POWER INNOVATIONS INTERNATIONAL

LITEON GROUP

MPDU

Main Power Distribution Unit

User's Manual

MNL151

Rev 4.3

Export Classification EAR99

READ THIS MANUAL CAREFULLY
SAVE ALL INSTRUCTIONS

This manual contains important information needed to operate the MPDU™ safely and efficiently. Please read all instructions carefully before installing or operating equipment.

Keep this manual handy for easy reference.

ELECTRICAL WARNING

Applying information contained in this manual to any other product, including customized Q-LS systems with nonstandard specifications, may cause injury.

MPDU™, MPDS™, Q-LS™, Q-LS Uninterruptible Power Quality™, UPQ™, and UPQ-NetAgent9™ are trademarks of Power Innovations International, Inc.

This manual may accompany other instructional addendums about additional customizations to standard MPDS™ systems. Please contact Power Innovations if additional manuals are needed and have not been received.

Product names mentioned herein may be trademarks and/or registered trademarks of their respective companies.

TABLE OF CONTENTS

Important Safety Instructions

This manual contains important instructions that should be followed during installation and for maintenance of the MPDU™ system.

CAUTION
Install the MPDU™ system in a temperature-controlled indoor environment where it is clean, dry, and free of conductive contaminants.

CAUTION
For safety, please ensure that all individual circuit breakers are in the OFF position prior to installing the MPDU™ system to the Q-LS™ system. Serious injury or death may result from failure to ensure that all power connections are OFF.

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1. INTRODUCTION

1.1 Description

The Main Power Distribution Unit™ (MPDU) is designed with three-phase 120/208 VAC input. The unit supplies single-phase 120 VAC and three-phase 120/208 VAC output power. The MPDU comes in four varieties with different power output options: The Weapons Tactical Trainer (WTT), the Training System Support Center (TSSC), Parts Task Trainer (PTT), and the Virtual Maintenance Trainer (VMT). The MPDU serves as the main source of AC power into the training device(s). The MPDU monitors the status and distributes power to all equipment requiring AC power within the training devices.

The MPDU features a user-friendly touchscreen to access data, which is monitored by sophisticated software. The intelligent monitoring software is easily accessible through the user-friendly touchscreen on the front side of the unit as well as remotely through a TCP/IP Ethernet connection. Using the software, the user can access real time data and event history of the unit, as well as data and historical event data from both the MPDU and the attached Q-LS™ system.

