THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINNERING TECHNOLOGY
LEVEL 4
FINAL EXAMINATION- ACADEMIC YEAR 2008/2009
MEX4242/ECX4240 AUTOMOTIVE ELECTRONICS
DATE : 4th April 2009
TIME : 0930 HRS. – 1230 HRS.
DURATION : three HOUR [3 HRS.]

045

READ THE FOLLOWING INSTRUCTIONS BEFORE ANSWERING THE PAPER

Instructions:

1. This question paper consist six questions.
2. Answer **question 0**1, which is **compulsory** and **three** others.

Questioon01 (spend approximately one hour) [40 Marks]

Appendix 1 gives some details of a typical ABS system used in a passenger vehicle. The drive of the vehicle complains that though he cannot notice any malfunction, the ABS warning lamp turns on and stays on while driving.

a) Briefly explain how you would diagnose the problem in this vehicle. You should indicate complete procedure step by step.
b) Inside the control relay there are two individual relays to operate the pump motor and the solenoid valves. How do you test whether the coils of the two relays and the diode are in order?
c) How do you test whether the contact points of the two relays inside the control relay are in good working condition?
d) As given in the "Speed sensor inspection procedure" you have to measure the resistance and also inspect the waveform. Explain why only a resistance measurement is insufficient to confirm the functioning ability of the sensor.
e) Briefly explain the working principle of a speed sensor? Suggest a suitable electronic circuit to process this signal in order to be able to measure the speed of the wheel.

Question 02 [20 Marks]

Controller Area Network (CAN) is a novel technology for in-vehicle networks. In the past, automotive manufacturers connected electronic devices in vehicles using point-to –point wiring systems. Manufacturers began using more and more electronics in vehicles, which resulted in bulky wire harnesses that were very heavy and expensive. They then replaced dedicated wiring with in-vehicle networks, which reduce wiring cost, complexity and weight.

a) What type of bus system is used in CAN?
b) In what part of a vehicle is the CAN used?
c) Explain the benefits of using the CAN.

[20 Marks]

Question 03

Pressure sensors are used at different places in automobiles. Intake manifold pressure is measured by using MAP sensor which is also a pressure sensor.

a) Explain the operation of MAP (Manifold Absolute Pressure) sensor.
b) Why dos the ECM need to know the MAP sensor signal?
c) What are the different voltage signals at Idel level and WOT level?
d) How do you detect a faulty MAP sensor?
e) Why do we need to know the specific voltage drop at different pressures?

[20 Marks]

Question 04

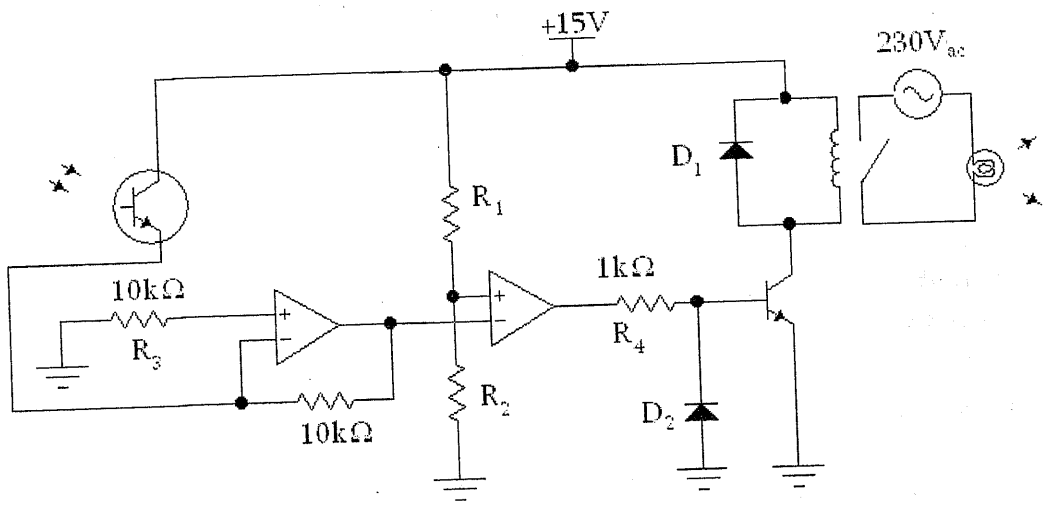


Figure Q4

The circuit shown in the Figure Q4 is an automatic light switch. This light is automatically switched on under poor light conditions and switch off when there is sufficient light.

a) Explain the action of the circuit identifying each sub- circuit.
b) How do you control the threshold?
c) What is the purpose of the diodes D_1 and D_2 and the resistors R_3, R_4?
d) What is the power dissipation in the transistor? Let the resistance of the coil of relay be 100Ω.

