of KT600;
- In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
- In the menu of special oscillograph for automobile, select AIR/FUEL and press [ENTER] button to enter selection menu for air/fuel;
- Select FUEL INJECTION (FI), press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions;
- If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

4.3.4 Waveform Analysis

Refer to Fig.4-6, 4-7 and 4-8 for waveform characteristics of all nozzles.

Conventional (Saturated Switch Driver) Fuel Injector

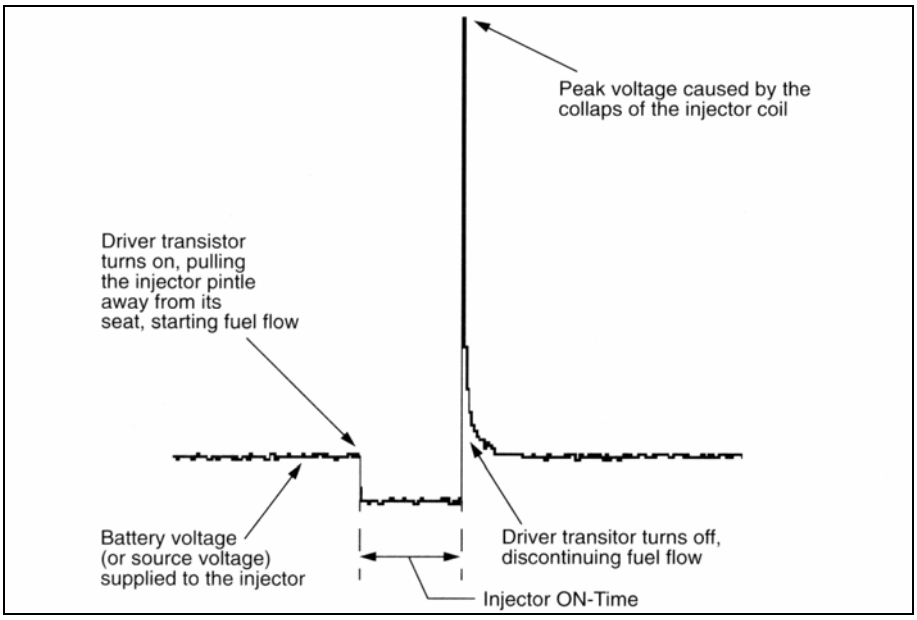


Fig.4-6

Pulse-Width Modulated Fuel Injector

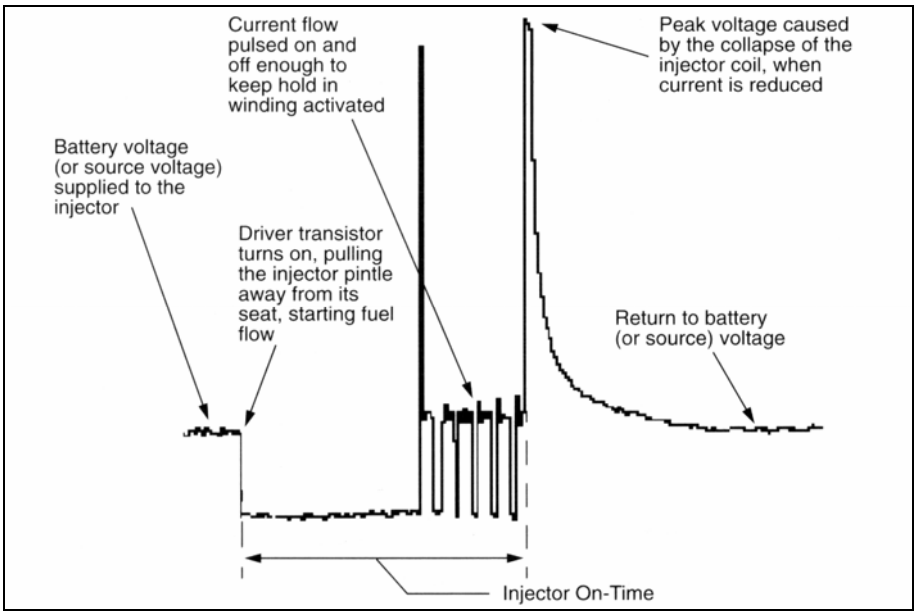


Fig.4-7

Current-Controlled (Peak and Hold) Fuel Injector (Throttle Body and Port Fuel Injection Systems)

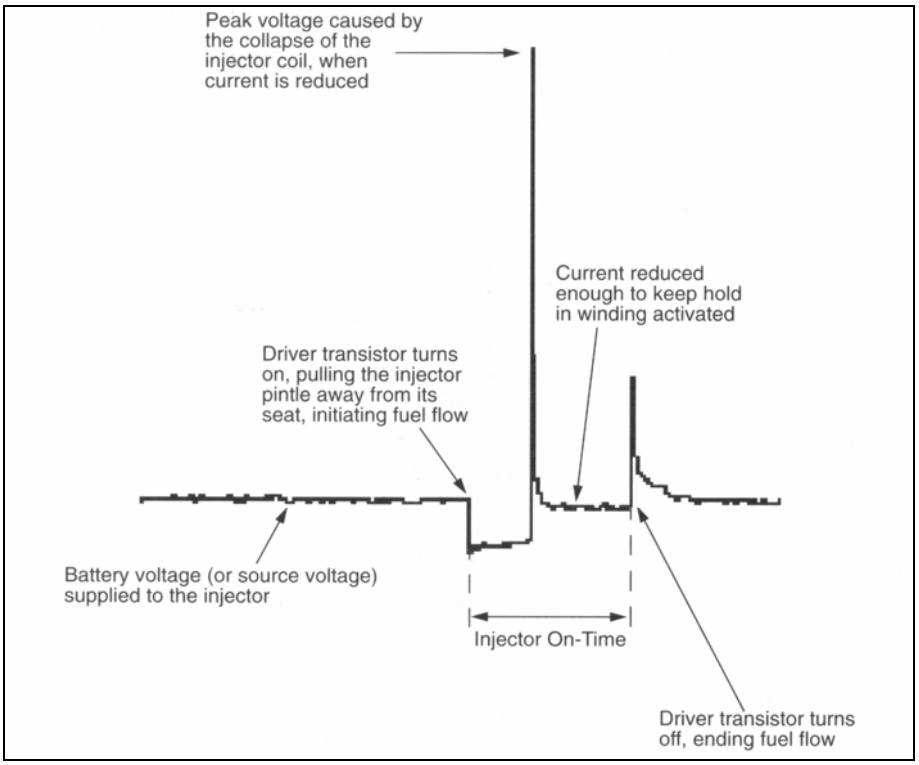


Fig. 4-8

4.4 Solenoid Coil for Mixing Ratio Control (MC)

Computer-controlled system uses step motor of solenoid coil for mixing ratio control to control measuring of fuel, and assists control of injection time by making use of the signal sent back to computer by TPS and oxygen sensor.

Driven by the grounding switch of solid circuit in ECU, solenoid coil for mixing ratio control works periodically. When solenoid coil is driven, fuel needle is pushed down to limit fuel flow. When ECU circuit is switched off, the action of limiting flow in main fuel pipe is released to increase concentration of mixing gas.

4.4.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding, pierce test probe into the signal line of solenoid coil for mixing ratio control. Connecting diagram of multi-point fuel injection is shown as Fig.4-9.

