

**KES**

Design Standard for  
On-Board Diagnosis-1 (OBD-I)

KES M – D002A

(EST.) 1988 – 12 – 19  
(REV.) 1992 – 04 – 25

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## 1. Scope of Application

This standard shall be applied to a unit using OBD-I (On-Board Diagnosis-1) system among a digital control unit used to a control for power train of a vehicle.

## 2. Purpose

The purpose of this standard is to plan standardization of specifications, and quality assurance and unification of on-board diagnosis system.

## 3. Specification Items in Specification Manual

This design standard specifies the on-board diagnosis standard and a back-up function of malfunction, and describes the following items on the specification manual.

- (1) Content that this design standard (Including revision number) shall be applied
- (2) Classification of hardware type by an outer joint
- (3) Output monitor target (Assist diagnosis : Assist diagnosis function)
- (4) Hardware system backup operation
- (5) Definition of flag and malfunction judgment data such as Xtest, Xnst, etc.
- (6) Types and specifications of detection of malfunction and back-up function
- (7) Indication of items to warn for drivers (User warning)
- (8) Logic formula of switch monitor function
- (9) Indication of maximum value (CFB max) and minimum value (CFB min) of feedback compensation monitor (CFB monitor hereinafter)

In case that there are special indications except for those mentioned above, refer to the specification manual first.

## 4. Establishment of Standard

The revision of this standard shall be done by signature of revision space. When revised, change standard numbers described in the specification manual along with re-distribution of standards.

## 5. Design Standard

### 5.1 Hardware Design

#### 5.1.1 Classification of hardware type

- (1) For the classification of hardware type, classify as Table 1 according to existence of inputs and outputs shown in outer connection schematic (Refer to Figure 1) in the specification manual.
- (2) Judgment of transistor on in the output monitor circuitry is that a voltage level of a transistor in open state 2.0 ~ 4.0V higher in the room temperature than an earth terminal.

