MAXIMA TECHNOLOGIES & SYSTEMS, INC.

MINI-MFD™ Multi-Function Display

Technical Manual

Table of Contents

Chapter 1

Scope and Use of This Manual

…provide the reader with enough background information to understand the overall operation of the Mini-MFD™…

The intent of this manual is to provide the reader with all of the information required to install and troubleshoot the Mini Multi Function Display, M-MFD, as well as to provide background information regarding the overall operation of a data-bus. Additional data-bus information not covered in this manual is available from the SAE.

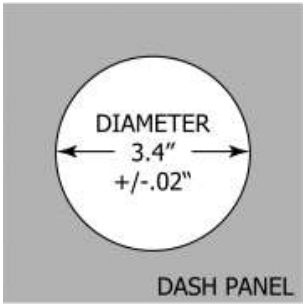
The user is expected to have a basic knowledge of the vehicle's electrical wiring, circuits, and schematics as well as operating parameters normally displayed on an instrument cluster, such as engine RPM, vehicle speed, engine temperature, transmission temperature, engine oil pressure, transmission oil pressure, etc.

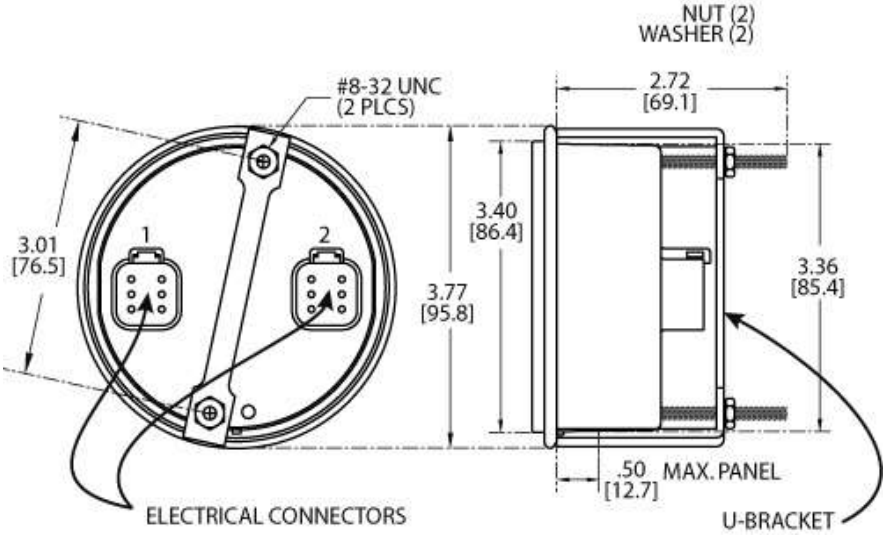
Chapter 2

Installation Instructions

Mini-MFD™

- Recommended panel hole size is 3.4" ± 0.02" or 86.4mm ±0.51mm.
- Insert the instrument in the panel and place the U-bracket over the mounting studs.
- Install one washer and one nut on each stud over the U-bracket.
- Tighten the nuts (4 to 6 in.-lb.) to secure the instrument.





Mini-MFD™ Wiring

Both connectors are used to make the electrical connections.

