QUICK GUIDE

OBD-II SENSOR KIT FOR TRAINING

Model: SENSOR KIT-13

I. INTRODUCTION

1. Overview

SENSOR KIT-13 is a product of DTDAUTO Technology Team/ Institute of Physics in 2013

SENSOR KIT-13 designed used for vocational training of vehicle electronic fuel injection system

SENSOR KIT-13 is a compact teaching trainer, flexible, efficient, appropriate research, training course on electricity and fuel. Very convenient for teaching in many places moved by personal motorcycle or cars

Equipment building on real parts of the Toyota electronic fuel injection system with full function as "**Input, ECU, Output**"

SENSOR KIT-13 manufactured in Vietnam, according to the standard equipment of the Vietnam vocational training

2. BASIC SPECIFICATION

2.1 The equipment

- Includes full sensor system used on OBD-II engine of Japan Toyota manufacturer

Sensors	ECM	Actuators
- 01 Intake air sensor unit (THA, MAF) - 01 Engine temp. sensor (THW) - 01 Oxygen sensor (HO2S) - 01 Throttle position sensor (TPS) - 01 Knock sensor (KNK) - 01 Engine speed sensor (RPM) - 01 Cam shaft position sensor (G) - 04 Switchs as AC, STA, STP, Power Steel Switch (PSS)	01 ECM – Engine Control Module	- 01 injector - 01 ignition coil, igniter, spark - 01 ISC valve - 01 Check Engine Light

- Installation KIT practices style for transported by hands. Senors can work as Car with 12VDC power adaptor integrated inside

- The connectors with electrical diagram principle allow learners and teachers test, check actual parameters (Live data) convenient

- "PAN MAKER" able to create basic faults for learning and teaching: there are 02 options create fault by normal switchs or setting on computer

- The connector used exchange data with a computer or scanner

- Use measuring by Mutimeter and AutoScope (pulse measuring device)

- Use PC Diagnostic scanner (high serial data)

2.2. Document and software for training:

- Electronical pdf file support training with text, images, animation, animations for new ignition and electronic fuel injection systems. It is suitable for teaching with projector and multimedia training

- OBD-II software for read/ clear fault codes, show Engine Live data

- AutoScope software, PAN Maker software…

2.3. Full component parts

Image of SENSOR KIT - 13 full set

- 01 OBD-II KIT sensors
- 01 full set of equipment for OBD-II Diagnosis
- 01 Multi-meter
- 01 full set of PC Auto Scope equipment for check automotive signal pulses
- 01 CD of DTD CODE software license used for: lookup fault codes, vocational training
- 01 English guidebook
- Some cable accessories

3. PURPOSE

Being teaching aids and educational tools teaching for teachers and trainees training schools vocational automobile:

- Understand all of components basic sensors on new OBD-II standard of Cars

- Understand principles and principles working of the sensors with electronic fuel injection system & ignition

- Understand, analysis the dependence between the INPUT (signal input sensors) and OUTPUT (signal control actuators) through ECU (electrical controller)

- Understand electrical wiring diagram of system, installation position structure actual event on the car (according to accompanying documentation)

- Understand ways trouble diagnosis and repair by the different methods:

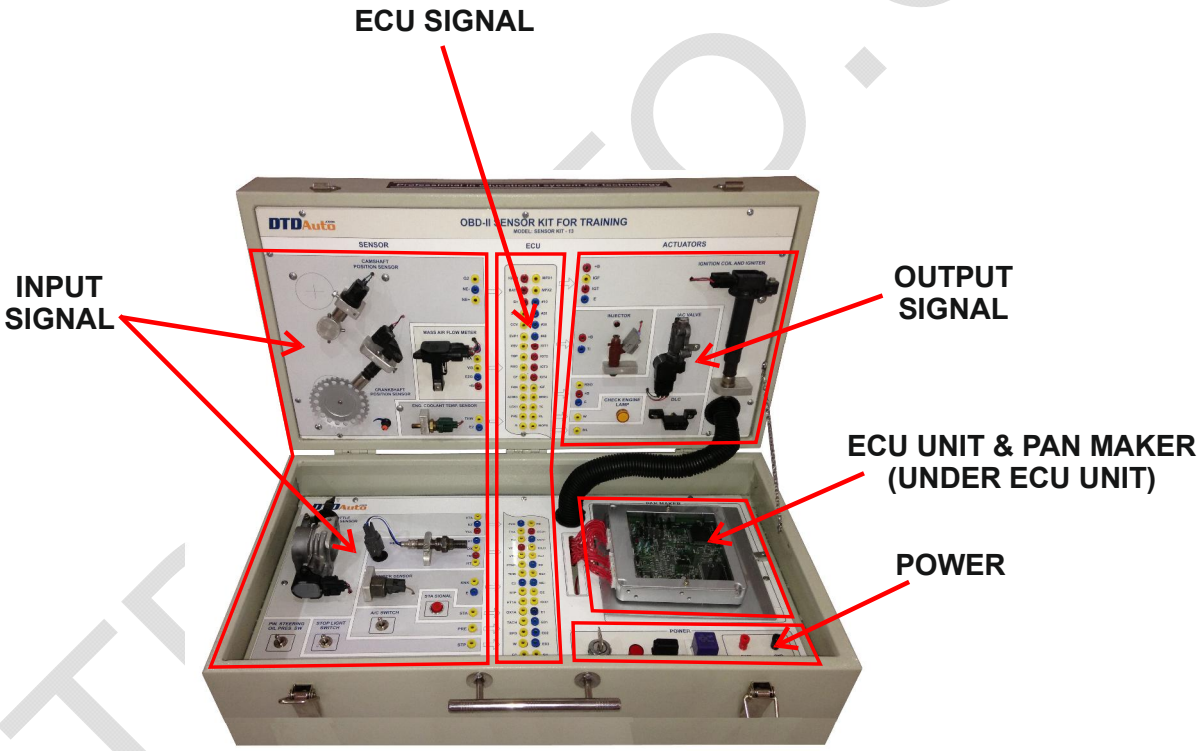
+ Replacing and excluding

+ Find fault position via analyzing on electrical wiring diagram

+ Find fault by interligent diagnostic tools and other measurement equipment

II. THE POSITION AND FUNCTION BLOCKS IN EQUIPMENT

1. LOCATION OF SIGNAL AND FUNCTION BLOCKS



2. MAIN COMPONENTS

NAME	IMAGES	FUNCTIONS
OBD –II Scantool		- Used for fault diagnosis lessons - Read / Clear fault codes - Displays parameter live data *(Steps of installing software, please to see documents use OBD-II Scantool)*
Auto Scope		Use to test electrical signal pulses in the lessons
Multi-Meter		Use measuring electricity and electrical signals

III. PROCEDURE FOR EQUIPMENT OPERATION

1. CONTENTS

- Observe the sensors, other components of the sensor system (Input), ECU and actuators

- Survey of the specific activities of each component, function blocks as INPUT, OUTPUT and ECU

- Survey of the dependence between the INPUT (input signals from sensor) and OUTPUT (control signals of actuators) and control algorithm inside the ECU (Electronic Control Unit)

- Combined with adaptors, tools, control softwares on the computer, students can examine, test, research read / clear faults of all system

2. STEPS FOR USE, SURVEY INPUT AND OUTPUT

2.1. Operate initial mode

- Preparation:

+ Power suply with 02 ways: 220V AC by power a cable (3 pins cable) or 12V/DC battery (Red connector is positive, black connector is negative)

+ Device placed in a safe location, avoiding industrial noise, avoids high temperature, high humidity...

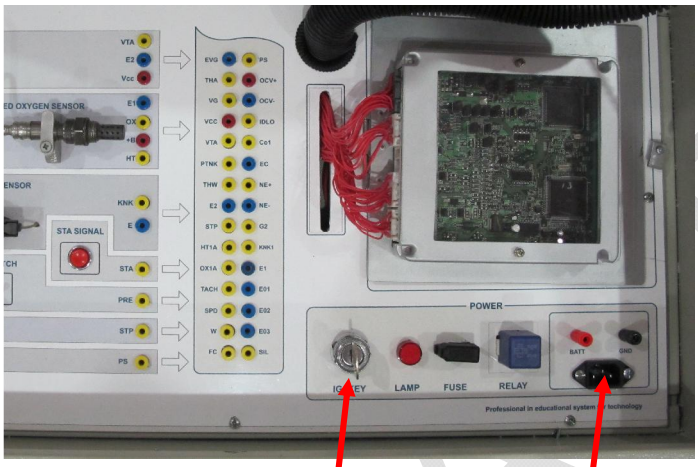
*+ Turn all "PAN MAKER" switch is ON. (**Notes:** ON: switched at above is normal mode; OFF: switched at below is fault mode)*

- Running:

