



# Trip computer





**Objectives**

- To understand the concept of trip computer.
- To understand the function of trip computer (ET, AFC, IFC, DTE, AVS, etc)
- To understand the troubleshooting method.

Trip computer is a microcomputer controlled driver information gauge that displays information related to driving, such as estimated distance to empty, average speed and driving time on the LCD.

If you press the ▼ / OFF button for less than 1second, the light of the LCD will turn off. If you press the ▼ / OFF button again, the lights of the LCD will turn on.

Non-navigation variants	<b>Calendar</b> →	<b>ET</b> → Elapsed time	<b>AFC</b> → Average Fuel Consumption	<b>IFC</b> → Instant Fuel Consumption	<b>DTE</b> → Distance To Empty	<b>AVS</b> Average Speed
Navigation variants	<b>ET</b> → Elapsed time	<b>AFC</b> → Average Fuel Consumption	<b>IFC</b> → Instant Fuel Consumption	<b>DTE</b> → Distance To Empty	<b>AVS</b> Average Speed	



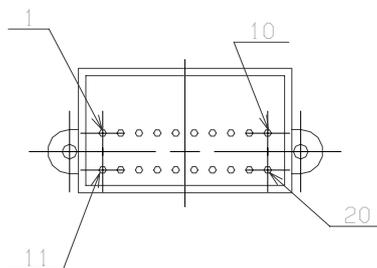
## 1. Trip computer



- Display color: Reddish amber
- 4 push-buttons are located at bottom side of the display.
- It is illuminated by standard Orange LEDs.

## 2. Connector

### 2.1 20-pin connector description

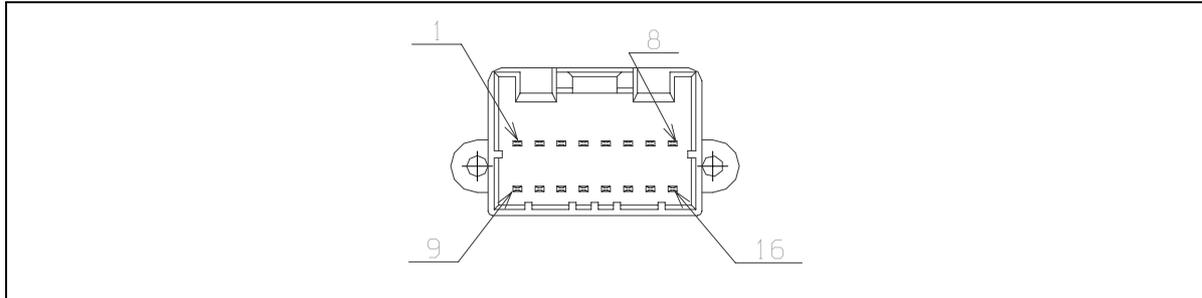


No.	Function	No.	Function
1	Ignition	11	Injection
2	Battery	12	Fuel sender input
3	ACC	13	NC
4	Signal (Electronic) ground	14	Power ground
5	ILL(+)	15	Fuel ground
6	ILL(-)	16	NC
7	Ambient(+)	17	Speed input
8	Ambient(-)	18	Tachometer input
9	CAN(+)	19	*Diagnosis
10	CAN(-)	20	NC

Remarks: DIAGNOSIS - One wire for manufacturing diagnosis interface.



## 2.2 16-pin connector description



No.	Function	No.	Function
1	Door front left	9	Tail gate
2	Door front right	10	Stop lamp left
3	Door rear left	11	Stop lamp right
4	Door rear right	12	NC
5	NC	13	NC
6	NC	14	NC
7	NC	15	NC
8	NC	16	NC



### 3. Display

Segmented LC display provides trip computer, calendar & clock, audio information, outside ambient temperature, door & trunk lid open status, tire pressure status, and stop lamp status, in black (foreground) against orange (background) with 318 segments which are controlled via 1:4 duty rate.

Audio information is available depending on the variants. Navigation variants do not show audio information because it is displayed on navigation display, and the audio information segments are used for calendar display exclusively.

