DSP-52

J1939 CAN-Bus Reader Manual

For CAN-Bus SAE-J1939 Protocol

固也泰電子工業有限公司
KUTAI ELECTRONICS INDUSTRY CO., LTD.

ISO 9001
BSMI

Headquarters : No.3, Lane 201, Chien Fu ST., Chyan Jenn Dist., Kaohsiung, TAIWAN
Tel : + 886-7-8121771 **Fax :** + 886-7-8121775 **URL :** http://www.kutai.com.tw

TABLE OF CONTENTS

Section ***Page***

1. CHAPTER ONE INTRODUCTION

1.1 Introduction

Electronically controlled engines are becoming ever popular. The data from various control components are communicated through a fast and stable network (CAN-Bus). Since the release of SAE-J1939 protocol, different manufacturers are now able produce products that can operate and communicated according to the unified definition of data communication.

The baud rate from SAE-J1939 in CAN-Bus is limited to 250k Bits/s. In network length of 40 meters with maximum of 10 nodes (ECUs), in network length of 10 meters with maximum of 30 nodes (ECUs). It does not support master-slave network or allows the Plug & Play and other features.

1.2 Product Description

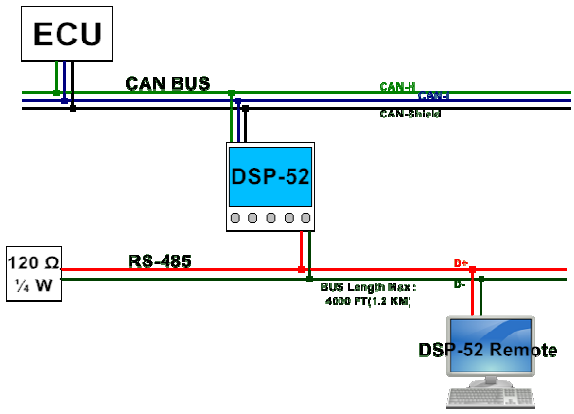
The DSP-52 CAN-Bus Reader is used to interpret the SAE-J1939 protocol's parameters and diagnostic codes, and graphically display the information on the LCD panel. The arrangement of display, the measuring units and language can be customized according to the user preference. Overall, a DSP-52 is used to simplify and replace multiple display meters and gauges.

1.2.1 Features

- Large single color LCD with graphical display
- Hidden multi-function menu
- Single click to return to graphical display menu
- 4 pages display arrangement with total of 16 graphical display readouts and 4 readouts per page
- 8 item data tracking and curve graph displayed
- Records up to 100 failure code history (ADTC)
- 1 failure warning output
- RS-485 port for system remote access
- IP67 Water-Resistance (Below Water 1 Meter)

1.2.2 Network Structure

The DSP-52 receives the SAE-1939 data packet via CAN-Bus from the ECU and graphically displays the value on the LCD screen. By connecting through RS485 port user can remotely monitor and access the DSP-52.



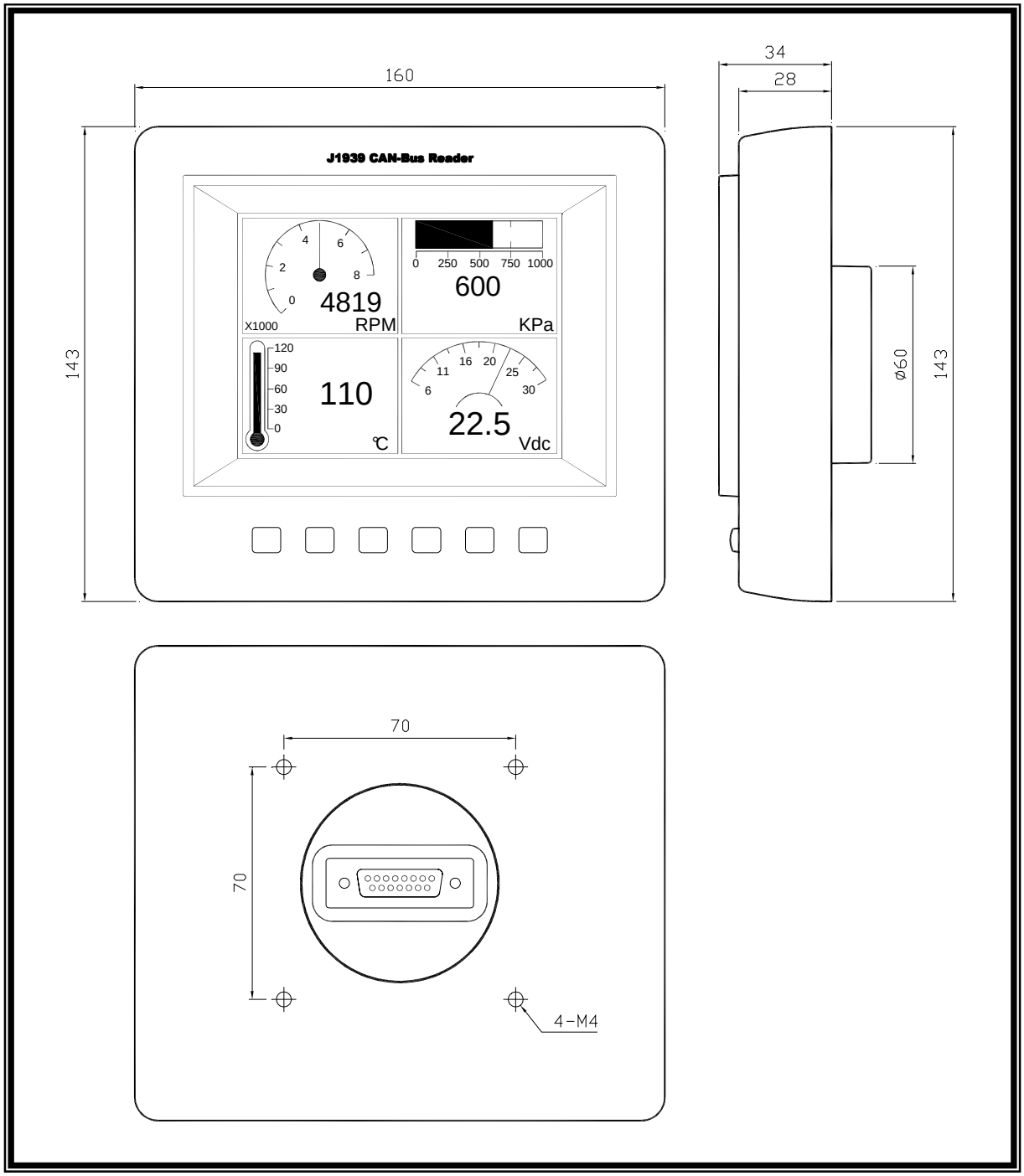
DSP-52 Network Structure Diagram

1.3 Electrical Characteristics

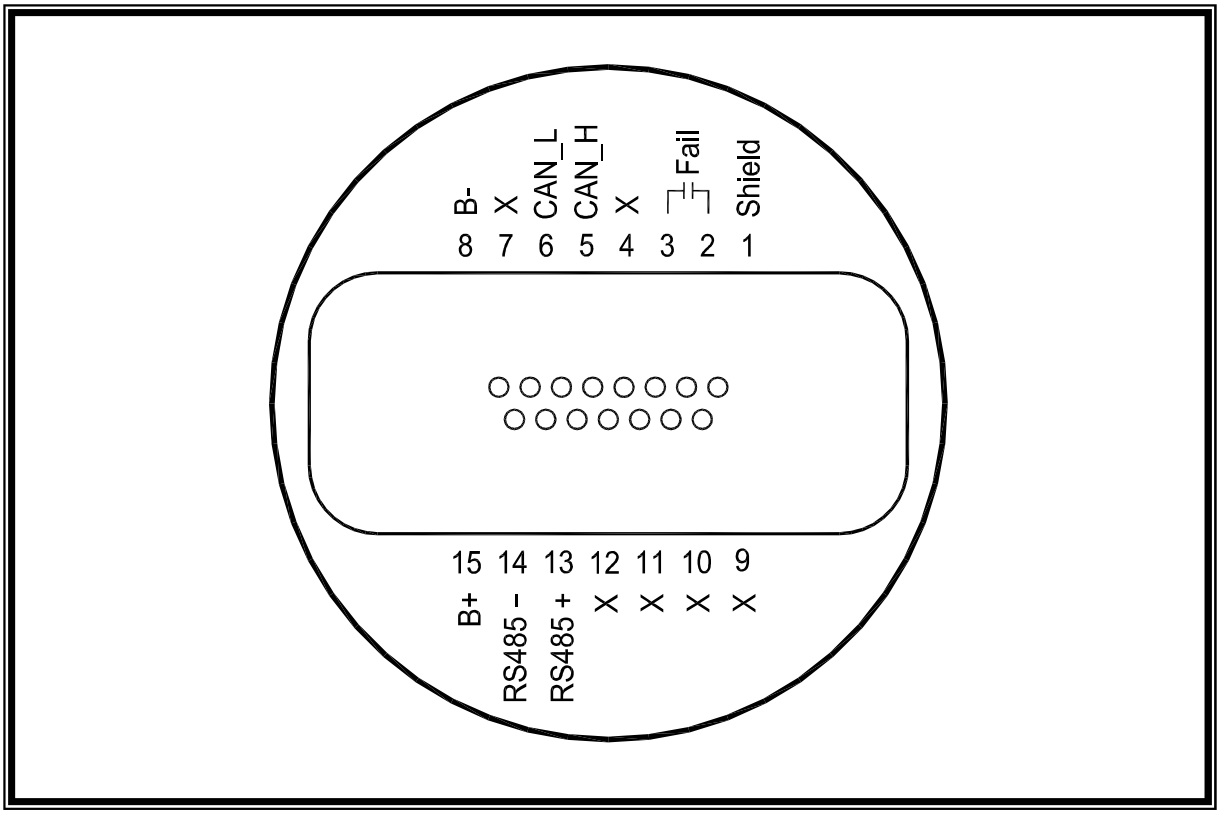
ITEM	SPECIFICATION
DC Supply	8~60 VDC
CAN Bus Protocol	SAE-J1939 Protocol
CAN Bus Baud Rate	250 k BPS
RS-485 Protocol	Mod Bus Protocol
RS-485 Baud Rate	38400 BPS
Contact Capacity	1A or 30VDC Max@10VA
Power Consumption	<2W
Water-Resistance	IP67 (Below Water 1 Meter)
Operate Temperature	-10℃ ~ 70℃
Storage Temperature	-20℃ ~ 80℃
Relative Humidity	up to 100%
Weight	555g ±2% (include harness total 700 g)

