



Digiac Auto Electronics
Panel Trainer
User Manual

ME690/E

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Introduction

The DIGIAC Auto Electronics Panel Trainer system is a flexible training system designed to teach topics in Automotive Electrical and Electronic Engineering. The student will follow self-paced **learning materials** (either computer-delivered or paper-based) containing essential theory and practical exercises covering the main topics of study.

The Panel Trainer contains circuit components needed to carry out practical exercises given in the corresponding laboratory manual. The components are arranged so that they can be interconnected using 4 mm shrouded leads to form an electrical circuit. Clear circuit layouts and test points are screen printed onto the front panel.

The Panel Trainer is arranged with a number of switched faults. The faults are switched in by special relays in the Panel Trainer, which may be operated manually by means of a rotary switch located inside a lockable door on the right hand side panel. Alternatively, when the Panel Trainer is used in a computer managed laboratory, the fault relays may be operated automatically by the student's PC (personal computer) workstation.

A Panel Trainer and its accompanying learning materials form a **study module**.

The operation of the Panel Trainer is explained, in detail, in the following pages of this user manual.

Panel Trainer

The Panel trainer contains the following components:

- Electrical circuit board
- Internal power supply
- Function switch under a lockable door.

Electrical circuit board

The circuit board contains the electrical and electronic components required in the laboratory manual experiments. It also contains fifteen relay switches, which are capable of switching fifteen different faults into the Panel Trainer. As mentioned in the Introduction, these faults may either be switched in automatically by a computer managed PC workstation, or inserted manually by the instructor.

Internal power supply

The internal power supply is capable of delivering power to meet the internal requirements of the Panel Trainer.

Function Switch

A sixteen-way hexadecimal-coded rotary switch for setting fault numbers, and a slide switch to enable/disable faults, are concealed by a lockable door. These may be used by the instructor to manually operate any one of the fifteen relay switches on the electrical circuit board, in order to insert a fault into the Panel Trainer.

AC Power Connection

Power Requirements

The Panel Trainer is designed to operate using either:

- **220/240 V, 50/ 60 Hz AC**

or:

- **110/ 120 V, 50/ 60 Hz AC**

Please read the **ratings label** located on the right hand side panel, next to the AC power socket to determine the requirements for your Panel Trainer.

Below the AC power socket is a fuse compartment. For 220/240 V use, the fuse must be a **20 mm, 1 A anti-surge type**, for 110/ 120 V use, the fuse must be a **20 mm, 2 A anti-surge type**.

Important Note:

This equipment must be grounded. Ensure that the Panel Trainer power cord is plugged into an AC outlet that has a ground (earth) connection (3 pin outlet).

Connecting AC Power

The IEC power cord is connected to an IEC (AC power) socket located on the right hand side panel of the Panel Trainer. The AC power socket contains an integral fuse compartment. To the left of the socket is the AC power switch.

- Plug the power cord into the **AC power socket** located on the right hand side panel of the Panel Trainer. Connect the other end of the power cord to an AC outlet.
- Operate the AC **ON/OFF** rocker switch located to the left of the AC power socket on the right hand side panel.
- Switch **ON** the **Power Supplies** switch on the front panel. The lamp next to it should now be illuminated.

If the **Power Supplies** lamp does not light, inform your instructor. It is possible that there is no AC power to the Panel Trainer, the fuse has 'blown', or that there is a fault with the unit.

Please note that all power supplies are protected from damage caused by short circuit conditions.

Switched Fault Selection

Faults can be inserted in two ways:

- **Automatically, using a computer managed PC workstation**
- **Manually, via an internal rotary switch**

Automatic Fault Selection

Faults may be inserted automatically, via a computer managed PC workstation, at appropriate places throughout LJ learning materials, usually in fault-finding activities.

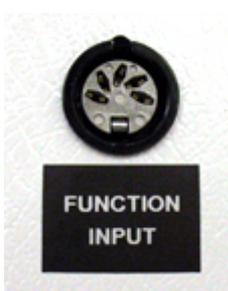
The computer managed PC workstation can be any personal computer that has been installed with computer managed student PC workstation software, and is operating in a computer managed environment.

For further information on setting up a computer managed PC workstation, please refer to the ClassAct ST520 Laboratory Management Instructor's Guide. The ClassAct ST520 Student Tutorial will guide the student through the operation and use of a computer managed PC workstation.

Once the computer managed PC workstation has been correctly set up to allow access to the required learning materials, the final steps are to connect the PC workstation to the Panel Trainer using the communication cable provided, and (if necessary) configure the PC to switch in faults using this cable.

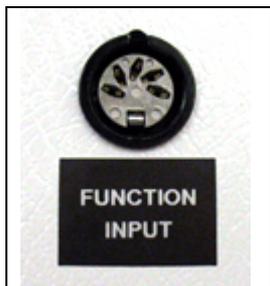
Before connecting the communication cable, use the following pictures to identify the type of Function Input connector on the side of your Panel Trainer:

DIN connector



USB connector





DIN connector

If the Function Input on your Panel Trainer uses a DIN connector, you will have been supplied with one of the following cable types:



Parallel fault switching cable

Connect this cable between the parallel (printer) port on the PC and the DIN connector on the Panel Trainer.

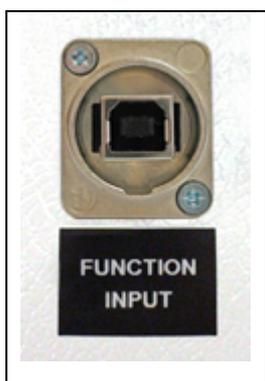
The PC workstation will automatically communicate via the parallel port, so no additional setup is required.