With non-navigation variants, on the other hand, calendar function becomes one of the trip computer functions.

Outside ambient temperature, clock information are always displayed except 'BATT OFF' mode.

Audio information can be displayed by Audio ON signal (CAN signal) in 'BATT ON and IGN OFF' mode. (Only non-navigation variant)

Door & trunk information can be displayed with battery on (and IGN off) condition.

TPMS, Stop lamp fail and other trip computer information (JTI, AVS, AFC, IFC, DTE) are displayed in 'IGN ON' mode.



Trip computer functions and changeover sequence as per variants are as follows. Functions are cyclically chosen in a loop by user action.

Non-navigation variants	<b>Calendar</b> →	<b>ET</b> → Elapsed time	<b>AFC</b> → Average Fuel Consumption	<b>IFC</b> → Instant Fuel Consumption	<b>DTE</b> → Distance To Empty	<b>AVS</b> Average Speed
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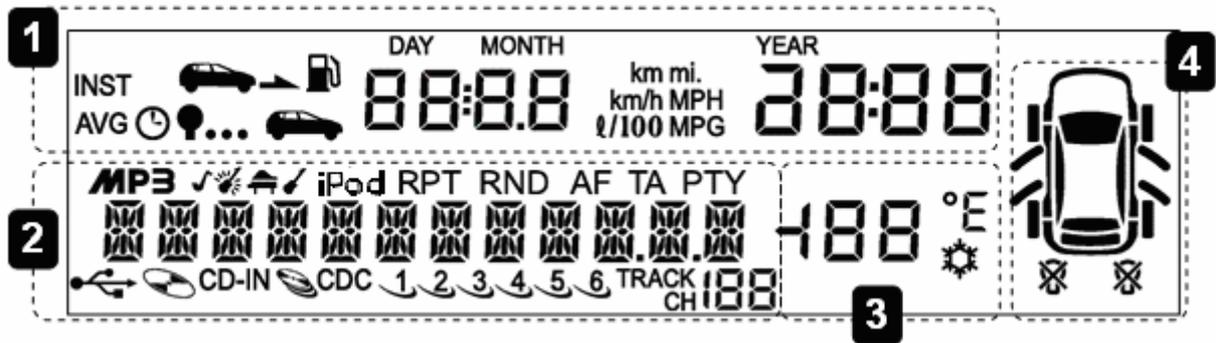
Display is controlled by 4 external push buttons: TRIP, RESET, UP and DOWN. TRIP button is also used to enter the clock and calendar setup mode. RESET button is used to reset AFC, AVS, ET and clock and also used to display the year in calendar mode.



### 3.1. Display area

#### 3.1.1 Non-navigation variants

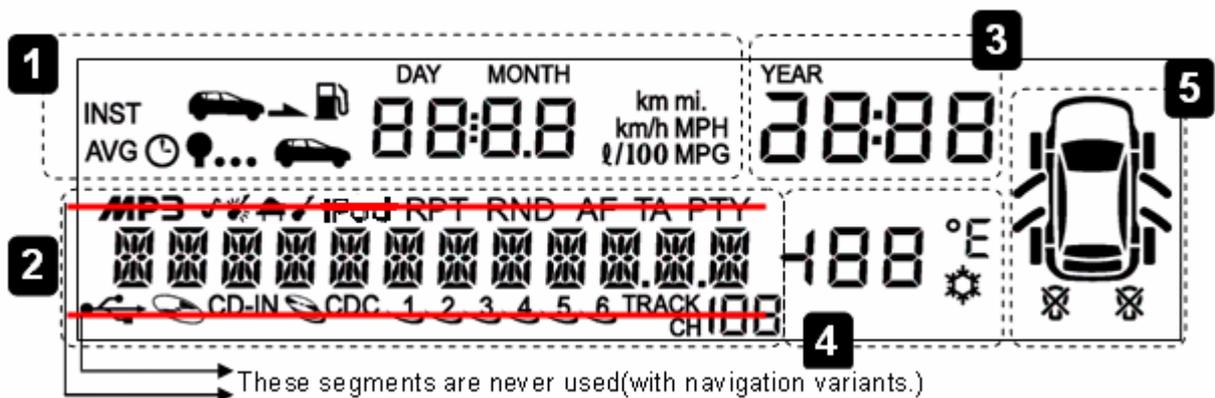
With non-navigation variants, segments are grouped as the following picture shows.