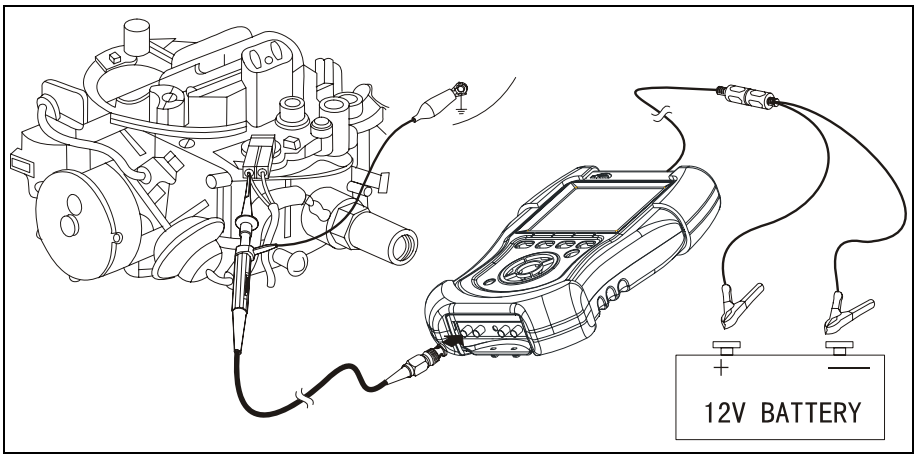


Fig. 4-9

4.4.2 Test conditions

- Start engine after connecting the instrument probe to solenoid coil for mixing ratio control (some vehicles have extra plug near solenoid coil for the convenience of connection), make sure that the fuel control system of engine is controlling fuel (pulse width is changing), the engine is in closed-loop control at this time.

- Intentionally cause large amount of vacuum leak (such as brake vacuum boost) and pay attention to signal change of computer when enriching mixture in order to compensate large amount of vacuum leak.
- Close choke to enrich mixture and pay attention to signal change of computer when compensating oxygen sensor which is lack of oxygen.

4.4.3 Test step

1. Connect equipment according to Fig.4-9, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select AIR/FUEL and press [ENTER] button to enter selection menu for air/fuel;
4. Select SOLENOID COIL FOR MIXING RATIO CONTROL (MC), press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions;
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

4.4.4 Waveform Analysis

The solenoid for mixing ratio control developed by GM company is widely used. Generally, if mixing ratio is adjusted properly, duty ratio of mixing gas control signal can fluctuate within about 50%.

4.5 Idle Air/Speed Control (IAC/ISC)

Idle air controller (IAC) of engine control unit adjusts engine idle and prevents stop. Some idle control system adopts step motor to control the air flow into bypass of throttle; other idle control systems use bypass control valve controlled by square wave signal sent by ECU. Due to impedance of coil, the square wave signals may be slightly different in shape.

4.5.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small

alligator clip on test probe to the negative of battery or grounding, pierce test probe into the IAC/ISC signal line. Connecting diagram of multi-point fuel injection is shown as Fig.4-10.

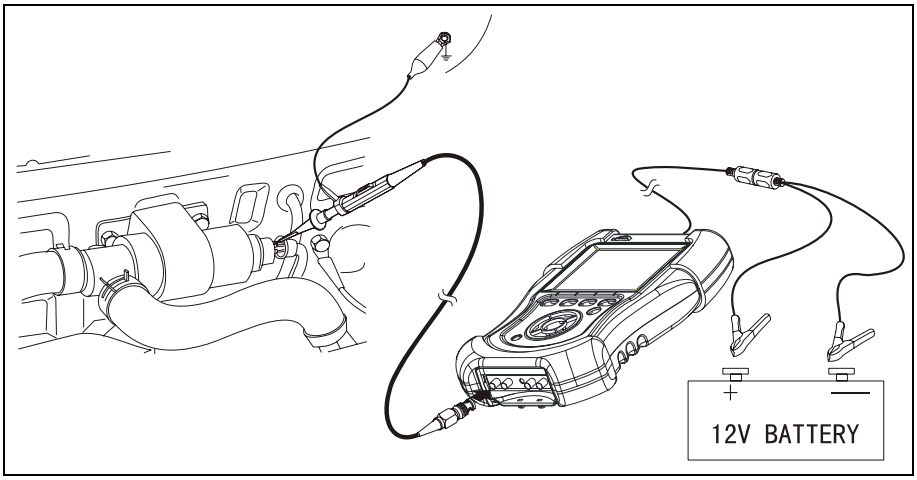


Fig. 4-10

4.5.2 Test conditions

- Start engine after connecting instrument to air control valve, and monitor conditions in cold, warm and hot engine state.
- Intentionally cause small vacuum leak and pay attention to the signal from engine control unit how to adjust opening of valve.

4.5.3 Test step

1. Connect equipment according to Fig.4-10, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select AIR/FUEL and press [ENTER] button to enter selection menu for air/fuel;
4. Select IDLE AIR/SPEED CONTROL (IAC/ISC), press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions;
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

4.5.4 Waveform Analysis

When switches for accessorial appliances (air conditioning, etc.) switch on or off and transmission apply or does not apply, engine control unit will change idle by controlling IAC/ISC to open/close throttle bypass. If idle remains unchanged, it is the most possible reason that IAC/ISC is damaged or throttle bypass is blocked. Refer to Fig.4-11 for characteristic waveform of common IAC/ISC, and refer to manufacturer's manual for possible special shapes.

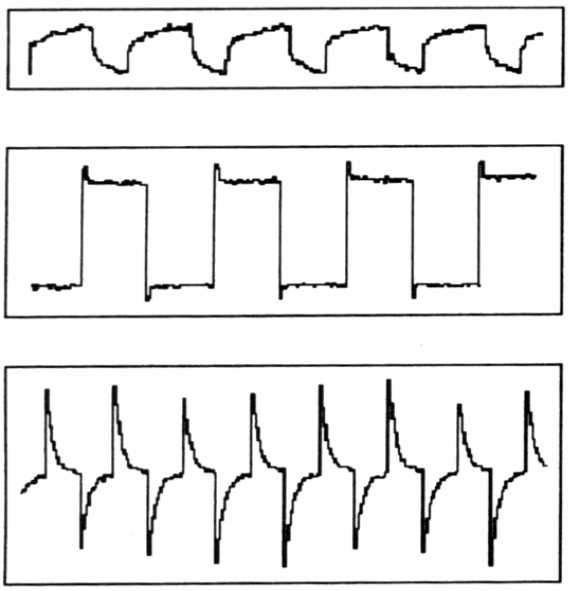


Fig. 4-11

V. Ignition System

This chapter briefly introduces how to use special oscillograph for automobile function of KT600 to diagnose ignition system, mainly including testing and connecting method for primary and secondary ignition waveform, and characteristic waveform, etc. The contents are not suitable for all vehicle models, but for you to better master how to use the instrument, and refer to original manual for diagnosis of specific vehicle model.

5.1 Knock Sensor-Piezoelectric Crystal

In order to achieve optimal performance and fuel economy for engine, ignition time should be adjusted properly to make combustion occur when crankshaft rotates to a particular angle, and start at the top dead center (TDC) of working stroke. If ignition occurs late, the power of the cylinder decreases, if ignition occurs early, knock occurs. Most knock sensor is made of piezoelectric crystal, and bolted to engine body. It is a kind of very special crystal which produces voltage when it is under mechanic stress. The voltage signal differs a lot due to knock conditions. The voltage, after being processed by ECU, is used to adjust ignition timing to achieve optimal engine performance.

5.1.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding, connect test probe to the signal line of knock sensor. Connecting diagram of multi-point fuel injection is shown as Fig.5-1.