USB fault switching cable

Connect this cable between the USB port on the PC and the DIN connector on the Panel Trainer.

To set up the PC workstation to use the USB fault switching cable, insert the supplied USB Communication Software installation disk and choose the *USB Fault Switching Adapter* option.



USB connector

If the Function Input on your Panel Trainer uses a USB connector, you will have been supplied with a standard USB cable. Connect this cable between the USB port on the PC and the connector on the Panel Trainer.

To set up the PC workstation to switch in faults via the Panel Trainer USB connector, insert the supplied USB Communication Software installation disk and choose the *Applications Hardware with USB Interface* option.

Manual Fault Selection

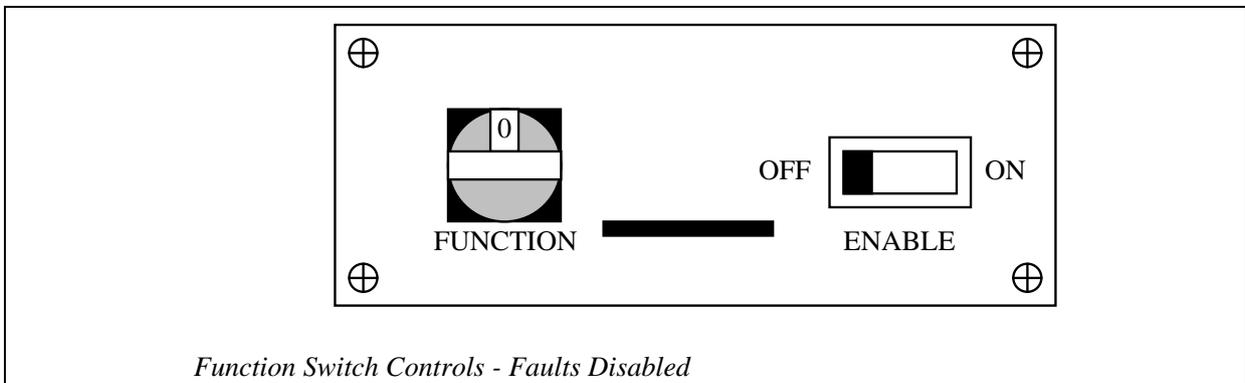
Two switches are located under a lockable door on the right hand side of the Panel Trainer. Fault switching can be performed manually by following the procedure described below.

Unlocking the Door

Insert the key in the lock. Turn the key counter-clockwise about 1/4 of a turn, the door will now open.

Selecting a Fault

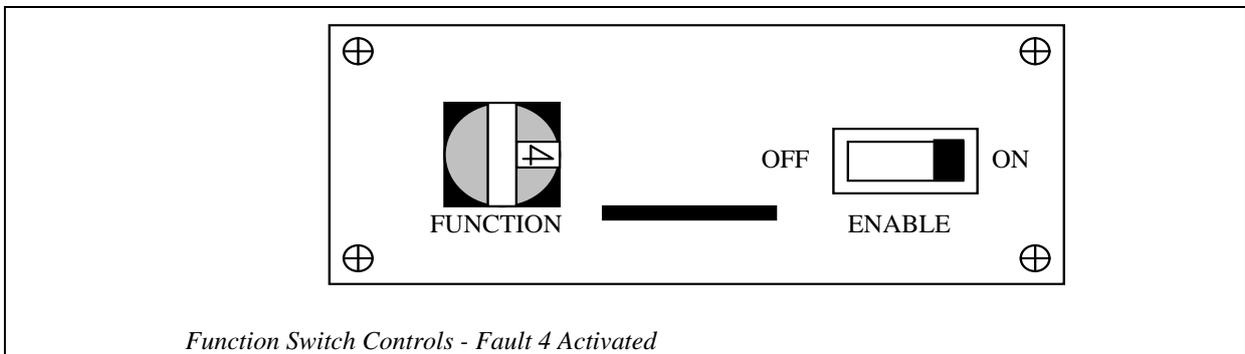
Unlocking the door will reveal two controls: a 16-way rotary switch and a two-way slide switch as shown below:



Ensure that the **ENABLE** switch is **OFF**.

Turn the **FUNCTION** switch knob until the desired fault number is displayed in the small window. The switch is numbered clockwise from **0** to **9** then **A** to **F**.

Switch **ENABLE** to **ON**. The selected fault will now be activated. You may hear a relay click inside the Panel Trainer. The diagram below shows fault 4 selected and activated.



As long as AC power is applied, the selected fault will remain activated irrespective of the position of the **Power Supplies** switch.

Locking the Door

Insert the key in the lock. Turn the key counter-clockwise for about 1/4 of a turn. Shut the door. Turn the key clockwise for about 1/4 of a turn, the door will now be shut.

Disabling the Fault

Unlock the door.

Switch **ENABLE** to **OFF**.

Replace the door.

Note:

No harm will be done if you rotate the **FUNCTION** switch while the **ENABLE** switch is **ON**. However, to maximize relay life it is recommended that you follow the correct procedure and disable while making your selection.

Laboratory Manual Worksheets

If the student is using a laboratory manual at a workstation that is *not* computer managed, then as soon as they start a fault-finding activity (also known as a **Worksheet**), they will need to ask the instructor to enable the relevant fault.