1	Trip computer, Clock and Calendar	2	Audio information
3	Outside ambient temperature(OAT)	4	Door & Tail gate (=trunk lid open), TPMS, Stop lamp failure

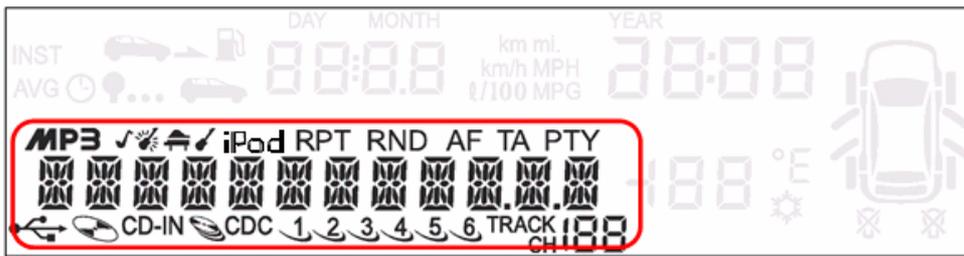
#### 3.1.2 Navigation variants

With navigation variants, segments are grouped as the following picture shows.



1	Trip computer	2	Calendar
3	Clock	4	Outside ambient temperature(OAT)
5	Door & Tail gate (=trunk lid open), TPMS, Stop lamp failure		

### 3.2 Audio Display



Audio display part consists of 12 characters, various icons and track number. ED trip computer communicates with Audio unit via CAN. ED Trip computer also communicates with Radio Unit via CAN. If CAN timeout for Audio is occur, Audio display is disappear after 10sec.

### 3.3 Distance to Empty (DTE)

The microprocessor gets the fuel sender signal and the fuel injection signal and calculates an estimated Distance to Empty with a resolution of 1 km or 1 mile. If the displayed DTE will be less than 50 km or 30 miles the DTE icons displayed and the “- - -” flashes with 1 Hz.

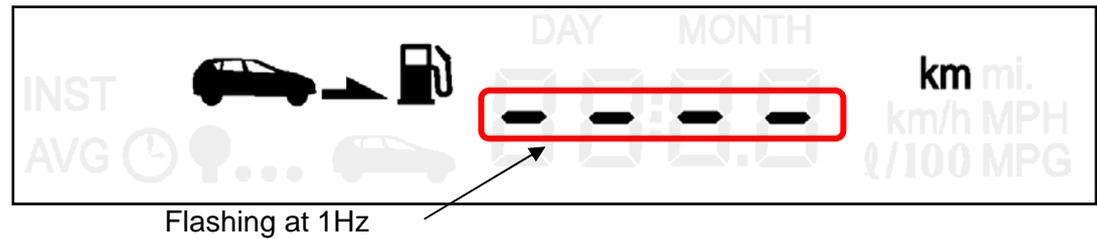
If the fuel sender input is out of range (e.g. short circuit or open input) for more than 20 seconds the DTE will display “- - -”.

The DTE display unit (km, MI.) could be changed by pressing the ‘RESET button longer than 4 seconds in DTE or AFC display mode. This operation also changes the AFC unit. The changed unit is valid until the battery is disconnected.

- Input: speed signal (distance), fuel sender signal and injection signal
- Range: values between 0 and 1500 km or miles
- Resolution: 1 km or 1 mile
- Offset: minus 2 of the fuel volume for the DTE calculation
- Note: The DTE function is an estimation of the vehicle range remaining, based on the remaining fuel volume and an average fuel consumption figure, derived from the historical pattern of driving. The range function differs fundamentally from all other displayed values in that it is a prediction as opposed to indication of a measurement



DTE Display 1. Normal mode

**DTE Display 2. DTE warning**

### 3.3.1 Calculation of Fuel Sender

The fuel sender input value will be damped via software in the microprocessor. Therefore in normal driving condition movements of the fuel input are minimized..