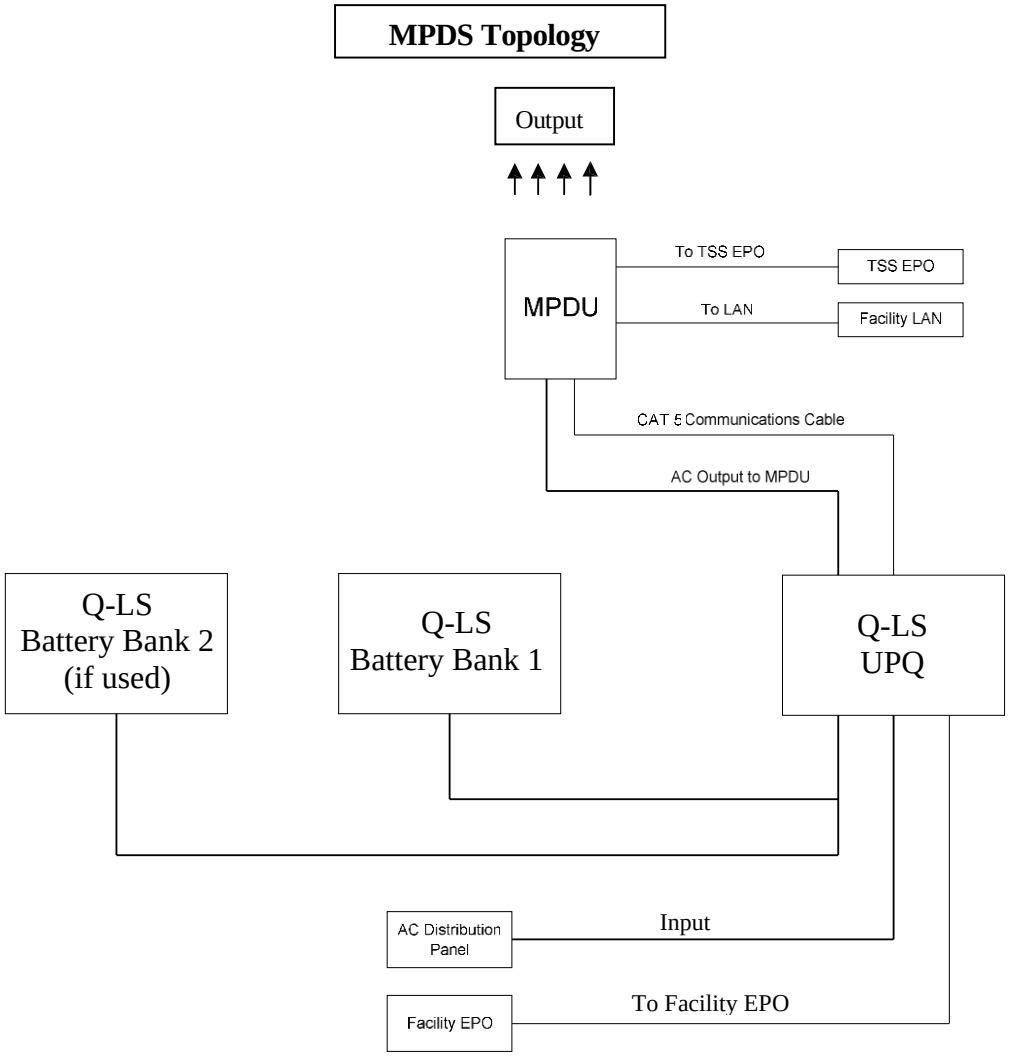


Figure 1—MPDS Topology

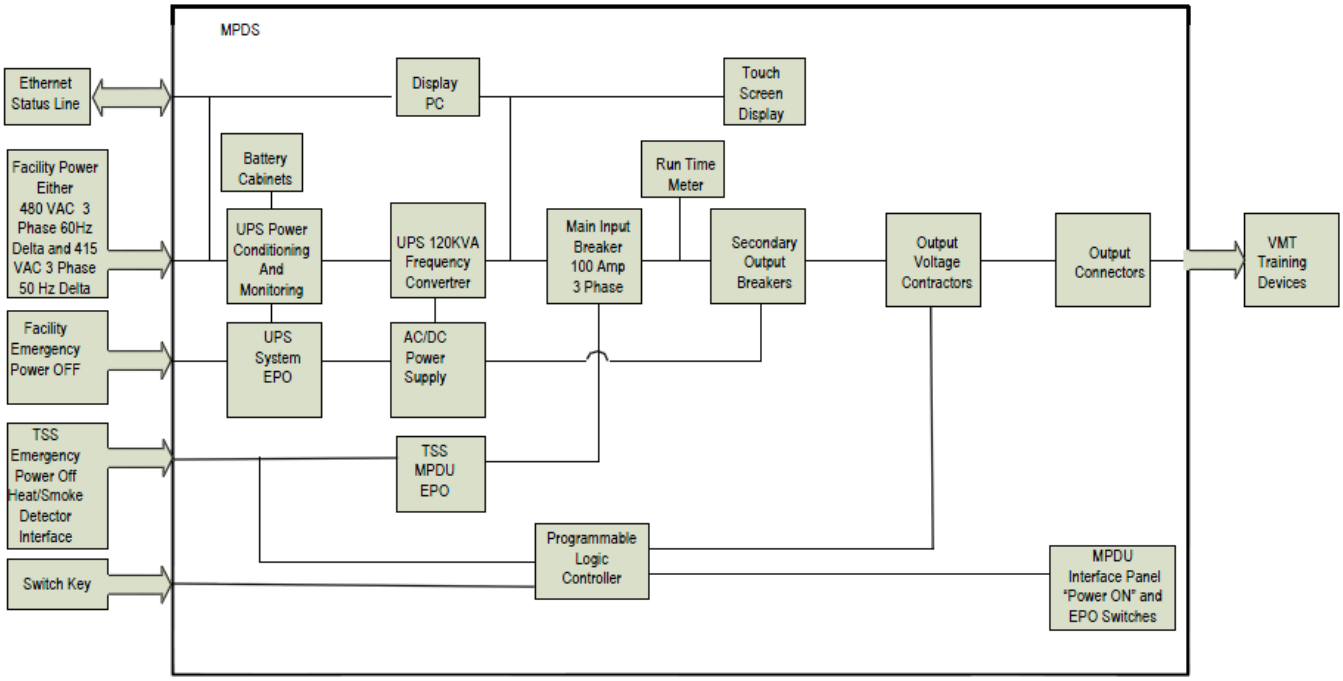
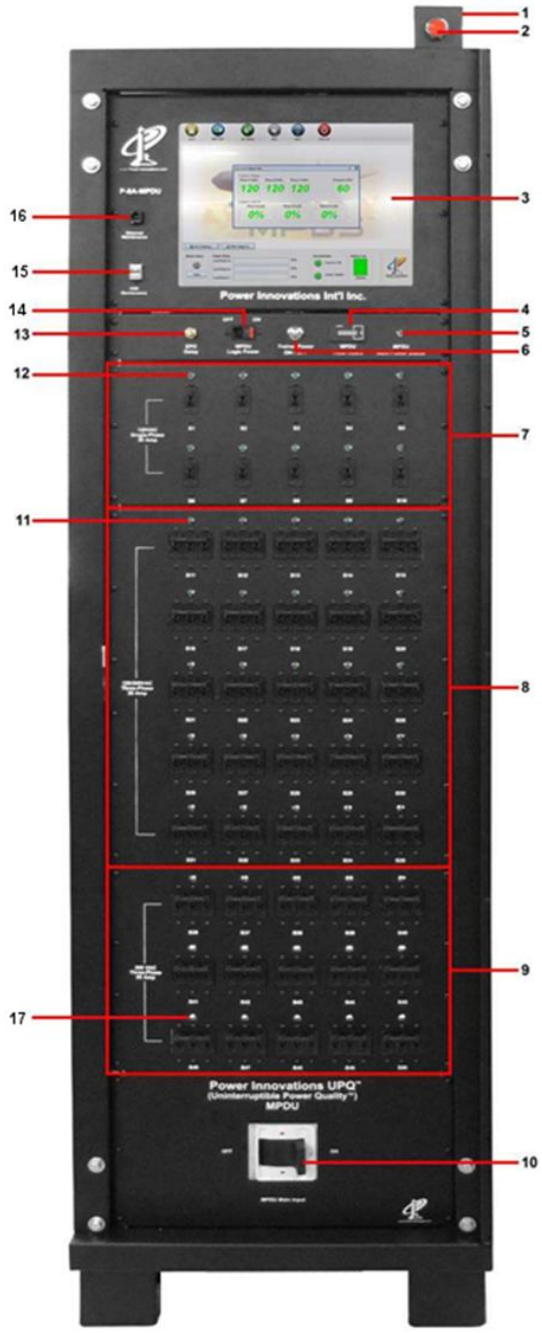