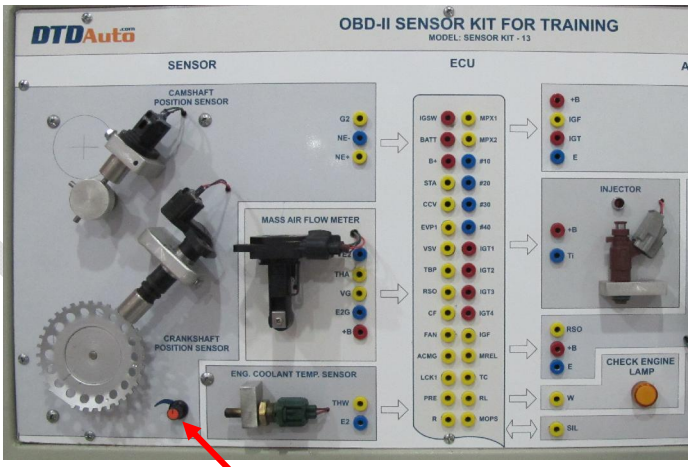
+ Step 1: Turn "ON" the ignition key

+ Step 2: Adjust engine RPM from a speed potentiometer (in the frame of CKP sensor and CMP)

Observed: injection and ignition frequency varies engine rpm

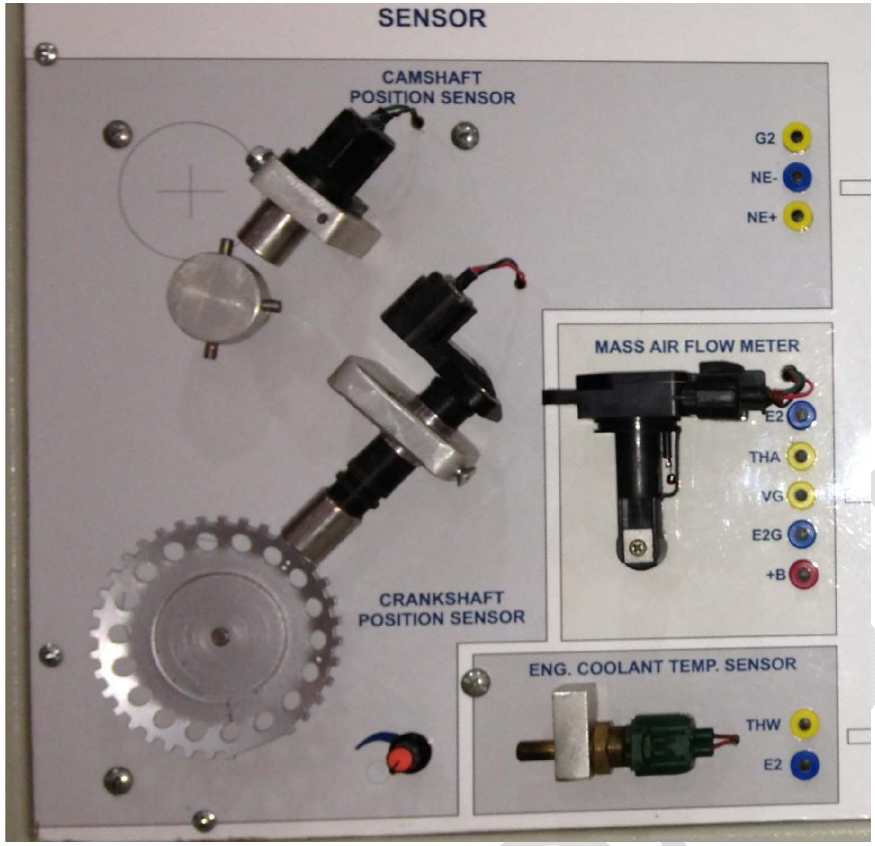


Ignition key *220VAC power*



Engine speed potentiometer

2.2. Actions for measuring, checking of INPUT (sensor signals)



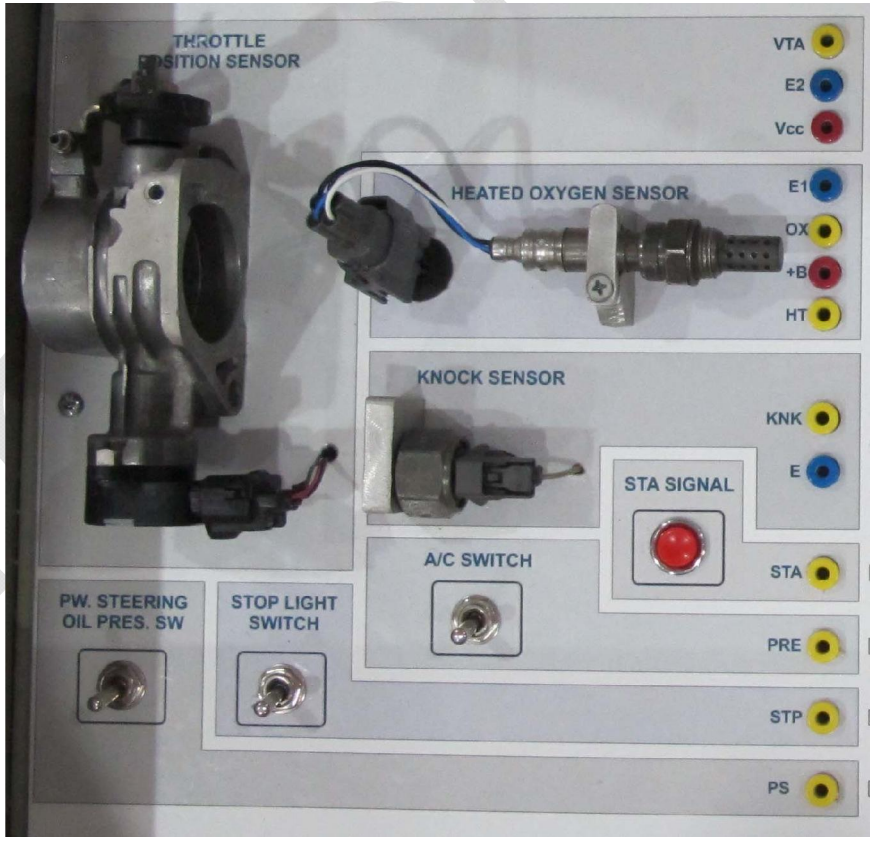
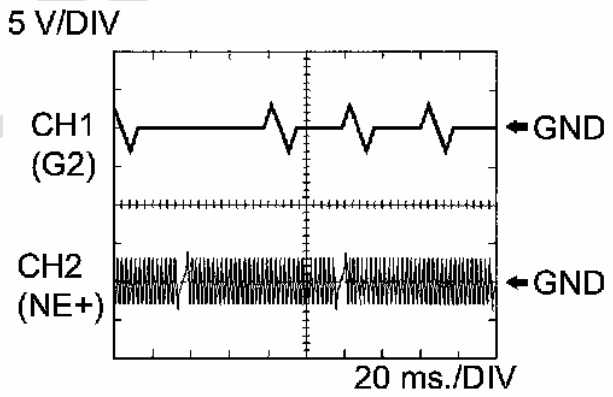
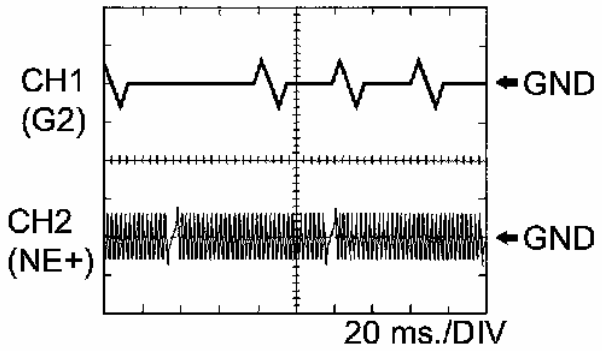
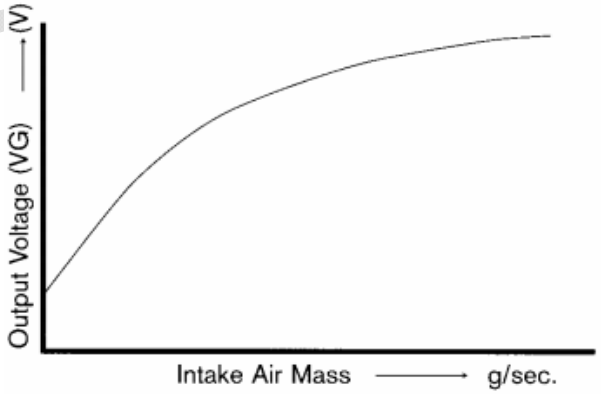