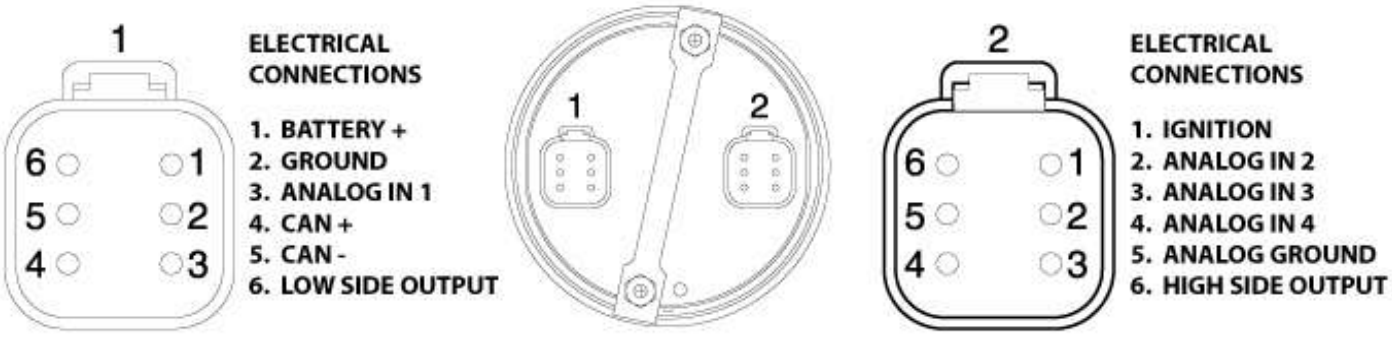
CONNECTOR 1

- Connect Pin (1) to the positive side of the battery through the ignition switch.
- Connect Pin (2) to vehicle ground.
- Connect Pin (3) to Analog input.
- Connect Pin (4) to data-bus + (J1939 ONLY).
- Connect Pin (5) to data-bus - (J1939 ONLY).
- Connect Pin (6) to resistive or inductive lead (low side output).

Per SAE-J1939 specification, the instrument does not contain a bus termination resistor. Data-bus termination is required for proper operation. Use a 120Ω ¼ Watt resistor between Bus+ and Bus- to terminate the data-bus. See data-bus termination section for additional information.

CONNECTOR 2

- Connect Pin (1) to the positive side of the battery through the ignition switch.
- Pin (2) to Analog input.
- Connect Pin (3) to Analog input.
- Connect Pin (4) to Analog input.
- Connect Pin (5) to Analog sender ground.
- Connect Pin (6) to resistive or inductive lead (high side output)



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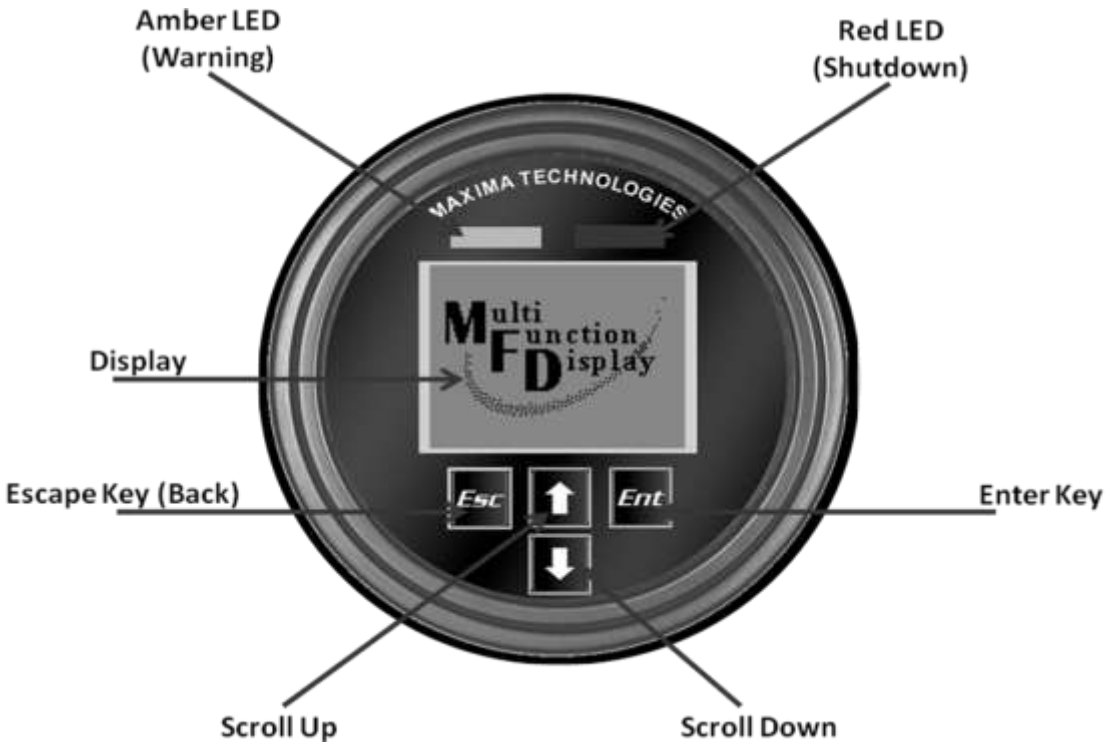
Chapter 3

Display Features

The image below is a detail of the Mini-MFD™ display features.