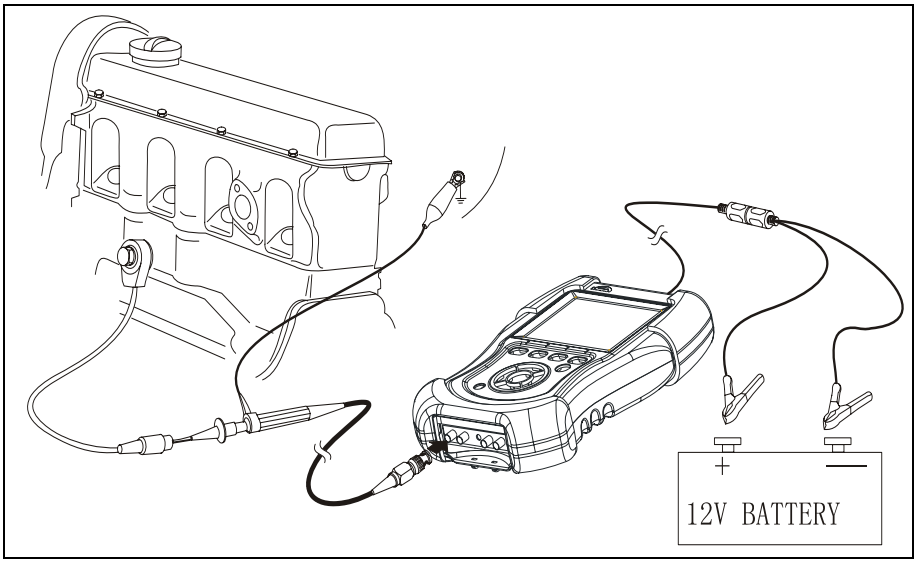


Fig. 5-1

5.1.2 Test conditions

Offline test of knock sensor (sensor disconnected)

- Disconnect knock sensor, and connect instrument to sensor;
- Use mallet strike cylinder body near sensor to make sensor produce signal.

Online test of knock sensor (delayed ignition test)

- Conduct advance time test according to article 5.5;
- Use mallet strike cylinder body near sensor to make sensor produce signal;
- Observe ignition time to confirm that ignition delays when knock signal is received by ECU.

5.1.3 Test step

1. Connect equipment according to Fig.5-1, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select IGNITION SYSTEM and press [ENTER] button to enter selection menu for ignition system;
4. Select KNOCK SENSOR-PIEZOELECTRIC CRYSTAL, press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions.
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the

waveform for reference when repair is needed.

5.1.4 Waveform Analysis

The waveform of knock sensor has direct relation with knock degree and reason, so each waveform looks a little different. Knock sensor mainly checks whether there is signal. For most vehicles, when ECU receives signal from knock sensor, it will delay ignition till knock disappears. Refer to Fig.5-2 for characteristic waveform of ordinary knock.

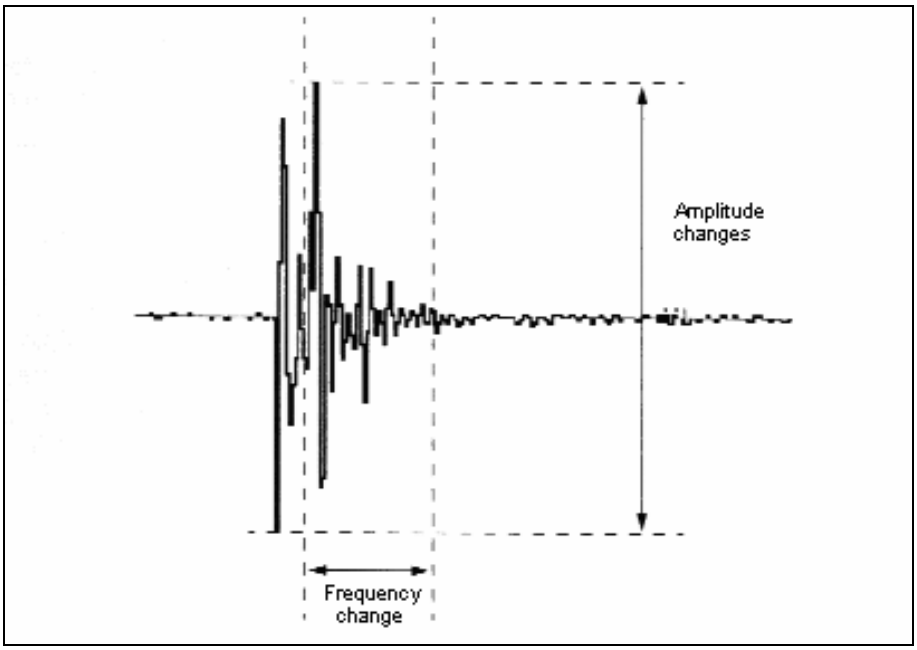


Fig. 5-2

5.2 Secondary Ignition

We can effectively check traveling performance of vehicle and reason for emission problem through analysis of ignition secondary waveform. Generally, the waveform is mainly used to check whether high voltage line of spark plug is short or open, and whether spark plug misfires due to carbon deposit. Secondary waveform of ignition is also affected by different engine, fuel supply system, air intake system and ignition condition, so we can effectively test the failure in mechanic parts of engine, fuel supply system parts and ignition system parts in accordance with secondary waveform of ignition.

When testing, we generally divide into three kinds according to ignition system:

traditional ignition, direct ignition and double end ignition. Traditional ignition generally refers to distributor ignition, which is usually adopted by domestic vehicles of old model; direct ignition generally refers to ignition mode in which one cylinder corresponds to one ignition coil, which is normally used in high grade car; double end ignition means one ignition coil ignites two cylinders at the same time, which is common currently in Era Superman, JETTA GT, Fukang and Audi V6 engine.

5.2.1 Connecting Equipment

Since ignition mode and ignition system of the engines to be tested differ in connection, connecting method is also different. Please confirm ignition mode of engine to be tested before testing secondary ignition waveform. We will illuminate the test and connecting method of three common ignition modes in the following.

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first.

Traditional ignition: Take out inductive pickup and capacitive pickup from packing case. Connect one end of inductive pickup to CH5/(CH3) port, use signal clip to clip high voltage line of one cylinder of engine. Please check that there is “This side faces to spark plug” on the signal clip, do not clip reversely; connect one end of capacitive pickup to CH1 port, and then use one clip to clip general high voltage line. Refer to Fig.5-3 for connecting method.

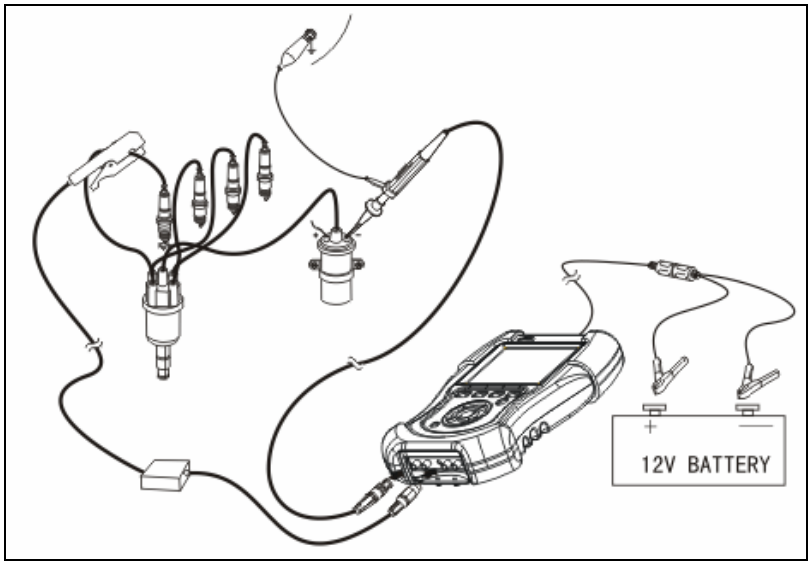


Fig. 5-3

Direct ignition: Take out inductive pickup and capacitive pickup from packing case. Connect one end of inductive pickup to CH5/(CH3) port, use signal clip to clip high voltage line of one cylinder of engine. Please check that there is “This side faces to spark plug” on the signal clip, do not clip reversely; connect one end of capacitive pickup to CH1 port, and then use capacitive pickup to clip high voltage line of each cylinder.