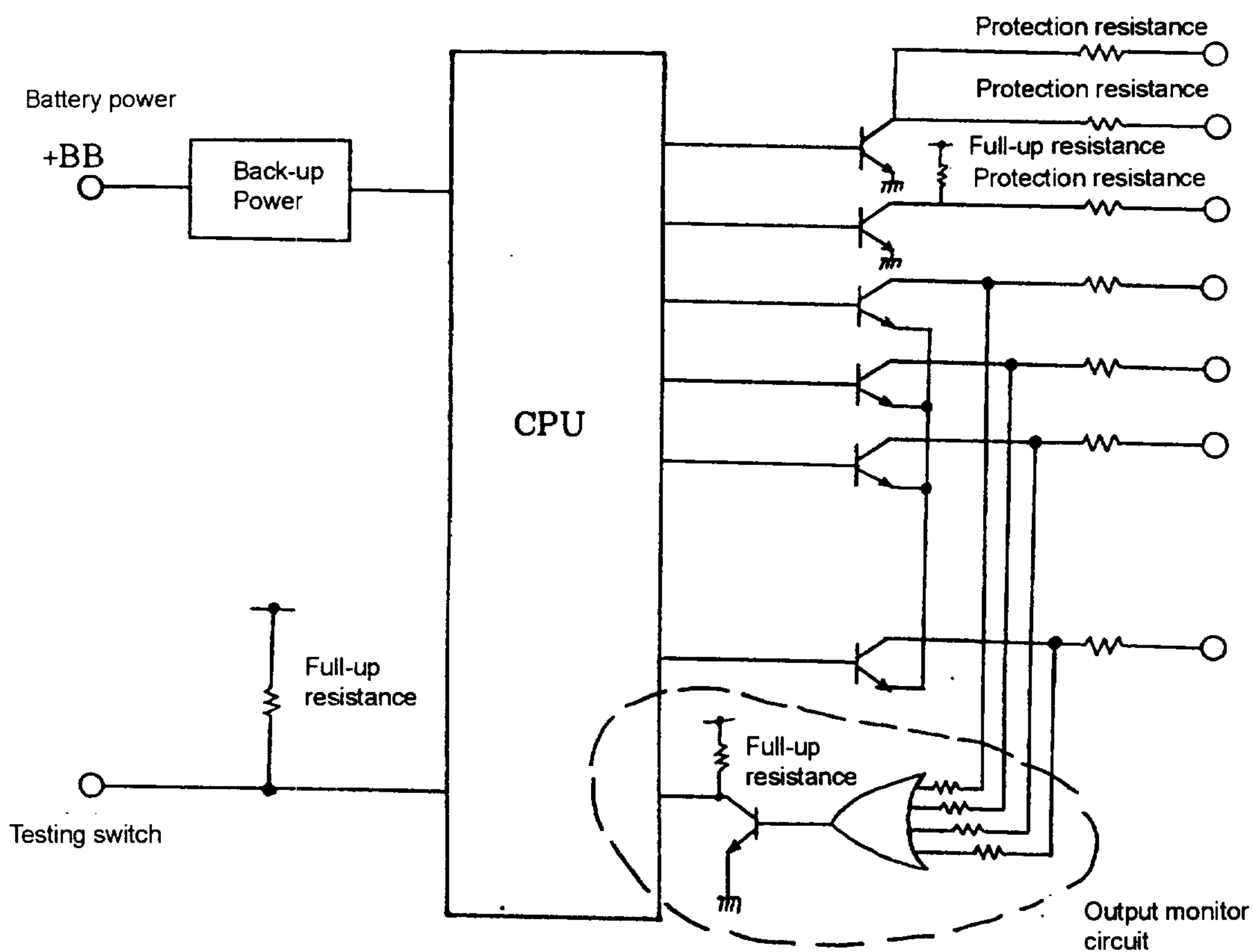


Fig. 1 Outer connection schematic

Table 1 Composition and classification of hardware

|   |          |                                         |                                                           | Hardware type |        |        |
|---|----------|-----------------------------------------|-----------------------------------------------------------|---------------|--------|--------|
|   | Terminal | Term                                    | Specification                                             | Type 1        | Type 2 | Type 3 |
| 1 | +BB      | Input of back-up power and memory power |                                                           | ●             | ●      | ×      |
| 2 | MIL      | MIL output terminal                     | Lamp 3.4W, Protection resistance 10Ω                      | ●             | ×      | ×      |
| 3 | FAIL     | Fail Lamp output terminal               | LED+500Ω, Protection resistance 330Ω                      | ●             | ●      | ●      |
| 4 | MON      | Monitor output terminal                 | LED + 500Ω, Protection resistance Ω<br>Full-Up resistance | ●             | ●      | ●      |
| 5 |          | Output monitor circuit                  |                                                           | ●             | ●      | ●      |
| 6 | Test     | Test mode judgment input terminal       | Full-up resistance 660Ω                                   | ●             | ●      | ●      |

**Note 1)** MIL: Mal-Function Indication Lamp (Lamp during malfunction)

**Note 2)** ●: Includes the function,  
×: Does not include the function

5.1.2 Design of hardware back-up function

When operating abnormally due to the malfunction of the CPU, make sure to perform back-up control by the hardware, and decide how to set up the output state of the hardware at this time.

- (1) It shall possess a watch dog timer function, which detects a congestion state of the CPU, and a function to reset the CPU.
- (2) Hardware back-up control shall be operated under any of the following conditions.
  - (a) Battery voltage  $\leq 5.7 \pm 0.3V$   
(However, at more than 5.4V of voltage, the CPU shall operate normally.)
  - (b) From when the CPU is reset by the watch dog timer function, until a next watch dog pulse is inputted.

- (3) The backup control function is specified in a hardware system backup operation section in the specification manual. At this time, the definition of On/Off of the output terminal specifies a transistor operation when each of the output terminals has the high impedance.

5.2 Design of software

The following software design standard is based on the hardware type 1. Therefore, for those parts that do not correspond to in type 2 and type 3 are not considered and may be ignored.

5.2.1 Classification of test mode

- (1) Classification according to input state of test terminal

- (a) Test switch on mode

A state that the test switch is closed (Xtest = 1 : State that test switch is grounded)

- (b) Test switch open mode: A state that the test switch is open (Xtest = 0)

- (2) Classification according to engine state

- (a) Engine rotation mode (Xnst = 1)

A state that the engine has started and is running faster than the standard number of revolutions.