Chapter 4

Navigation & Keypad Functions

Ent	**Enter Key** – Select a menu or parameter
Esc	**Escape Key** – Exit a screen or go back
⬆	**Up Arrow** – Scroll up through screens or parameters
⬇	**Down Arrow** – Scroll down through screens or parameters

Basic Navigation

When **Enter** Ent is pressed, the main menu items are displayed.

Pressing the Arrow Keys  will move the menu selector to the other menu items.

Pressing the Enter Key  on the highlighted menu item will open up the particular menu page.

Pressing the **Arrow Keys**  will move the selection bar to other menu items.

When the desired item is highlighted by the selection bar, pressing **Enter**  will select that item and display the corresponding screen.

Chapter 5

Operation

The following is a guide for navigating the Mini-MFD™ main menu, and sub-menus after start-up:

When the display is powered on, the start-up screen appears.

1. The default primary parameter will be displayed in a 1-Up display format.

Display Setup

The screen can be configured to display a single engine parameter (1-Up Display), or two parameters at once (2-Up Display):

1. From the Main Menu use the Arrow Keys to select either the 1-Up or 2-Up display and press Enter.

Parameter Options

1. Configure Signals – This option allows for customized programming of which parameters are displayed.
2. Sort Signals – This option allows you to arrange the order in which the selected parameters will be displayed.
3. Load Defaults – This option contains a set of 10 engine parameters: Vehicle speed, Engine coolant temperature, Engine oil temperature, Engine oil level, Engine speed, Engine oil pressure, Engine average fuel economy, Fuel level, Charging system potential, and Actual engine torque.

Selecting Display Parameters

Configure Signals

1. From the Main Menu select the ***"Settings Menu"*** and press Enter, then select ***"Configure Signals"*** and press Enter.

2. From the "***Configure Signals"*** menu, select the option for ***"Select Signals"*** and press Enter. The list of parameter options is displayed.

3. Parameters that are currently being broadcasted on the CAN bus are identified by the " " to the left of the signal name.
4. To remove a parameter form the active display, select the parameter and press Enter.
5. To add a parameter to the active display, select the parameter and press Enter. Once the custom parameter selection has been completed press Escape to return to the Configure Signals menu.

Sort Signals

1. From the ***"Configure Signals"*** menu, select the option for ***"Sort Signals"*** and press Enter.

2. Using the Arrow Keys scroll through the current order of the parameters and press Enter to select the parameter you want to move. Once selected the parameter will be displayed in bold text.

3. Use the Arrow Keys to move the selected parameter to the desired spot in the parameter order and press Enter to complete the change.

Load Default Parameters

1. From the Configure Signals menu select the option for Load Defaults and press Enter.
2. Confirm the selection by using the Arrow Keys and press Enter.

Chapter 6

Setting Outputs & Inputs

Digital Outputs

The Mini-MFD™ has 2 digital outputs. One output is configured as Low side output and the other one as high side output. The current application allows to configure them for following the warning lamp (yellow) and the shutdown lamp (red).

1. From the Main Menu select the **"*Settings Menu*"** and press Enter, then select **"*Configure outputs*"** and press Enter.

2. From **"*Configure outputs*"** you can choice between ***"High Side"*** and ***"Low Side"***:

Once selected High side or Low side you can select what event turn on the output: None (output disabled), warning, stop and both events.

Chapter 7

Settings Menu

Adjust Contrast – Use the **Arrow Keys** to adjust the contrast and press **Enter** when finished.

Adjust Backlight – Use the **Arrow Keys** to select the backlight intensity and press **Enter**.

Languages – Use the **Arrow Keys** to select the language of preference and press **Enter**. English

Select Units – Use the **Arrow Keys** to select the unit of preference and press **Enter**.

Pop-up Settings – Display pop-up windows for fault codes. This option is enabled by default. Use the **Arrow Keys** to select whether you want to enable or disable them and press **Enter.**

Auto Scroll Mode – This is an optional setting that when enabled will automatically cycle through the active parameters pausing on each screen.