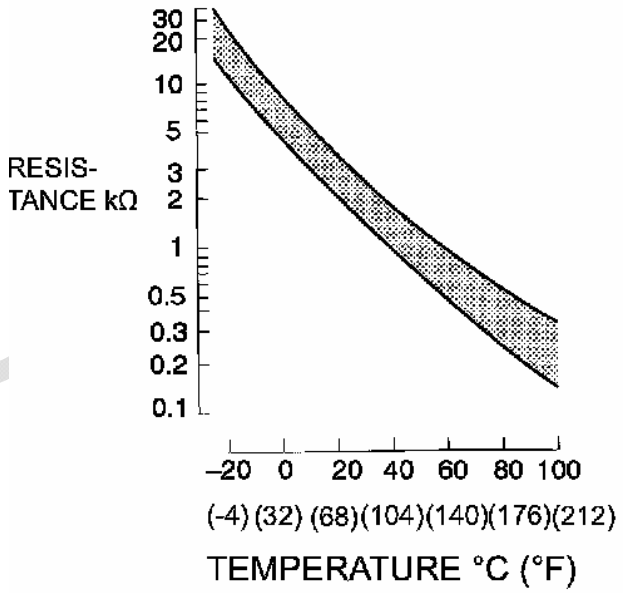
Image for frame of input sensors

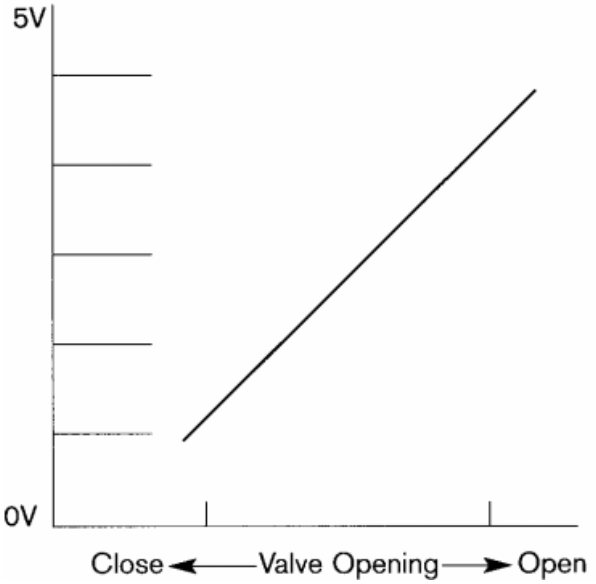
Note: guide of OBD-II Scantool and Autoscope please follow the section 2.5 and 2.6

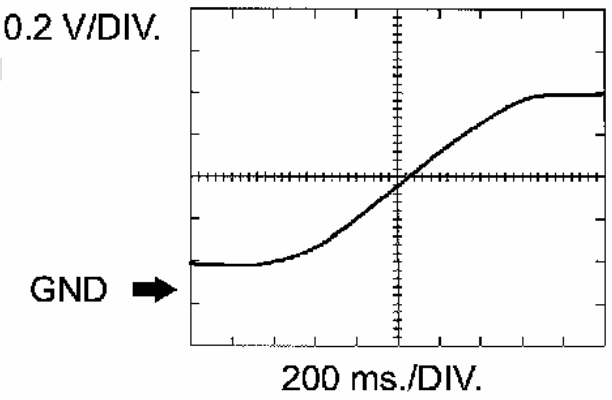
Sensor name	Pin name	Condition for activation	Tools	Test result
CKP **(Crankshaft Position Sensor)**	NE - Ne-	**Measure resistance value of sensor** - Turn OFF Ne +, Ne- in PAN maker	Car Meter Multi meter	1.630Ω - 2,740Ω (Temp: 10 ° C - 50° C) 2.065Ω - 3,225Ω (Temp: 50 ° C - 100° C)
		Engine is running (RPM <>0) - Turn ON Ignition key - Adjust the potentiometer to change different speeds	Auto Scope	 **Pulse sample**
		Survey RPM came to main microchip in ECM using a diagnostic tool - Turn ON Ignition key - Adjust the potentiometer to change different speeds - Connect the OBD-II scantool to OBD KIT's connector	OBD-II Scantool	Observe value of RPM in RPM live data show on OBD-IIScantool, the engine speed will be changed when signal changes
CMP **(camshaft position**	G2 – Ne-	**Measure resistance value of sensor** - Turn OFF G2, Ne- in PAN maker	Car Meter Multi meter	835Ω – 1400Ω (Temp: 10 ° C - 50° C) 1060Ω – 1645Ω (Temp: 50 ° C - 100° C)

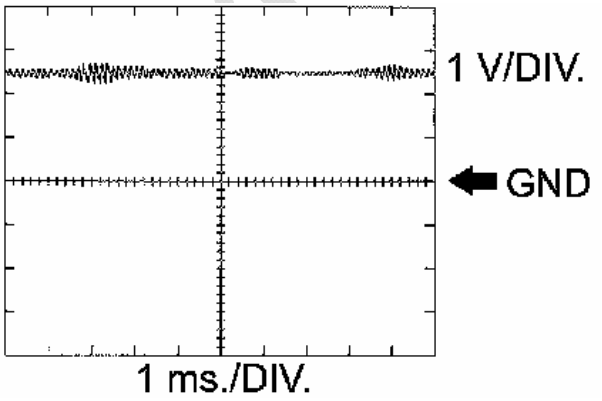
sensor)		**Engine is running (RPM <>0)** - Turn ON Ignition key - Adjust the potentiometer to change different speeds	Auto Scope	5 V/DIV  **pulse sample**
IAT **(Intake air temperature sensor)**	THA – E2	**Measure resistance value of sensor** - Turn OFF "THA" in PAN maker	Car Meter Multi meter	- 13.6kΩ – 18.4 kΩ (Temp: -20°C) - 2.21kΩ – 2.69 kΩ (Temp: -20°C) - 0.49 kΩ – 0.67kΩ (Temp: -60°C)
		Survey operation of sensor - Turn ON Ignition key - Turn OFF "THA" in PAN maker - Use heating blower into the sensor changes from low to high	Multi meter or Auto Scope	Sensor signal voltage will be changed - If the temperature rises → voltage drops - If the temperature drops → voltage increases
		Survey IAT came to main microchip in ECM using a diagnostic tool - Turn ON Ignition key - Connect the OBD-II scantool to OBD KIT's connector - Use heating blower into the	OBD-II Scantool	Observe value of IAT in **"Intake air temperature"** live data show on OBD-II Scantool, IAT value will be changed when heating changes

		sensor changes from low to high		
MAF **(intake air flow sensor)**	Vcc – E2	**Check voltage supply for sensor** - Turn ON Ignition key	Multi meter or Auto Scope	Vcc about 5V
	VG – E2G	**Survey VG signal voltage to ECM** - Turn ON Ignition key - Turn ON "VG" in PAN maker - Use air flow blower into the sensor changes from low to high	Multi meter or Auto Scope	Voltage sensor changes: - If the air flow increase → voltage rise - If the air flow reduce → voltage drops 
		Survey MAF came to main microchip in ECM using a diagnostic tool - Turn ON Ignition key - Connect the OBD-II scantool to OBD KIT's connector - Use air flow blower into the sensor changes from low to high	OBD-II Scantool	Observe value of MAF in **"Intake air flow sensor"** live data show on OBD-II Scantool, MAF value will be changed when air flow changes
ECT **(engine coolant temperature**	THW – E2	**Check resistance value of sensor** - Turn OFF "THW" in PAN maker	Multi meter	- 0,1kΩ – 25kΩ (Temp.: -20°C - 100°C)

sensor)				
		Check operation of sensor - Turn ON Ignition key - Turn ON "THW" in PAN maker - Use heating blower into the sensor changes from low to high	Multi meter or Auto Scope	Sensor signal voltage will be changed - If the temperature rises → voltage drops - If the temperature drops → voltage increases
		Survey THW came to main microchip in ECM using a diagnostic tool - Turn ON Ignition key - Connect the OBD-II scantool to OBD KIT's connector - Use heating blower into the sensor changes from low to high	OBD-II Scantool	Observe value of THW in **"Coolant Temperature Sensor"** live data show on OBD-II Scantool, THW value will be changed when temparature changes

TPS **(Throttle position sensor)**	Vcc – E2	**Check voltage supply for sensor** - Turn ON Ignition key	Multi meter or Auto Scope	Vcc about 5V
	VTA – E2	**Check resistance value of sensor** - Turn OFF "VTA" and "Vcc" in PAN maker	Multi meter	- 0.2kΩ – 5.7kΩ (throttle fully closed) - 2.0kΩ – 10.2kΩ (Throttle is fully opened)
		Survey VTA signal voltage to ECM - Turn ON Ignition key - Turn ON "VTA", "Vcc" and "E2" in PAN maker - Change throttle opening angle from small to large	Multi meter or Auto Scope	Sensor signal voltage will be changed show on as below: 
		Survey VTA came to main microchip in ECM using a diagnostic tool - Turn ON Ignition key	OBD-II Scantool	Observe value of VTA in **"Absolute Throotle possition"** live data show on OBD-II Scantool, VTA value will be changed when Throttle position changes