- (b) Engine stop mode (Xnst = 0)

A state that the engine is stopped or cranking  
However, an ignition switch is on at this time.

5.2.2 Functions according to modes

It is classified as in the following Table 2 according to each mode.  
Output for each function is output from MIL, FAIL, MON terminals.

Table 2 Check function according to mode

| Function                        | Mode            |  | Test switch Off mode<br>(Xtest = 0) | Test switch On mode<br>(Xtest = 1)                 |
|---------------------------------|-----------------|--|-------------------------------------|----------------------------------------------------|
|                                 | Ouput           |  |                                     |                                                    |
| Single trial check function     | MIL, FALL & MON |  | Single trial check function I       | Single trial check function II                     |
| Malfunction indication function | MIL, FALL       |  | User warning function               | Service code indication function<br>(Service code) |
| Monitor function                | MON             |  | O <sup>2</sup> monitor function     | CFB Monitor function (Xnst = 1)                    |
|                                 |                 |  |                                     | SW Monitor function (Xnst = 0)                     |

**(1) Single trial check function**

It is to confirm existence of system malfunctions such as a computer, MIL lamp in a meter set, and composed wire harness system related to those before operating malfunction indication function and monitor function. At this time, the single trial check I is designed to operate by lightening as the same time as other warnings inside the meter set.

**(2) Malfunction indication function**

This shows an existence of malfunctions and their parts during malfunction. This function is composed of a malfunction detection function, which determines the malfunction, and a malfunction indication function, which indicates the malfunction.

**(a) Malfunction detection function**

There are a self diagnosis function, which detects the malfunction of input systems during normal driving condition, and an assist diagnosis function, which detects the malfunction that is created voluntarily

**(Note)** When performing the assist diagnosis function, since the voluntary malfunction condition is operated by the software itself in the computer, it does not influence actual driving, etc.

**(b) Malfunction indication function**

This includes a user warning function, which notifies by lighting continuously at occurrence of malfunction, and a service code indication function, which notifies malfunctioning parts according to blinking patterns of the lamp (or a buzzer). (Refer to Figure 5 for lighting pattern) However, there is a case that the user warning function is not indicated even though the malfunction is detected.

**(3) Monitor function****(a) O<sub>2</sub> Monitor function**

It notifies a change of concentration of oxygen in an exhaust gas by blinking according to inputs into an O<sub>2</sub> sensor.

**(b) CFB monitor function**

It notifies a control state of an air-fuel ratio by outputting a feedback amount of the air-fuel ratio.

**(c) Switch monitor function**

It notifies an existence of malfunction of switch input system by operating artificially On/Off of various switch input system for inputs of the computer. Theory is principally

that it turns off when each switch is in normal condition, in another word, when the operating part is in general condition, and it lights up when some operation is performed.

### 5.2.3 Design of malfunction detection function

#### (1) Design of self diagnosis function

##### (a) Malfunction detection condition

Refer to Table 4. Write down the corresponding malfunction detection conditions in the specification manual.

When it is not in the standard, mention in the specification manual separately.

##### (b) Software backup function

When the malfunction flag is occurred according to the malfunction detection condition, operate the software backup control. For the specifications of the software backup control, refer to Table 4. When it is not in the standard, mention in the specification manual separately.

##### (c) Battery backup function

Use the specifications for hardware type 1 and 2.

There are 2 methods to backup malfunction flag in IG. OFF state.

One is a method to backup the malfunction currently occurring, and the other is a method to backup the current malfunction and the past malfunction simultaneously.

The user warning indication utilizes the former method, and the service code indication utilizes the latter one.

#### (2) Malfunction indication flag setting method

Set the malfunction flag detected by the malfunction detection conditions in Table 4.

##### (a) Malfunction indication flag A (For user warning indication)

If the malfunction detection flag is one by logical (Logical : AND) a detected result first by the malfunction detection conditions in Table 4 (<sup>Note</sup>) and a current detected result, save it. This is cancelled if the malfunction condition is cancelled in the hardware type 3, but it is in the backup memory domain in the hardware types 1 and 2.