1. From the "***Settings Menu***" select the option for Auto Scroll Mode and press Enter.
2. Select Enabled or Disabled and press Enter.

Chapter 8

Diagnostics Menu

Active Fault Codes – Displays active fault codes reported.

Inactive Fault Codes – Display a log of inactive fault codes.

Cleat All Fault Codes – Clears all active and inactive fault codes.

System Information – The system information screen displays the hardware system serial number, current software version, and current system version. Read-only information is displayed in this menu, no changes can be made.

Faults and Warnings

The Mini-MFD™ provides two means for detecting faults and warnings: visual LEDs on the display case, and pop-up fault indicators on the display. See Appendix B for list of fault code information.

Visual Indication

- Amber LED (Warning)
- Red LED (Shutdown)

Pop-Up Indicators

1. When a fault is detected, a pop-up window will be displayed listing the current fault information.

2. The pop-up window will display the fault code description, the SPN (Suspect Parameter Number), and FMI number.
3. To acknowledge the fault, press the Enter key.
4. To view the active faults, select the Active Faults option from the Diagnostics Menu. Scroll through the active faults by using the Arrow Keys.

5. To view the inactive faults, select the Inactive Faults option from the Diagnostics Menu.

Appendix A

Mini-MFD™ J1939 Engine and Transmission Parameters:

Message	PGN	SPN	Signal
EECC1	F004	190	EngSpeed
EECC1	F004	513	Actual
HOURS	FEE5	247	EngTotalHoursOfOperation
LFC	FEE9	182	EngTripFuel
LFC	FEE9	250	EngTotalFuelUsed
ET1	FEEE	110	EngCoolantTemp
ET1	FEEE	174	TngFuelTemp1
ET1	FEEE	175	EngOilTemp1
ET1	FEEE	52	EngIntercoolerTemp
EF1_P1	FEEF	94	EngFuelDeliveryPress
EF1_P1	FEEF	98	EngOilLevel
EF1_P1	FEEF	100	EngOilPress
EF1_P1	FEEF	111	EngCoolantLevel
LFE	FEF2	183	EngFuelRate
LFE	FEF2	184	EngInstantaneusFuelEconomy
LFE	FEF2	185	EngAverageFuelEconomy
AMB	FEF5	108	BarometricPress
AMB	FEF5	172	EngAirInletTemp
IC1	FEF6	105	EngIntakeManifold1Temp
IC1	FEF6	107	EngAirFilter1DiffPress
IC1	FEF6	173	EngExhaustGasTemp
EFL_P2	FEDB	157	EngInjectorMeteringRail1Press
EFL_P2	FEDB	1349	EngInjectorMeteringRail2Press
FD	FEBD	975	EstPrecentFanSpeed
HPG	F008	1762	HydPress
ETC1	F002	191	TransOutputShaftSpeed
ETC1	F002	161	TransInputShaftSpeed
ETC8	F00C	3030	TransTorqueConverteRatio
ETC2	F005	524	TransSelectedGear
ETC2	F005	523	TransCurrentGear
TRF1	FEF8	127	TransOilPress
TRF1	FEF8	177	TransOilTemp
AA1	FE8C	441	AuxTemp1
AA1	FE8C	442	AuxPress1
CCVS	FEF1	84	Wheel_BasedVehicleSpeed
VEP1	FEF7	167	ChargingSystemPotential
VD	FEE0	244	TripDistance

VD	FEE0	245	TotalVehicleDistance
VF	FE68	1638	HydTemp
DD	FEFC	96	FuelLevel1
	61443	91	Accelerator pedal pos
	61443	92	Eng. percent load at current speed
	65270	81	Eng. Diesel filter intk press
	65271	168	Battery / power input
	65271	158	Keyswitch battery power
	65110	1761	Aftertreatment 1 SCR Catalyst Tank Level
	65110	3031	Aftertreatment 1 SCR Catalyst Tank Temperature
	64891	3719	Diesel Particulate Filter 1 Soot Load Percent
	61454	3216	Aftertreatment 1 Intake NOx
	61455	3226	Aftertreatment 1 Outlet NOx

Appendix B

All fault codes come from "Source Address 0" which is the engine ECM, or "Source Address 3" which is the Transmission ECM.