Worksheet Fault Selection

A table relating fault-finding worksheets to fault relay numbers will be found in the instructor's **Solutions Book** for the laboratory manual that the student is using.

An example is shown below:

Chapter	Section	Question No	Answer
12 Worksheet Section Motor Circuit	Worksheet 1	Fault 4	(Removed)
	Worksheet 2	Fault 9	
	Worksheet 3	Q1	Y
	Worksheet 4	Fault C	
	Worksheet 5	Fault 5	
	Worksheet 6	Fault 8	

If we look at the above table it can be seen that Fault 4 needs to be set for Worksheet 1, Fault 9 for Worksheet 2, etc.

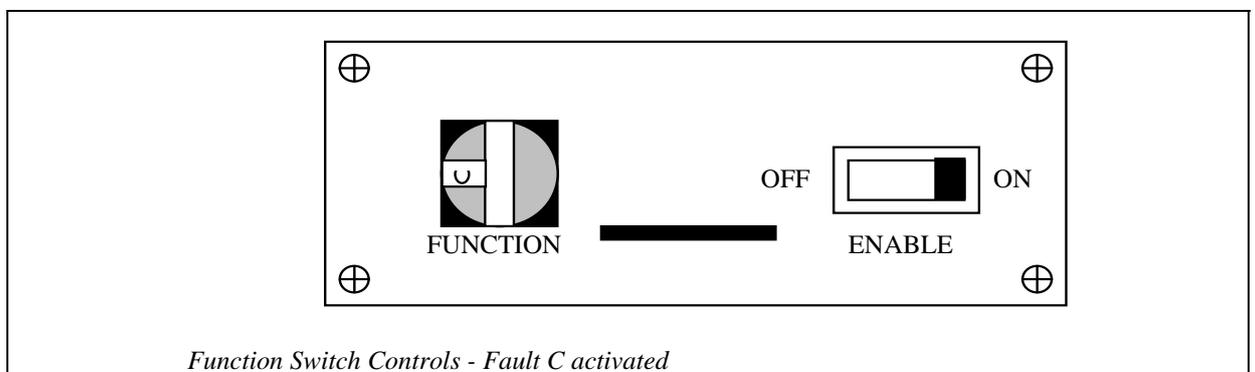
Sometimes a worksheet may not contain a fault setting (as with Worksheet 3 above). This will be the case if the worksheet requires the student to build a circuit and then confirm that it is working correctly.

Worksheet Fault Selection Example:

Let us assume that **Worksheet 4** is to be attempted.

Referring to the table, **Worksheet 4** requires **Fault C** to be enabled.

- Open the side door.
- Ensure the ENABLE switch is OFF.
- Turn the FUNCTION switch knob until a small letter C appears in the window.
- Turn the ENABLE switch ON. The switches should appear as shown:



- Lock the door and let the student commence work.

Disabling the Fault

As soon as the worksheet has been completed, the student will need to ask the instructor to remove the fault or perhaps insert a different one.

- Open the side door.
- Ensure the ENABLE switch is OFF.
- If another worksheet is to be attempted, enable the correct fault using the procedure outlined above.
- Lock the door.

Panel Trainer Fault Descriptions

Panel Trainer PT7.1 – Automotive Electrics

HEX Switch Position	Fault Symptoms	Fault Description
0	Not used.	
1	No main beam headlamps, when selected.	Open circuit wiring between Beam (SW3) and Flash (SW4) switches and main headlamps (between sockets 9.12/9.15 and 9.20).
2	Brake and reverse lights both on at the same time.	Direct wiring short between LHS reverse lamp and RHS brake lamp (between sockets 2.5/2.7 and 8.1/8.3).
3	Horn permanently on.	Horn Switch (SW7) short circuit between sockets 9.32/9.35 and 9.33.
4	No LHS dip headlamp, when selected.	Open circuit wiring to LHS dip headlamp, between sockets 1.7 and 7.1 and 9.17.
5	No RHS indicators, when selected.	Open circuit wiring between Turn Switch (SW5) and RHS indicator lamps (between sockets 9.34 and 7.7/8.7).
6	All indicators permanently on.	Flasher contacts short circuit, between socket 10.8 and Battery and Fuse Circuit #5 B+ (socket 5.3).
7	Dip headlamps permanently on.	Headlamp Switch (SW2) short circuit. Battery and Fuse Circuit #5 B+ (socket 5.3) shorted to sockets 9.8 and 9.11.
8	Main beam will not flash when selected.	Open circuit wiring from Battery and Fuse Circuit #5 B+ (socket 5.3) to Flash Switch (SW4), socket 9.16.
9	Starter motor does not operate, solenoid does.	Open circuit motor winding, between sockets 6.2/6.3 and ground.
A	Starter motor permanently engaged, solenoid stuck.	Solenoid contact short circuit, between sockets 6.2 and 6.6/9.42.
B	Starter solenoid trips fuse protection when operated.	Resistance of solenoid is too low, 10 ohms switched in, instead of normal 50 ohms, between ground and socket 6.6.
C	Lights are dim etc.	Low/flat battery voltage (390 ohms resistor in series with 12 volt supply to any load).
D	No RHS dip headlamp, when selected.	Open circuit wiring between RHS dip lamp and ground (between sockets 9.17/7.1/1.7 and 7.3/7.4).
E	Horn does not work.	Open circuit wiring between Circuit #4 Relay socket 4.3 and Circuit #3 Horn socket 3.1.
F	Not used.	