When the vehicle is standing ( $v < 2 \text{ km/h}^*$ ) the fuel volume value is decreased only by the injected fuel.

During normal driving condition, the fuel volume for DTE calculation is changed by the fuel sender value and the injected fuel at the same time.

### 3.3.2 Deduction Mode (Low Fuel Area)

- If the indicated fuel volume is below 8 liters the deduction mode is active.  
-> Entry of deduction mode.
- As long as the fuel sender value (high damped fuel volume) is below 7 liters the fuel volume is decreased only by the injected fuel.
- If the fuel sender value is above 9 liters, the deduction mode is deactivated and fuel volume values for DTE calculation is changed by the fuel sender value and the injected fuel at the same time. -> Exit of deduction mode

### 3.3.3 Calculation of Injected Fuel Quantity (F)

Basis for the calculation of the consumed fuel is the signal from the ECM. This signal allows determining the quantity of the injected fuel. The ECM signal provides constant fuel consumption value per pulse.

Input: injection signal,  $80 \mu$  liter per pulse for Gasoline.

Calculation:  $F = \text{Number of Pulse} * 80 \mu\text{l}$

F = Fuel quantity ( $\text{mm}^3$  per two engine cycles)



### 3.3.4 Calculation of Average Fuel Consumption (AFC)

Basic for the average fuel consumption are the calculated fuel quantity and the driving distance. The fuel consumption value is damped to avoid bouncing of the displayed DTE value.

Input: speed signal (distance) and injected fuel quantity (F)

$$\text{Calculation: } \text{AFC} = \frac{F * 100}{\text{DIST}}$$

AFC = Average fuel consumption [l/100km]

F = Fuel quantity since last calculation [l]

DIST = Distance since last calculation [km]

### 3.3.5 Calculation of Distance to Empty (DTE)

The distance to empty is calculated from the remaining fuel and the fuel consumption.

Input: fuel sender signal and average fuel consumption (AFC)

$$\text{Calculation: } \text{DTE} = \frac{F\_vol - \text{DTE\_offset}}{\text{AFC}}$$

DTE = Distance to empty [km or miles]

F\_vol = Remaining fuel volume of tank [l]

AFC = Average fuel consumption [l/100km]

DTE\_offset = Offset for the indication [l]

### 3.4 Elapsed Time (ET)

The Elapsed Time shows the time in hours and minutes (hh : mm) that the ignition has been switched on and the engine is running since the last ET reset. The ET is reset to 0:00 when the drive time is being displayed and the RESET button is pressed for more than 1 second.

When 99:59 is reached, the time will continue to increase from 0:00.

Input: none (Internal clock)

Range: 0:00 to 99:59

Error Rate: under 0.1%

Resolution: 1 minute

Data Storage: DT data is not saved in the EEPROM. Battery discharge or disconnection will cause DT data loss (reset to 0:00).





### 3.5 Average Fuel Consumption (AFC)

The microprocessor calculates the average fuel consumption from the total fuel used and the distance that the ignition has been switched on and the engine is running since the last Average Consumption reset. The total fuel used is calculated from the fuel consumption input. The display is updated every second. The Average Consumption is reset when (i) the Average Consumption is being displayed and (ii) the reset button is pressed for longer than 1second. Following a reset, “- - “ is displayed for 500 meters to allow enough data to be obtained for a valid calculation to be performed. The display reads in either l/100 (litres/100km) or MPG (miles/gallon). In case of MPG, \*imperial (UK) gallon or U.S. gallon is chosen for calculation by EEPROM configuration. The AFC display unit ( l/100km, MPG) could be changed by pressing the UP button longer than 3 seconds in trip computer display mode. The changed unit is valid until the battery is disconnected.

If the total fuel used or distance since the last average consumption reset reaches the maximum value, both values are halved and the calculation continues.