		- Connect the OBD-II scantool to OBD KIT's connector - Change throttle opening angle from small to large		
HO2S **(Oxygen sensor heat generator)**	OX – E1	**Survey OX signal voltage to ECM** - Take out the oxygen sensor from the bracket, using a flame to burn sensor about 15 seconds (temperature up to 350°C or higher)	Multi meter or Auto Scope	OX sensor signal voltage will be changed from 0V-1V (voltage monitor graph form below) 
		Survey OX came to main microchip in ECM using a diagnostic tool - Turn ON Ignition key - Connect the OBD-II scantool to OBD KIT's connector - Take out the oxygen sensor from the bracket, using a flame to burn sensor about 15 seconds (temperature up to 350°C or higher) - Turn ON "OX", and "E2" in PAN maker	OBD-II Scantool	Observe value of O2S sensor in **"O2 Sensor 1, Bank 1"** live data show on OBD-II Scantool will be changed when burning

KS **(engine knock sensor)**	KNK – E	Create collisions by hand with a metal materials hit into the sensor body about 1 times / sec	Auto Scope	 **Pulse sample**
STA (start signal)	STA – E1	- Turn ON Ignition key	Multi meter (Car Meter)	STA signal voltalge about 0V
		Ignition key is being position of engine is starting or "STA SIGNAL" button are pressing		STA signal voltalge about 6V to up
STP (brake switch signal)	STP – E1	- Turn ON Ignition key - Switch **"STP"** Turn OFF (no press brakes)	Multi meter (Car Meter)	STP signal voltalge below 1.5V
		- Turn ON Ignition key - Switch **"STP"** Turn ON (press brake pedal)		STA signal voltalge about 6V to up
PSW **(pressure oil signal switch for steering power)**	PS –E1	- Turn ON Ignition key - Switch "**PSW**" OFF	Multi meter (Car Meter)	PS signal voltalge about 6V to up
		- Turn ON Ignition key - Switch "**PSW**" ON		PS signal voltalge about 0V
A /C Switch	PRE – E1	- Turn ON Ignition key - Switch "**A/C SWITCH**" OFF	Multi meter (Car Meter)	PRE signal voltalge about 6V to up

(switch signal of conditioning clutches)		- Turn ON Ignition key - Switch "**A/C SWITCH**" ON	(Car Meter)	PRE signal voltalge about 0V

2.3. Actions for measuring, checking of OUTPUT (Control Actuators)

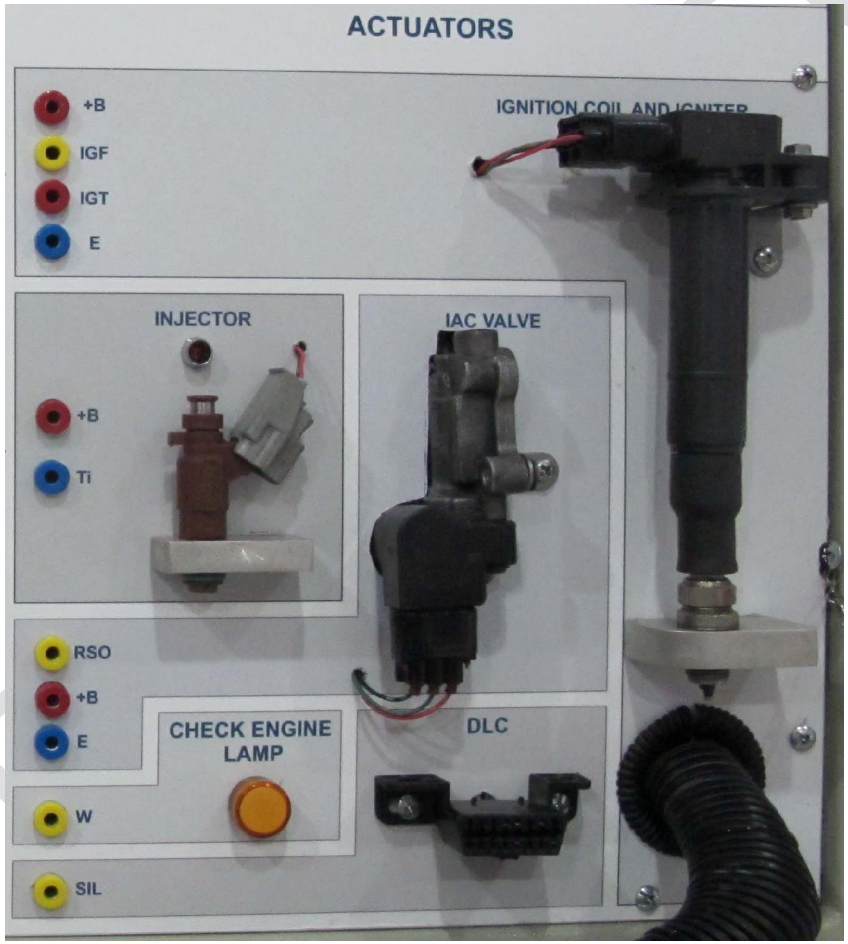
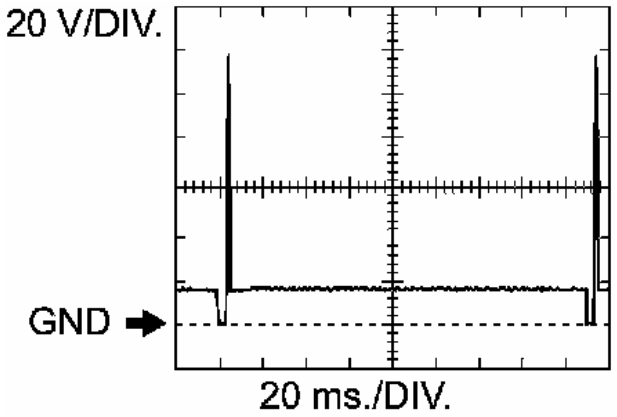
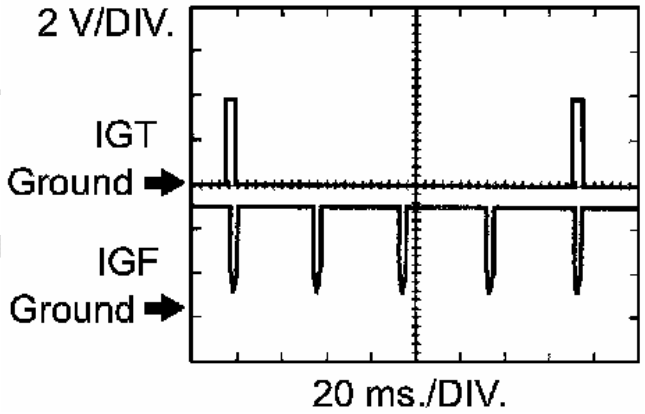


Image for frame of actuators (OUTPUT Signals)

Actuator name	Pin name	Condition for activation	Tools	Test result
Injector	Ti – E01 (#10 –E01)	**Check resistance value of injector** - Switch **"ti"** or **"+B"** OFF in PAN maker	Multi meter (Car Meter)	- 3.4 Ω – 14.2 Ω (Temp: 20°C)
		Check the operation of the injectors by hand - Power ON key - Switch "Ti" OFF in PAN maker - Quick swipe Ti to E1 (Notes, connect & disconnect only about 2 times / sec)		Injector will be opened(a LED will light when injector is openning)
		Survey control injector signal pulse when the engine working - Turn ON Ignition key - Start the KIT, adjust speed by potentiometer (test the signal at different speeds)	Auto Scope	 **Pusle sample**
Ignition coil		**Check the operation of ignition coil by hand** - Turn ON Ignition key - Switch "IGT" OFF in PAN maker		Spark will be created

		- Quick swipe IGT on ignition coil lto 12V or 5V (notes: do not connect in long time over 1 sec)		
	IGT – E1 IGF – E1	**Survey electrical pulse to control igniter when engine operation** - Turn ON Ignition key - Switch "IGF" ON in PAN maker - Start the KIT, adjust speed by potentiometer (test the signal at different speeds)	Auto Scope	 **Pusle sample**
ISC Valve **(valve control idle speed)**	RSO – E1	**Check operation of ISC Valve by hand** - Turn ON Ignition key - Switch "RSO" OFF in PAN maker - Quick swipe RSO pin on ISC Valve to E1 (Notes, connect & disconnect only about 2 times / sec, not keep longer)		Valve operation is sequentially follow number of swipe
		Survey control pulse ISC Valve		Refer documents on the internet

2.4. Survey dependency between INPUT and OUTPUT through ECU's controlling

Notes: need to start operation of KIT system before the checking

STT	INPUT		OUTPUT	
1	**Ne**		**ti**	
	Actions	Input checking	Actions	Outout checking
	Change engine speed by potentiometer on RPM frame.	**Method 1:** Observe engine speed changes by your eye, use Autoscope test pulse signal Ne from 2 pins of sensor changes in the frequency **Method 2:** Observe engine speed changes by your eye and check with RPM live data show on OBD-II Scantool	Connect Autoscope with ti signal and E1. test signal pulse when engine is running	Ti frequency will change when engine speed is changed
2	**Ne**		**IGT**	
	Change engine speed by potentiometer on RPM frame.	**Method 1:** Observe engine speed changes by your eye, use Autoscope test pulse signal Ne from 2 pins of sensor changes in the frequency **Method 2:** Observe engine speed changes by your eye and check with RPM live data show on OBD-II Scantool	Connect Autoscope with IGT signal and E1. test signal pulse when engine is running	- IGT frequency will change when engine speed is changed - IGT position on autoscope will shift when engine speed is changed - Ignition angle advance show on OBD-II Scantool live data autoscope will change when engine speed is changed