Panel Trainer PT7.2 - Ignition Systems

HEX Switch Position	Fault Symptoms	Fault Description
0	Not used.	
1	Spark Plugs 1 and 3 do not flash, when PT7.2 configured as electronic ignition (using ICM).	TR1 coil driver in Circuit #5 has open circuit base terminal (from socket 5.3 to transistor).
2	Spark Plugs 2 and 4 do not flash, when PT7.2 configured as electronic ignition (using ICM).	TR2 coil driver in Circuit #5 has short circuit emitter and collector terminals (short between sockets 5.7 and 5.8).
3	The pulses at socket 7.3 reduce in amplitude and double in frequency, when PT7.2 configured as electronic ignition (using ICM).	ICM in Circuit #7 has short circuit output terminals (short between sockets 7.4 and 7.6).
4	Not used.	
5	No output from alternator stator (output waveforms at sockets 8.3, 8.11 and 8.12 disappeared).	Circuit #8, three-phase alternator rotor winding has failed open circuit, between sockets 8.7 and 8.13.
6	No output from camshaft sensor.	Circuit #6, CID sensor has failed short circuit, to ground, between sockets 6.1 and 6.3.
7	The pulse width at socket 7.3 should vary slightly, when PT7.2 configured as electronic ignition (using the ICM).	Switches a relay in the timing Circuit #7 to affect the dwell period, but not officially used with Lab Manuals or On-screen Material.
8	Alternator stator output low (output waveform at socket 8.3 reduced in amplitude).	Circuit #8, three-phase alternator stator winding L5 has failed open circuit, between sockets 8.3 and 8.8.
9	Alternator rectifier output low, one of three waveform peaks missing, because of failed diode.	Circuit #8, three-phase alternator rectifier diode has failed open circuit, between sockets 8.21 and 8.14/8.24.
A	No output from crankshaft sensor.	Circuit #6, PIP sensor has failed short circuit, to ground, between sockets 6.2 and 6.4.
B	Alternator stator output low (output waveform at socket 8.12 disappeared).	Circuit #8, three phase alternator stator winding L7 has failed short circuit, between sockets 8.12 and 8.8.
C	All spark plugs do not flash, when wired into an ignition circuit, e.g. when PT7.2 configured as contact breaker ignition system.	Coil T1 in Circuit #4 has failed, open circuit secondary winding, between sockets 4.4 and 4.5.

Panel Trainer PT7.2 - Ignition Systems *Continued* ...

HEX Switch Position	Fault Symptoms	Fault Description
D	Faulty contact breakers.	Contact breaker in Circuit #3 has high resistance (100 ohms when closed, between sockets 3.6 and 3.12).
E	Spark Plug PL2 will not flash/is dimmer, when wired into an ignition circuit, e.g. when PT7.2 configured as contact breaker ignition system.	HT lead 2 in Circuit #2 has high resistance (52 kilohms, between sockets 2.3 and 2.9). The pulse at socket 2.3 is shorter by about 30%.
F	Spark Plug PL1 will not flash, when wired into an ignition circuit, e.g. when PT7.2 configured as contact breaker ignition system.	PL1 in Circuit #2 is short circuit, between socket 2.2 and ground.

Panel Trainer PT7.3 - Engine Management

HEX Switch Position	Fault Symptoms	Fault Description
0	Not used.	
1	Engine RPM changes. Coolant temperature indicator drops to one LED. Diagnostic display M/F lamp on (engine coolant temperature sensor voltage too high, code 23).	Open circuit thermistor, on its ground side, (5 volts at socket 1.37, REAL/SIM switch set to REAL).
2	Diagnostic display M/F lamp on. Engine has to run for a short period, before fault is indicated (knock sensor fault, code 56).	Short circuit knock sensor, between socket 1.36 and ground.
3	Diagnostic display M/F lamp on. Engine has to run for a short period, before fault is indicated (oxygen sensor fault – lean mixture, code 38).	Voltage measured at socket 1.3 is low (low resistance), indicating more oxygen in the exhaust gas.
4	Diagnostic display M/F lamp on. Engine has to run for a short period, before fault is indicated (oxygen sensor fault, code 28).	Open circuit oxygen sensor, between socket 1.3 and ground (no voltage if switch at socket 1.3 set to LHS, otherwise 5V).
5	Engine will not idle, may run rough, stalls before you can notice any difference as throttle is decreased. Diagnostic display M/F lamp on (power drop from cylinder 1, code 61).	High resistance primary coil winding (COIL 1/4), between sockets B+ and 1.10.
6	Engine will not start. Diagnostic display M/F lamp flashes, code 21 (turn ignition switch to start to repeat code flash).	Crankshaft sensor short circuit to ground, at socket 1.2.
7	Diagnostic display M/F lamp on (PIP/SPOUT signals out of phase, code 58).	No SPOUT signal at socket 1.9, because of short circuit to ground.

Panel Trainer PT7.3 - Engine Management *Continued* ...