\* where 1Gallon(US) = 3.785 ltr, 1Gallon(UK) = 4.546 ltr)

Range: 0.0 to 99.9 l/100km or 0.0 to 99.9 MPG

Resolution 0.1 l/100km or MPG



AFC Display 1. Normal mode



AFC Display 2. After Reset



### 3.6 Instantaneous Fuel Consumption (IFC)

The microprocessor calculates the instantaneous fuel consumption from the instantaneous fuel used and the distance that the ignition has been switched on. The instantaneous fuel used is calculated from the fuel consumption input. The display is updated every second. The Instantaneous Consumption is reset when (i) the Instantaneous Consumption is being displayed and (ii) the reset button is pressed for longer than 1 second. The display reads in either l/100 (litres/100km) or MPG (miles/gallon). In case of MPG, \*\*imperial (UK) gallon or U.S. gallon is chosen for calculation by EEPROM configuration. The IFC display unit ( l/100km, MPG) could be changed by pressing the UP button longer than 3 seconds in trip computer display mode. The changed unit is valid until the battery is disconnected.

\* If speed is below 30km/h, IFC is displayed "- -"

\*\* Where 1Gallon (US) = 3.785 liter, 1Gallon (UK) = 4.546 liter

\*\*\* Init value (before first calculation: time for integration of speed and injection pulse) is 0.0 ltr/100km or MPG. (Example: after reset with speed > 30km/h, IFCO is displayed 0.0 for 1sec)

Range: 0.0 to 99.9 l/100km or 0.0 to 99.9 MPG

Resolution 0.1 l/100km or MPG



IFC Display 1.



### 3.7 Average Vehicle Speed (AVS)

The microprocessor calculates the Average Speed from the distance and time since the last AVS reset. The AVS is reset when the average speed is being displayed and the reset button is pressed for more than 1000ms. For 500 meters following a reset "- - -" is displayed. This allows the collection of enough data for a valid calculation.

If the distance or time since the last average speed reset reaches the maximum value, both numbers are halved and the calculation continues.

The AFC value is not stored in the EEPROM, battery discharge or disconnection will cause a reset. (reset to "- - -").

Display range: 0 to 260kph or 160 mph

Resolution: 1 kph or mph

Error Rate: under 1.0%

Input: tachometer and speed input (calibrated by means of the pulses/km number [k-factor] programmed into the EEPROM), internal clock counter

#### 3.7.1 Exception Behaviour

Internal calculation of Average Vehicle Speed will be decreased to zero if:

Over maximum speed condition has been detected ( $V \geq 300$  km/h)

AVS value is stopped if:

Under voltage condition has been detected (speed signal may be corrupted)

AVS value is frozen:

After receiving valid information, the calculation continues based on the last computed values and the result is displayed immediately.



AVS Display 1. Normal mode



AVS Display 2. After Reset



### 3.8 Calendar & Clock

#### 3.8.1 Non-Navigation Variant

The ED Trip computer shows Calendar. The Calendar includes the day, month, year and the clock. The day, month and the year shows only in the calendar mode. The clock is displayed in every mode except the first 10 seconds in the calendar mode. For first 10 seconds in calendar mode the Year is displayed. When RESET button is pushed over 1 second, the year is displayed again for about 10 seconds. When MODE button is pushed over 2 seconds in calendar mode, the ED trip computer enter the calendar mode, the order of setup is Year-> Month-> Day. When MODE button is pushed over 2 seconds in other mode, the ED trip computer enters the clock setup mode the order of setup is Hour -> Minute. To go next setting in setup mode, MODE button should be pressed under 1 second. The segments in setting should be blink, and then the value could be changed by up or down button.

\* 'DAY', 'MONTH', 'YEAR' segments are displayed in calendar set up mode.

\*\* 'DAY', 'MONTH', 'YEAR' segments are displayed when year is displayed.