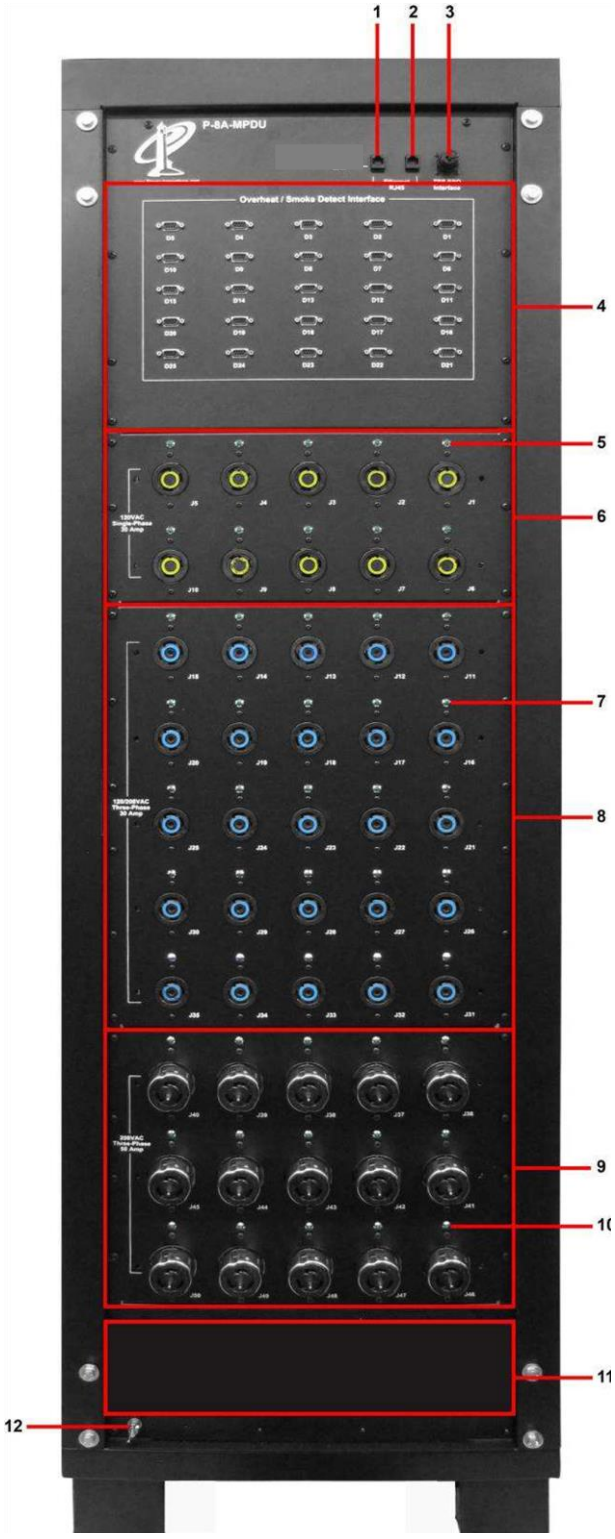
Figure 2—MPDS VMT Block Diagram

1.2 WTT MPDU Front Panel



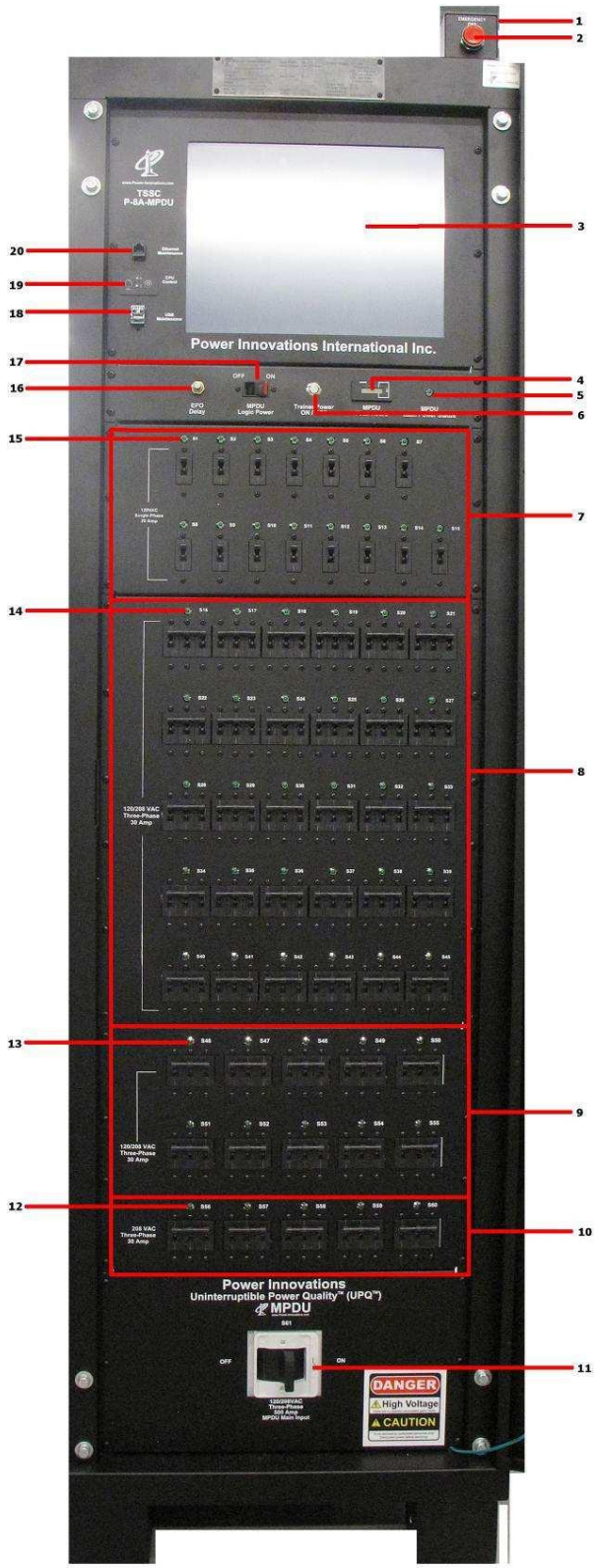
1. Alarm Speaker: PLC controlled.
2. EPO Switch: Emergency Power OFF.
3. Touchscreen: Gives user access to MPDS™ status.
4. MPDU Total Hours: Total run time, in hours, of the MPDU when the main input breaker (#10) is ON.
5. MPDU Main Power Status Indicator LED: Indicates the power input status of the MPDU. If the LED is illuminated, the MPDU is receiving input power, which means the main input breaker (#10) is ON.
6. Trainer Power ON / OFF Button: Turns the trainer power ON / OFF.
7. 30 Amp 1Ø Output Circuit Breakers: Activate or deactivate 1Ø system output power.
8. 30 Amp 3Ø Output Circuit Breakers: Activate or de-activate system 3Ø output power.
9. 50 Amp 3Ø Output Circuit Breakers: Activate or de-activate system 3Ø output power.
10. 500A 3Ø MPDU Main Breaker with shunt trip: Turns the MPDU output power ON / OFF.
11. 30 Amp-3Ø Power Distribution Indicator LEDs: Indicate the power output status of the connectors. If an LED is illuminated, the receptacle is live.
12. 30 Amp 1Ø Power Distribution Indicator LEDs: Indicate the power output status of the connectors. If an LED is illuminated, the receptacle is live.
13. EPO Delay Button: Activates EPO Delay.
14. MPDU Logic Power Breaker: Turns the MPDU Logic ON/OFF.
15. USB Maintenance: Connects external equipment to internal PC for user maintenance.
16. Ethernet Maintenance: Connects external equipment to internal MPDU intranet.
17. 50 Amp 3Ø Power Distribution Indicator LEDs: Indicate the power output status of the connectors. If an LED is illuminated, the receptacle is live

1.3 WTT MPDU Back Panel



1. Q-LS Communication Link: Connects the MPDU to the Q-LS system.
2. RJ-45 Ethernet Port: Connects the MPDU to the local network.
3. CPC Connector: TSS EPO Interface
4. DB-9 Connector: Connects temperature, smoke, and other sensors to the MPDU's internal PLC Logic.
5. 30 Amp 1Ø Power Distribution Indicator LEDs: Indicate the power output status of the connectors. If an LED is illuminated, the receptacle is live.
6. 30 Amp 1Ø Power Output Receptacles: Connect the load to 30 Amp – 120VAC output power via L5-30 connectors.
7. 30 Amp-3Ø Power Distribution Indicator LEDs: Indicate the power output status of the connectors. If an LED is illuminated, the receptacle is live.
8. 30 Amp-3Ø Power Output Receptacles: Connect the load to 30 Amp – 120/208 VAC output power via L21-30 connectors.
9. 50 Amp-3Ø Power Output Receptacles: Connect the load to 50 Amp – 208 VAC output power via CS-8369 connectors.
10. 50 Amp-3Ø Power Distribution Indicator LEDs: Indicate the power output status of the connectors. If an LED is illuminated, the receptacle is live.
11. Input Gland Plate: Removable to allow input and ground wire installation.
12. Grounding Studs/Plate: Single or multiple (optional) ground attachment points allow the grounding of other equipment to the MPDU.