HEX Switch Position	Fault Symptoms	Fault Description
7	Diagnostic display M/F lamp on (PIP/SPOUT signals out of phase, code 58).	No SPOUT signal at socket 1.9, because of short circuit to ground.
8	Diagnostic display M/F lamp on (purge canister valve fault, code 73).	Open circuit purge canister coil, between sockets B+ and 1.5/1.8.
9	Engine will not idle, runs rough. Diagnostic display M/F lamp on (power drop from cylinder 1, code 61).	Open circuit fuel injector wiring (INJ 1/4), between socket B+ and 1.26/1.30.
A	Engine has rough idle. Only works when engine is idling. Diagnostic display M/F lamp on (IAC valve fault, code 48).	IAC valve not energised, 12 volts on both sides of valve as sockets 1.23/1.24 are shorted to supply (when switch near socket 1.24 is to the RHS).
B	Engine has rough idle. Only works when engine has low revs. Diagnostic display M/F lamp on (EGR valve fault, code 48).	EGR valve and IAC valve wiring shorted between sockets 1.23/1.24 and 1.22/1.27 (when switches near sockets 1.24 and 1.27 are to the RHS).
C	Engine speed doesn't changes (fixed). Diagnostic display M/F lamp on (throttle pot voltage too high, code 25).	Throttle pot doesn't work, wiper is open circuit at socket 1.35.
D	Engine will not start. Diagnostic display M/F lamp flashes code 52 (fault not seen if engine is already running).	Neutral switch doesn't work, shorted to ground at socket 1.41.
E	Brake switch does not work (diagnostic display M/F lamp does not illuminate).	Brake switch is faulty, open circuit to ground at socket 1.40.
F	Not used.	

Panel Trainer PT7.4 - Vehicle Displays and Accessories *Continued* ...

HEX Switch Position	Fault Symptoms	Fault Description
0	Not used.	
1	RHS seat switch has failed. No seat belt warning when RHS belt switch open (voice warning / seat belt lamp on).	Open circuit wiring, between sockets 1.2 and 1.8.
2	Not used.	
3	LHS seat belt switch is faulty. Permanent seat belt warning (voice warning / seat belt lamp on).	LHS seat belt switch has failed, short circuit to ground, at socket 1.1.
4	High coolant temp. Voice warning on. SERV lamp on.	Coolant temp sensor has failed open circuit, between socket 1.16 and ground.
5	Vehicle speed is not displayed. Speed slider does not work.	Open circuit between socket 1.23 and ground.
6	Air bag lamp on. Vehicle will not start. Voice warning on. SERV / STOP lamps on.	Left and right impact sensors and safing sensor shorted, between sockets 1.15, 1.17 and 1.20.
7	Car mimic (VDO) shows both doors open, when only one door switch is operated.	Door switches are shorted together, between sockets 1.10 and 1.11.
9	Interior lamp does not work when door is opened.	Open circuit interior lamp, between socket 1.7 and ground.
A	Low coolant temp (no LED's). Voice warning on. SERV lamp on.	Coolant temp sensor has failed short circuit, between socket 1.16 and ground.
B	No voltage at red socket 2.6 (battery+ fuse has blown).	Open circuit between 12V supply and socket 2.6.
C	LHS main headlamp not working. Voice warning on. SERV lamp on.	Open circuit LHS main lamp, between socket 1.3 and ground.

Panel Trainer PT7.4 - Vehicle Displays and Accessories *Continued* ...

HEX Switch Position	Fault Symptoms	Fault Description
D	Windscreen wipers will not autopark.	Open circuit between autopark microswitch and wiper switch.
E	Fuel level pot does not work. Fuel level display stuck on red LED.	Wiper of fuel level pot is open circuit, therefore pot value fixed to 10 kilohms, between socket 1.3 and ground.
F	Windscreen wipers will not function.	Open circuit supply to wiper switch.

Panel Trainer PT7.5 - Air Conditioning Systems

HEX Switch Position	Fault Symptoms	Fault Description
0	Not used.	
1	Blower fan only operates in one blower switch position (fast, fully clockwise).	Open circuit between the Blower Resistor Assembly and ground, thermal limiter operated? (fast position works because resistors are not used in this position).
2	Connect a long lead between sockets 1.1 and 1.18. Connect another lead between sockets 1.2 and 1.17. The pressure gauges should change in an erratic manner.	Simulates water in the refrigerant.
3	Blower fan operates at the same speed for blower switch positions 3 and 4.	Last resistor and thermal limiter in the Blower Resistor Assembly Circuit shorted to ground.
4	No blower fan operation.	Fan motor fuse open circuit, therefore no supply voltage at socket 1.6 and associated fan sockets 1.7, 1.9, 1.10 and 1.11.
5	No compressor operation (A/C Heater Function Selector switch set to MAX A/C).	Clutch cycling pressure fuse open circuit, therefore no supply voltage at socket 1.13 and associated clutch sockets 1.14 and 1.15.
6	Compressor runs continuously (A/C Heater Function Selector switch set to MAX A/C).	Simulates constant voltage across A/C clutch, i.e. pressure switch constantly closed (can't be measured using DMM set to resistance).
7	Compressor cycling time has changed (A/C Heater Function Selector switch set to MAX A/C).	Compressor on for a shorter time (20 seconds, instead of 55 seconds).
8	A/C Heater Function Selector switch does not work correctly.	Operation of the A/C Heater Function Selector switch does not change LED's on the ventilation mimic (ignition on).
9	Panel/Defrost Door LED's do not change when A/C Heater Function Selector switch operated.	This fault simulates a faulty panel defrost vacuum motor.
A	Air to Floor Outlets LED's do not change when A/C Heater Function Selector switch operated.	Defective floor/panel door, stuck in the floor position.