**(Note)** Indicate the malfunction indication flag setting method for this in the specification manual.

(Except pulse system, and O<sub>2</sub> sensor system)

For those that are not applied, malfunction flag = Malfunction indication flag

(b) Malfunction indication flag B (For service code indication)

If the malfunction indication flag A (For user warning indication) becomes 1, save it into the memory domain at the same time. This does not disappear even if the malfunction condition is cancelled.

When there is “STA” signal, the malfunction flag is not saved in the memory domain during ‘STA ON.’ However, exclude items detected only from ‘STA ON.’

It is only applied to the hardware types 1 and 2, and shall be the backup memory domain.

5.2.4 Malfunction output function

(1) User warning output function

Express the output objects in the specification manual. However, do not output the malfunctions detected by the assist diagnosis function.

(2) Service code output function

(a) Refer to Table 3, and output the corresponding malfunction code.

However, in case of no malfunction after checking the terminals, output ‘OFF’ state (Malfunction code ‘00’ state) continuously, and when the control unit system is malfunctioning, output ‘ON’ state continuously. (Malfunction code at this time is ‘88’ to be blinking continuously)

(b) Service code blink method

It operates when Xtest = 1.

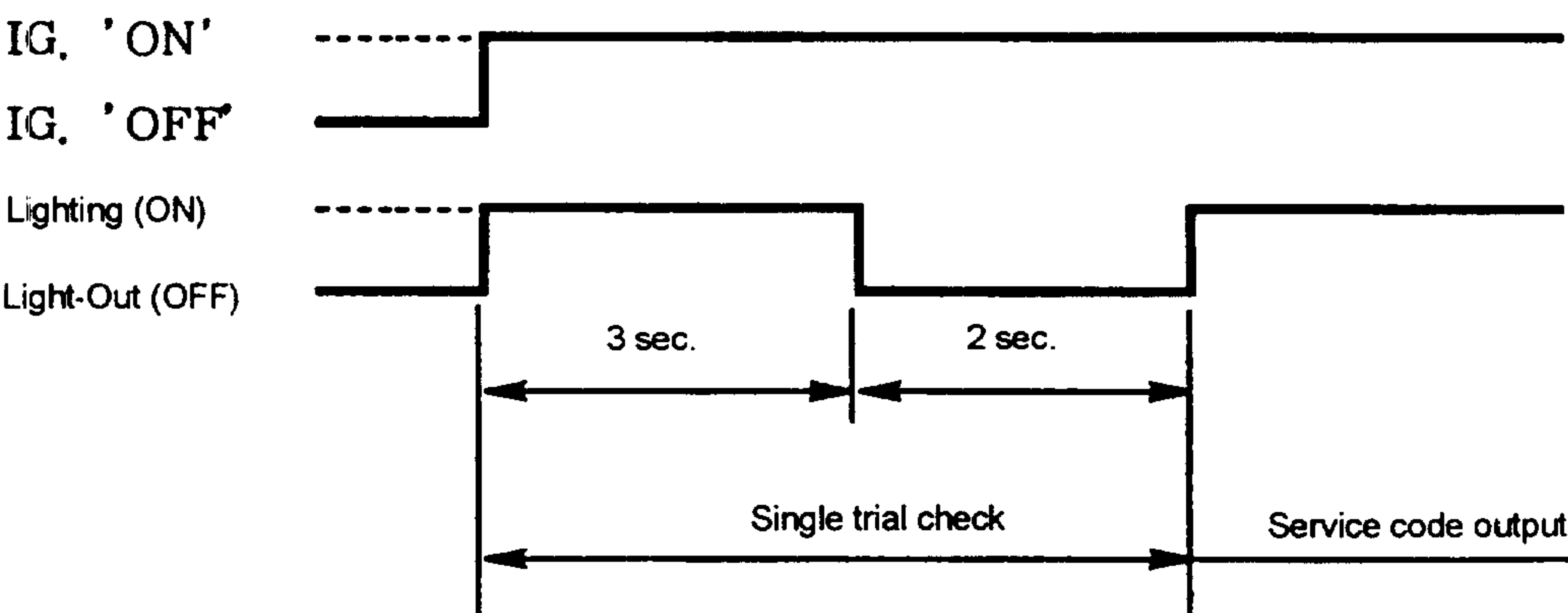
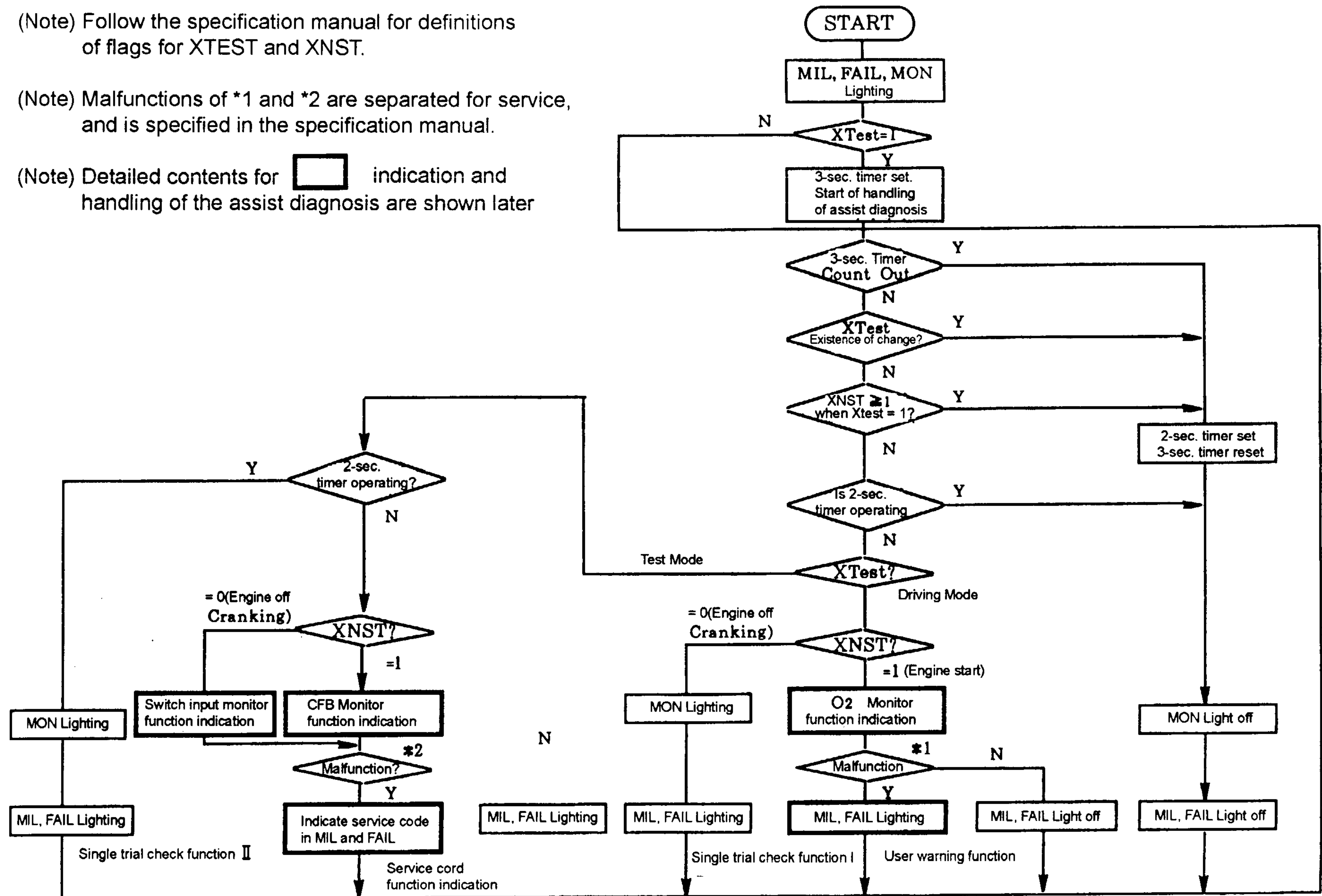


Figure 2

Refer to Figure 3 and Figure 4 for detailed flow chart.

(Note) Detailed contents for ☐ indication and handling of the assist diagnosis are shown later



### Figure 3