Double end ignition: Take out inductive pickup and capacitive pickup from packing case. Connect one end of inductive pickup to CH5/(CH3) port, use signal clip to clip high voltage line of one cylinder of engine. Please check that there is “This side faces to spark plug” on the signal clip, do not clip reversely; check polarity of ignition coil, if one side is positive, the other side is sure to be negative. Polarity of the same side is the same, share the same capacitive pickup. Refer to Fig.5-4 for connecting method.

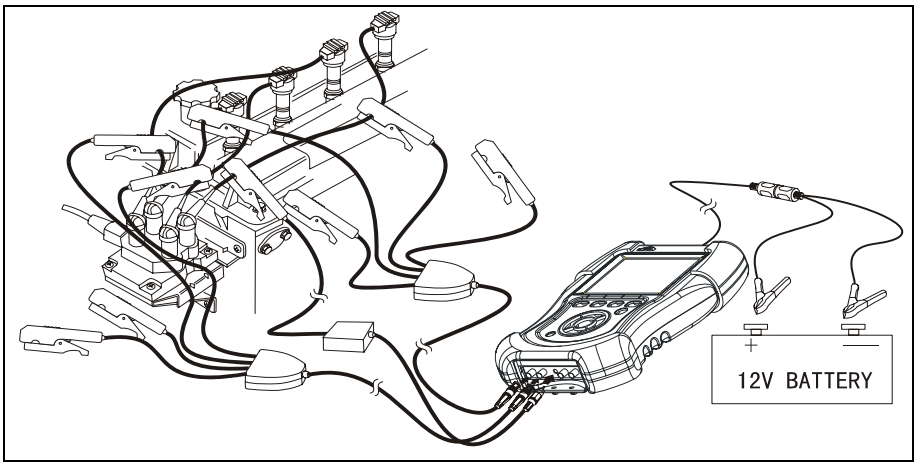


Fig. 5-4

5.2.2 Test conditions

Start engine, and test the performance of testing elements at different load and speed. Spark plug, ignition connector and the elements of other secondary circuit may function abnormally at high load. Conduct these tests (on power tester or road test) at load state to precisely locate failure position in the system.

5.2.3 Test step

1. Connect equipment according to Fig.5-4, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select IGNITION SYSTEM

and press [ENTER] button to enter selection menu for ignition system;

4. Select SECONDARY IGNITION, and press [ENTER] button to confirm;
5. Select ENGINE PARAMETER SETTING, press [ENTER] button, and screen displays as Fig.5-5;

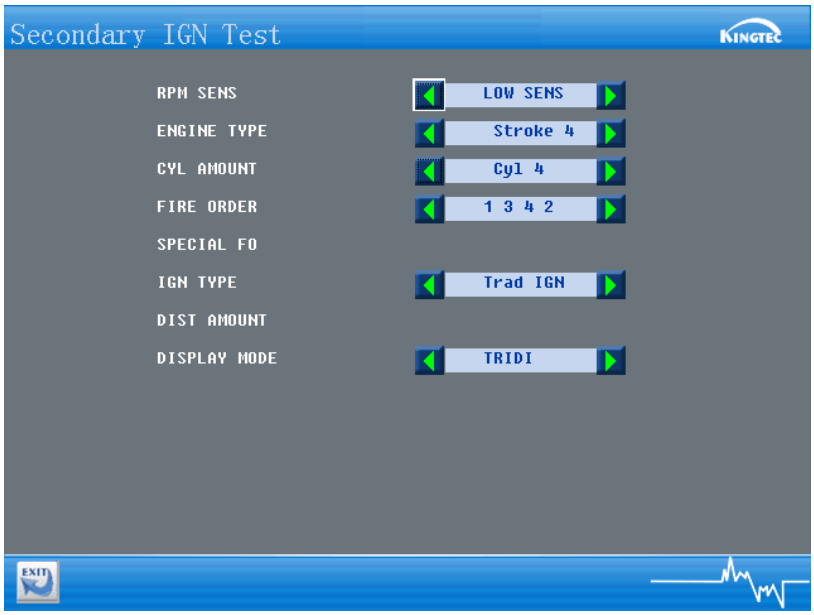


Fig. 5-5

6. You can change parameters according to the tested engine. Press UP and DOWN button to select desired item and press LEFT and RIGHT button to change parameter. Press [EXIT] button to return to previous menu after change is completed;
7. Press DOWN button to select secondary ignition test, press [ENTER] button to confirm. Waveform will be displayed on the screen according to test conditions.
8. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.
9. Shown as Fig.5-6.

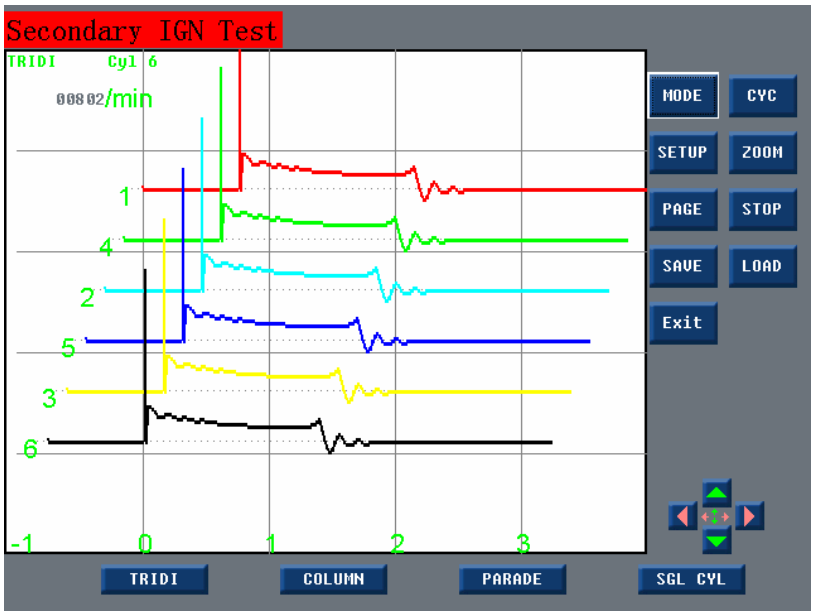


Fig. 5-6

Notes:

- ***Select mode, and press LEFT and RIGHT button to change display mode of secondary ignition waveform, such three-dimensional waveform, paratactic waveform, longitudinal waveform and single cylinder display;***
- ***Press LEFT and RIGHT button to select parameter, and press [ENTER] to confirm. You may also return engine parameter setting interface to re-change parameters.***

5.2.4 Waveform Analysis

Secondary waveform of ignition is divided three parts: closed part, ignition part and middle part.

Closed part: This period of time is the time when triode is on or platinum contact is connected, and falling edge of waveform should be kept consistent, indicating that each cylinder has the same dwell angle and ignition timing is correct.

Ignition part: including an ignition line and a spark line (combustion line). Ignition line is a vertical line, representing breakdown voltage; spark line is an approximate horizontal line, representing a voltage needed to keep current pass clearance of spark plug.

Middle part: it displays that ignition coil consumes surplus energy through primary and secondary oscillation, normally 2 oscillatory wave at least. Refer to Fig.5-7 for characteristic waveform of traditional secondary ignition.