Panel Trainer PT7.5 - Air Conditioning Systems *Continued ...*

HEX Switch Position	Fault Symptoms	Fault Description
B	Temperature blend door LED's stuck in the COOL position.	Mechanical fault, simulating a broken temperature control cable, between the cool/warm switch and the blend door.
C	Leak detector pitch increases slightly when lead from socket 1.5 is plugged into socket 1.1 (pitch unchanged with the other sockets).	Simulates refrigerant leak.
D	Leak detector pitch increases considerably when lead from socket 1.5 is plugged into socket 1.4 (pitch unchanged with the other sockets).	Simulates refrigerant leak.
E	Leak detector pitch increases when lead from socket 1.5 is plugged into socket 1.2 or 1.3 (pitch unchanged with the other sockets).	Simulates refrigerant leak.
F	Connect a long lead between sockets 1.1 and 1.18. Connect another lead between sockets 1.2 and 1.17. The pressure gauges readings will be wrong or change.	Simulates condenser restriction.

Panel Trainer PT7.6 - Heavy Vehicle (Diesel) Wiring

(Note: Some faults on this Panel Trainer are dual function)

HEX Switch Position	Fault Symptoms	Fault Description
0	Not used.	
1	No main beam headlamps, when selected.	Open circuit wiring between Beam (SW3) and Flash (SW4) switches and main headlamps (between sockets 9.12/9.15 and 9.20).
1	Alternator rectifier output low, one of three waveform peaks missing, because of failed diode.	Three-phase alternator rectifier diode has failed open circuit, between socket 13.13 and diode D16.
2	Brake and reverse lights both on at the same time.	Direct wiring short between LHS reverse lamp and RHS brake lamp (between sockets 2.5/2.7 and 8.1/8.3).
3	Horn permanently on.	Horn Switch (SW7) short circuit between sockets 9.32/9.35 and 9.33.
4	No LHS dip headlamp, when selected.	Open circuit wiring to LHS dip headlamp, between sockets 1.7 and 7.1 and 9.17.
4	No output from alternator stator.	Three-phase alternator rotor winding has failed open circuit, between sockets 13.2 and 13.5.
5	No RHS indicators, when selected.	Open circuit wiring between Turn Switch (SW5) and RHS indicator lamps (between sockets 9.34 and 7.7/8.7).
5	Windscreen wipers will not autopark.	Open circuit between autopark microswitch and wiper switch (between sockets 14.1 and 14.8).
6	All indicators permanently on.	Flasher contacts short circuit between socket 10.8 and Battery and Fuse Circuit #5 B+ (socket 5.3).
6	Windscreen wipers will not function.	Open circuit supply to wiper switch, between sockets 9.44 and 14.4.
7	Dip headlamps permanently on.	Headlamp Switch (SW2) short circuit. Battery and Fuse Circuit #5 B+ (socket 5.3) shorted to sockets 9.8 and 9.11.
8	Main beam will not flash when selected.	Open circuit wiring from Battery and Fuse Circuit #5 B+ (socket 5.3) to Flash Switch (SW3), socket 9.16.
8	Courtesy lamp not illuminated when door is opened.	Open circuit between sockets 12.17 and 12.19.
9	Starter motor does not operate, solenoid does.	Open circuit motor winding, between sockets 6.2/6.3 and ground.

Panel Trainer PT7.6 - Heavy Vehicle (Diesel) Wiring *Continued* ...

(Note: Some faults on this Panel Trainer are dual function)

HEX Switch Position	Fault Symptoms	Fault Description
A	Starter motor permanently engaged, solenoid stuck.	Solenoid contact short circuit, between sockets 6.2 and 6.6/9.42.
B	Starter solenoid trips fuse protection when operated.	Resistance of solenoid is too low, 10 ohms switched in, instead of normal 50 ohms, between ground and socket 6.6.
C	Lights are dim etc.	Low/flat battery voltage (390 ohms resistor in series with 12 volt supply to any load).
D	No RHS dip headlamp, when selected.	Open circuit wiring between RHS dip lamp and ground (between sockets 9.17/7.1/1.7 and 7.3/7.4.
D	Glow plug 6 does not function.	Glow plug has failed low resistance, between sockets 11.24 and 11.30.
E	Horn does not work.	Open circuit wiring between Circuit #4 Relay socket 4.3 and Circuit #3 Horn socket 3.1.
E	Glow plug 1 does not function.	Glow plug has failed open circuit, between sockets 11.29 and 11.30.
F	All glow plugs do not function.	Glow plug relay contact open circuit, between sockets 11.5 and 11.10.

Panel Trainer PT7.7 - Diesel Engine Management

Position:		Fault:	
Bank Switch	HEX Switch	Symptoms	Description
1	0	Not used.	
1	1	Coolant temperature display shows maximum (5 LED's on). Red engine protection (EP) lamp on. Fault code = 151.	Wiring shorted in coolant temperature sensor circuit, between socket B pins 1 and 2 (disconnect sensor to investigate).
1	2	MAT display shows minimum (0 LED's on). Yellow warning lamp on. Fault code = 154.	Manifold ambient temperature sensor open circuit, between socket A pins 1 and 2 (disconnect sensor to investigate).
1	3	MAT display shows maximum (5 LED's on). Red engine protection (EP) lamp on. Fault code = 155.	Manifold ambient temperature sensor short circuit, between socket A pins 1 and 2 (disconnect sensor to investigate).
1	4	OTS display shows minimum (0 LED's on). Yellow warning lamp on. Fault code = 213.	Wiring open in oil temperature sensor circuit, between socket A pins 1 and 2 (disconnect sensor to investigate).
1	5	OTS display shows maximum (5 LED's on). Red engine protection (EP) lamp on. Fault code = 214.	Wiring shorted in oil temperature sensor circuit, between socket B pins 1 and 2 (disconnect sensor to investigate).
1	6	Vehicle speed display shows minimum (1 LED's on). Red stop lamp on. Fault code = 132.	Throttle position sensor with wiper shorted to ground, between socket A pins 1 and 2 (disconnect sensor from ECU to investigate).
1	7	Vehicle speed display shows minimum (1 LED's on). Red stop lamp on. Fault code = 132.	Throttle position sensor open circuit, between socket A pins 1 and 3 (disconnect sensor from ECU to investigate).
1	8	OPS display shows minimum (0 LED's on). Red engine protection (EP) lamp on. Fault code = 143.	Oil pressure sensor open circuit, between socket A pins 1, 2 and 3 (disconnect sensor from ECU to investigate).