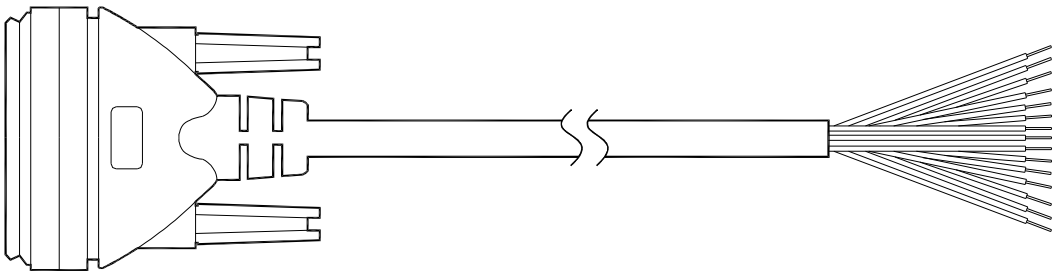
2. CHAPTER TWO HARDWARE DESCRIPTION

2.1 Outline Dimension (Unit : mm)



2.2 Pinout Diagram



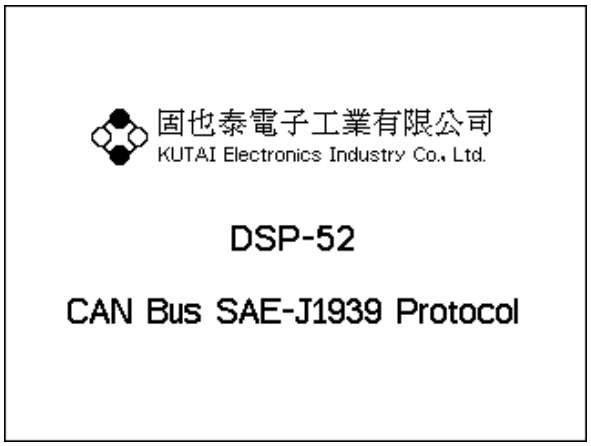


ITEM	COLOR	DESCRIPTION	ITEM	COLOR	DESCRIPTION
1	Red	CAN Bus Shield	9	Red / White	Spare terminal
2	Pink	Alarm Contact Output	10	Brown / White	Spare terminal
3	Gray	Alarm Contact Output	11	Black / White	Spare terminal
4	Yellow	Spare terminal	12	Light Green	Spare terminal
5	Green	CAN_H	13	Purple	RS485 D+
6	White	CAN_L	14	Orange	RS485 D－
7	Blue	Spare terminal	15	Black	Battery +
8	Brown	Battery－			

3. CHAPTER THREE FUNCTION DESCRIPTION AND OPERATE INDICATION

3.1 DSP-52 Startup Cover Page

The DSP-52 displays a startup cover page for 5 seconds. The startup cover page can be self customized. User can upload a 320 × 240*1-bit BMP picture file to the system memory via remote access software. After rebooting the system, the startup cover page will be updated to the new design.



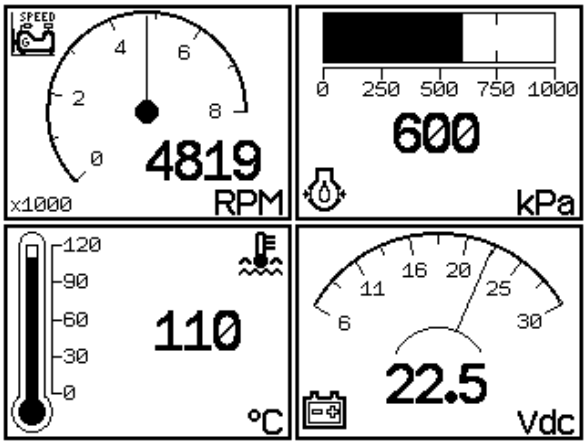
DSP-52 Default Startup Cover Page

DSP-52 Customized Startup Cover Page

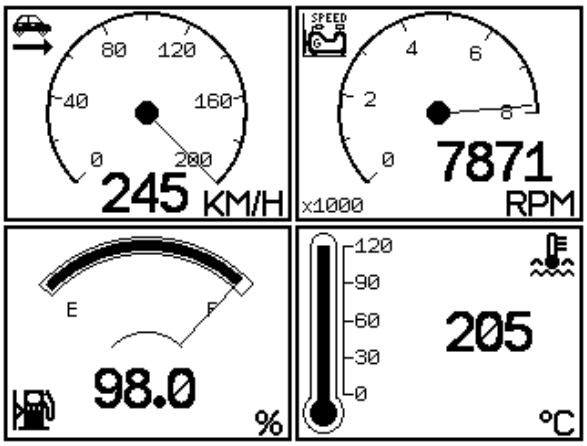
3.2 Analogy and Digital Gauge

16 graphical analogy and digital gauges can be rearranged in the preferred sequence of 4 display gauges per page from the total of 4 pages (For more information please reference from Chapter 3.3 “Customize Common Display Gauge”) Press “Next Page”  to change to next display screen.

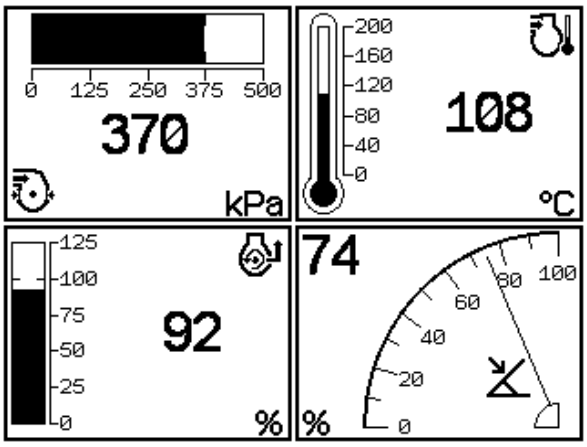
3.2.1 Analogy Gauge



Page 1 Common Analogy Gauge

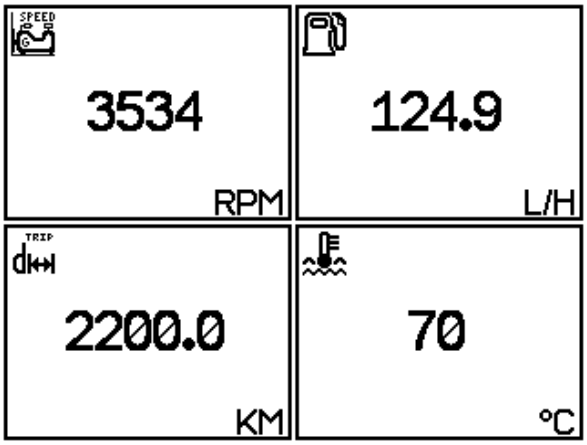


Page 2 Common Analogy Gauge



Page 3 Common Analogy Gauge

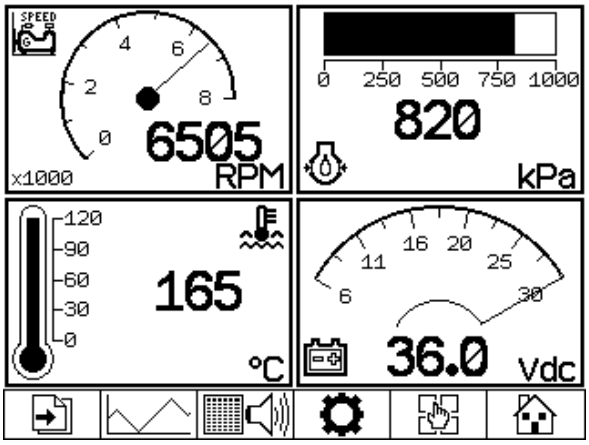
3.2.2 Digital Gauge



Page 4 Common Digital Gauge

3.2.3 Gauge Menu Bar

Press any key, the menu bar will appear at the bottom of the LCD display screen with 6 functions keys corresponding to the push bottom below the LCD screen. If no buttons are pressed in 5 seconds, the menu bar will disappear to provide more detailed graphical display.