Question 05 [20 Marks]

For many applications in the vehicle, the ECM (Engine Control Module) needs to know the position of mechanical components. There are various position sensors used to find the exact position of valves, pedals, etc.

a) List the different types of position sensors commonly used on vehicles.

b) Explain the operation of the potentiometer position sensor.

c) Draw a position sensor circuit and label it.

d) Explain the testing procedure for the TPS (Throttle Position Sensor)

Question 06 [20 Marks]

Consider the transistor switch circuit shown in the Figure Q6 below. The transistor has following characteristics: $h_{FE} = 100$, $I_{CO} = 50\mu A$, $V_{CE(sat)} = 0.2$ V.

a) Determine I_B, I_C, V_C, and power dissipation in the transistor when the switch S is open state and closed state separately.
b) What is the used of 10 kΩ resistor and the capacitor C?
c) Calculate the maximum theoretical value possible for R.
d) If the light bulb in the circuit is replaced by a relay switch having same specifications. State the additional precautions that must be taken for safe operation of the circuit.

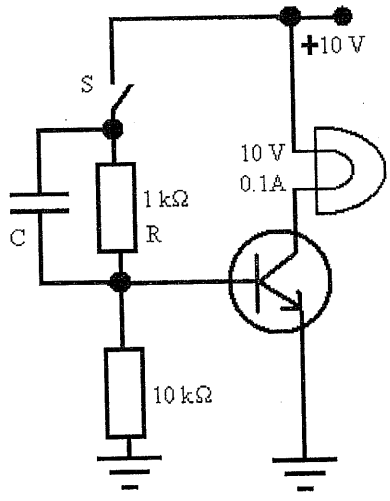
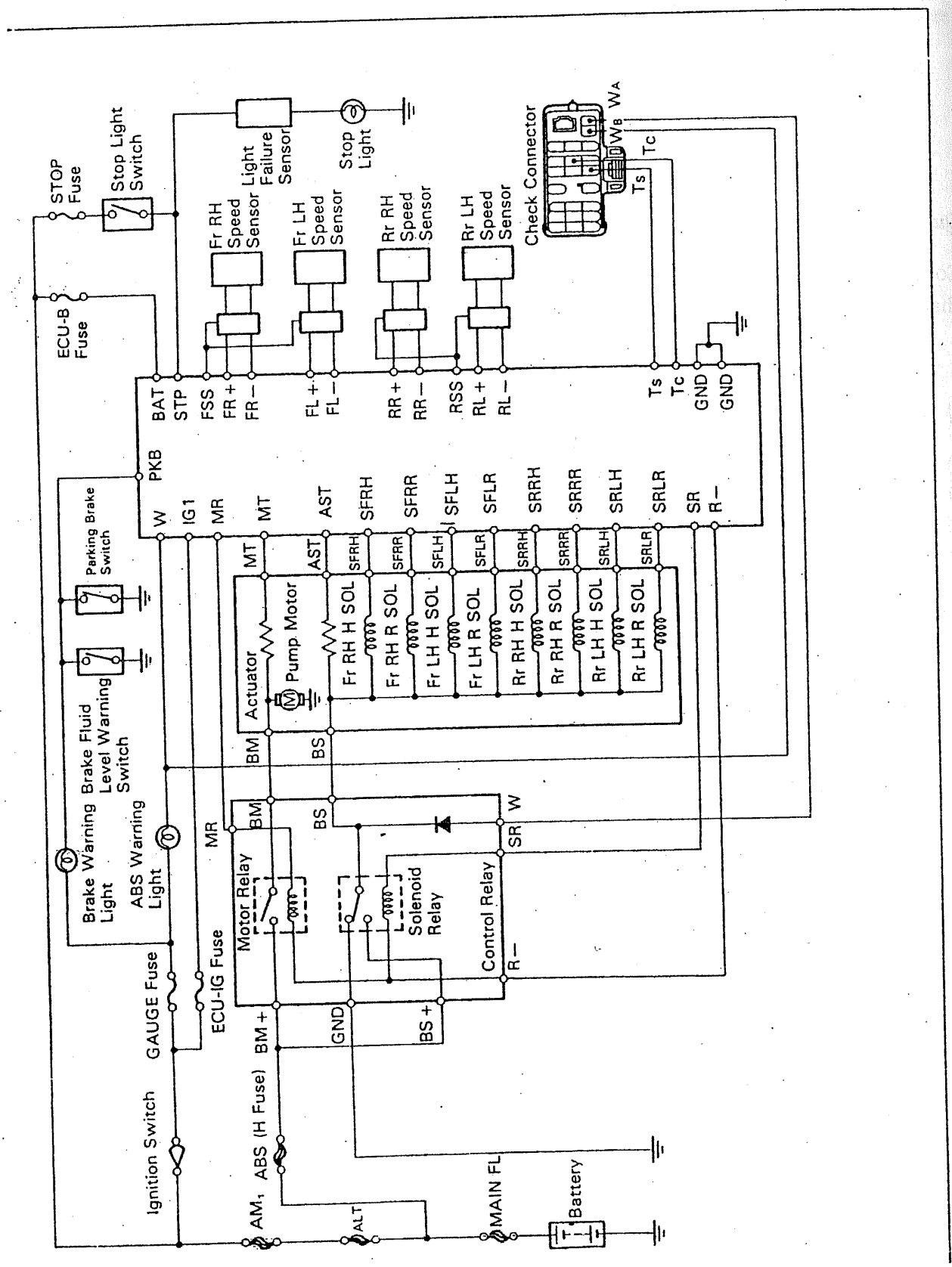
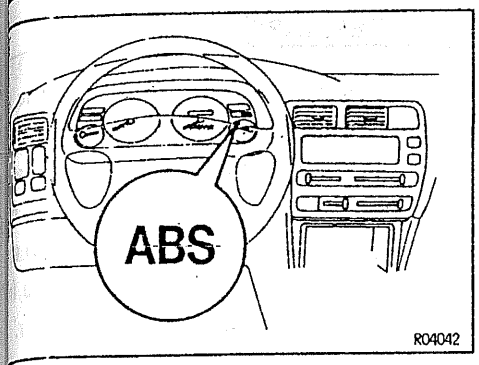