Panel Trainer PT7.7 - Diesel Engine Management *Continued* ...

Position:		Fault:	
Bank Switch	HEX Switch	Symptoms	Description
1	9	AAP display shows maximum (5 LED's on). TBPS display shows minimum (0 LED's on). OPS display shows low (0, 1 or 2 LED's on). Yellow warning lamp on. Fault code = 123.	Turbo boost pressure sensor short circuit VCC (plus others affected), between socket B pins 1 and 3 (disconnect sensor from ECU to investigate).
1	A	AAP display shows maximum (5 LED's on). Yellow warning lamp on. Fault code = 222.	Ambient air pressure sensor open circuit wiper, between socket A pins 1 and 2 (disconnect sensor from ECU to investigate).
1	B	AAP display shows minimum (0 LED's on). Yellow warning lamp on. Fault code = 221.	Ambient air pressure sensor short circuit wiper and 5V, between socket A pins 2 and 3 (disconnect sensor from ECU to investigate).
1	C	Yellow warning lamp on. Fault code = 681.	Idle inc/dec switch 'inc' contact open circuit, between cab interface connector pin 1 and the idle 'inc' pin on the ECU mimic.
1	D	Yellow warning lamp on. Fault code = 611.	Clutch switch open circuit contact, between socket A pins 1 and 2 (disconnect switch from ECU to investigate).
1	E	TBPS display shows maximum (5 LED's on). Yellow warning lamp on. Fault code = 122.	Turbo boost pressure sensor open circuit ground, between socket A pins 1 and 2 (disconnect sensor from ECU to investigate).
1	F	CTS display shows minimum (0 LED's on). Yellow warning lamp on. Fault code = 145.	High resistance coolant temperature sensor – 100 kilohms, between socket A pins 1 and 2 (disconnect sensor from ECU to investigate).

Panel Trainer PT7.7 - Diesel Engine Management *Continued* ...

Position:		Fault:	
Bank Switch	HEX Switch	Symptoms	Description
2	0	Not used.	
2	1	Cruise control on/off switch does not work. Yellow warning lamp on. Fault code = 621.	Wiring open in cruise control switch circuit, between cab interface panel connector pin 4 and ECU pin marked 'CRUISE CONTROL ON/OFF'.
2	2	Brake switch does not operate. Yellow warning lamp on. Fault code = 631.	Wiring open in brake switch circuit, between brake switch connector pin 2 and ECU pin marked 'BRAKE SWITCH'.
2	3	Engine brake coil 1 fails to operate (no LED comes on when engine brake switch is operated). Yellow warning lamp on. Fault code = 243.	Wiring shorted in engine brake coil circuit, across engine brake coil 1, pin 1 of socket B and the ground pin, which is part of the engine brake mimic.
2	4	Engine shuts down. Red stop lamp on. Fault code = 115.	Wiring open in engine position sensor circuit, between socket B pin 1 and ECU pin marked 'EPS RETURN'.
2	5	Vehicle speed display shows 2 LED's on. Red stop lamp on. Fault code = 432.	Idle relay open circuit coil, measure between ground and idle relay 'idle on' and 'idle off' pins for unchanging outputs.
2	6	Vehicle speed display shows 2 LED's on. Red engine protection (EP) lamp on. Fault code = 235.	Coolant level sensor open circuit contacts, between socket A pins 1, 2, 3 and 4, (disconnect sensor from ECU to investigate).
2	7	Vehicle speed display shows 2 LED's on. Red engine protection (EP) lamp on. Fault code = 235.	Wiring open in coolant level sensor circuit, between socket B pin 3 and ECU pin marked 'COOLANT LEVEL LOW SIGNAL' (disconnect sensor from ECU to investigate).
2	8	Engine shuts down. Red stop lamp on. Fault code = 254.	Fuel valve short circuit coil, between pin 1 of socket A (valve disconnected from ECU) and the ground pin, which is part of the fuel valve mimic.

Panel Trainer PT7.7 - Diesel Engine Management *Continued* ...