1.4 TSSC MPDU Front Panel

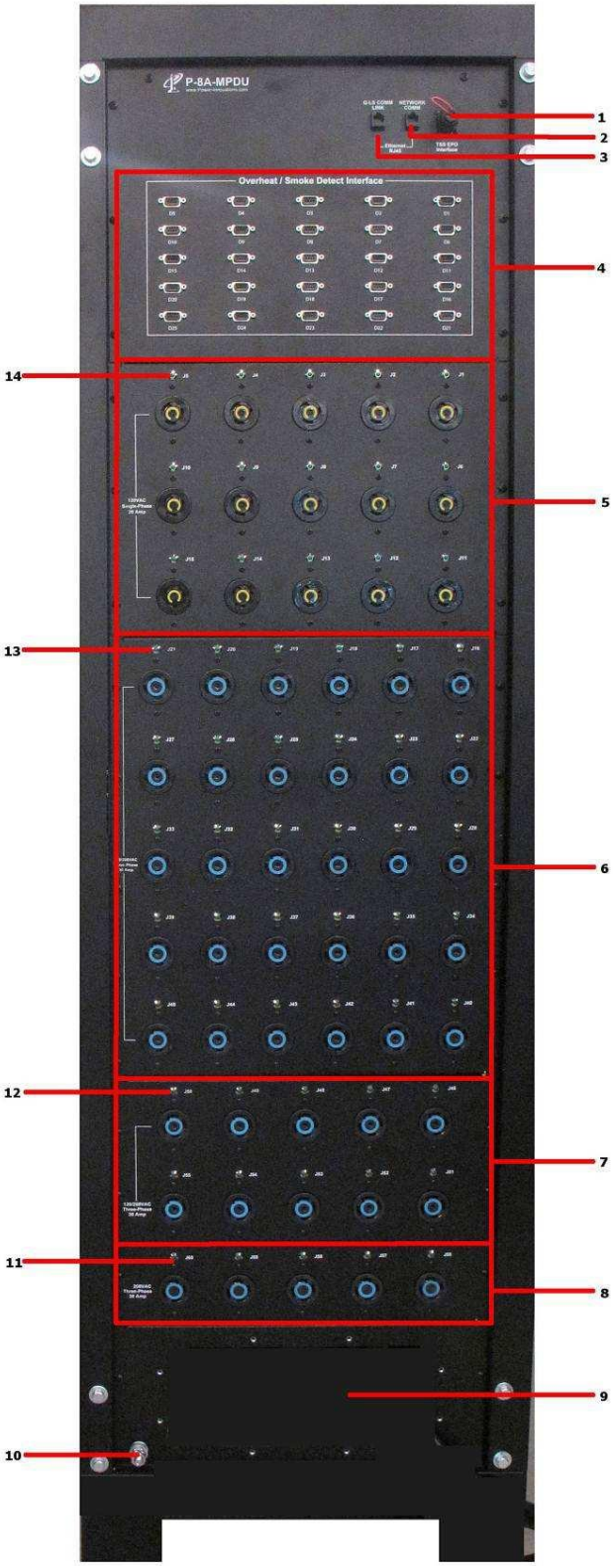


1. Alarm Speaker: PLC controlled.
2. EPO Switch: Emergency Power OFF.

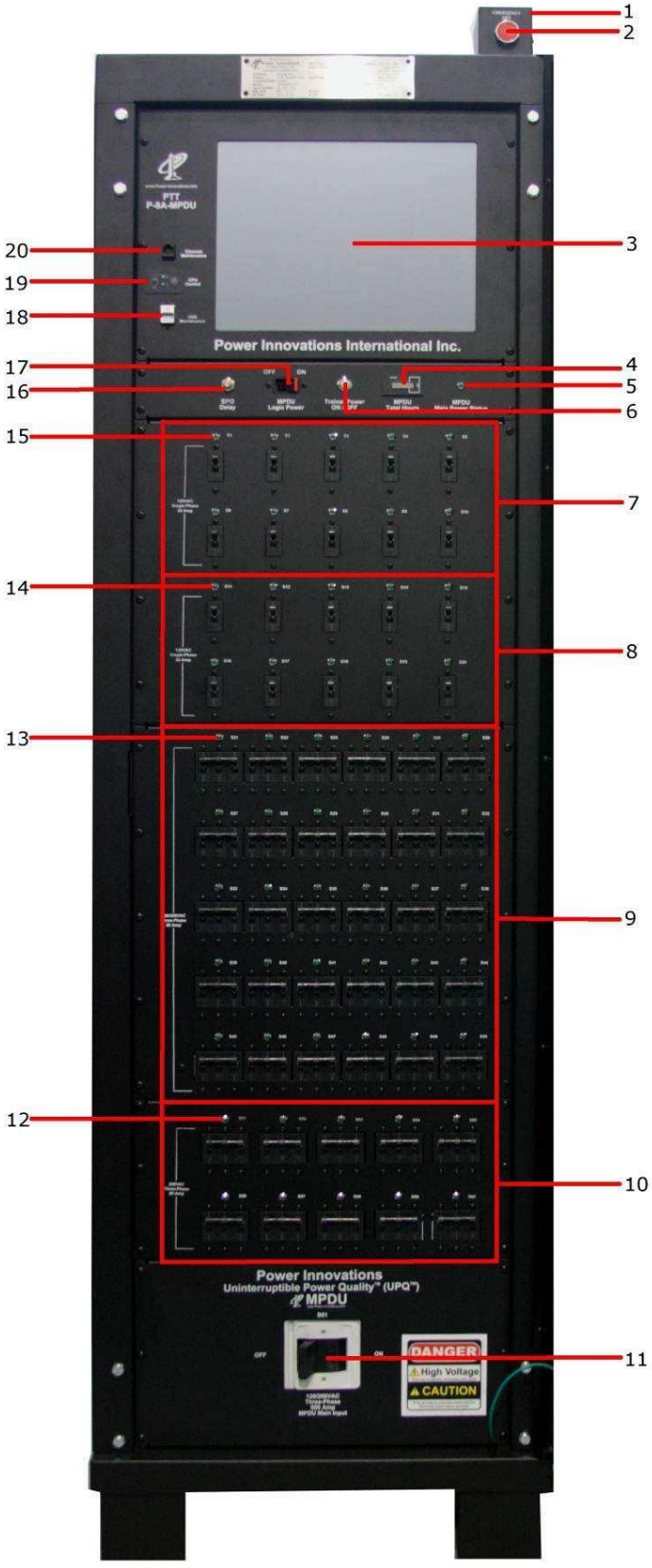
3. Touchscreen: Gives user access to MPDS status.
4. MPDU Total Hours: Total runtime in hours of MPDU with main input breaker (11) ON.
5. MPDU Main Power Status Indicator LED: Indicates the power status of the MPDU. If the LED is illuminated, the MPDU is receiving input power and the main input breaker (11) is ON.
6. Trainer power ON/OFF button: Turns the trainer power ON or OFF.
7. 120V AC Single-phase 20A Circuit Breakers: Switch breakers to turn output ON or OFF.
8. 120/208V AC Three-phase 30A Y Circuit Breakers: Switch breakers to turn output ON or OFF.
9. 120/208V AC Three-phase 30A Y Circuit Breakers (second panel): Switch breakers to turn output ON or OFF.
10. 208V AC Three-phase 30A Δ Circuit Breakers: Switch breakers to turn output ON or OFF.

11. MPDU Main Input Breaker: Turns the MPDU output ON or OFF.
12. 208V AC Three-phase 30A Δ Indicator LED: Indicator LED illuminates if power is ON to the output receptacle.
13. 120/208V AC Three-phase 30A Y Indicator LED (second panel) Indicator LED illuminates if power is ON to the output receptacle.
14. 120/208V AC Three-phase 30A Y Indicator LED: Illuminates if power is ON to the output receptacle.
15. 120V AC Single-phase 20A Indicator LED: Illuminates if power is ON to the output receptacle.
16. EPO Delay Button: Activates EPO delay.
17. MPDU Logic Power Breaker: Turns the MPDU Logic module ON or OFF.
18. USB Maintenance Ports: Allows the connection of external USB equipment for PC maintenance.
19. CPU Control Button: Allows user to cycle power or reset the PC.
20. Ethernet Maintenance: Allows the connection of an RJ45 Ethernet cable to connect external devices to the MPDU.

1.5 TSSC MPDU Back Panel

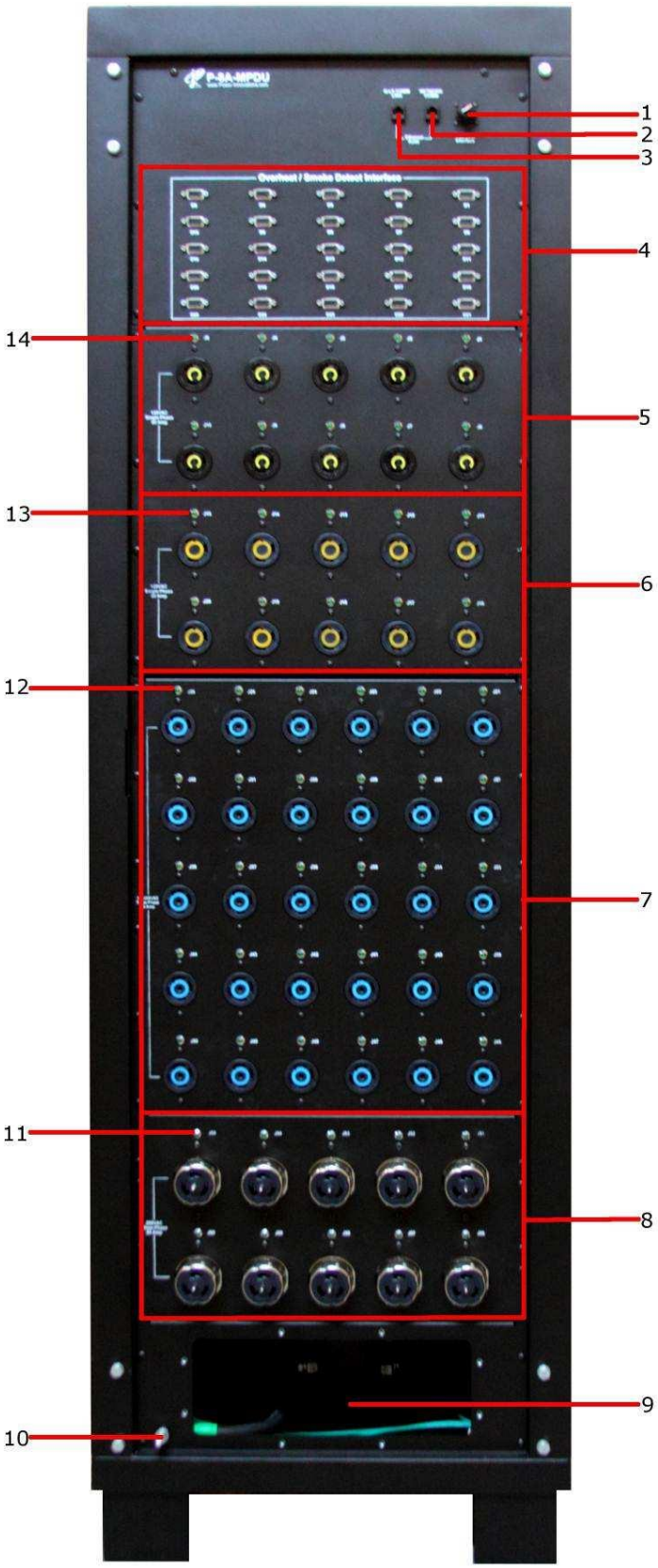


1. CPC Connector: TSS EPO Interface.
2. RJ45 Ethernet Port: Connects the MPDU to the local network.
3. Q-LS Communication Link: Connects the MPDU to the Q-LS system.
4. DB-9 Connectors: Connects temperature, smoke, and other sensors to the MPDU internal PLC logic.
5. 120 VAC Single-phase 20 Amp Receptacles: Connect the load to 20A-120 V AC output power via L5-20 connectors.
6. 120/208 VAC Three-phase30 Amp Y Receptacles: Connect the load to 30A-120/208 V Y AC output power via L21-30 connectors.
7. 120/208 VAC Three-phase 30 Amp Y (second panel) Receptacles: Connect the load to 30 Amp 120/208 V Y AC output power via L21-30 connectors.
8. 208 VAC Three-phase 30 Amp Δ Receptacles: Connect the load to 30 Amp 208 V Δ AC output power via L15-30 connectors.
9. Input Gland Plate: Removable to allow input and ground wire installation.
10. Grounding Studs/Plate: Single or multiple (optional) ground attachment points allow the grounding of other equipment to the MPDU.
11. 208 VAC Three-phase 30 Amp Δ Indicator LED: Illuminates if the receptacle is live.
12. 120/208 VAC Three-phase 30 Amp Y (second panel) Indicator LED: Illuminates if the receptacle is live.
13. 120/208 VAC Three-phase 30 Amp Y Indicator LED: Illuminates if the receptacle is live.
14. 120 VAC Single-phase 20 Amp Indicator LED: Illuminates if the receptacle is live.