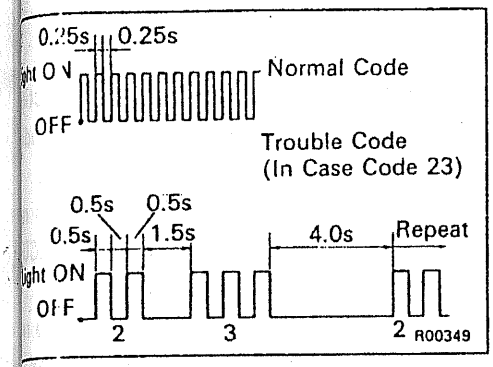
Figure Q6

Appendix I

WIRING DIAGRAM







DIAGNOSIS SYSTEM

DESCRIPTION

BR02P–04

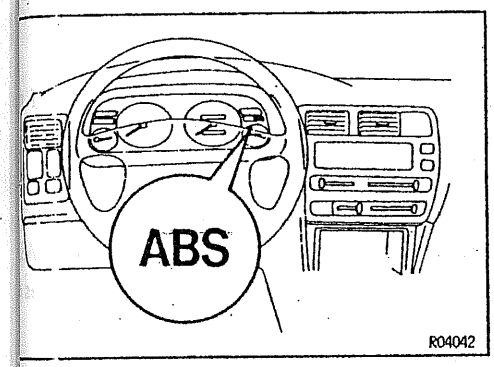
If a malfunction occurs, the system will identify the problem and the computer will store the codes for the trouble items.

At the same time, the system informs the driver of a malfunction via the "ABS" warning light in the combination meter.

By turning on the ignition switch and disconnecting the short pin of check connector, the trouble can be identified by the number of blinks (diagnostic code) of the warning light.

In the event of two codes, that having the smallest numbered code will be identified first.

HINT: The warning light does not show the diagnostic codes while the vehicle is running.



DIAGNOSIS SYSTEM INSPECTION

BR02R–03

1. INSPECT BATTERY VOLTAGE

Inspect that the battery voltage is about 12 V.

2. CHECK THAT WARNING LIGHT TURNS ON

(a) Turn the ignition switch on.

(b) Check that the "ABS" warning light turns on for 3 seconds.

If not, inspect and repair or replace the fuse, bulb and wire harness.