SPN	FMI	Signal
190	0-31*	EngSpeed
513	0-31*	Actual
247	0-31*	EngTotalHoursOfOperation
182	0-31*	EngTripFuel
250	0-31*	EngTotalFuelUsed
110	0-31*	EngCoolantTemp
174	0-31*	TngFuelTemp1
175	0-31*	EngOilTemp1
52	0-31*	EngIntercoolerTemp
94	0-31*	EngFuelDeliveryPress
98	0-31*	EngOilLevel
100	0-31*	EngOilPress
111	0-31*	EngCoolantLevel
183	0-31*	EngFuelRate
184	0-31*	EngInstantaneusFuelEconomy
185	0-31*	EngAverageFuelEconomy
108	0-31*	BarometricPress
172	0-31*	EngAirInletTemp
105	0-31*	EngIntakeManifold1Temp
107	0-31*	EngAirFilter1DiffPress
173	0-31*	EngExhaustGasTemp
157	0-31*	EngInjectorMeteringRail1Press

1349	0-31*	EngInjectorMeteringRail2Press
975	0-31*	EstPrecentFanSpeed
1762	0-31*	HydPress
191	0-31*	TransOutputShaftSpeed
161	0-31*	TransInputShaftSpeed
573	0-31*	TransTorqueConverteRatio
524	0-31*	TransSelectedGear
523	0-31*	TransCurrentGear
127	0-31*	TransOilPress
177	0-31*	TransOilTemp
441	0-31*	AuxTemp1
1387	0-31*	AuxPress1
84	0-31*	Wheel_BasedVehicleSpeed
167	0-31*	ChargingSystemPotential
244	0-31*	TripDistance
245	0-31*	TotalVehicleDistance
1638	0-31*	HydTemp
96	0-31*	FuelLevel1
91	0-31*	Accelerator pedal pos
92	0-31*	Eng. percent load at current speed
81	0-31*	Eng. Diesel filter intk press
168	0-31*	Battery / power input
1761	0-31*	Aftertreatment 1 SCR Catalyst Tank Level
3031	0-31*	Aftertreatment 1 SCR Catalyst Tank Temperature
3216	0-31*	Aftertreatment 1 Intake NOx
3226	0-31*	Aftertreatment 1 Outlet NOx
3719	0-31*	Diesel Particulate Filter 1 Soot Load Percent

FMI Description:

FMI	Description
0	Data above normal most
1	Data below normal most
2	Data erratic
3	Voltage above normal
4	Voltage below normal
5	Current below normal
6	Currnet above normal
7	Merch system not respond
8	Abnormal frequency
9	Abnormal update rate
10	Abnormal rate of change
11	Root cause unknown
12	Bad intellgent device

13	Out of calibration
14	Special instructions
15	Data above normal least
16	Data above normal moderate
17	Data below normal least
18	Data below normal moderate
19	Network data error
20	Data drifted hight
21	Data drifted low
22	Reserved
23	Reserved
24	Reserved
25	Reserved
26	Reserved
27	Reserved
28	Reserved
29	Reserved
30	Reserved
31	Condition exists

Appendix C

Current Mini-MFD™ analog inputs supported:

Analog input	Type	Signal
0	Voltage	Battery voltage (Internal input)
1	Voltage	Intellisensor 1-4v
2	Resistor	Fuel sensor 240-33 Ohms
3	Resistor	Fuel sensor 180-10 Ohms
4	Resistor	Fuel sensor 90-0 Ohms.

Chapter 9

Understanding Data-Bus Operation

… data-bus is like an information super-highway in the vehicle…

Data-Bus Basics

While this information applies to many types of data-busses, the Mini-MFD operates exclusively over the SAE J1939 data-bus.

The data-bus is like an information super-highway in the vehicle. A data-bus allows various controllers, such as the engine controller, transmission controller, chassis controller, etc. to communicate with each other and any other components connected to the data-bus.