3	**MAF**		**Ti**	
	Create changes of Intake air flow by air blower to MAF sensor	**Method1:** Observe Maniford air flow value will be changed via live data function on OBD-II Scantool **Method2:** Use a multimeter to observe VG signal voltage will be changed	Use Autoscope to measure ti pulses between pins ti and E2	ti pulse width will change (reduction), fuel is less if the engine temperature increases and else
4	**THW**		**Ti**	
	Change temprature (ECT)	**Method1:** Observe the engine temperature changed via live Data function on OBD-II Scantool **Method2:** Use a multimeter to measure voltage of signal will be changed between pins THW and E2 **Method3:**	Use Autoscope to measure ti pulses between pins ti and E2)	ti pulse width will change (reduction), fuel is less if the engine temperature increases and else

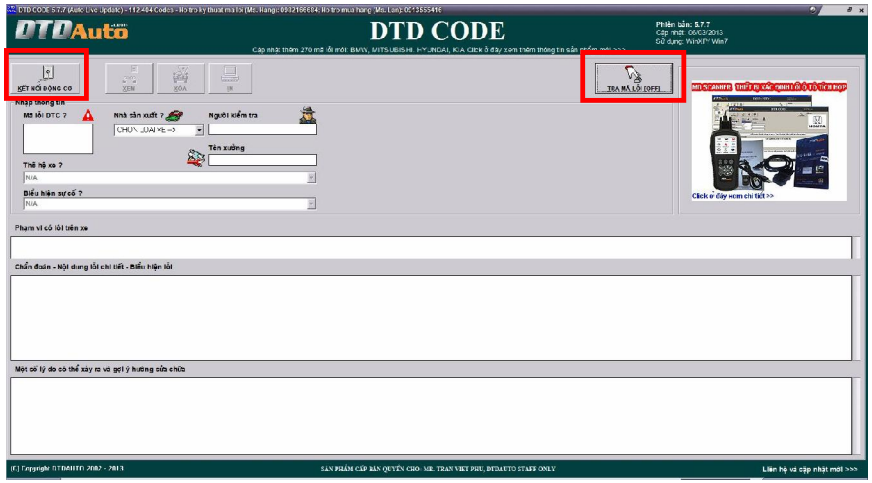
		Use Autoscope to measure voltage of signal will be changed between pins THW and E2		
5	**THA**		**ti**	
	Change temprature (THA)	**Method1:** Observe the engine temperature changed via live Data function on OBD-II Scantool **Method2:** Use a multimeter to measure voltage of signal will be changed between pins THA and E2 **Method3:** Use Autoscope to measure voltage of signal will be changed between pins THA and E2	Use Autoscope to measure ti pulses between pins ti and E2)	ti pulse width will change (reduction), fuel is less if the engine temperature increases and else
6	**STA**		**Ti**	
	Create starting status by push a STA switch on the KIT or turn ignition key to START position	**Method1:** Observe STA changed to "ON" via live data function on OBD-II Scantool	Use Autoscope to measure ti pulses between pins ti and E2	ti pulse width will change (increases), fuel is increases when the engine is starting and else

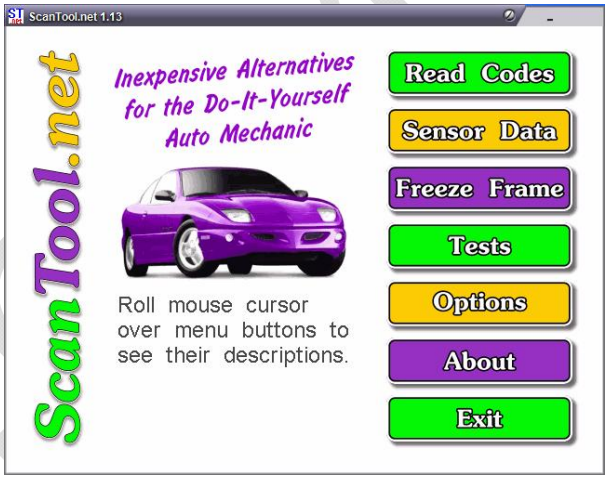
		<u>Method2</u>: Use a multimeter to observe status of STA signal will be changed from about 0V to 6V or more		
Similar you able survey to other parameter such as OX (oxygen sensor signal) and ti				

2.5. The process of lessons for OBD fault diagnosis

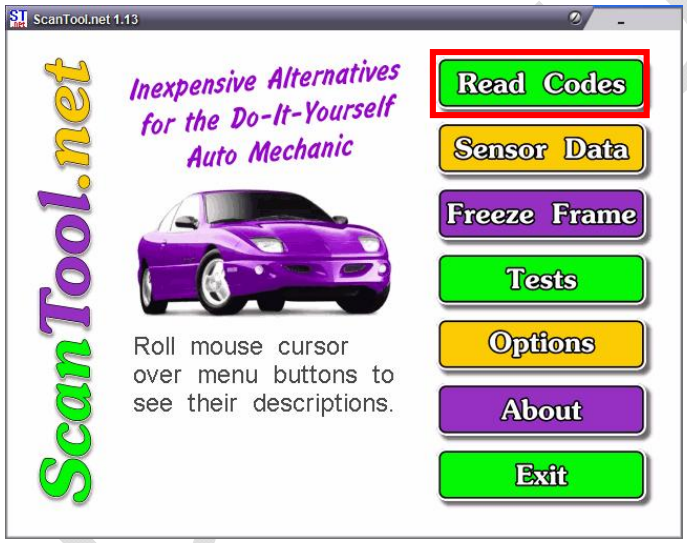
- **READ FAULT CODE**

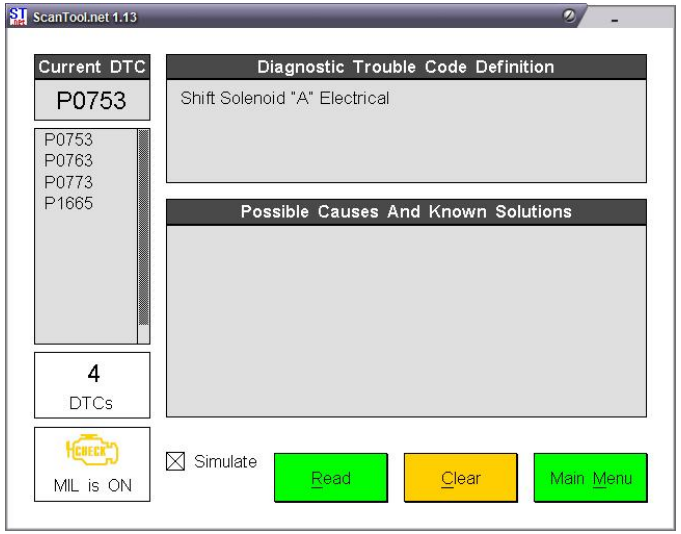
Steps	Action	Status
1	Connect OBD-II Scantool to KIT OBD-II connector	
2	- Turn ON Ignition key of KIT - Set a engine speed by potentiometer on RPM frame	- Power lamp show on - Ignition system and fuel injection will be operation (injectors and sparks are working)
3	Start **DTD CODE software**	
4	Click on "Look up fault code" then next to click on "Connect to engine" (see image below)	Scantool.net window show on top *(see image below)*

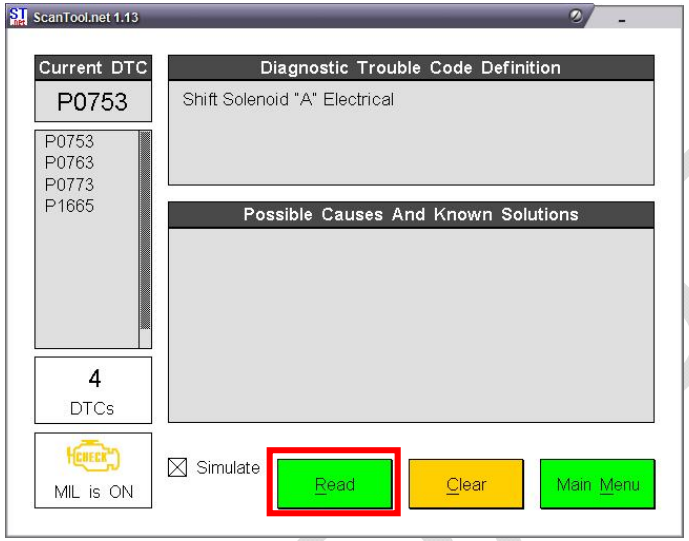
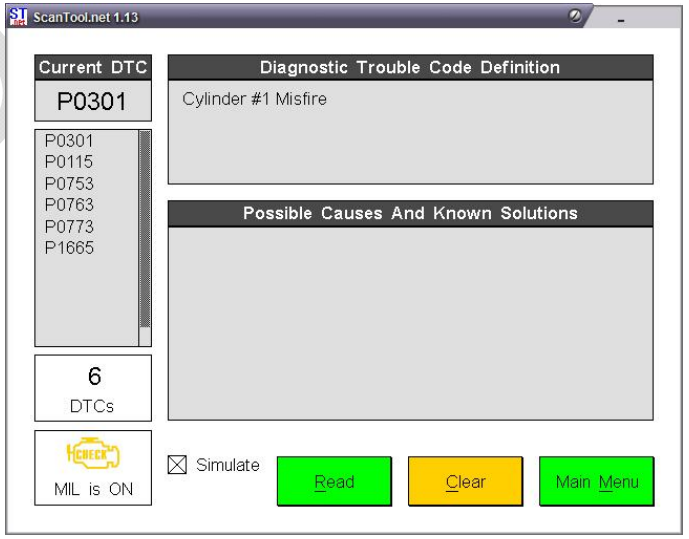