Graphical Gauge Menu bar screen

Next Page

Curve Graphics

ADTC Record

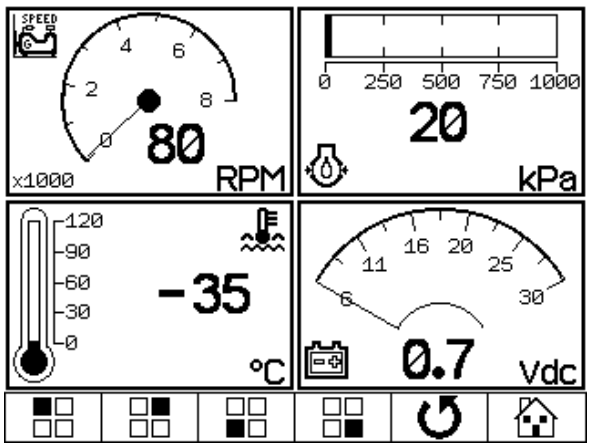
System Setting

Customizing Display Gauge

Home

3.3 Customize Common Display Gauge

In the Analogy and Digital Gauge display, press Customizing Display Gauge key , user can select to switch and change the corresponding gauge combination as desired. (For example : Press ■□ key the bottom left gauge will be changed to a different gauge display. The order of switch can be referenced from Chapter 3.3.1 “Common Gauge List”).



Customize Common Display Gauge Screen

Switch Top-Left Gauge

Switch Top-Right Gauge

Switch Bottom-Left Gauge

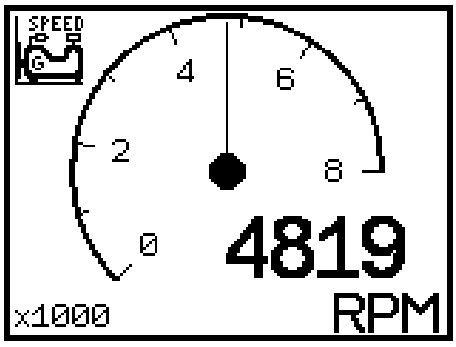
Switch Bottom-Right Gauge

Return to Previous Page

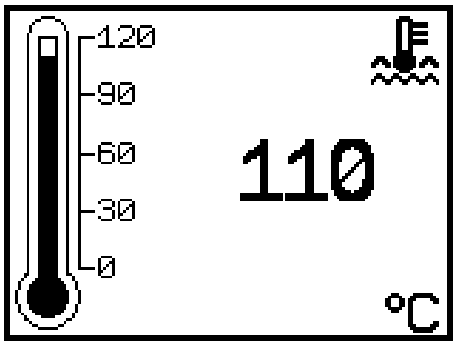
Home (Back to Gauge Display)