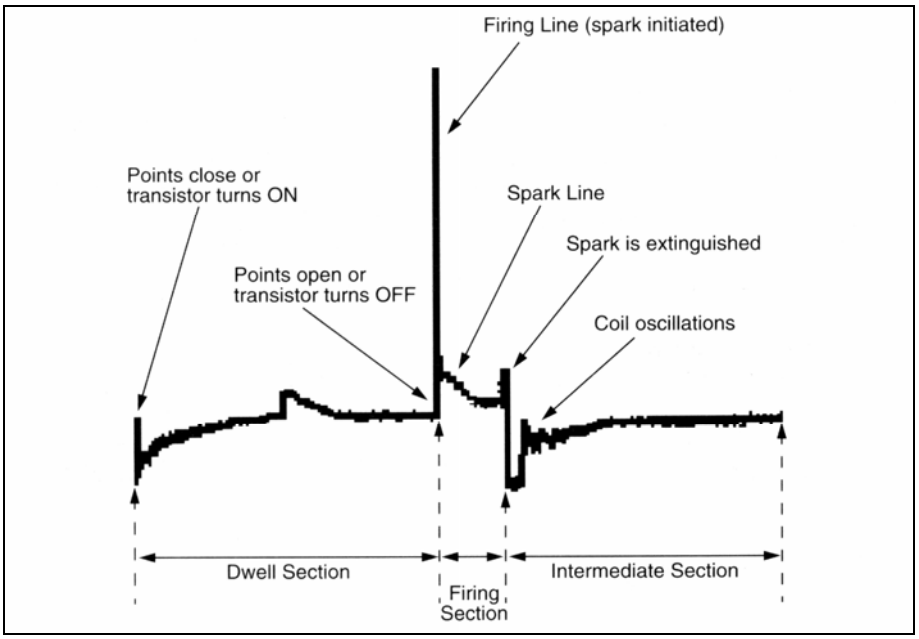


Fig. 5-7

5.3 Primary Ignition

The display of primary ignition dwell angle brings convenience for diagnosis of traditional ignition. The advent of electronic ignition control system removes the need to adjust dwell angle since ignition dwell angle is controlled by ECU. Due to mutual inductance of primary and secondary coil of ignition, spark that occurs at secondary circuit will be fed back to primary circuit, therefore, primary ignition is also very important.

5.3.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first.

Take out inductive pickup and test probe from packing case. Connect one end of inductive pickup to CH5/(CH3) port of KT600, use signal clip to clip high voltage line of one cylinder of engine. Please check that there is “This side faces to spark plug” on the signal clip, do not clip reversely; connect one end of test probe to CH1 port, place the attenuation switch on test probe to “X10” position to connect to “IG-“ signal line of ignition coil, as shown Fig.5-8.

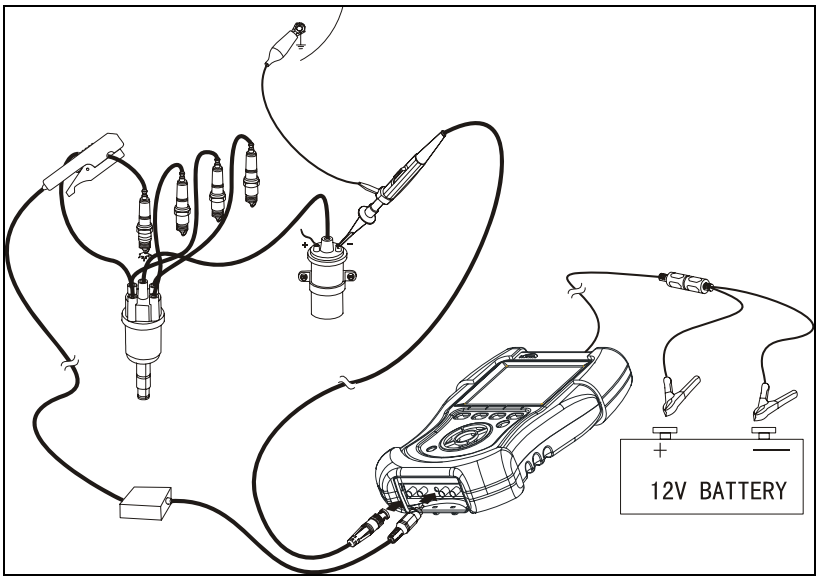


Fig. 5-8

5.3.2 Test conditions

Start engine, and test ignition system at different load to test the performance of elements. Primary ignition module may not work properly at high load and high temperature.

5.3.3 Test step

1. Connect equipment according to Fig.5-8, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select IGNITION SYSTEM and press [ENTER] button to enter selection menu for ignition system;
4. Select PRIMARY IGNITION, and press [ENTER] button to confirm;
5. Select ENGINE PARAMETER SETTING, and press [ENTER] button to confirm;
6. You can change parameters according to the tested engine. Press UP and DOWN button to select desired item and press LEFT and RIGHT button to change parameter. Press [EXIT] button to return to previous menu after change is completed;
7. Press DOWN button to select MULTIPLE CYLINDER MODE WITH PRIMARY IGNITION for test, please select SINGLE CYLINDER MODE WITH PRIMARY IGNITION if it is direct ignition, press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions; If necessary, you can select parameters such as period, amplitude value and level, and then

press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

5.3.4 Waveform Analysis

Observe whether the height of ignition breakdown peak voltage of each cylinder is relatively consistent, and change of dwell angle when engine load and speed change.

5.4 Distributor Trigger

Electromagnetic distributor trigger: the electromagnetic sensor used for distributor trigger consists of a permanent magnet and a magnetic core. Filament wrapped on the core functions as pickup coil. Non-magnetic trigger wheel is installed on distributor shaft and has the same number of teeth as cylinder number. When one tooth of trigger wheel passes magnetic field (formed by pickup coil), a signal is produced. Magnetic sensor or variable magnetoresistive sensor usually has two conducting wires and produces its own signal.

Hall effect distributor trigger: Hall effect switch has a fixed sensor and a trigger wheel, and requires a small input voltage to produce output voltage. When rotary vane passes through between magnet and Hall element, output voltage changes. This signal is sent, in square waveform, to ignition module to trigger ignition coil.

Photoelectric distributor trigger: photoelectric signal generator produces voltage signal by using light produced by LED to trigger photoelectric triode. Trigger wheel is a piece of disc with small hole, which rotates in the clearance between LED and photoelectric triode.

5.4.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding, pierce test probe into the signal line of distributor. Connecting diagram of Hall effect distributor trigger is shown as Fig.5-9.

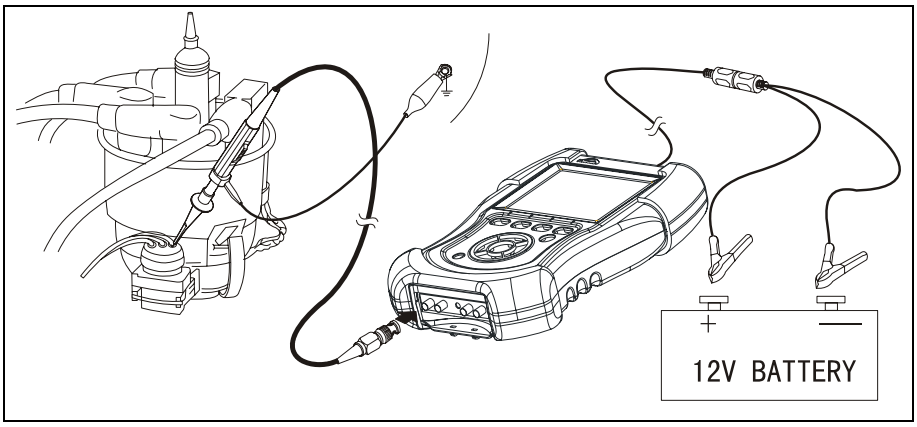


Fig. 5-9

5.4.2 Test conditions

- If you are diagnosing “Cannot start” failure, connect wires as connection note, and then start engine. Check whether there is signal. If there is, problem is not here; if there is no signal or signal is too weak, check whether sensor fails or lines have problem.
- If engine can be started, connect wires as connection note. Start engine, and check engine in various working conditions.