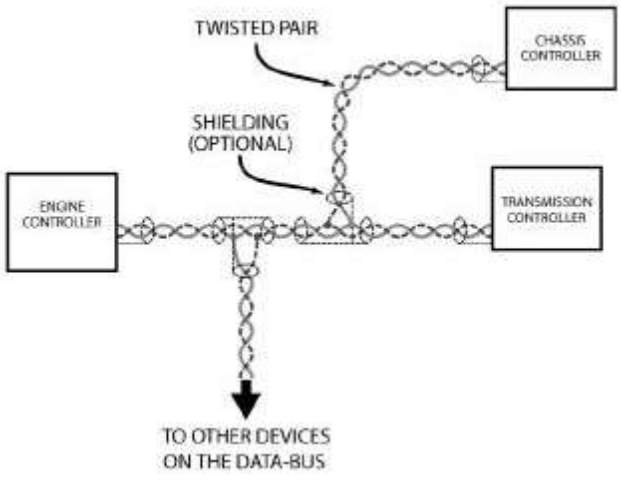
Most new diesel engines are controlled by an Electronic Control Module (ECM) that uses information from various sensors to adjust operating parameters, such as fuel injection, to optimize power, increase fuel economy, and lower emissions. The data-bus enables the ECM to send/receive vast amounts of information to/from the transmission computer or any other computer connected to the data-bus, greatly simplifying the vehicle's electrical system.

The data-bus contains most operating information about the vehicle, such as engine and vehicle speed, coolant and oil temperatures, oil and fuel pressures, as well as error codes from the various controllers.

Data-Bus Hardware

The physical aspects of the data-bus are quite simple. It's nothing more than a pair of wires twisted together, commonly referred to as a twisted pair, running from one controller to another.

SAMPLE DATA-BUS ILLUSTRATION



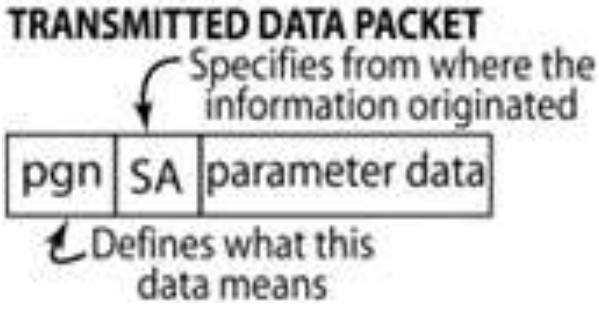
Data-Bus Communication Protocol Basics

SAE J1939 data-bus devices transmit data to and/or receive data from the bus. Data is broken down into a structured format, designated specifically by the SAE standard, containing a Source Address (SA), a Parameter Group Number (PGN), and parameter data.

The source address is the number at the beginning of the data packet that identifies where the data was transmitted from. For example, SA 0 indicates that the data packet was transmitted from the primary engine controller.

The parameter group number is the identification label for the group of data that follows the PGN. This defines what type of information the parameter data will be (e.g. engine oil pressure values).

The parameter data is a group of data bytes that contain the specific values of the particular PGNs parameters (e.g. engine oil pressure). When a device *listening* to the data-bus *hears* the appropriate SA and PGN, it then reads the desired data to complete the data transmission.



Data-Bus Termination

The SAE specification for the J1939 data-bus requires data-bus termination. The J1708/1587 data-bus does not require termination. Termination is required to attenuate any electrical noise developed by the high-speed data transfer. If the termination resistors are not present, loss of data-bus communication may occur.

Termination simply means installing two 120Ω ½-Watt resistors between positive bus wire and negative bus wire at each end of the data-bus backbone. If the installation involves connecting to an existing data-bus, termination should already exist and no additional termination is required. The SAE specification forbids the use of internal data-bus termination, because the data-bus must remain intact if any device is removed. If a specific module terminated the data-bus and that module was removed, then the data-bus could cease to operate.

The data-bus shield must also be terminated properly. Using a wire, the shield should be connected to ground as close as possible to the battery ground. This termination connection to ground can be anywhere along the data-bus, but it must only be connected at **ONE** point. The shield should also connect to the shield pin of all data-bus devices (**NOT GROUND**).

Per the SAE J1939 specification, bus shielding is optional and may not be found on all systems.