3.3.1 Common Gauge List

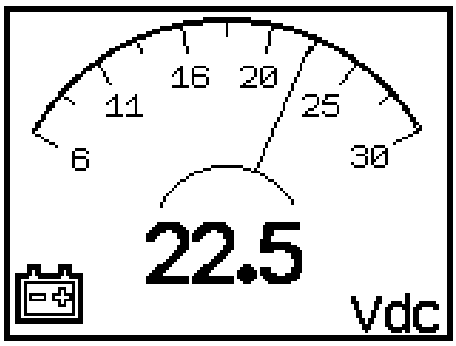
1. Engine Speed



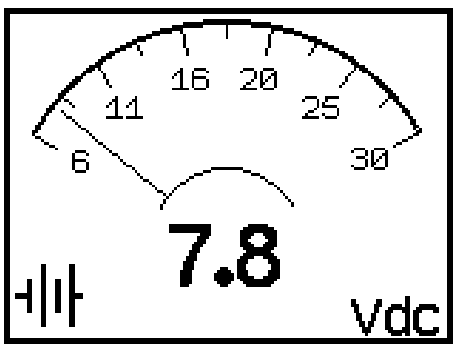
2. Engine Coolant Temperature



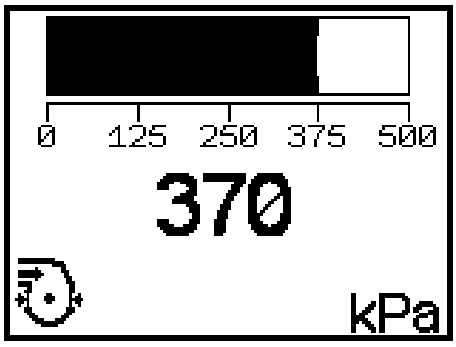
3. Key switch Battery Potential



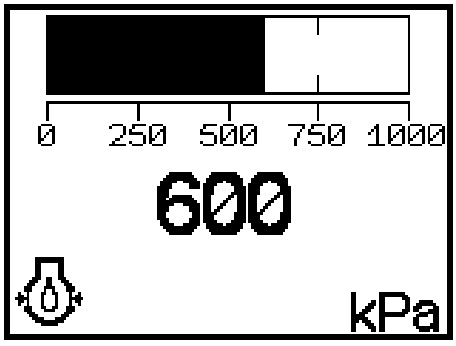
4. Battery Potential / Power Input



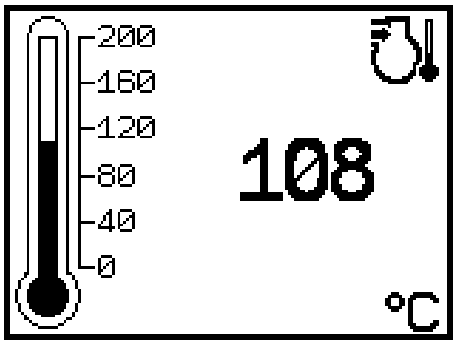
5. Engine Intake Manifold Pressure



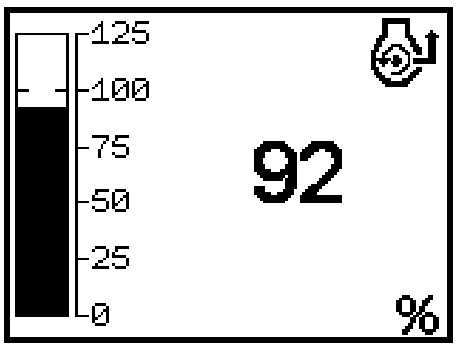
6. Engine Oil Pressure



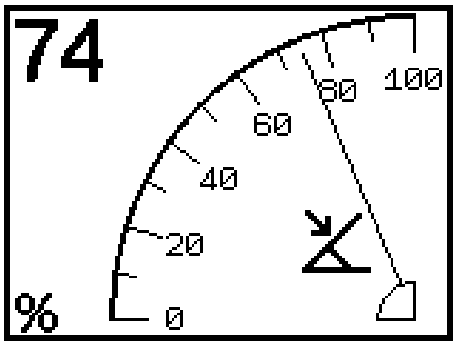
7. Engine Intake Manifold Temperature



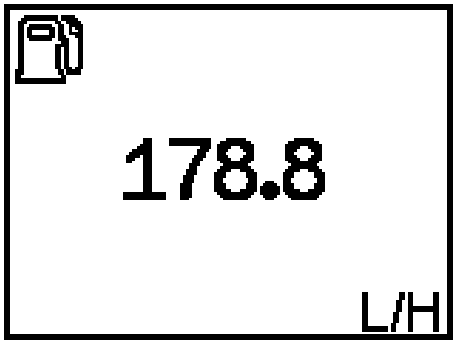
8. Engine Percent Load at Current Speed



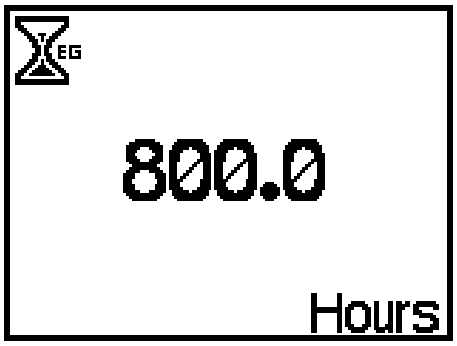
9. Accelerator Pedal Position



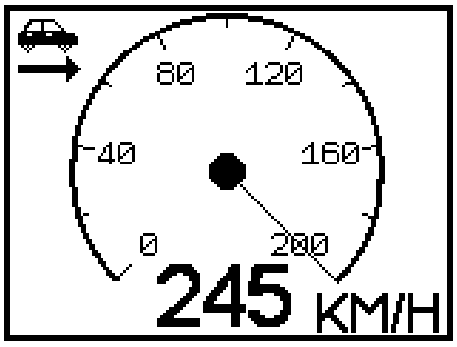
10. Engine Fuel Rate



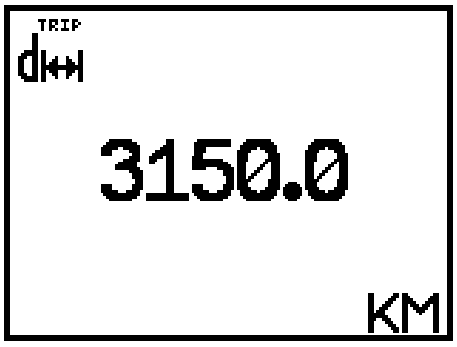
11. Engine Total Hours of Operation



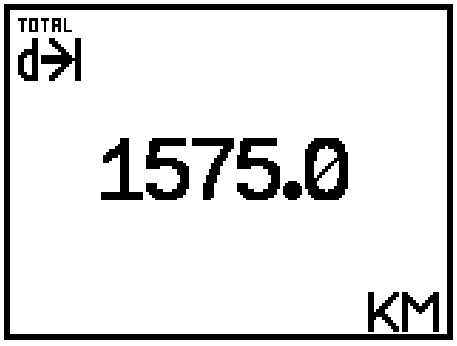
12. Wheel-Based Vehicle Speed



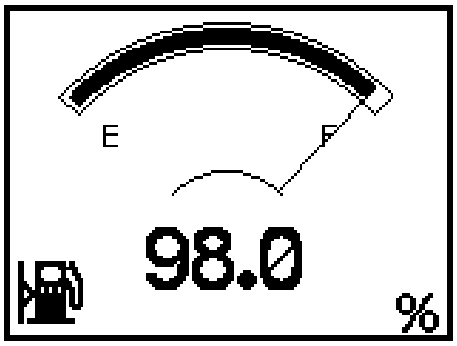
13. Trip Distance



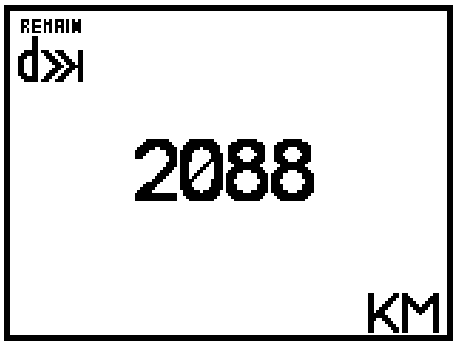
14. Total Vehicle Distance



15. Fuel Level

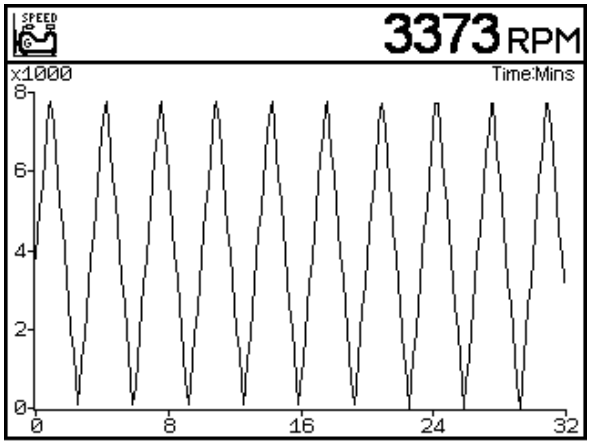


16. Distance Remaining



3.4 Curve Graphics Record

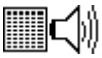
DSP-52 offers 8 curve graphics records, with programmable recording time from 4, 8, 16, 32, 60 minutes, 2, 4, and 8 Hours (For more information please reference from Chapter 3.6.1.4 “Meter Range Setting”). This function allows user to understand the variation in value during the recording time. The system does not save the record, new curve graphics will be supplied when system reboots.



Curve Graphics Record Screen


Analogy and Digital Gauge Display Function


Switch to Next Curve


ADTC Record Function

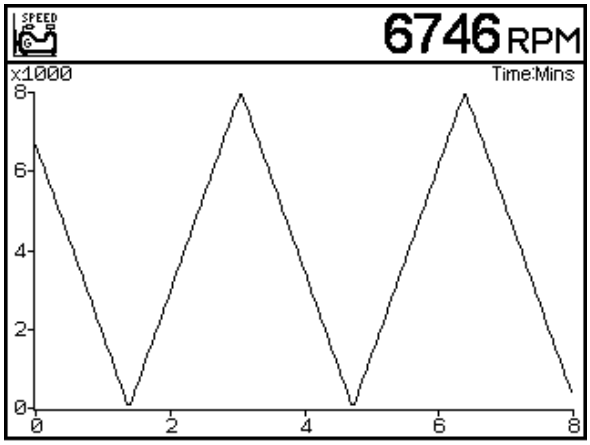

Enter System Setting Function


Hide Menu Bar

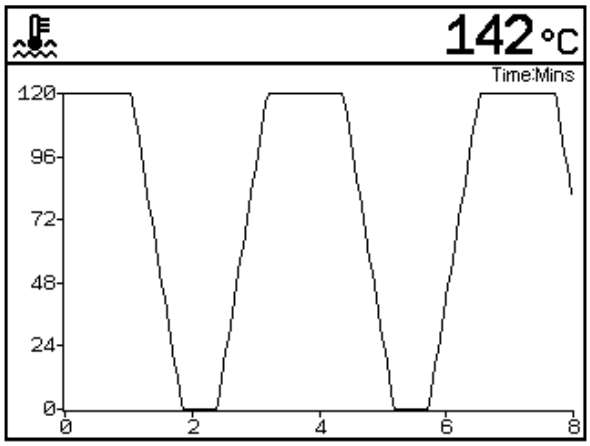

Home (Back to Gauge Display)