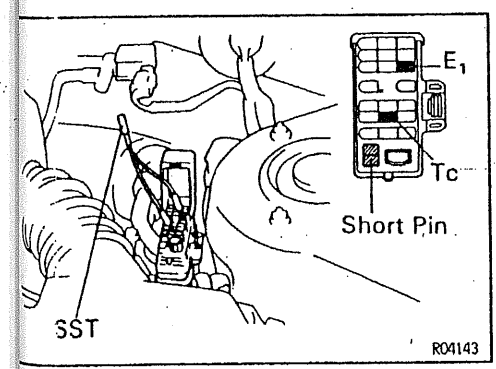
3. READ DIAGNOSTIC CODE

(a) Turn the ignition switch on.

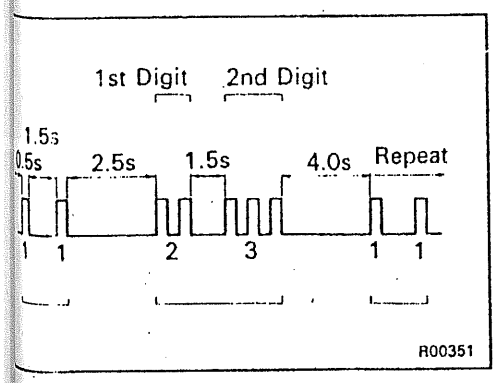
(b) Using SST, connect terminals Tc and E_1 of check connector.

SST 09843–18020

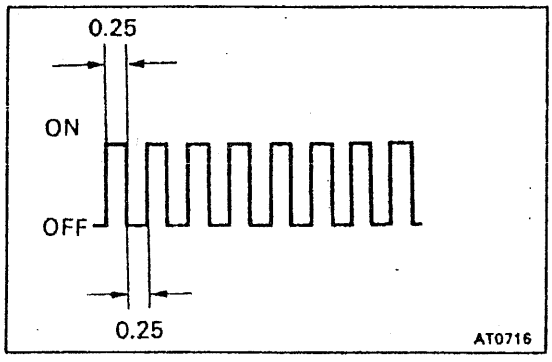
(c) Pull out the short pin from the terminals Wa and Wb of the check connector in engine room.



(d) In event of a malfunction, 4 seconds later the warning light will begin to blink. Read the number of blinks.
(See DIAGNOSTIC CODE on page BR–59)



HINT: The first number of blinks will equal the firs
digit of a two digit diagnostic code. After a 1.5 secon
pause, the 2nd number of blinks will equal the 2n
number of a two digit code. If there are two or mor
codes, there will be a 2.5 second pause between each
and indication will begin after 4.0 second pause fro
the smaller value and continue in order to larger.



(e) If the system is operating normally (no malfunction) the warning light will blink once every 0.5 seconds.

(f) Repair the system.

(g) After the malfunctioning components has been repaired, clear the diagnostic codes stored in the ECU. (See page BR–60)
HINT: If you disconnect the battery cable while repairing, all diagnostic codes in the ECU will erased.

(h) Remove the SST from terminals Tc and E_1 of the check connector.
SST 09843–18020

(i) Install the short pin to the terminals Wa and Wb.

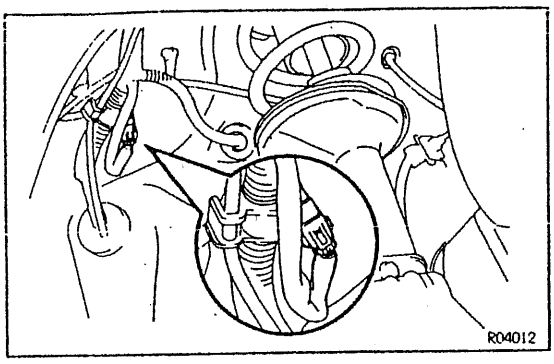
(j) Turn the ignition switch on, and check that the "ABS" warning light goes off after the warning light goes on for 3 seconds.