Display range: DAY: 1 ~ 31, MONTH: 1-12, YEAR: 2005~2099 HOUR: 1~24, Minute: 00~59

Resolution: 1 (Day, Month, Year, Hour, Minute)

Input: Internal Clock



Calendar & Clock Display: Day-Month and Clock



Calendar Display: Day-Month and Year



### 3.8.2 Navigation Variant

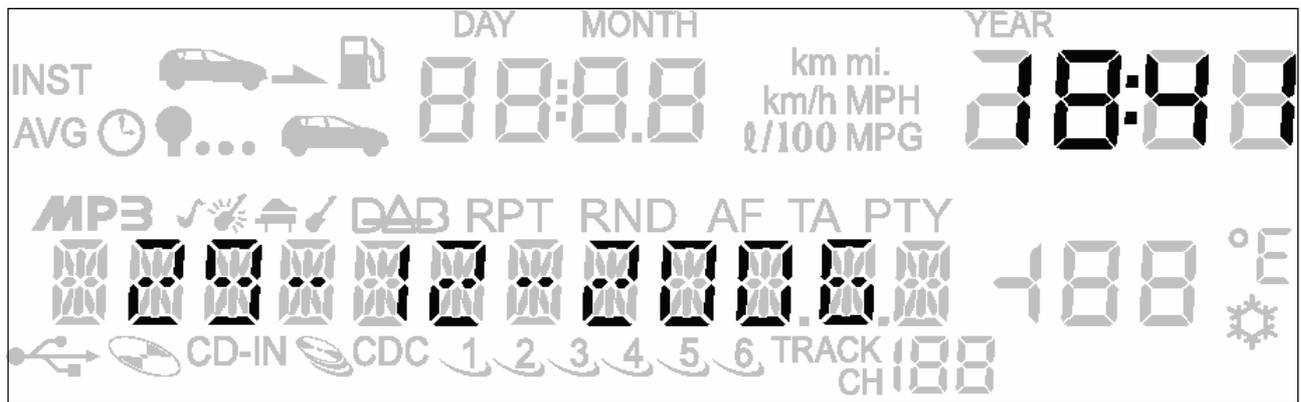
The ED Trip computer always shows Calendar information in audio range of LCD, in overall mode. The Calendar includes the day, month, and year. The clock is displayed in every mode. When MODE button is pushed over 2 seconds in every mode, the ED trip computer enter the calendar and clock set up mode, the order of setup is Hour -> Minute -> Year-> Month-> Day. To go next setting in setup mode, MODE button should be pressed under 1 second. The segments in setting should be blink, and then the value could be changed by up or down button.

\* 'DAY', 'MONTH', 'YEAR' segments are not displayed in all modes.

Display range: DAY: 1~31, MONTH: (01 ~ 12), YEAR: 2005~2099 HOUR: 1~24, Minute: 00~59

Resolution: 1 (Day, Month, Year, Hour, Minute)

Input: Internal Clock



Calendar & Clock Display: Navigation Variant

### 3.9 Outside Ambient Temperature (OAT)

A resistive sender provides the trip-computer with the outside ambient temperature. The microprocessor measures the resistance of the sender.

Display Range: -40°C to +80°C or -40 to 176°F

Resolution: 1°C or 1°F



OAT Display 1.Fahrenheit



OAT Display 2.Centigrade



OAT Display 3 (Ice on road)

#### Sender Characteristics:

Temperature (°C)	Temperature (°F)	Sender Resistance (kΩ)	Tolerance (°C)
-40	-40	881.030	±4
-30	-22	480.410	±4
-20	-4	271.210	±2
-10	14	158.180	±2
0	32	95.096	±2
10	50	58.799	±2
20	68	37.315	±2
30	86	24.260	±4
40	104	16.130	±4
50	122	10.950	±4
60	140	7.579	±4
70	158	5.341	±4
80	176	3.828	±4



### 3.10 DOOR and Trunk Lid / TPMS / Stop Lamp Fail Display

Door open, trunk lid open, and stop lamp failure are based on digital inputs, while TPMS inputs come via CAN.

#### Door open

Input	All segments on	No input	Trunk Lid
LCD segments			

Input	Front Left	Front Right	Rear Left	Rear Right
LCD segments				

#### TPMS

Input	Front Left	Front Right	Rear Left	Rear Right
LCD segments				

\* TPMS pre-warning is not work and CAN timeout function is skipped.

#### Stop lamp failure

Input	Left	Right
LCD segments		