3.4.1 Curve Graphics Item List

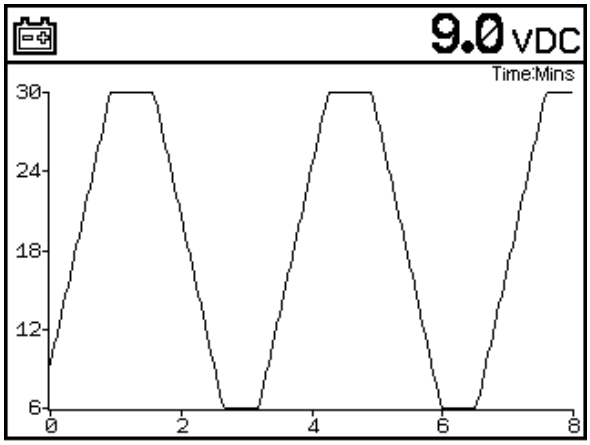
1. Engine Speed



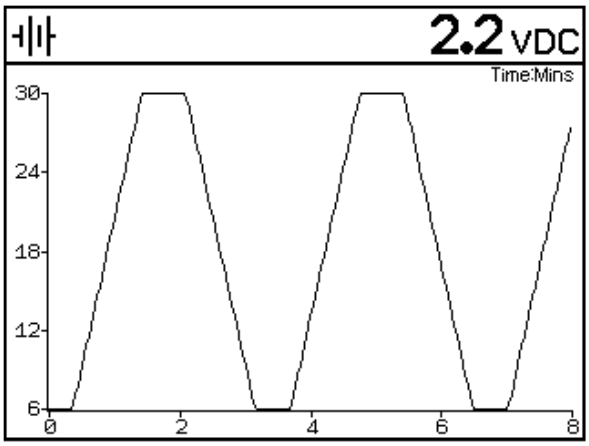
2. Engine Coolant Temperature



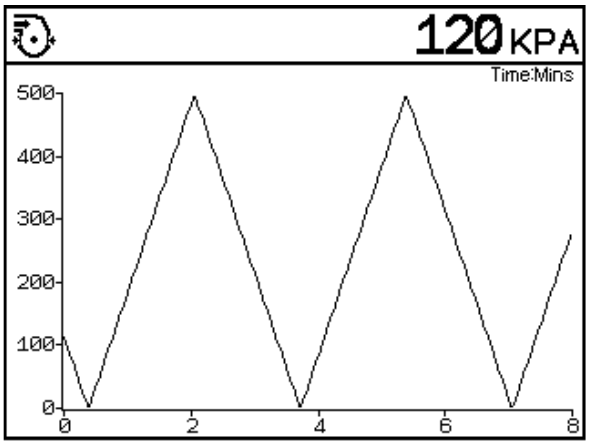
3. Key switch Battery Potential



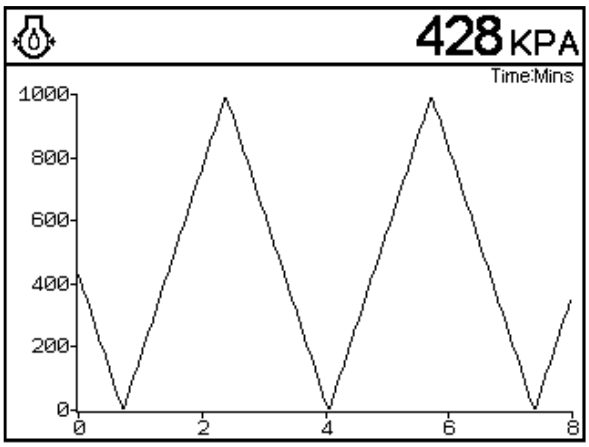
4. Battery Potential / Power Input



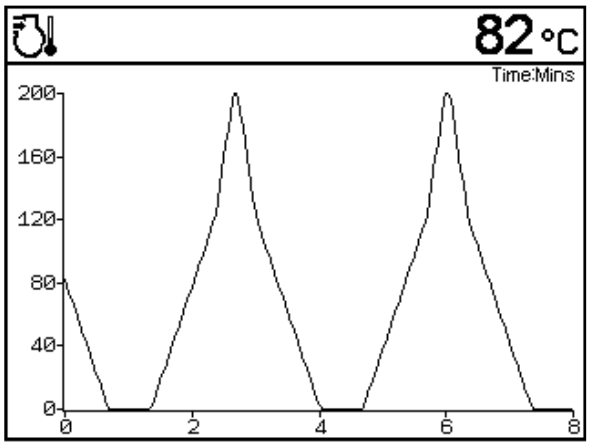
5. Engine Intake Manifold Pressure



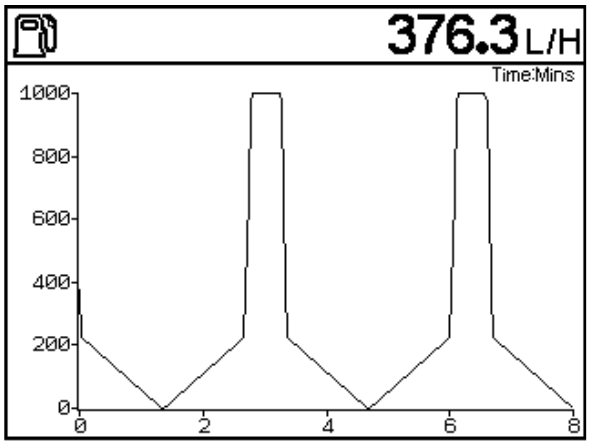
6. Engine Oil Pressure



7. Engine Intake Manifold Temperature

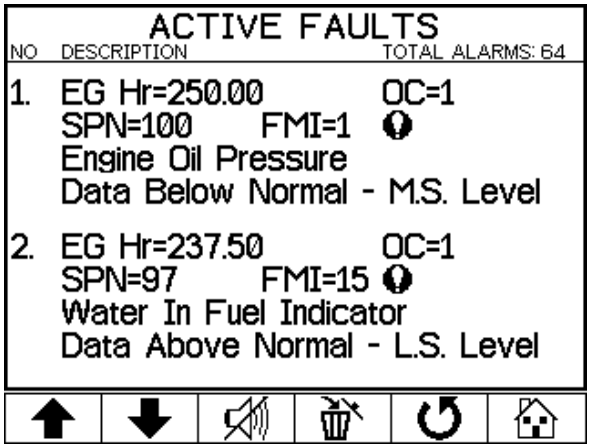


8. Engine Fuel Rate



3.5 ADTC Message

DSP-52 can record up to 100 failure code history ADTC (Active Diagnostic Trouble Code). Precisely records engine operating hours, number of occurrence, SPN (Suspect Parameter Number), FMI (Failure Mode Indicator) and warning lamp indicator.



ADTC Message with Menu Bar

Previous ADTC Record

Next ADTC Record

Mute

Delete All ADTC Record

Return to Last Function

Home (Back to Gauge Display)

Warning Lamp Icon：

Malfunction Indicator Lamp

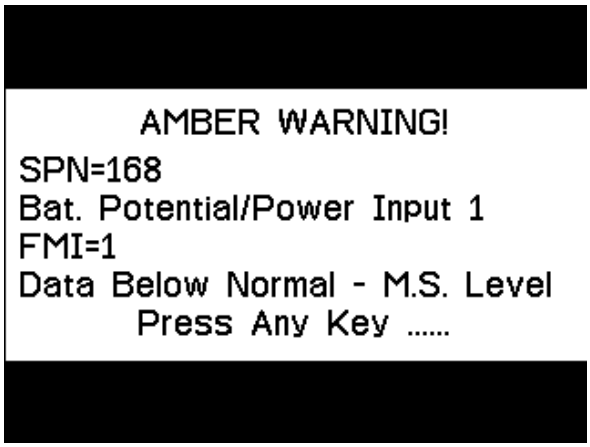
Red Stop Lamp

Amber Warning Lamp

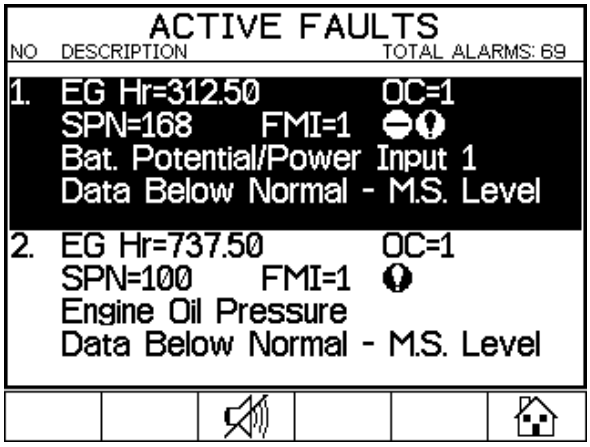
Protect Lamp

3.5.1 ADTC Warning

In an ECU failure warning, the LCD screen flashes continuously. Press any key and the screen will immediately switch and locked in the active warning page until the ECU failure warning is excluded to resume operation of the DSP-52.



ADTC Warning Flash Page



ADTC Message Lock at Active Warning Page

Mute

Home (Back to Gauge Display)

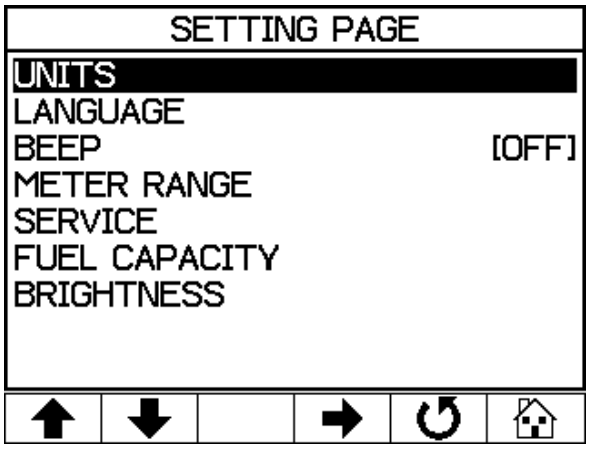
3.6 System Setting

System setting is divided into three categories:

1. Setting Page
2. System Page
3. J1939 Item List

3.6.1 Setting Page

To Adjust and set the display units, language, operating beep sound, meter range, service maintenance schedule, engine fuel tank capacity, and LCD brightness.



Setting Page

 Previous Setting Item

 Next Setting Item

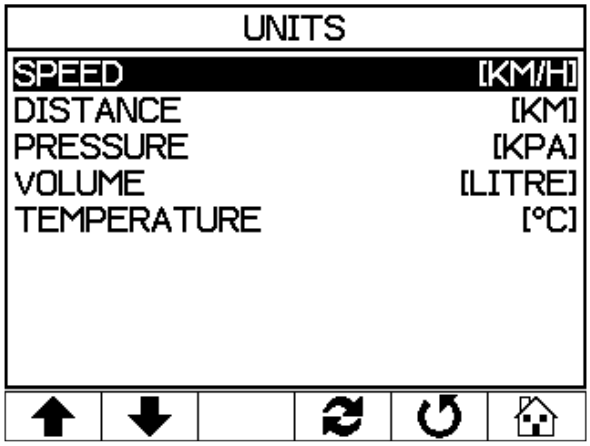
 Enter Setting Page or Change Setting Selection

 Return Last Function

 Home (Back to Gauge Display)

3.6.1.1 Unit Setting

The measuring and display units for distance, pressure, volume and temperature can be programmed according to user preference.



Unit Setting Screen

 Previous Unit Setting

 Next Unit Setting

 Change Unit Setting Selection

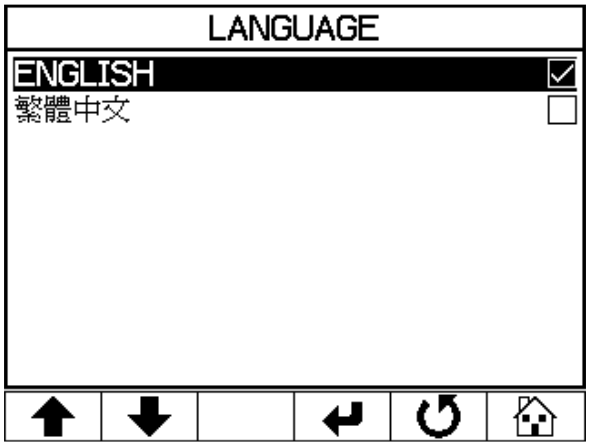
 Return to Last Function

 Home (Back to Gauge Display)

- Speed Unit：KM/H, MPH
- Distance Unit：KM, MILES
- Pressure Unit：KPA, PSI, BAR
- Volume Unit：LITRE, GAL
- Temperature Unit：℃、℉

3.6.1.2 Language Setting

In the language setting, the DSP-52 is currently available in Mandarin and English only.