5.4.3 Test step

1. Connect equipment according to Fig.5-9, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select IGNITION SYSTEM and press [ENTER] button to enter selection menu for ignition system;
4. Select DISTRIBUTOR TRIGGER, press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions;
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

5.4.4 Waveform Analysis

Refer to Fig.5-10, 5-11 and 5-12 for characteristic waveform triggered by three kinds of distributors.

Primary Distributor Triggering (Hall Effect)

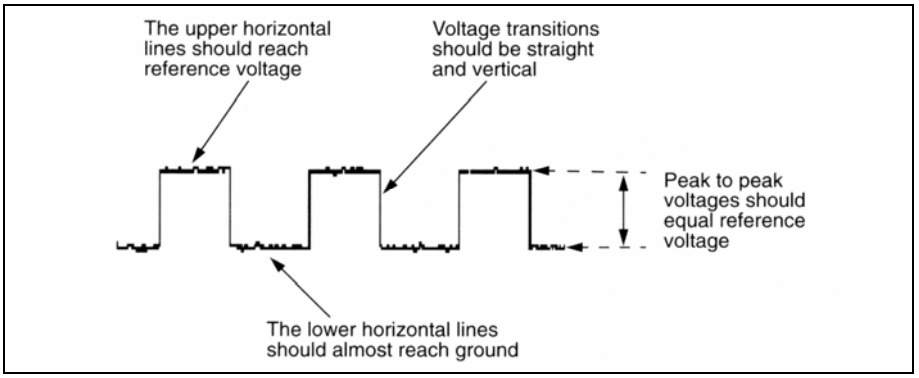


Fig. 5-10

Primary Distributor Triggering (Magnetic)

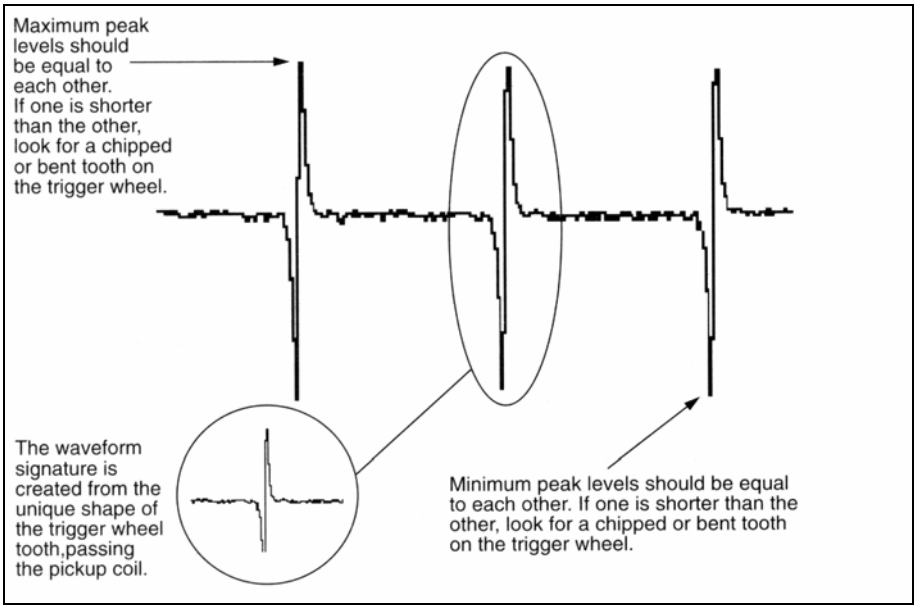


Fig. 5-11

Primary Distributor Triggering (Optical)

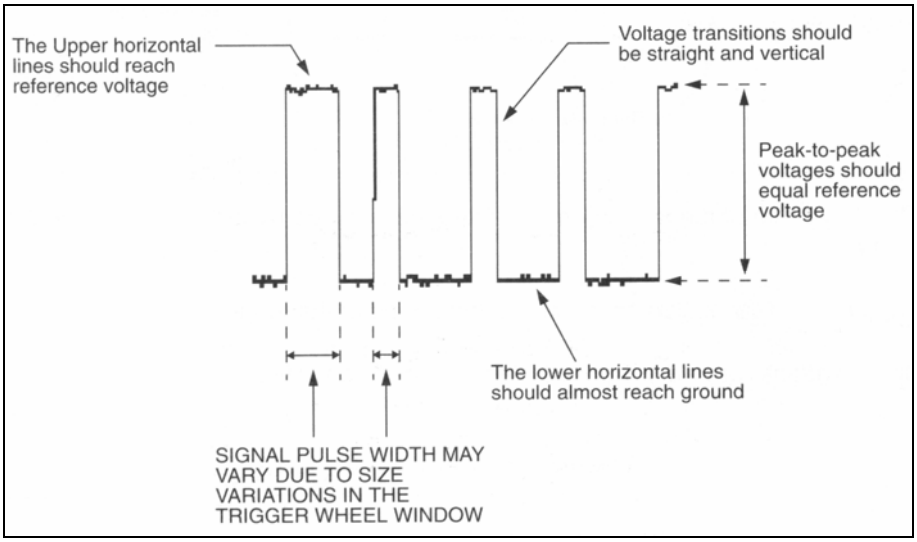


Fig. 5-12

5.5 Advance Time

Two channels of KT600 can determine ignition advance time of the ignition system. Connect CH1 to the first cylinder or primary of ignition coil (ignition module), and CH2 to TDC signal.

5.5.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect two test probes to CH1 and CH2 (CH1 and CH2 port) of KT600 respectively. Connect inductive pickup to Channel CH5/(CH3), and then connect the small alligator clip connected to test probe CH1 to the negative of battery or grounding, pierce test probe into the “-“ connector of ignition coil and signal line of crankshaft position sensor. Refer to Fig.5-13 for connection method.

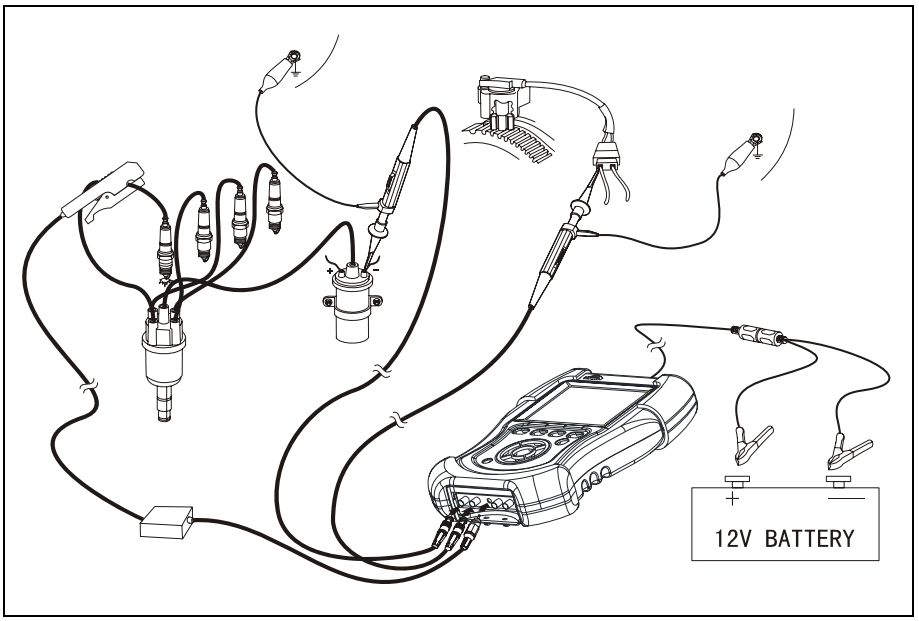


Fig. 5-13

5.5.2 Test conditions

- Connect KT600, and the test line on Channel CH2 cannot be grounded;
- Start engine and let it run at idle, slowly accelerate it and observe result displayed on the screen;
- When electronic and mechanic (if found) advances begin to function, the increment of ignition advance can be observed.

