

SBC Training: Modular Magnetic Training System (MMTS) Operation Manual

Electrical System Training Modules

Table of Contents

1. Explanation of Components or “Nodes”
 2. Safety Precautions
 3. Magnetic Worksheets
 4. Building a Circuit
 5. Teaching with the System
 6. Using a Digital Multimeter (DMM)
 7. Interpreting Voltage Drop Across Loads
 8. Basic Lesson Example
 9. Troubleshooting
 10. Warranty and Safety Information
-

1. Explanation of Components or “Nodes”

Each component in the system is referred to as a “node.” The nodes are magnetic and can be used with magnetic worksheets, whiteboards, or other magnetic surfaces. The backside of each node has a port that can be unscrewed using the supplied “plastic key” (essentially a plastic coin), a large flat-blade screwdriver, or similar tools to access the circuit board. This allows you to set the node to one of three conditions: open, normal, or high resistance, by moving the red or black jumper among the pins. The nodes also have built-in circuit protection to prevent overloads if a circuit is improperly built.

The circuit boards will have 2 or 3 pins, depending on the node:

- **Nodes with 3 pins:** These can be set to normal, high resistance, or open conditions by moving the jumper.
 - **“NOM” or “NORM” (Normal):** When the jumper connects the NOM/NORM pin to the central pin, the node is in a normal condition.
 - **“RES” (High Resistance):** When the jumper connects the RES pin to the central pin, the node is in a high resistance condition, enabling a 33k ohm resistor in the circuit.
 - **Open Condition:** If the jumper is removed completely or is only on one pin, the node is in an open condition.
- **Nodes with 2 pins:** These can be set to either normal or open conditions.
 - **“NOM” or “NORM” (Normal):** When the jumper connects the NOM/NORM pin to the other pin, the node is in a normal condition.
 - **Open Condition:** If the jumper is removed completely or is only on one pin, the node is in an open condition.

Jumpers can be removed with fingertips or with needle nose pliers.

Larger nodes have additional circuits, each with the same layout and capacity for creating all three conditions. For example, the “ground block” node has 6 circuits, each with 3 pins and a jumper.

Types of Nodes:

- Battery
- Fuse
- Wire
- Latching Switch
- 12mm LED
- 19mm LED
- Splice
- Splice-RT
- Splice-LT
- 3-Way Switch
- Turn Signal ECU
- Ground

2. Safety Precautions

Always ensure that you follow proper safety procedures when working with electricity. Use appropriate safety equipment, such as safety glasses and steel-toed boots. Ensure you are working in a well-ventilated area. These systems should be used in a classroom setting, but could also be used in a lab. It is crucial to follow all local OSHA or similar regulations for the work, testing, or teaching that is occurring.

Additional safety guidelines:

- Do not eat or drink around the system.
- Do not use the system with wet hands.
- Do not use the system outdoors.
- Avoid high temperatures, which can damage the equipment.
- The equipment should not be stored in high temperatures, such as inside a vehicle, as the nodes and magnetic sheet can be damaged.
- Store the magnetic maps flat or rolled up as received in the carrying and storage case.

3. Magnetic Worksheets

Magnetic worksheets can be used on a steel workbench, whiteboard, or other magnetic surfaces. These worksheets include outlines of specific circuits to show how they should be assembled. They are designed to train students on how circuits operate. Additionally, vehicle-specific training boards can be provided, which include connector numbers, pin numbers, etc., to train students at the bench and then on the vehicle.

Instructors can use dry-erase markers on the magnetic sheets to outline and highlight nodes. Permanent markers should not be used as they may damage the sheets. Dry-erase markings should be cleaned off after each use and not left on for an extended period to prevent staining.

Additional Magnetic Worksheets can be purchased at www.sbctrainingllc.com along with student and instructor worksheets. OEM-specific magnetic sheets can also be created upon request. For more manuals and worksheets, visit www.sbctrainingllc.com/manuals.

4. Building a Circuit

Magnetic worksheets include diagrams of the necessary nodes and how they plug together. Place each node on the corresponding markers on the worksheet and then connect them as indicated to create the circuit.

Circuits can be powered by a battery-powered supply unit (requires 8 AA batteries to make 12 volts) or a bench-style power supply. Ensure the power supply provides the correct 12 volts direct current (12VDC).

Recommended Batteries

Use Energizer alkaline AA batteries for the battery-powered supply unit. Avoid using lithium-ion batteries or other types that may pose a risk if shorted or installed incorrectly.