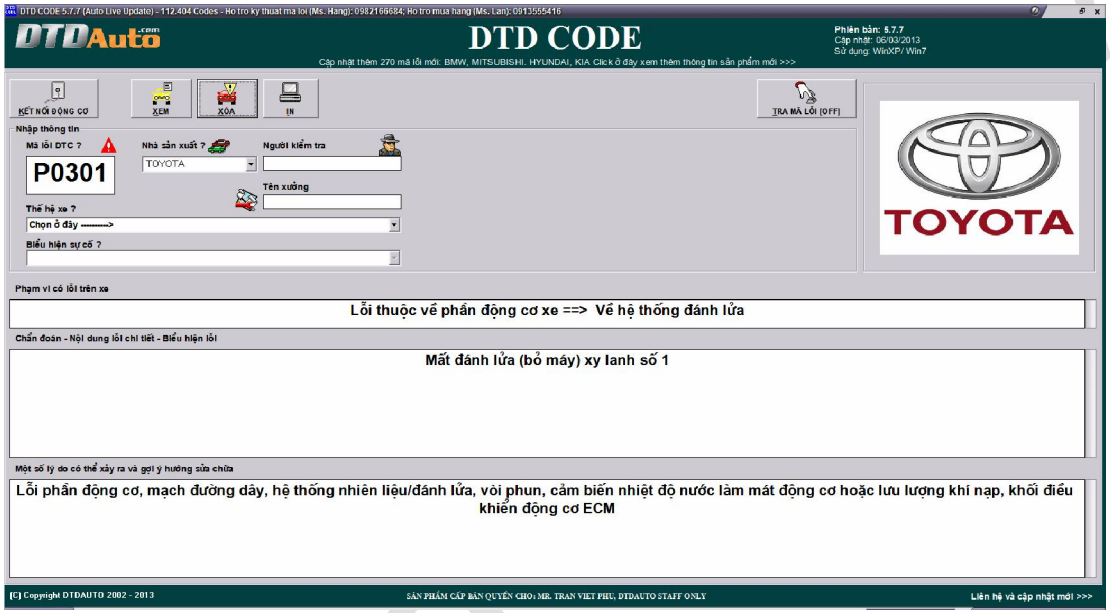


5	Select **"Read Codes"** *(see image below)*	**Notes:** Maybe some fault codes of automatic gearbox, VVT-I show on always, because these systems do not have in the KIT. (see picture below)





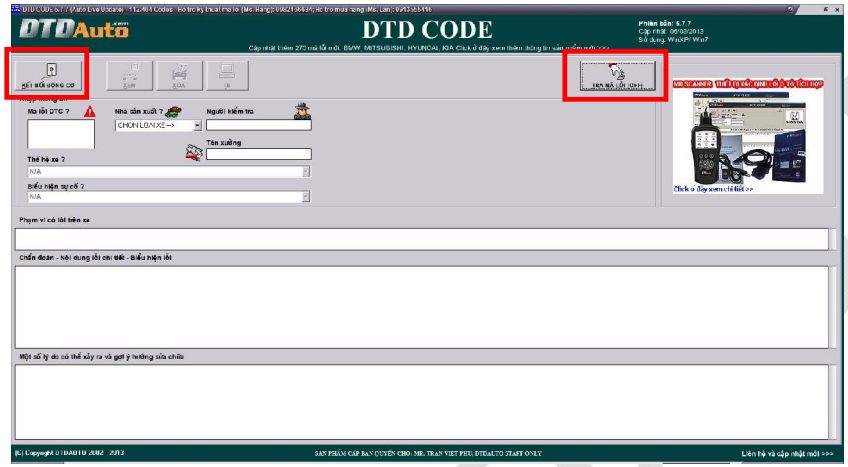
6	Creating malfunction from switchs in the "PAN MAKER" **Example:** - Create ignition fault (interrupt IGT signal by disconnect IGT switch OFF in PAN maker) - Create a disconnection of engine temperature sensor by turn THW switch OFF in PAN maker)	System KIT will not ignition (igniter is not high voltage)
7	Read fault codes by clicking on "Read" button	02 fault codes appear more are "P0301" and "P0115"
		
8	Look up content of fault codes with DTD CODE software	P0301: Cylinder 1 ignition circuit fault P0115: Engine cooling sensor circuit fault

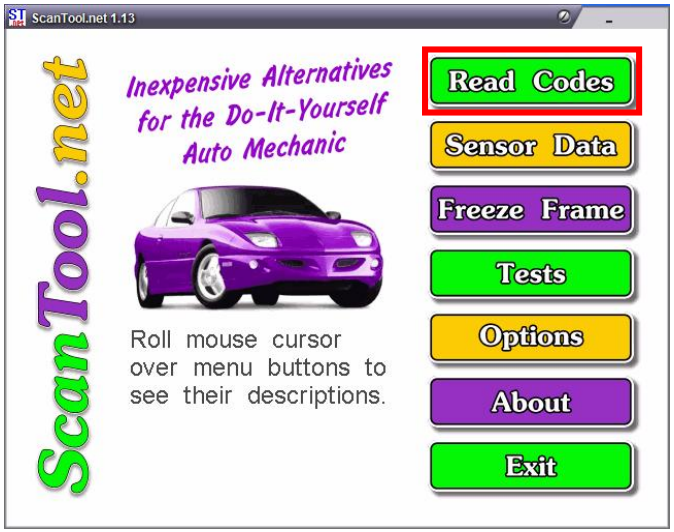
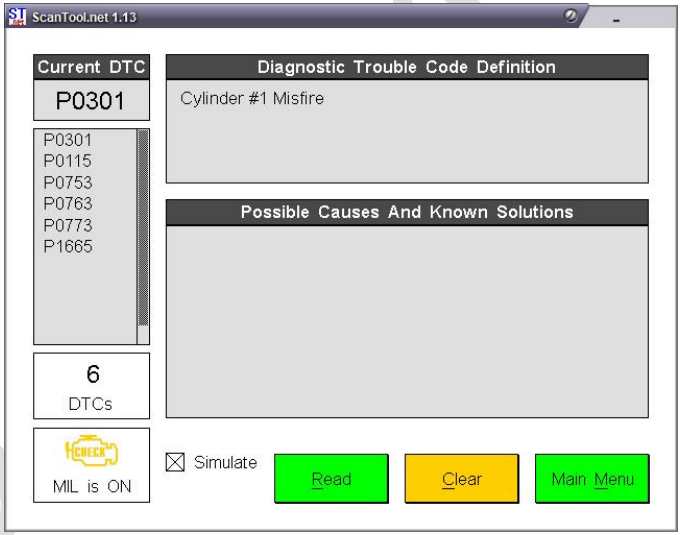
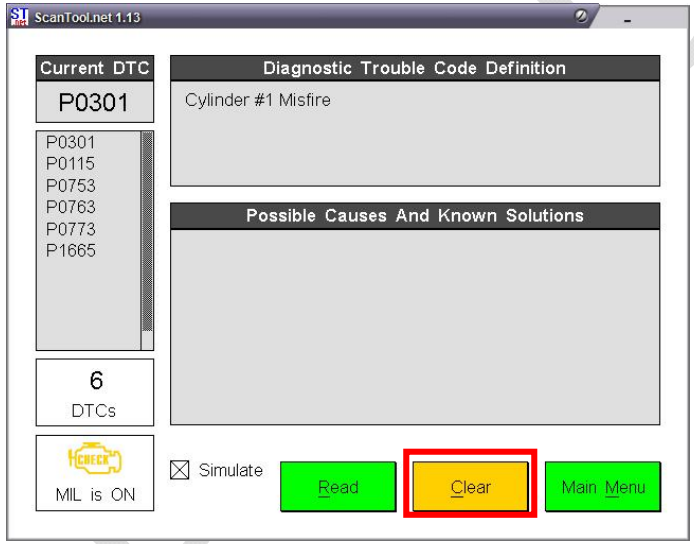
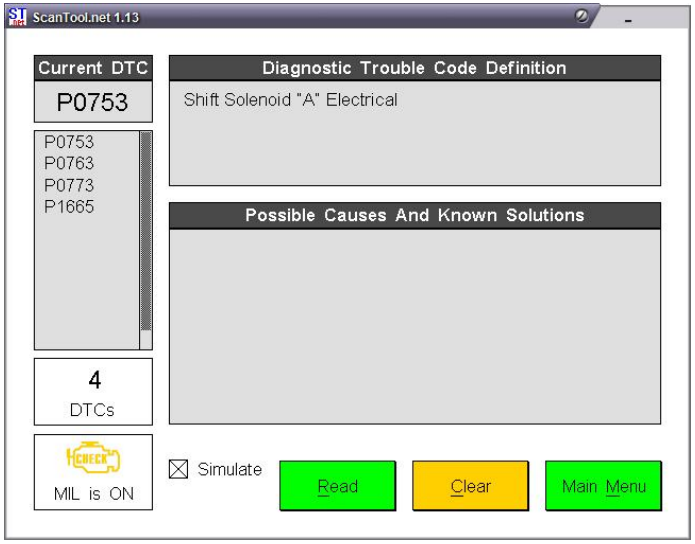