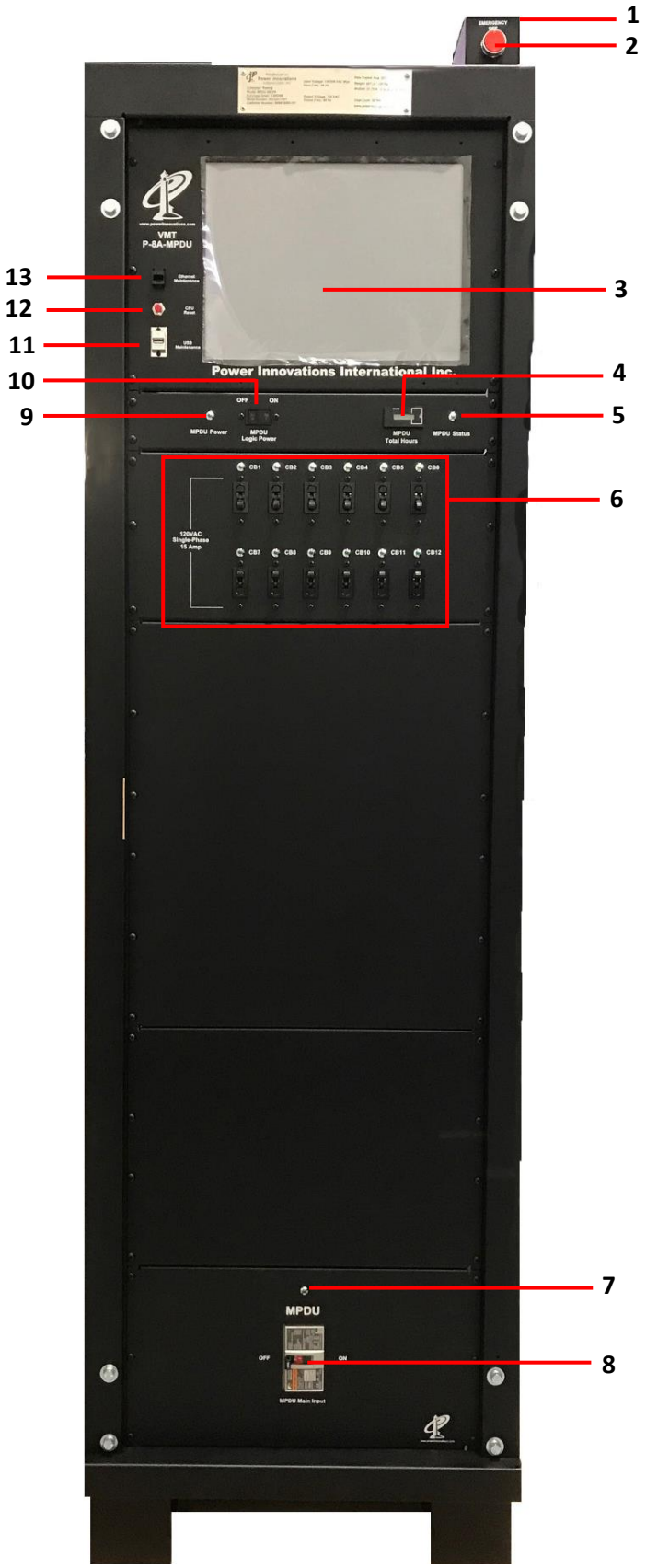
1.6 PTT MPDU Front Panel

1. Alarm Speaker: PLC controlled.
2. EPO Switch: Emergency Power Off.
3. Touchscreen: Gives user access to MPDS status.
4. MPDU Total Hours: Total runtime in hours of MPDU with main input breaker (11) ON.
5. MPDU Main Power Status Indicator LED: Indicates the power status of the MPDU. If the LED is illuminated, the MPDU is receiving input power and the main input breaker (11) is ON.
6. Trainer power ON/OFF button: Turns the trainer power ON or OFF.
7. 120 VAC Single-phase 20 Amp Circuit Breakers: Switch breakers to turn output ON or OFF.
8. 120 VAC Single-phase 30 Amp Circuit Breakers: Switch breakers to turn output ON or OFF.
9. 120/208 VAC Three-phase 30 Amp Circuit Breakers: Switch breakers to turn output ON or OFF.
10. 208 VAC Three-phase 50 Amp Circuit Breakers: Switch breakers to turn output ON or OFF.
11. MPDU Main Input Breaker: Turns the MPDU output ON or OFF.
12. 208 VAC Three-phase 50 Amp Indicator LED: Indicator LED illuminates if power is ON to the output receptacle.
13. 120/208 VAC Three-phase 30 Amp Indicator LED: Indicator LED illuminates if power is ON to the output receptacle.
14. 120 VAC Single-phase 30 Amp Indicator LED: Illuminates if power is ON to the output receptacle.
15. 120 VAC Single-phase 20 Amp Indicator LED: Indicator LED illuminates if power is ON to the output receptacle.
16. EPO Delay Button: Activates EPO delay.
17. MPDU Logic Power Breaker: Turns the MPDU Logic module ON or OFF.
18. USB Maintenance Ports: Allows the connection of external USB equipment for PC maintenance.
19. CPU Control Button: Allows user to cycle power or reset the PC.
20. Ethernet Maintenance: Allows RJ45 Ethernet cable to connect external devices to the MPDU.



1.7 PTT MPDU Back Panel

1. CPC Connector: TSS EPO Interface.
2. RJ45 Ethernet Port: Connects the MPDU to the local network.
3. Q-LS Communication Link: Connects the MPDU to the Q-LS system.
4. DB-9 Connectors: Connects temperature, smoke, and other sensors to the MPDU internal PLC logic.
5. 120 V AC Single-phase 20 Amp Receptacles:
   Connect the load to 20A-120 VAC output power via L5-20 connectors.
6. 120 V AC Single-phase 30 Amp Receptacles:
   Connect the load to 30 Amp 120 VAC output power via L5-30 connectors.
7. 120/208 VAC Three-phase 30 Amp Receptacles. Connect the load to 30 Amp 120/208 VAC output power via L21-30 connectors.
8. 208 VAC Three-phase 50 Amp Receptacles: Connect the load to 50 A-208 VAC output power via CS-8369 connectors.
9. Input Gland Plate: Remove to allow input and ground wire installation.
10. Grounding Studs/Plate: Single or multiple (optional) ground attachment points allow the grounding of other equipment to the MPDU.
11. 208 VAC Three-phase 50 Amp Indicator LED: Illuminates if the receptacle is live.
12. 120/208 VAC Three-phase 30 Amp Indicator LED: Illuminates if the receptacle is live.
13. 120 VAC single-phase 30 Amp Indicator LED: Illuminates if the receptacle is live.
14. 120 VAC Single-phase 20 Amp Indicator LED: Illuminates if the receptacle is live.