Language Setting Screen

Previous Language

Next Language

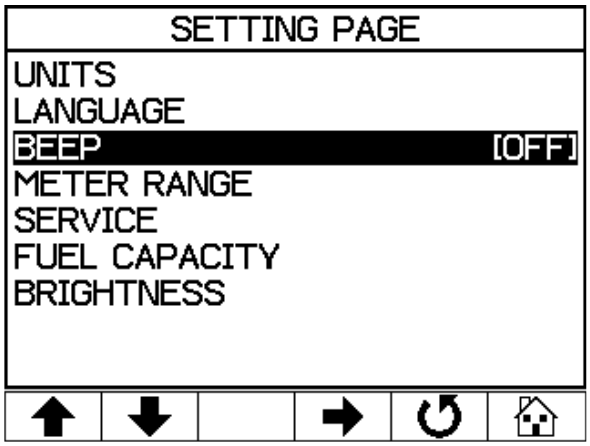
Enter (Select Language)

Return to Last Function

Home (Back to Gauge Display)

3.6.1.3 Beep Setting

The Beep sound for push button and failure warning can be turned [ON] and [OFF] in the Beep Setting.

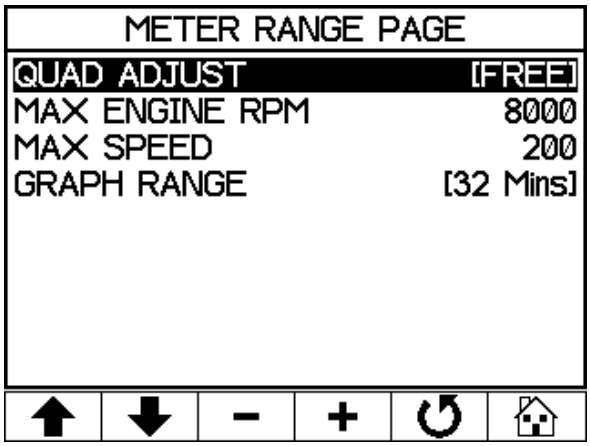


Beep Setting Screen

Enter Setting Page or Change Setting Selection

3.6.1.4 Meter Range Setting

The Meter Range Setting is for setting the maximum range of the engine RPM, vehicle speed, locking of gauge display combination to prevent accidental change during operation and curve graph recording time.



Meter Range Setting Page

Previous Setting Item

Next Setting Item

Select Last Setting Option

Select Next Setting Option

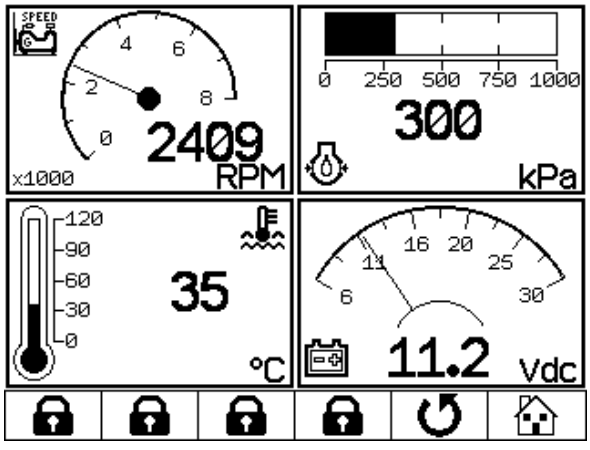
Return to Last Function

Home (Back to Gauge Display)

- Lock Quad Gauge Combination :

  [FREE] Gauge combination non-locked

  [LOCK] Gauge combination locked



Gauge Combination Locked (Select Disable)

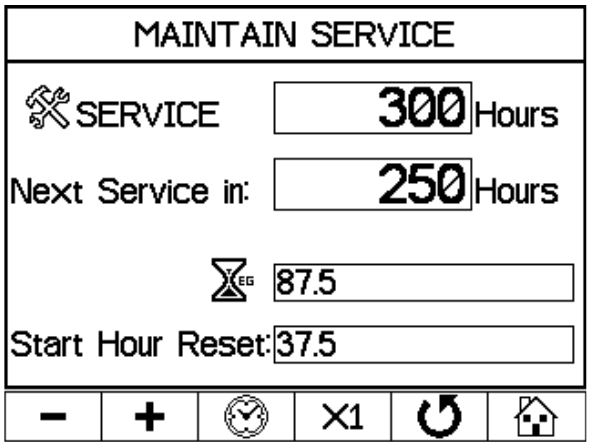
- Maximum engine RPM range setting:2000 ~ 9000 RPM.
- Maximum vehicle speed range setting:100 ~ 200.
- Curve graphic recording time range setting : 4, 8, 16, 32, 60 minutes, 2, 4, and 8 Hours.

3.6.1.5 Maintenance Service Setting

In the language setting, the DSP-52 is currently available in Mandarin and English only.

The maintenance service setting provides addition protection for the engine to schedule required maintenance and service. When the timer is set to 0 hour then the function is cancelled [OFF].

Press start hour reset key to reset the Start Hour by referencing from Engine Total Hours of Operation as the next original starting hours.



Maintenance Service Setting Page

− Decrease Service Hour

+ Increase Service Hour

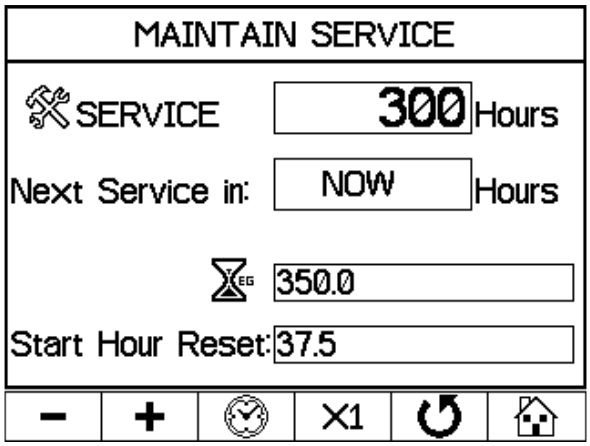
Start hour reset key. Set Engine Total Hours of Operation as the start hour.

X1 o quickly increase or decrease the value of hour setting, press X1 then the value became X10 therefore when press − or +, the value will increase or decrease by 10. Press X10 then the value became X100 therefore when press − or +, the value will increase or decrease by the 100.

Return to Last Function

Home (Back to Gauge Display)

Example : The Start Hour Reset was first set at 37.5 of operation hour. The Maintenance Service schedule is set to perform after 300 hours of operation, therefore the scheduled maintenance Service needs to be performed at 337.5 hours (300+37.5=337.5). From the illustration below, the current total operation hour is 350 hours, therefore the scheduled maintenance service is already pass due for 12.5 hours and the “Next Service in :” will appear Now to inform user to perform maintenance immediately.

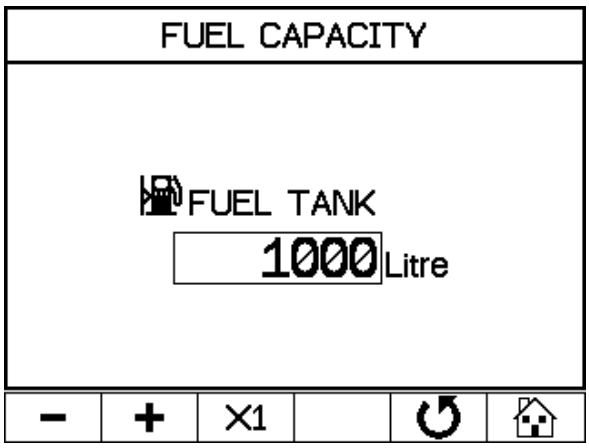


Maintain Service Time Up

3.6.1.6 Fuel Capacity Setting

DSP-52 able to interpret the SAE-J1939 packet message, but in order to calculate correct remaining fuel capacity, user must first program the correct fuel tank capacity.

The Remaining fuel = fuel tank capacity × level



Fuel Capacity Setting Page

− Decrease Fuel Capacity

+ Increase Fuel Capacity

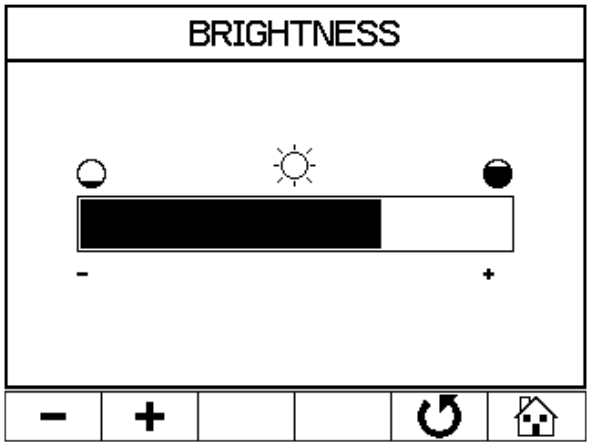
X1 To quickly increase or decrease the value of fuel tank capacity setting, press X1 then the value became X10 therefore when press − or +, the value will increase or decrease by 10. Press X10 then the value became X100 therefore when press − or +, the value will increase or decrease by the 100. Press X100 then the value became X1000 therefore when press − or +, the value will increase or decrease by the 1000.