You can use steps from 6 to 8 with other fault codes from SENSOR KIT - 13

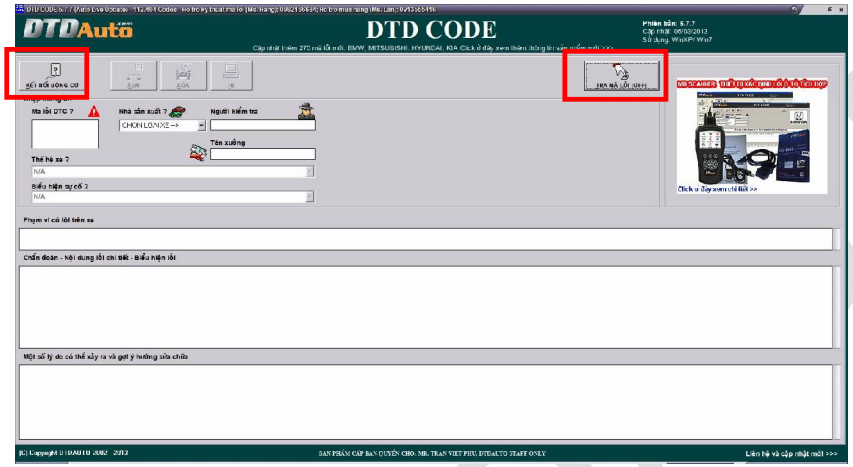
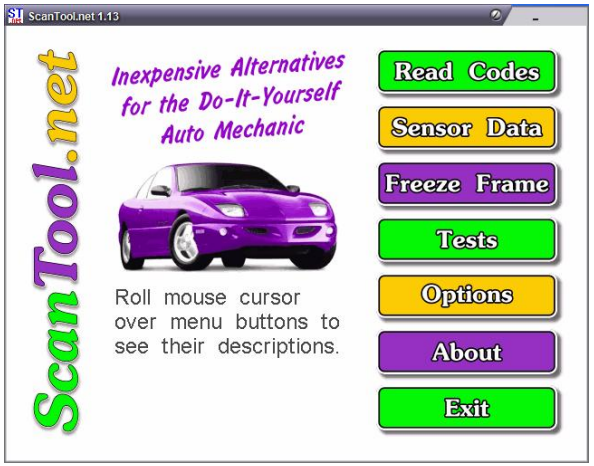
➢ **CLEAR CODES**

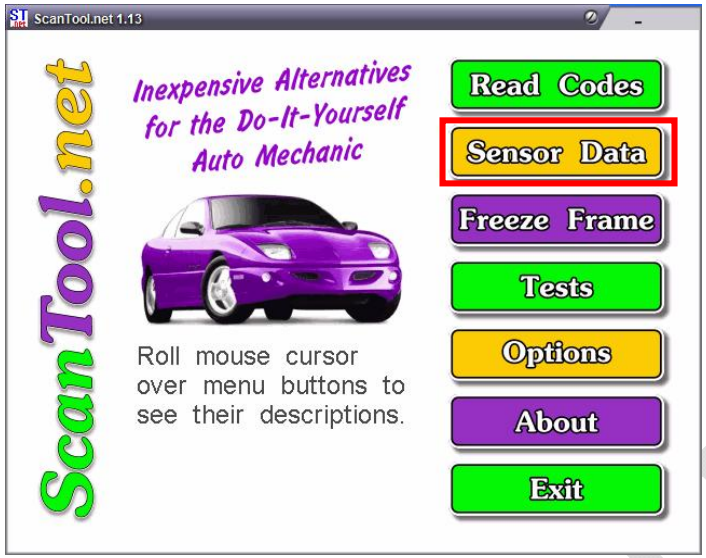
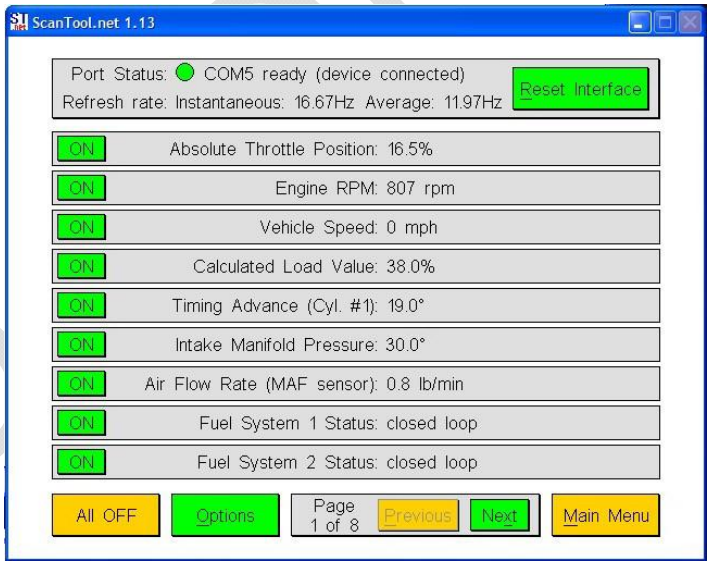
Edit 23/05/2013

Steps	Action	Status
1	Connect OBD-II Scantool to KIT OBD-II connector	
2	- Turn ON Ignition key of KIT	- Power lamp show ON
3	Start **DTD CODE** software	
4	Click on "Look up fault code" then next to click on "Connect to engine" (see image below)	Scantool.net window show on top *(see image below)*
		
5	Select **"Read Codes"** *(see image below)*	**Notes:** Maybe some fault codes of automatic gearbox, VVT-I show on always, because these systems do not have in the KIT. (see picture below)

		
6	Turn ON all switches in PAN maker	Ignition and fuel injection system normal operation
8	Click on the "**Clear**" and select "Yes, I'm sure" when a confirm report is shop on top	P1300 fault code in the ECU memory is cleared. it will do not appear this code in list again
		