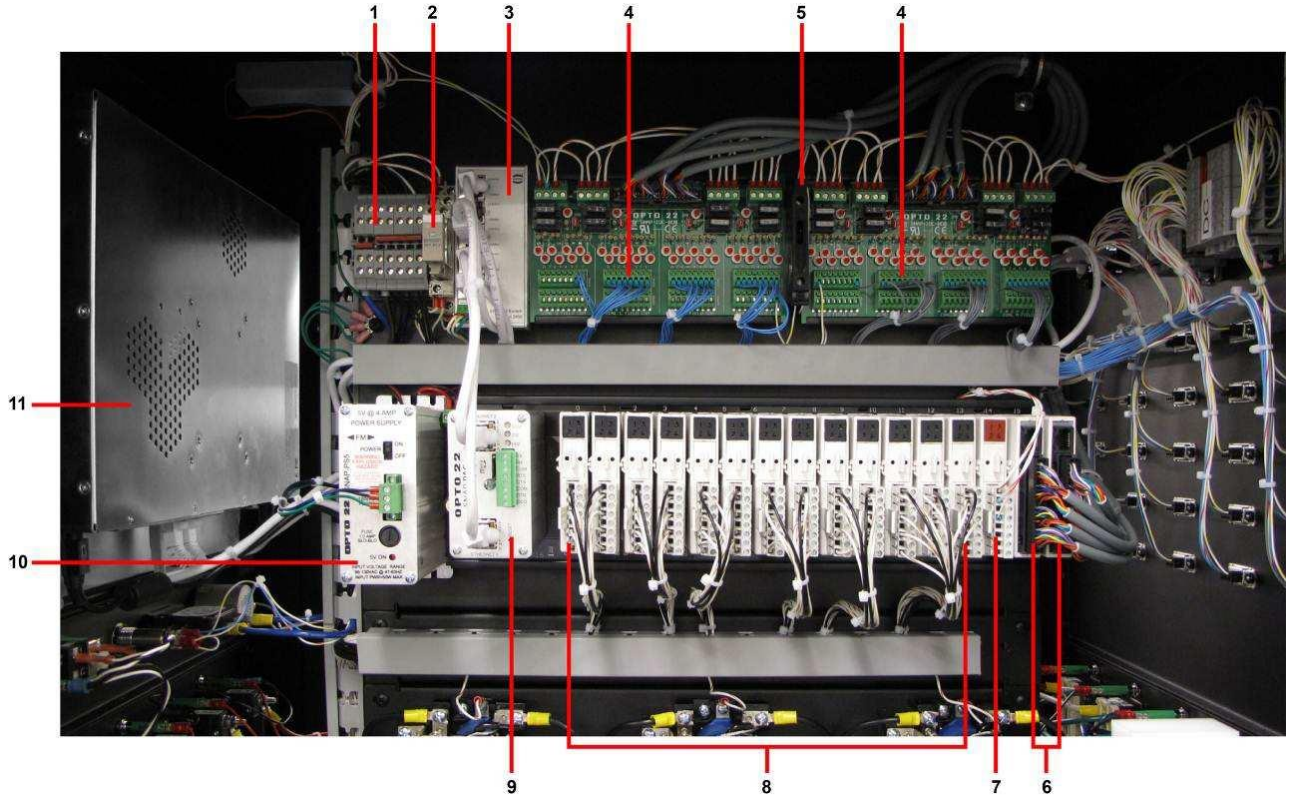
1.8 VMT MPDU Front Panel

1. Alarm Speaker: PLC controlled.
2. EPO Switch: Emergency Power Off.
3. Touchscreen: Gives user access to MPDS status.
4. MPDU Total Hours: Total runtime in hours of MPDU with main input breaker (8) ON.
5. MPDU Status Indicator LED: Indicates the power status of the MPDU. If the LED is illuminated, the PLC has completed booting up.
6. 120 VAC Single-phase 15 Amp Circuit Breakers: Switch breakers to turn output ON or OFF.
7. MPDU Power Status Indicator LED: Indicates the power status of the MPDU. If the LED is illuminated, the MPDU is receiving input power and the main input breaker is ON.
8. MPDU Main Input Breaker: Turns the MPDU output ON or OFF.
9. MPDU Power Indicator LED: Indicates the MPDU has been power on with the main input breaker ON.
10. MPDU Logic Power Breaker: Turns the MPDU Logic module ON or OFF.
11. USB Maintenance Ports: Allows the connection of external USB equipment for PC maintenance.
12. CPU Reset Button: Allows user to cycle power or reset the PC.
13. Ethernet Maintenance: Allows RJ45 Ethernet cable to connect external devices to the MPDU.

1.9 VMT MPDU Back Panel

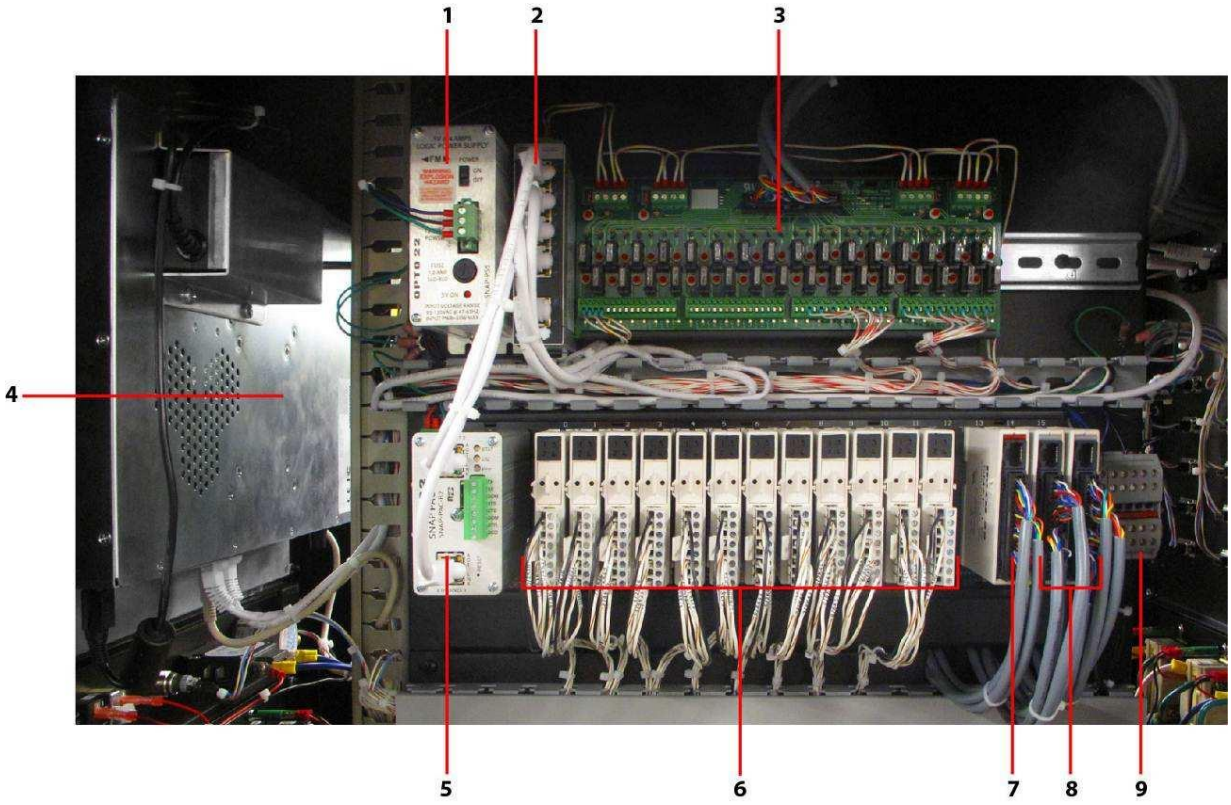
1. RJ45 Ethernet Q-LS Comm. Link: Connects the MPDU to the Q-LS.
2. RJ45 Ethernet Network Comm.: Connects the MPDU to the local network.
3. Q-LS EPO Interface.
4. J3 EPO Out: Connects temperature, smoke, and other sensors to the MPDU internal PLC logic.
5. J2 EPO In Connection:
   Connects temperature, smoke, and other sensors to the MPDU internal PLC logic.
6. 120 VAC Single-phase 15 Amp Receptacles:
   Connect the load to 15 Amp 120 VAC output power via L5-15R connectors.
7. E1 multiple ground attachment that allows the grounding of other equipment to the MPDU.
8. Key Switch: J1 Control Key that connects to the “Trainer Power ON/OFF” key switch on the front of the Support Equipment Cabinet.