5.5.3 Test step

1. Connect equipment according to Fig.5-13, switch on power supply switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select IGNITION SYSTEM and press [ENTER] button to enter selection menu for ignition system;
4. Select ADVANCE TIME, press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions;
5. If necessary, you can select parameters such as period, amplitude value and level, and then press directional button to change waveform. You may also select STOP button and press it to freeze waveform, select STORE to store the waveform for reference when repair is needed.

5.5.4 Waveform Analysis

Refer to Fig.5-14 for characteristic waveform.

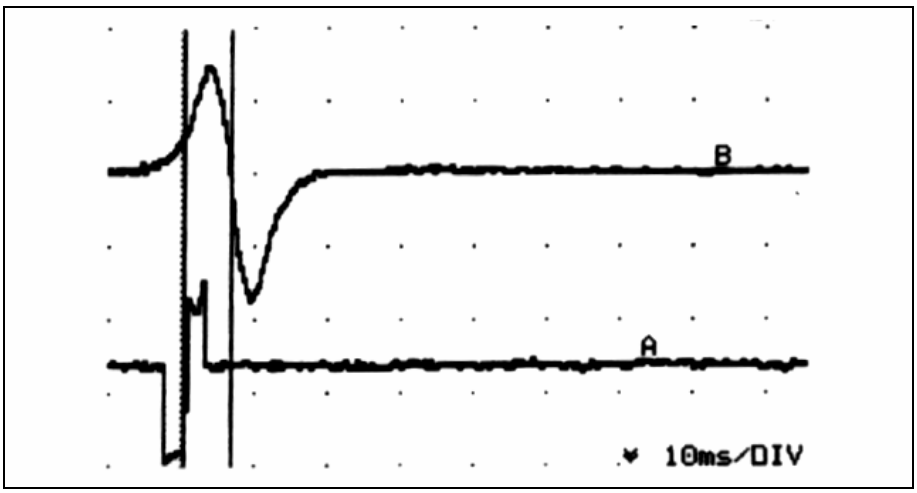


Fig.5-14

VI. Electric System

This chapter mainly introduces how to use special oscillograph for automobile of KT600 in common vehicle electric system, mainly for check of charging system, battery, coil and diode, etc.

6.1 Battery Test

The problem of charging system is usually from vehicle owner who complains about “Cannot start”, battery cannot provide electric energy at this time, while starting motor cannot drive engine. The first step usually is to test battery, and charge battery first if necessary.

When measuring system voltage, surface charge of the battery can be released several minutes after turning on headlight, and then turn off headlight and measure the voltage between two terminals of the battery. If possible, use gravimeter to measure specific gravity of each separate cell of the battery. Battery load test should be conducted to check battery performance at load state. Because only charging state is displayed in voltage test, not in battery conditions.

6.1.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding. Connect test probe to positive of battery.

6.1.2 Test conditions

Let headlight on for about 3 minutes to remove the surface charge in the battery.

6.1.3 Test step

1. Connect equipment, switch on power switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select ELECTRIC SYSTEM and press [ENTER] button to enter selection menu for electric system;
4. Select BATTERY TEST, press [ENTER] button to confirm, and waveform will be

displayed on the screen depending on test conditions;

6.1.4 Waveform Analysis

Generally, amplitude value of battery voltage is displayed as a line on the oscillograph.

6.2 Charging Test

Charging output test: new electric regulator can maintain charging voltage between 13-15V, and charging system must provide sufficient output to maintain battery charging and need of vehicle.

Test rectifying diode: three-phase alternator uses three pairs of diodes to rectify output current. These diodes are usually installed on a insulating radiating seat or in rectifying bridge. Diode allows current to pass through in only one direction but not in the other. If diode is short, current can pass through in both directions; if open, current can pass through in neither direction.

The way of testing open or short diode is to connect one end of testing line of KT600 to one end of the diode, and to connect the other testing line to radiating seat or generator housing. And then test again in reverse direction. It should be displayed on KT600 that one direction is on while the other direction is off. If the testing result is on in both directions, the diode is short. If it is off in both directions, the diode is open.

6.2.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding. For different function test, the test location of test probe is also different. Refer to testing conditions for details.

6.2.2 Test conditions

Charging output test:

- Connect KT600 to the generator on the vehicle, as shown in Fig.6-1;
- Start engine, and conduct test at idle and load state, slowly increase engine speed;

- Turn on the electric appliances on the vehicle to make charging system loaded, such as headlight, water tank fan motor and wiper, etc.

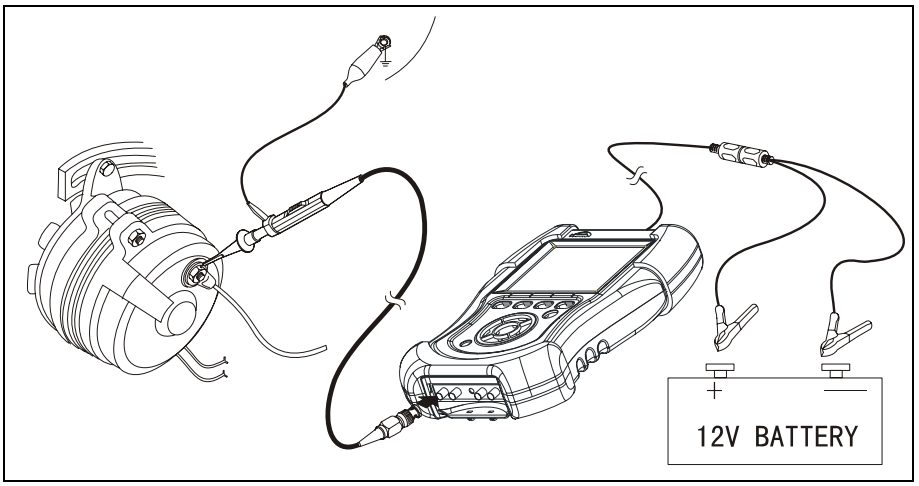


Fig. 6-1

Rectifying diode test

- Test rectifying bridge of generator after disconnecting generator;
- Diagnose generator failure according to the method recommended by manufacturer.

6.2.3 Test step

1. Connect equipment, switch on power switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select ELECTRIC SYSTEM and press [ENTER] button to enter selection menu for electric system;
4. Select CHARGING TEST, press [ENTER] button to confirm, and waveform will be displayed on the screen depending on test conditions;

6.2.4 Waveform Analysis

The waveform of charging voltage is a steady line.

6.3 Coil and Diode Test

When the energy of electromagnetic control unit disappears, change of magnetic field can induce burr of voltage. Clamping diode (or suppression diode) is used to filter these burrs, horn, relay, fan motor, clutch of air conditioning compressor and some fuel injection equipment are all examples.

A faulty diode produces noises that can be heard normally in sound system of vehicle. The waveform of these noise burrs will contain big burr when one level changes to another. These burrs can also affect sensitive sensors or control system in the vehicle.

6.3.1 Connecting Equipment

When connecting KT600 to extension line for power supply, choose battery or cigar igniter as power supply according to the battery position of vehicle mode tested. All connecting diagrams in this users manual take power supply by battery as example. If choosing cigar igniter connecter, confirm that cigar igniter has 12V battery voltage first. Connect test probe to Channel 1 (CH1 port), and then connect the small alligator clip on test probe to the negative of battery or grounding. Connect test probe to the power supply of solenoid coil, as shown in Fig.6-2.