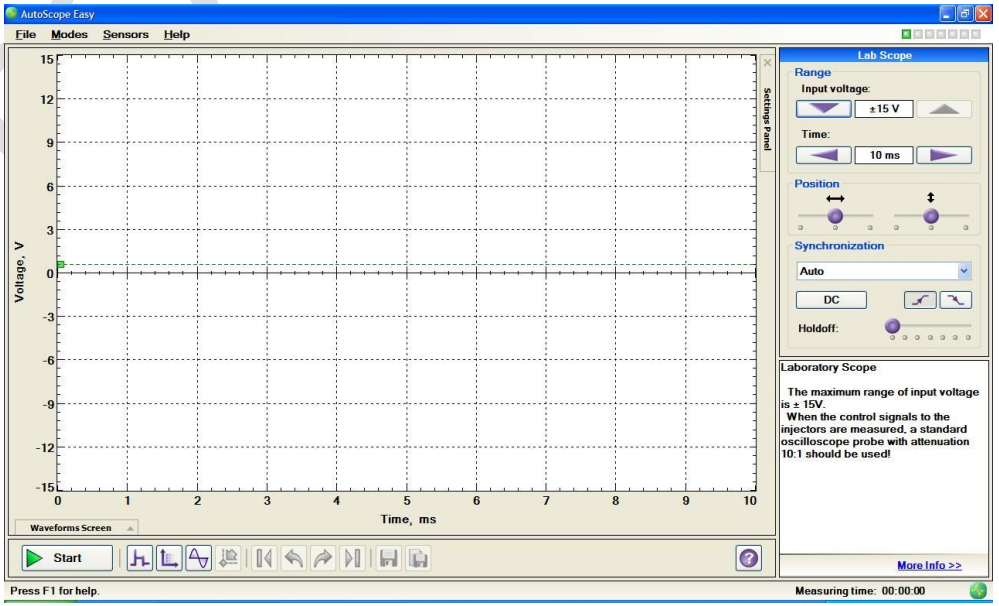
➢ SHOW PARAMETER LIVE DATA

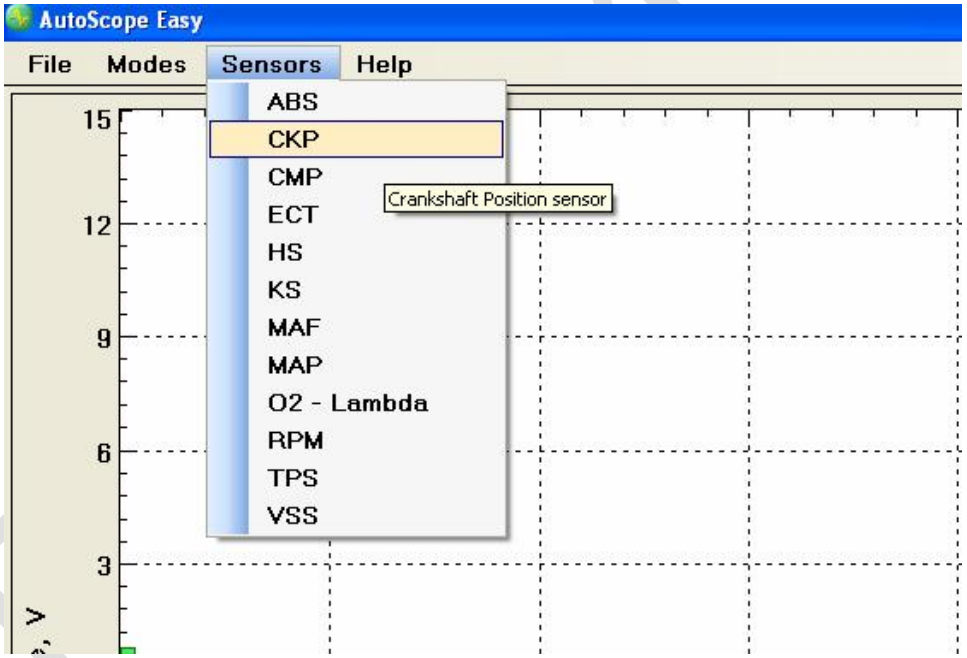
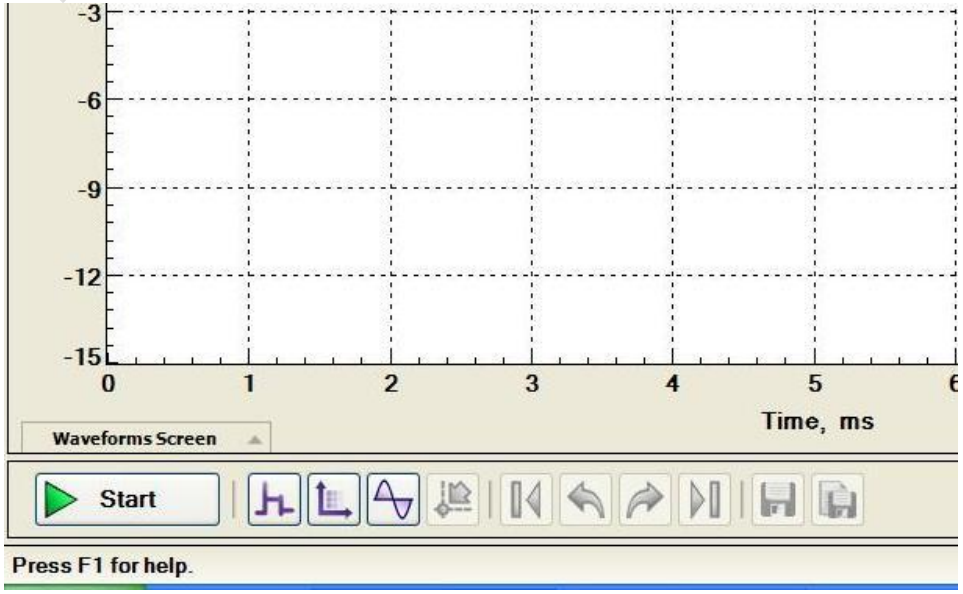
Steps	Action	Status
1	Connect OBD-II Scantool to KIT OBD-II connector	
2	- Turn ON Ignition key of KIT	- Đèn báo nguồn và đèn CHECK sáng
3	Start **DTD CODE** software	
4	Click on "Look up fault code" then next to click on "Connect to engine" (see image below)	Scantool.net window show on top *(see image below)*
		
5	- Select **"Sensor Data".**	Show list parameters as below: - *Absolute Throttle Position* - *Engine RPM* - *Vehicle Speed* - *Calculated Load Value* - *Timming Advance* - *Intake Manifold Pressure* ...

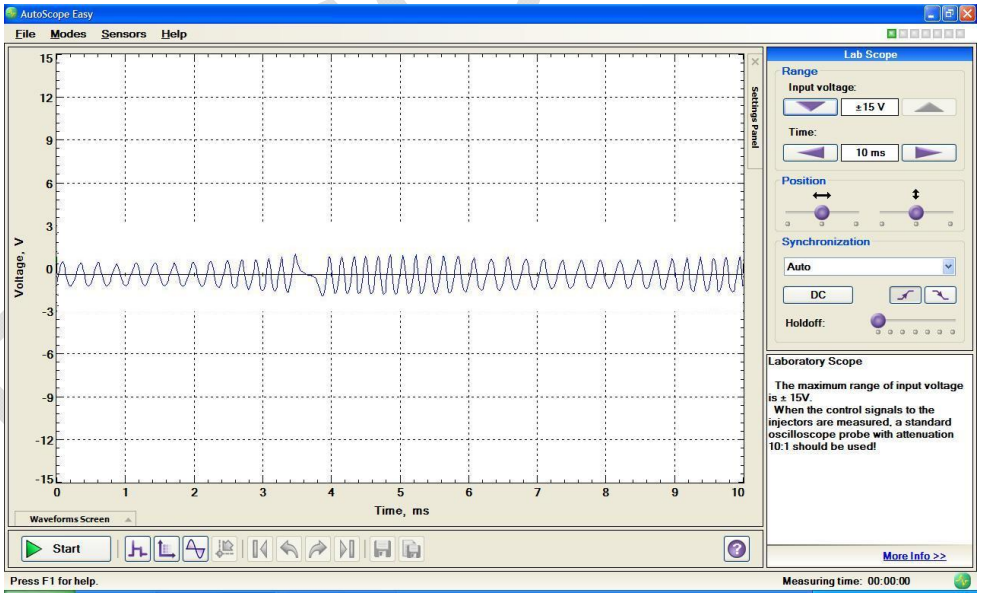
		- Live/ current data stored in 8 pages "Sensor Data" + Click "Next" to view other parameters in + Click "previos" view of the previous parameters
		
6	Change input, see status, value show on the software: - Change the ECT sensor temperature (should short or open) - Change engine speed (RPM). Change potentiometer speed increases or decreases in the region of CKP sensor and CMP	Observing the current parameters in the "Sensor Data": - "**Coolant temperature**" value line increases or decreases with temperature effects on sensor - Rotating machine speed "**Engine RPM**" value line increased or decreased by changing the potentiometer - Angle for Ignition system "**Ignition Timming Advance**" according to speed change and engine temperature
Change input value for other sensors, you will see the status change from "Sensor Data"		

2.6. User guide AutoScope for KIT

The steps measuring crankshaft position signal (Crankshaft position sensor)

Steps	Action	Status
1	Connect autoscope hardware to USB of computer	
2	Connect autoscope measure cable to the sensor for test as CKP: - Black clamp connect to "Ne-" pin on KIT - Red clamps connect to "Ne +" pin on KIT	
3	Start AutoScope software on the computer (it has installed on computer from CDROM before)	

4	Select the sensor to be tested: - Select the "Sensor" from menu - Select "CKP" from sub menu (Crankshaft position sensor)	
5	Select the "Start" button for working	

6	Operations on sensor KIT: - Turn ON ignition key - Set a engine speed value by potentiometer	
7	Observe format of the current pulse on the computer (changing the speed of rotation to survey the various states)	

Note when using Autoscope:

- View the pulse pattern by selecting "**Waveform Screen**"

- Setting the input voltage "**Input voltage**" and time "**Times**" to suit each sensor or actuator when tested

IV. NOTES IN THE USE

- Make absolutely true in the notice, instructions on equipment
- Avoid reverse connection battery electrodes
- When not in use, please turn off the power key, disconnect all power
- Do not take or adjust the mechanical structure of the system used outside the allowed range

V. STORAGE, MAINTENANCE

- Set KIT system in a dry, low humidity and industrial electrical interference
- Contact Phone: +84.913001792 or Email dtdauto@gmail.com when it is necessary

Thank you for reading this document carefully
I hope that you will be satisfied with SENSOR KIT-13 product!

INDEX

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