1.10 WTT Programmable Logic Controller (PLC)



1. PLC 120 VAC Bus.
2. EPO Relay.
3. Ethernet Hub for Digital communications between components.
4. PLC Input Module: High-density 32-port breakout module for smoke and heat detect.
5. Test Switch: Test module switch (user programmable for testing).
6. I/O Modules: 32-bit high-density input modules for smoke/heat detect boards.
7. I/O Module: I/O module used for EPO alarm speaker and trainer power ON/OFF switch (see 4 above).
8. I/O Modules: I/O Modules used for relay control.
9. PLC Brain/Controller: Runs user programmed strategies (Ethernet accessible).
10. PLC Power Supply: +5 V power supply with ON/OFF switch.
11. Touchscreen and embedded PC.

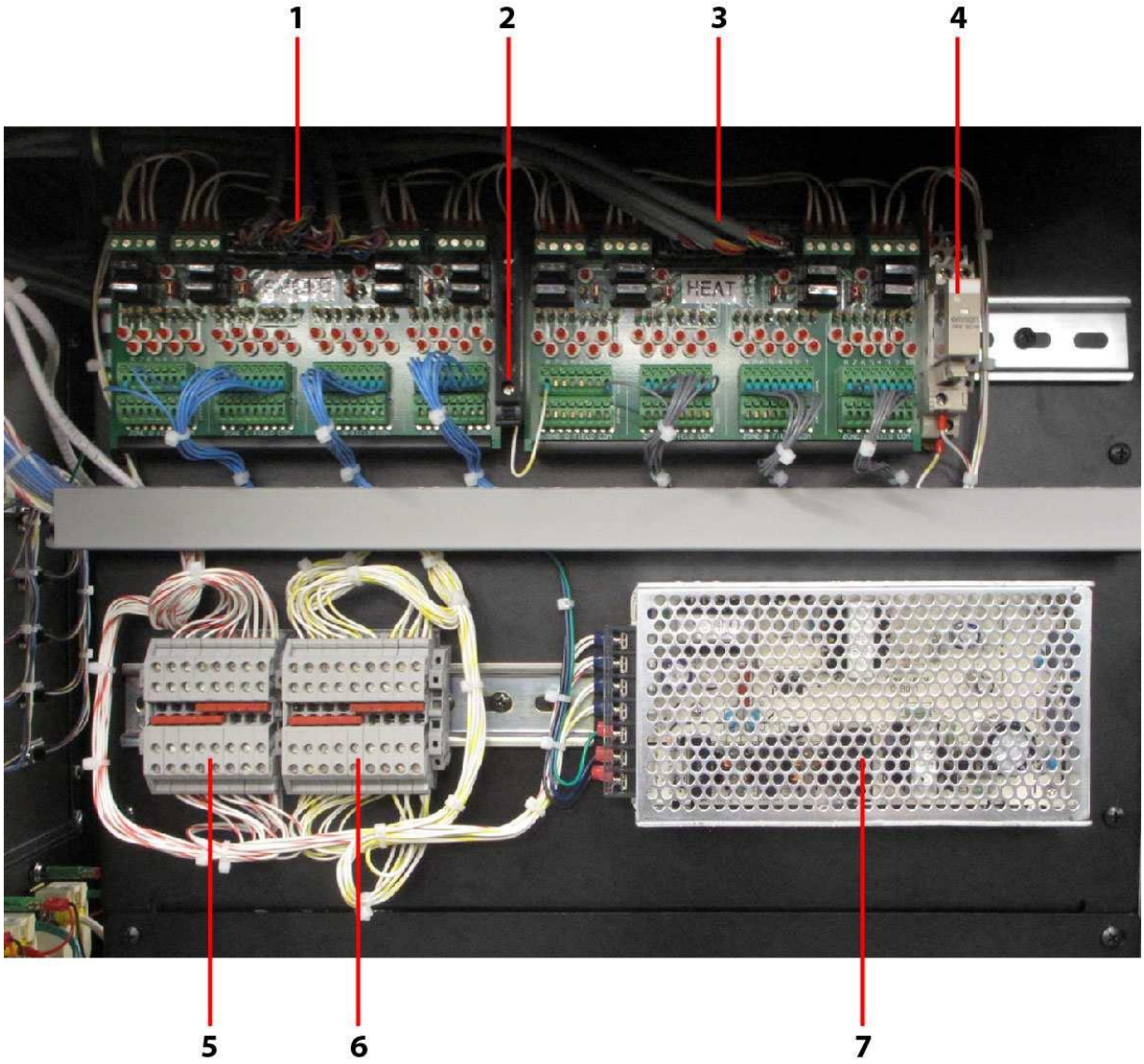
1.11 TSSC/PTT MPDU Programmable Logic Controller (PLC)



MPDU PLC Right Side

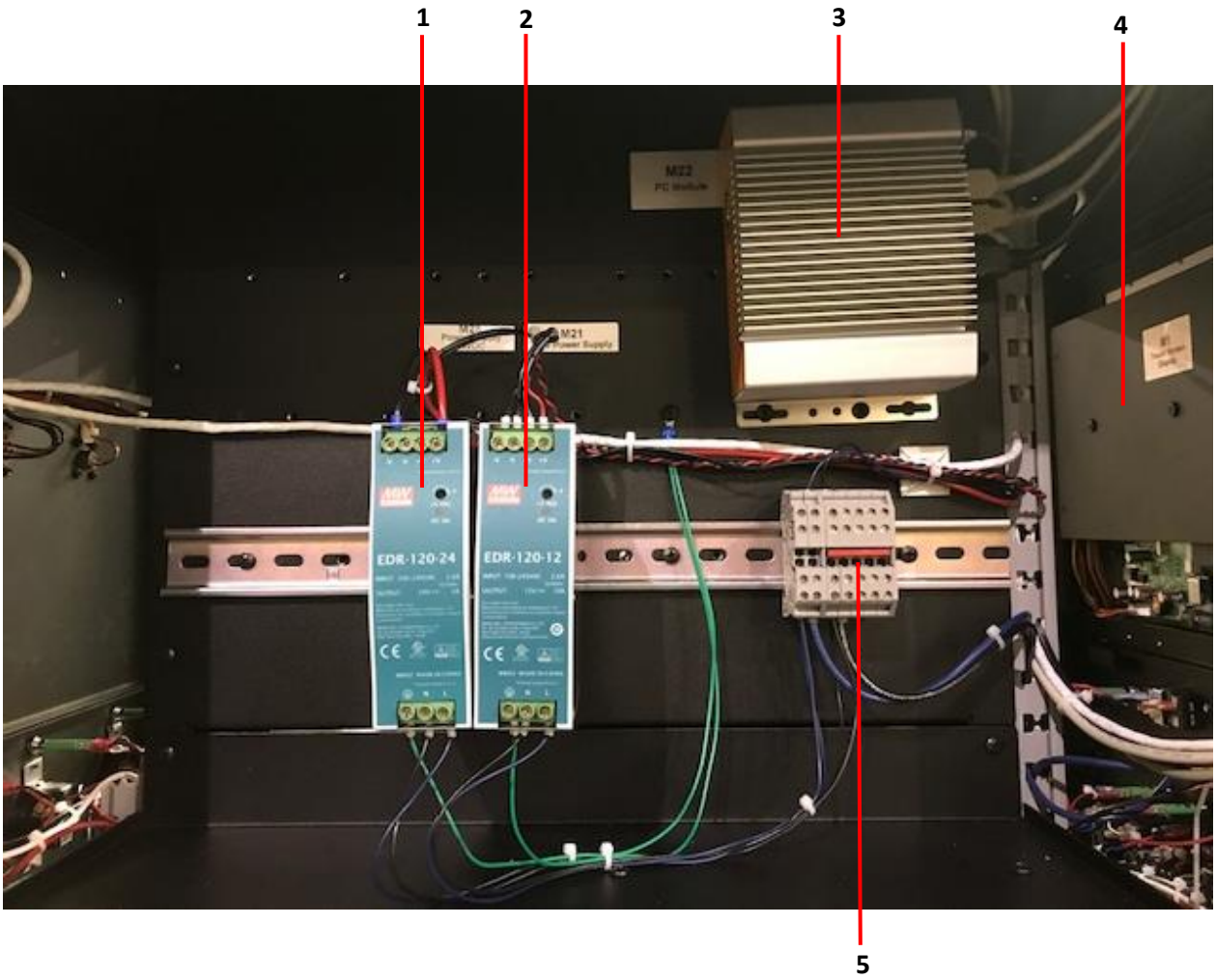
1. PLC Power Supply: +5 V power supply with ON/OFF switch.
2. Ethernet Hub for Digital communications between components.
3. Input High Density Breakout Board.
4. Touchscreen and embedded PC.
5. PLC Brain/Controller: Runs user programmed strategies (Ethernet accessible).
6. I/O Modules: I/O modules used for relay control.
7. HD Module: 32-bit high density input module for the HD breakout board.
8. I/O Modules: 32-bit high density input modules for smoke/heat detector boards.
9. PLC 120 V Bus.