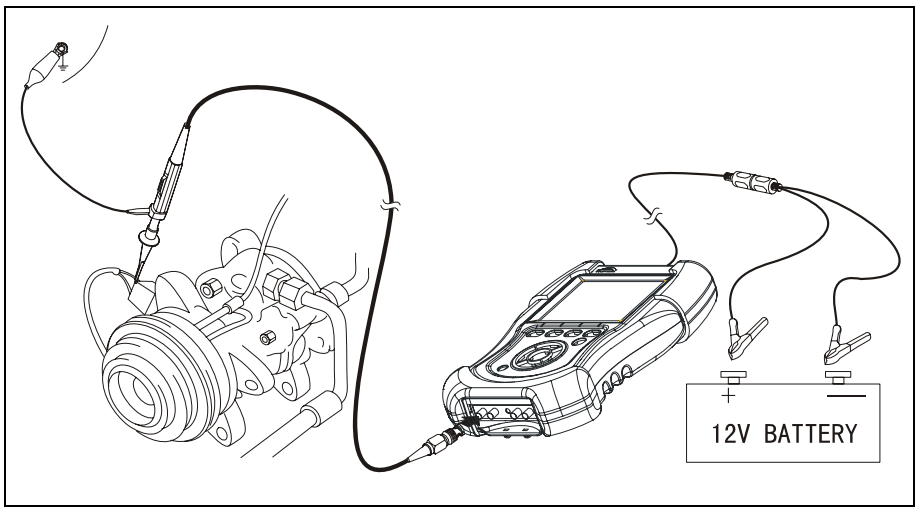


Fig. 6-2

6.3.2 Test conditions

Excite tested equipment, and then observe display of KT600.

6.3.3 Test step

1. Connect equipment, switch on power switch of KT600;
2. In Kingtec instrument menu, press UP and DOWN button to select 2. OSCILLOGRAPH, and press [ENTER] button to confirm;
3. In the menu of special oscillograph for automobile, select ELECTRIC SYSTEM and press [ENTER] button to enter selection menu for electric system;
4. Select COIL AND DIODE TEST, press [ENTER] button to confirm, and

waveform will be displayed on the screen depending on test conditions;

6.3.4 Waveform Analysis

Refer to Fig.6-3 for characteristic waveform of clamping diode.

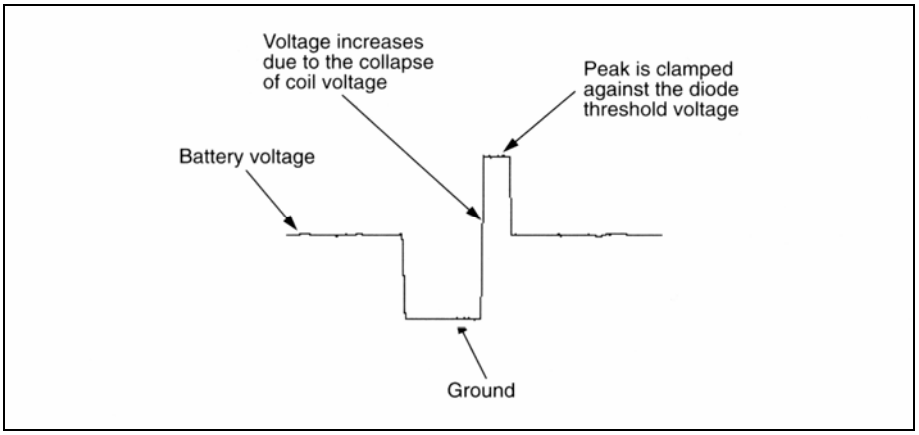


Fig.6-3

VII. Recorder

7.1 Operation Instructions of Recorder

Operation of recorder is basically the same as that of universal oscillograph, its main function is to quickly capture waveform in real time and store it for playback. Shown as Fig.7-1.

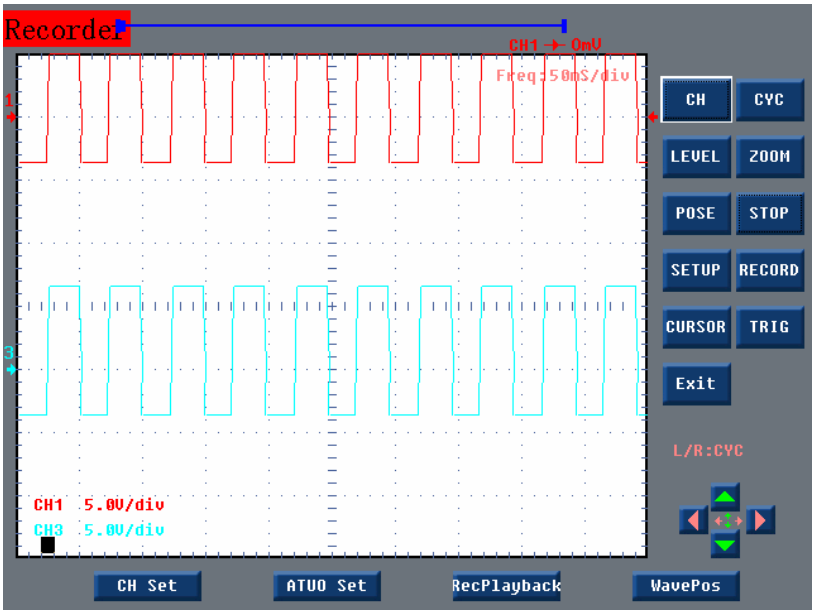


Fig. 7-1

7.2 Operation of Recorder Setting Interface

When recorder is at low speed (>=50ms), you can select record of 2 screens/5 screens/10 screens/full screen (64kbit data); at high speed (<=40ms), you can select record of 20 screens/50 screens/100 screens/full screen (64kbit data); you can select starting point trigger type: level trigger, rising edge trigger, falling edge trigger and close trigger, at the same time you can also select tracking of waveform by cursor when re-playing. Shown as Fig.7-2.

Fig. 7-2

7.3 Playback function of Recorder

You can select single step playback and continuous playback, and you can also send it to PC through serial port line by clicking “SEND”. With waveform preview software, you can clearly play and record waveform. Shown as Fig.7-3.

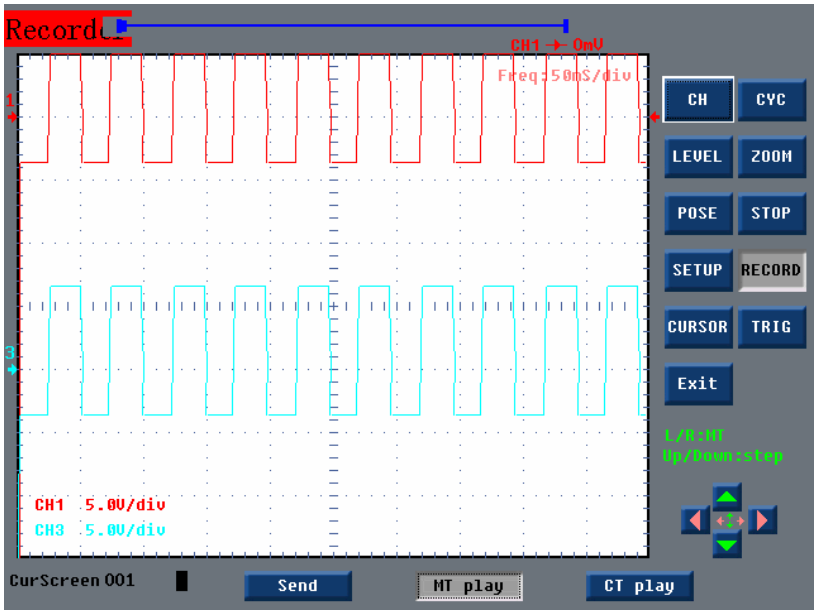


Fig. 7-3

VIII. Pressure/Temperature System (Optional)

This function can only be realized with purchase of external module, and specific operation is to be updated.