Code No.	Light Pattern	Diagnosis	Trouble Part
11	ON / OFF	Open circuit in solenoid relay circuit	• Actuator inside wire harness • Control relay

BR028-01

DIAGNOSTIC CODE

Code No.	Light Pattern	Diagnosis	Trouble Part
11	ON / OFF	Open circuit in solenoid relay circuit	• Actuator inside wire harness • Control relay • Wire harness and connector of solenoid relay circuit
12		Short circuit in solenoid relay circuit	
13		Open circuit in pump motor relay circuit	• Actuator inside wire harness • Control relay • Wire harness and connector of pump motor relay circuit
14		Short circuit in pump motor relay circuit	
21		Open or short circuit in 2 position solenoid of front right wheel	• Actuator solenoid • Wire harness and connector of actuator solenoid circuit
22		Open or short circuit in 2 position solenoid of front left wheel	
23		Open or short circuit in 2 position solenoid of rear right wheel	
24		Open or short circuit 2 position solenoid of rear left wheel	
31		Front right wheel speed sensor signal malfunction	• Speed sensor • Sensor rotor • Wire harness and connector of vehicle speed sensor
32		Front left wheel speed sensor signal malfunction	
33		Rear right wheel speed sensor signal malfunction	
34		Rear left wheel speed sensor signal malfunction	
35		Open circuit in front left or rear right wheel speed sensor	
36		Open circuit in front right or rear left wheel speed sensor	
37		Wrong both rear axle hubs	• Rear sensor rotors
41		Abnormal battery voltage (less than 9.5 V/more the 16.2 V)	• Battery • Voltage regulator
51		Pump motor of actuator locked or open circuit in pump motor circuit in actuator	• Pump motor, relay and battery • Wire harness, connector and ground bolt or actuator pump motor circuit
Always on		Malfunction in ECU	• ECU

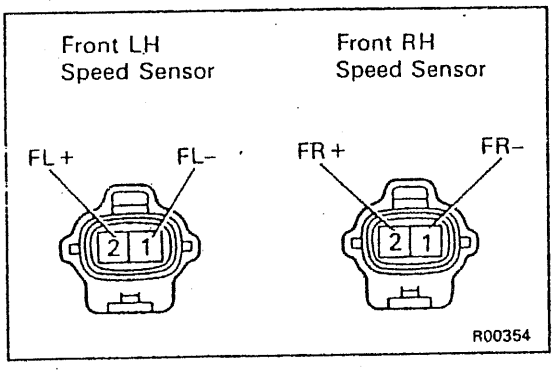


FRONT SPEED SENSOR INSPECTION

1. INSPECT SPEED SENSOR

(a) Remove the fendershield.

(b) Disconnect the speed sensor connector.

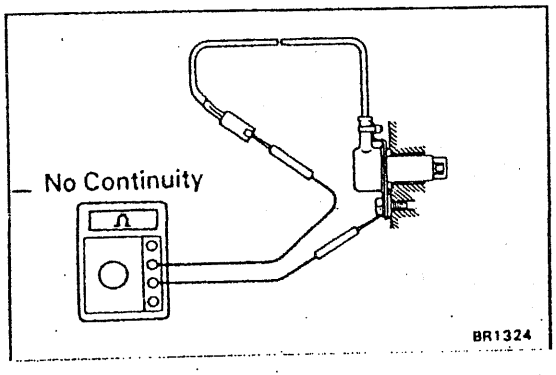


(c) Measure the resistance between terminals.

Resistance:

0.92 – 1.22 kΩ

If resistance value is not as specified, replace the sensor.

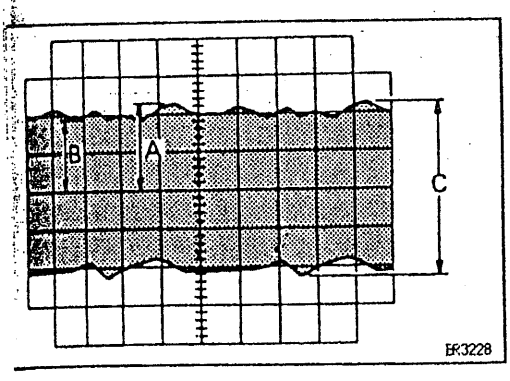


(d) Check that there is no continuity between each terminal and sensor body.

If there is continuity, replace the sensor.

(e) Connect the speed sensor connector.

(f) Install the fendershield.



BR031-04

FRONT SPEED SENSOR AND SENSOR ROTOR SERRATIONS INSPECTION (REFERANCE)

INSPECT FRONT SPEED SENSOR AND SENSOR ROTOR SERRATIONS BY USING AN OSCILLOSCOPE

(a) Connect an oscilloscope to the speed sensor connector.

(b) Run the vehicle at 20 km/h (12.4 mph), and inspect speed sensor output wave.

(c) Check that C is 0.5 V or more.

If not as specified, replace the speed sensor.

(d) Check that B is 30 % or more of A.

If not as specified, replace the sensor rotor.