Position:		Fault:	
Bank Switch	HEX Switch	Symptoms	Description
2	9	Engine shuts down. Red stop lamp on. Fault code = 691.	Wiring open in ignition switch circuit, between socket B pin 1 and ECU pin marked 'VEHICLE KEY SWITCH SIGNAL'.
2	A	Diagnostics mode can not be entered. Yellow warning lamp on. Fault code = 651.	Diagnostics switch open circuit contact, between pins 1 and 2 of the diagnostic switch connector (use socket A, disconnect switch from ECU).
2	B	Fan switch does not operate (fan clutch 1 LED does not come on). Yellow warning lamp on. Fault code = 661.	Wiring open in fan switch circuit, between fan switch socket B pin 1 and ECU pin marked 'MANUAL FAN' (disconnect switch from ECU to investigate).
2	C	Engine shuts down. Red stop lamp on. Fault code = 115.	Engine position sensor open circuit coil, between pins 1 and 2 of socket A (disconnect sensor from ECU to investigate).
2	D	Vehicle speed display shows 2 LED's on. Yellow warning lamp on. Fault code = 241.	Wiring shorted in vehicle speed sensor circuit, between pins 1 and 2 of socket B (disconnect sensor from ECU to investigate).
2	E	Vehicle speed display shows 2 LED's on. Yellow warning lamp on. Fault code = 241.	Vehicle speed sensor open circuit coil, between pins 1 and 2 of socket A (disconnect sensor from ECU to investigate).
2	F	No cruise control available. Yellow warning lamp on. Fault code = 621.	Wiring open in cruise control switch circuit, between cab interface connector pins 1 and 4.

Panel Trainer PT7.7 - Diesel Engine Management *Continued* ...

Position:		Fault:	
Bank Switch	HEX Switch	Symptoms	Description
3	0	Not used	
3	1	Vehicle speed display shows 2 LED's on. Yellow warning lamp on. Fault code = 322.	Injector 1 open circuit coil, between pins 1 and 2 of socket A (disconnect injector from ECU to investigate).
3	2	Vehicle speed display shows 2 LED's on. Yellow warning lamp on. Fault code = 331.	Wiring open in injector 2 circuit, between socket B pin 1 and ECU pin marked 'CYLINDER 2 RETURN' (disconnect injector from ECU to investigate).
3	3	Vehicle speed display shows 2 LED's on. Yellow warning lamp on. Fault code = 313.	Wiring shorted in injector 3 circuit, between pins 1 and 2 of socket B (disconnect injector from ECU to investigate).
3	4	Engine shuts down. Red stop lamp on. Fault code = 671.	Wiring open in fuel valve circuit, between socket B pin 1 and ECU pin marked 'FUEL SHUTOFF SUPPLY' (disconnect fuel valve from ECU to investigate).
3	5	Fan clutch 1 does not operate (no LED on). Yellow warning lamp on. Fault code = 245.	Wiring shorted in fan clutch coil circuit, between pin 1 of socket B and the ground pin which is part of the fan clutch mimic. (disconnect fan clutch from ECU to investigate).
3	6	Not used	
3	7	Not used	
3	8	Not used	
3	9	Not used	
3	A	Not used	
3	B	Not used	
3	C	Not used	
3	D	Not used	
3	E	Not used	
3	F	No engine brake 'hi' operation (unable to select 2 engine brake LED's on). Yellow warning lamp on. Fault code = 641.	Engine brake hi/lo switch - open circuit 'hi' contact (between cab interface connector pins 1 and 8).

Panel Trainer PT7.8 - Anti-Lock Braking Systems

HEX Switch Position	Fault Symptoms	Fault Description
0	Not used.	
1	Slip% bar LED for wheel sensor 2 shows maximum (5 LED's on). ABS warning lamp on. Scanner fault code = 34.	Wiring to sensor 2 is short circuit to ground (between breakout box pins 46 and 28).
2	Slip% bar LED for wheel sensor 4 shows maximum (5 LED's on). ABS warning lamp on. Scanner fault code = 33.	Wiring between ECU and sensor 4 is open circuit (between breakout box pin 45 and sensor 4 pin 4).
3	ABS warning lamp on. Scanner fault code = 63.	Wiring between ECU (drive pin) and the pump motor relay coil is open circuit (between breakout box pin 15 and pump relay pin 3).
4	Not used.	
5	ABS warning lamp on. Scanner fault code = 64.	Wiring between ECU and the brake fluid level switch is open circuit (between breakout box pins 8 and 26).
6	Slip% bar LED for wheel sensor 3 shows maximum (5 LED's on). ABS warning lamp on. Scanner fault code = 32.	The coil of sensor 3 has failed open circuit (between breakout box pins 29 and 47).
7	ABS warning lamp on. Scanner fault code = 22.	The wiring to HCU valve 3 is short circuit to ground (between breakout box pins 20 and 1).
8	ABS warning lamp on. Scanner fault code = 25.	The coil of HCU valve 2 has failed open circuit (between HCU pins 2 and 10).
9	ABS warning lamp on. Scanner fault code = 24.	The wiring from the ECU to HCU valve 1 is open circuit (between breakout box pin 38 and HCU pin 1).
A	Wheels stopped. ABS warning lamp on. Scanner fault code = 62.	The pedal travel sensor has failed open circuit (between breakout box pins 16 and 41).
B	ABS warning lamp on. Scanner fault code = 17.	The coil of the ABS relay has failed open circuit (between breakout box pins 34 and 53).

Panel Trainer PT7.8 - Anti-Lock Braking Systems *Continued* ...

HEX Switch Position	Fault Symptoms	Fault Description
C	ABS warning lamp on. Scanner fault code = 63.	The coil of the pump motor speed sensor has failed open circuit (between breakout box pins 31 and 49).
D	ABS warning lamp on. Scanner fault code = 29.	The supply wiring to the HCU has failed open circuit (between breakout box pin 1 and HCU pin 10).
E	Slip% bar LED for wheel sensor 1 shows maximum (5 LED's on). ABS warning lamp on. Scanner fault code = 31.	The wiring to sensor 1 has failed open circuit (between breakout box pins 30 and 48).
F	Not used.	