Return to Last Function

Home (Back to Gauge Display)

3.6.1.7 LCD Brightness

The LCD brightness can be adjusted from 10 ~ 100%.



LCD Brightness Setting Page

− Decrease LCD Brightness Level

+ Increase LCD Brightness Level

Return to Last Function

Return Gauge Display

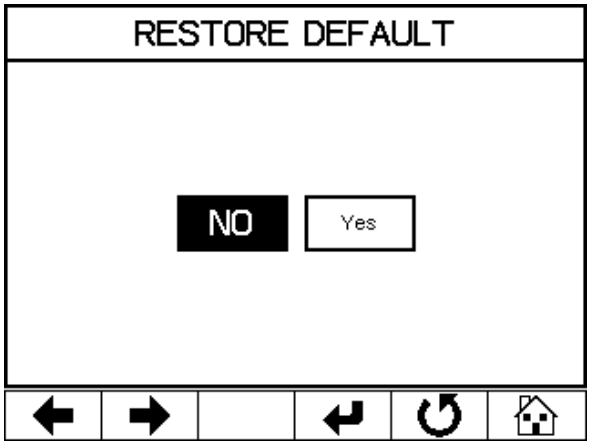
3.6.2 System Page

System Page is divided into four categories：

1. RESTORE DEFAULTS
2. RS-485 SETTING
3. J1939 SETTING
4. ABOUT DSP-52

3.6.2.1 Restore Defaults

In the Restore Defaults, by pressing [Yes] all customized settings will automatically reset to the factory original setting. (For more information please reference from Chapter 4.2 “DSP-52 Parameter Setting Table”)



LCD Brightness Setting Page

Previous Setting Item

Next Setting Item

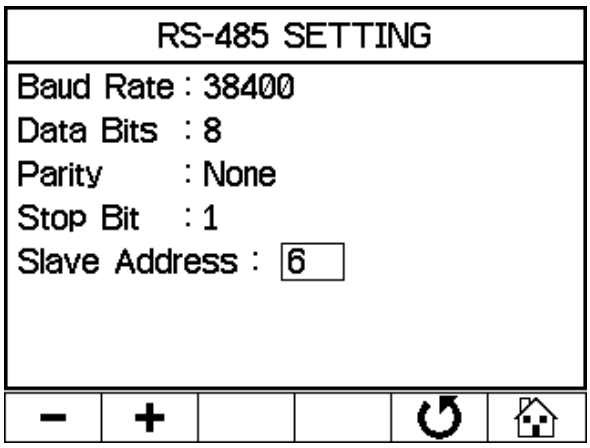
Select Setting Option

Return to Last Function

Return Gauge Display

3.6.2.2 RS-485 Setting

DSP-52 is equipped with RS-485 communication port for connecting with PC program (DSP-52 Remote). The advantage for RS485 are the long range connections from 500 up to 1000 meters), and high interference-free capability. The selected baud rate is 38400 Bits / Sec, compliant with the ModBus protocol with CRC-16 packet to test and confirm the accuracy of data. The slave address is to enable the PC program (DSP-52 Remote), to simultaneously connect to multiple controllers. For PC program connection details please refer to the DSP-52 Remote user manual.



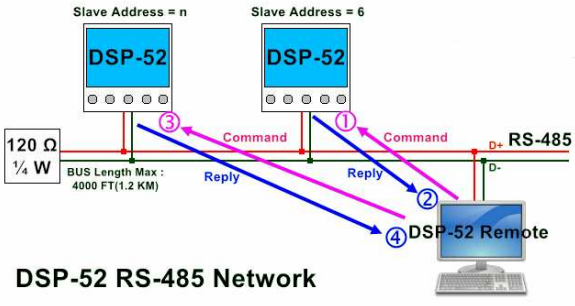
RS-485 Setting Page

Slave Address -1

Slave Address +1

Return to Last Function

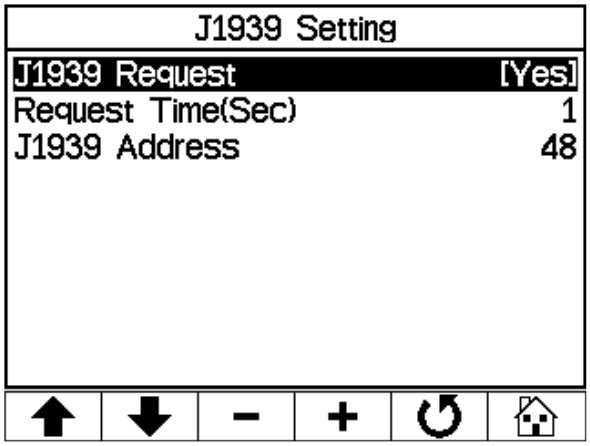
Return Gauge Display



DSP-52 Remote RS-485 Network

3.6.2.3 J1939 Setting

Not all J1939 parameters are automatically transmitted. Some parameters need to be requested by controller to the system, and submit a request packet message with a request address (J1939 address set 1 ~ 254). The system will then respond to the corresponding parameters. DSP-52 can also set whether to respond to the request or not, and set the time interval in between each request from 1 ~ 30 seconds.



J1939 Setting Page

Last Setting Item

Next Setting Item

Select Last Setting Option

Select Next Setting Option

Return to Last Function

Return Gauge Display

DSP-52 PGN Item Request：

0x00FE8C ： Auxiliary temperature (SPN441), Auxiliary pressure (SPN1387)

0x00FEDE：Engine air start pressure (SPN82)

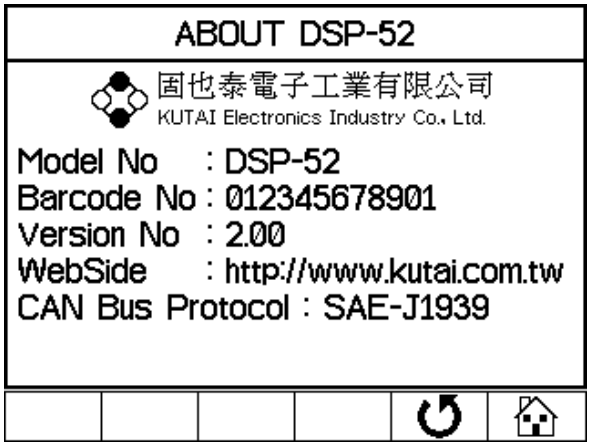
0x00FEE5 ： Engine total hours of operation (SPN247)

0x00FEE9：Engine trip fuel consumption (SPN182), Engine total fuel used (SPN250)

※ PGN : Parameter group number

3.6.2.4 About DSP-52

This page contains information of the manufacturer's and DSP-52 related information which includes, model name, bar code serial number, software version and CAN-Bus SAE-J1939 protocol.



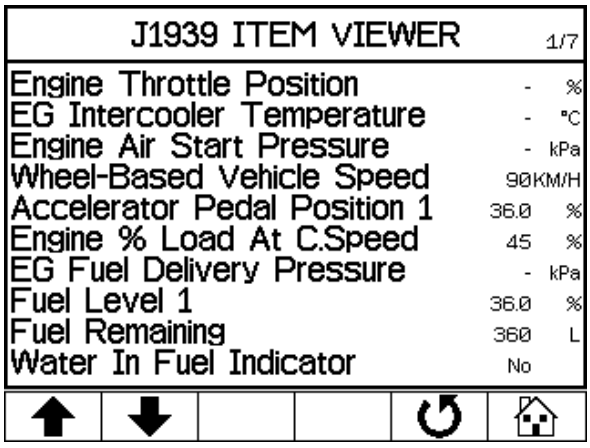
About DSP-52 Page

Return to Last Function

Return Gauge Display

3.6.3 J1939 Item Viewer

DSP-52 provides dozens of common parameters from the J1939 decoding library. User can view the complete list of parameters in this page.