5. Teaching with the System

Set up the circuit on the whiteboard and walk students through the circuit components and how it should work. Explain the basics of troubleshooting and common issues students might encounter.

6. Using a Digital Multimeter (DMM)

Students should use a digital multimeter (DMM) for testing the circuits. For checking resistance, select the resistance (ohms) setting. To measure voltage, select the voltage (volts) setting. Set the range appropriate to the circuit you are testing.

- **For testing resistance:** Disconnect the circuit from power. Connect the test leads to the component you want to measure. The display will show the value in ohms.
- **For testing voltage:** Power on the circuit. Connect the test leads in parallel across the points where you want to measure voltage. The display will show the value in volts.
- **For testing amperage:** Disconnect the circuit from power. Create an open circuit. Set the DMM to amperage. Connect the leads of the DMM in the series where the open circuit was created. Reconnect power to the circuit and turn the system “on” to measure current.

7. Interpreting Voltage Drop Across Loads

To measure the voltage drop across a load (e.g., an LED, node with enabled resistor, or other component):

1. Set the DMM to voltage measurement mode.
2. Place the red lead (positive) to the terminal just before or after the load.
3. Place the black lead (common or negative) to the common terminal after the node.
4. The DMM will display the voltage drop across that node or nodes, depending on lead placement.

Ensure your DMM is rated for the voltage and current levels you're working with, and use appropriate safety precautions to avoid injury or damage. Consult your DMM's manual for specific functionality details.

8. Basic Lesson Example

Introduction:

- Set up the circuit on the whiteboard and walk students through the circuit components and how it should work.
- Explain the basics of troubleshooting and common issues students might encounter.

Activity:

- Break students into teams. Teams take turns creating faults in the system and then timing one another on finding and fixing the faults.

9. Troubleshooting

If the circuit does not power up as expected:

1. Check the output of the power supply with your DMM.
2. If the voltage is correct, check the output and ground of the "Battery" Node.
3. Continue working down the circuit to see where voltage is being dropped or lost. With the circuit connected, place the black meter lead on the battery negative terminal and use the red meter lead to work down the circuit until you no longer see the correct voltage.
4. If you are losing voltage at an unexpected node, remove the bottom cover using a coin or similar object. Ensure proper placement of the terminal jumper. If the terminal jumper is not present, check for spares in your training kit or order online at www.sbctrainingllc.com. The node will continue to show as open if the jumper is not present.

10. Warranty and Safety Information

Warranty:

SBC Training warrants that the product is free from defects in workmanship for a period of twelve (12) months from the date of purchase. This warranty covers manufacturing defects only and does not extend to damage resulting from misuse, dropping, breaking, or any other form of physical damage.

In the event of a manufacturing defect, SBC Training will repair or replace the defective product. To initiate a warranty claim, the customer must contact SBC Training to return the damaged components for investigation.

Upon receipt of the defective product, SBC Training will evaluate the failure mode and determine whether it falls under the terms of this warranty. If the defect is confirmed to be covered by the warranty, SBC Training will repair or replace the product at no additional cost to the customer.

This warranty is non-transferable and does not cover normal wear and tear, cosmetic damage, or damage caused by improper use or maintenance. Any unauthorized repairs or modifications will void this warranty.

To the extent permitted by law, this warranty is the sole and exclusive remedy for defects in the product. SBC Training shall not be liable for any incidental or consequential damages arising from the use or inability to use the product, whether based on warranty, contract, tort, or any other legal theory.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state or country to country.

For warranty inquiries or claims, please contact:

SBC Training
brandon@sbctrainingllc.com
www.sbctrainingllc.com

Safety Information:

- Improper use of the equipment can cause damage and possible personal injury.
- SBC Training LLC does not take responsibility for any damage to equipment or persons while using the products.
- The 12V power supply should not be used for any high-current operations, such as jump-starting a vehicle.
- The 12V power supply should only be used with SBC Training LLC systems.
- Do not eat or drink around the system.
- Do not use the system with wet hands.
- Do not use the system outdoors.
- Avoid high temperatures, which can damage the equipment.
- The equipment should not be stored in high temperatures, such as inside a vehicle, as the nodes and magnetic sheet can be damaged.
- Store the magnetic maps flat or rolled up as received in the carrying and storage case.

For more information, visit www.sbctrainingllc.com.