J1939 Viewer Page

Last Page

Next Page

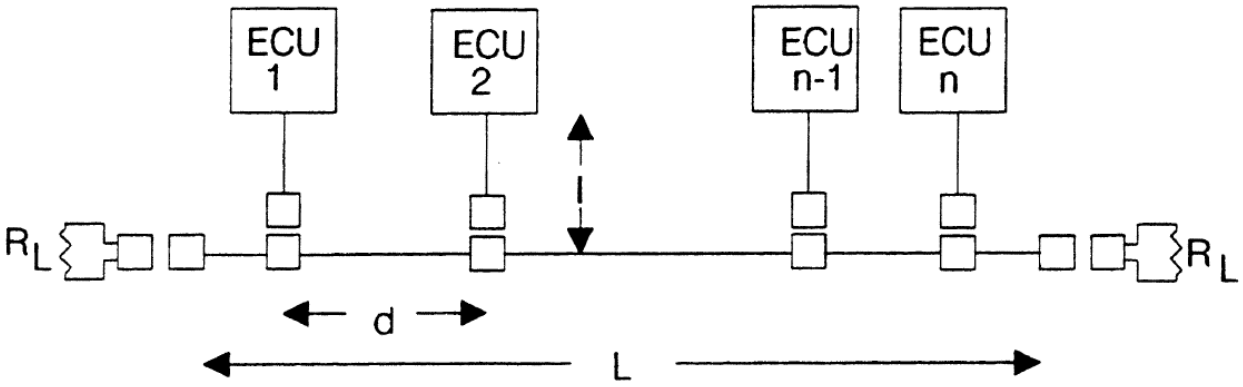
Return Last Function

Return Gauge Display

4. CHAPTER FOUR APPENDIX

4.1 J1939 Network Topology

SAE-J1939-11 protocol document defines the J1939 network topology and related provisions. For example from the following illustration, the number of ECU controller (n) is based and limited to the length of the main network. In a 40 meter network, the maximum number of nodes (ECUs) is 10 and if the network within 10 meters in length then maximum number of nodes (ECUs) is 30.



J1939 Network Topology

- Network to Node ECU Distance I：< 1m
- Node to Node ECU Distance d：0.1m ~ 40m
- Network Distance L：< 40m
- Terminating Resistor RL：Standard 120Ω, 110Ω ~ 130Ω (400mW)

4.2 DSP-52 Parameter Setting Table

NO	CONTENT	SETTING	DEFAULT
1	Speed unit	KM/H, MPH	KM/H
2	Distance unit	KM, MILES	KM
3	Pressure unit	KPA, PSI, BAR	KPA
4	Volume unit	LITRE, GAL	LITRE
5	Temperature unit	℃, ℉	℃
6	Language	English, Traditional Chinese	English
7	Beep	On, Off	On
8	Quad gauge adjust	Free, Lock	Free
9	Max engine speed	2000 ~ 9000 RPM	8000
10	Max vehicle speed	100 ~ 200	200
11	Graph time range	4, 8, 16, 32, 60 Mins, 2, 4, 8 Hours	32 Mins
12	Maintain service setting	0 (OFF) ~ 9999 Hours	OFF
13	Fuel capacity	0 ~ 10000 LITRE	1000 LITRE
14	LCD brightness	10 ~ 100 %	50%
15	RS-485 slave address setting	1 ~ 127	6

4.3 SPN Item Correspond Icon Table

ICON	ITEM NAME	ICON	ITEM NAME
	Engine speed		Accelerator pedal position
	Engine coolant temperature		Engine fuel rate
	Key switch battery potential		Engine total hours of operation
	Battery potential / power input		Wheel-based vehicle speed
	Engine intake manifold pressure		Trip distance
	Engine oil pressure		Total vehicle distance
	Engine intake manifold temperature		Fuel level
	Engine percent load at current speed		Distance remaining

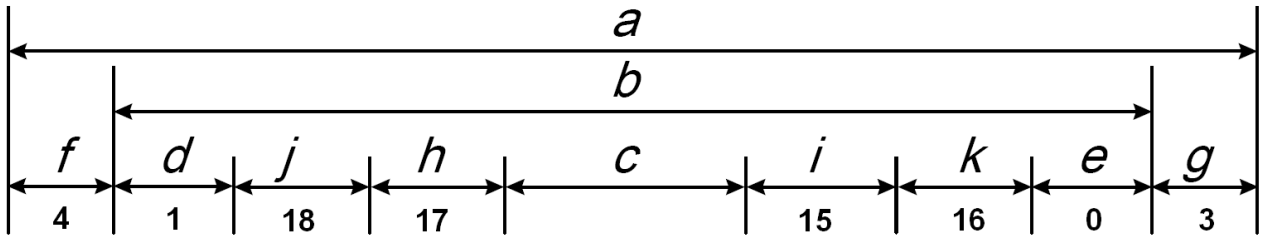
4.4 DSP-52 SPN Table

SPN	DESCRIPTION	SPN	DESCRIPTION
	Fuel remaining	157	Engine injector metering rail 1 pressure
	Distance remaining	158	Keys witch battery potential
	Service hours (machine hours)	161	Transmission input shaft speed
16	Engine fuel filter (suction side)	164	Engine injection control pressure
1382	Differential pressure	167	Charging system potential (voltage)
51	Engine throttle position	168	Battery potential / power input
52	Engine intercooler temperature	172	Engine air inlet temperature
82	Engine air start pressure	173	Engine exhaust gas temperature
84	Wheel-based vehicle speed	174	Engine fuel temperature
91	Accelerator pedal position	175	Engine oil temperature
92	Engine percent load at current speed	176	Engine turbocharger oil temperature
94	Engine fuel delivery pressure	177	Transmission oil temperature
96	Fuel level	182	Engine trip fuel
97	Water in fuel indicator	183	Engine fuel rate
98	Engine oil level	184	Engine instantaneous fuel economy
100	Engine oil pressure	185	Engine average fuel economy
102	Engine intake manifold pressure	190	Engine speed
103	Engine turbocharger speed	191	Transmission output shaft speed
105	Engine intake manifold temperature	244	Trip distance
106	Engine air inlet pressure	245	Total vehicle distance
107	Engine air filter differential pressure	247	Engine total hours of operation
108	Barometric pressure	250	Engine total fuel used
109	Engine coolant pressure	441	Auxiliary temperature 1
110	Engine coolant temperature	512	Driver's demand engine - percent torque
111	Engine coolant level	513	Actual engine - percent torque
114	14 net battery current	515	Engine's desired operating speed
115	Alternator current	517	Navigation - based vehicle speed
123	Clutch pressure	523	Transmission current gear
127	Transmission oil pressure	524	Transmission selected gear

SPN	DESCRIPTION	SPN	DESCRIPTION
573	Transmission torque converter lockup engaged	1172	Engine turbocharger compressor inlet temperature
975	Estimated percent fan speed	1240	Engine fuel leakage 2
1136	Engine ecu temperature	1349	Engine injector metering rail 2 pressure
1137	Engine exhaust gas Port 1 temperature	1387	Auxiliary pressure #1
1138	Engine exhaust gas Port 2 temperature		

4.5 J1939 FMI Descript

FMI (Failure Mode Indicator) - The FMI defines the type of failure detected in the subsystem identified by an SPN. Note that the failure may not be an electrical failure but may instead be a subsystem failure or condition needing to be reported to the service technician and maybe also to the operator. Conditions can include system events or status that need to be reported. The FMI, SPN, SPN Conversion Method and Occurrence Count fields combine to form a given diagnostic trouble code. The “Reserved to be Assigned by SAE” FMIs will be assigned by the SAE-J1939 Control and Communications Subcommittee if additional failure modes become necessary.



FMI Signal Ranges Diagram

4.5.1 FMI Region Descript Table

REGION	DESCRIPT
a	Total signal input range possible that can be seen by an electronic module.
b	Total signal range physically possible as defined by an application. The CARB (California air resources board) defined Rationality fault diagnostic condition is applicable anywhere in this region.
c	Range defined as normal for a given real world measurement.
d	Range defined as below normal, most severe level, of what is considered normal for the given real world measurement.
e	Range defined as above normal, most severe level, of what is considered normal for the given real world measurement.
f	Range which is low outside the range of what is considered physically possible for a given system, indicating a short to a low source has occurred.
g	Range which is high outside the range of what is considered physically possible for a given system, indicating a short to a high source has occurred.
h	Range defined as below normal, least severe level, of what is considered normal for a given real-world measurement.
i	Range defined as above normal, least severe level, of what is considered normal for a given real-world measurement.
j	Range defined as below normal, moderately severe level, of what is considered normal for a given real-world measurement.
k	Range defined as above normal, moderately severe level, of what is considered normal for a given real-world measurement.

4.5.2 FMI No Descript Table

FMI NO	REGION	FMI DESCRIPT
0	e	Data valid but above normal operational range
1	d	Data valid but below normal operational range
2		Data erratic, intermittent or incorrect
3	g	Voltage above normal or shorted high
4	f	Voltage below normal or shorted low
5		Current below normal or open circuit
6		Current above normal or grounded circuit
7		Mechanical system not responding properly
8		Abnormal frequency, pulse width or period
9		Abnormal update rate
10		Abnormal rate of change
11		Failure mode not identifiable
12		Bad intelligent device or component
13		Out of calibration
14		Special instructions
15	i	Data valid but above normal operational range (Least severe)
16	k	Data valid but above normal operational range (Moderately severe)
17	h	Data valid but below normal operational range (Least severe)
18	j	Data valid but below normal operational range (Moderately severe)
19		Received network data in error
20 ~ 30		Reserved for future assignment
31		Not available or condition exists