MPDU PLC Left Side



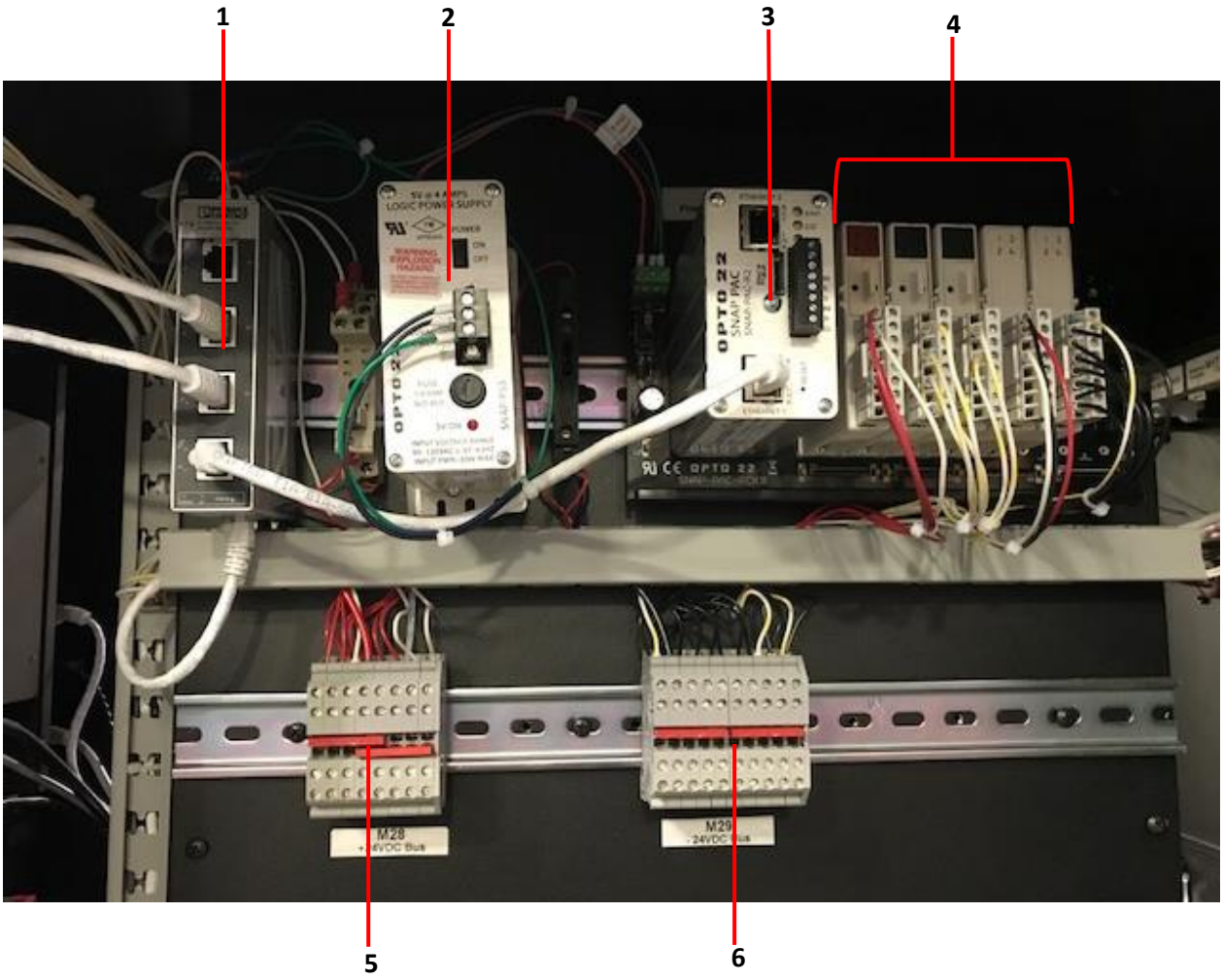
1. PLC Smoke Input Module: 32-bit high density breakout board for smoke detectors.
2. Test Switch: Test module switch (user programmable for testing).
3. PLC Heat Input Module: 32-bit high density breakout board for heat detectors.
4. EPO Relay
5. Heat/Smoke Positive Power Bus: Distributes power connections for heat/smoke modules.
6. Heat/Smoke Negative Power Bus: Distributes power connections for heat/smoke modules.
7. 24 V Heat/Smoke Power Supply: Provides power for heat/smoke input modules.

1.12 VMT MPDU Programmable Logic Controller (PLC)



MPDU PLC Left Side

1. 24 V power supply.
2. 12 V power supply.
3. PC module.
4. Touchscreen.
5. Terminal block.



MPDU PLC Right Side

1. Ethernet Switch, 8 TP RJ45 ports.
2. PLC Power Supply: +5 V power supply.
3. PLC Brain/Controller: Runs user programmed strategies (Ethernet accessible).
4. I/O Modules: I/O modules used for relay control.
5. +24 VDC terminal block.
6. -24 VDC terminal block

2. INSTALLATION

2.1 Unpacking the System

The MPDU™ is packed in a specially designed carton to protect it from damage during shipping. To transport or ship the unit, **use the original box**. When unpacking the system(s), carefully remove all packaging materials from the MPDU™ system and ensure that all items are received with the unit. Please reference your purchase order for a list of inclusions.

2.2 Contents of the System

All accessories/options and items included with the unit should be compared with the purchase order and packaging receipt during the unpacking process. Some of the listed items may include, but not be limited to, the following:

Instruction manual

Anchoring screws (½ inch diameter)

Mounting brackets

PLC Module Puller

EPO Jumper Plug

2.3 Inspection of the System

The MPDU™ system has passed a detailed quality verification procedure for all electrical and mechanical characteristics prior to shipment. The system has also been packaged so that it should arrive in perfect condition. Upon receipt of the unit, visually check the general condition and mechanical structure for any physical damage that may have occurred during shipment. If any physical damage is seen, have the carrier note the damage and contact Power Innovations immediately.

2.4 Site and Environment Considerations

The following precautions and recommendations should be taken into consideration before installing the MPDU™ system:

The MPDU™ system should be in a place with adequate ventilation.

The MPDU should be installed with a minimum of 24 inches (recommended 36 inches) clearance on both the left and right sides to allow access for service and maintenance.

It is important to ensure proper ventilation for heat evacuation when the MPDU is installed.

Do not locate the MPDU™ system near any of the following:

- Any heat source
- Pieces of machinery or equipment that produce metallic coil dust or powder
- Anything that produces corrosive substances or vapor
- Below the shower of a fire extinguishing (sprinkler) system (abnormal conditions of the MPDU™ system will be controlled by cutting off the power supply.)

The temperature and humidity values of the MPDU™ installation site must be within specified ranges. The system is capable of continuous normal operation within a temperature range of 0 ˚C (32 ˚F) to 50 ˚C (122 ˚F) and a relative humidity range of 0% to 90% (non-condensing). Under non-operating conditions, the equipment shall be capable of withstanding temperatures from -65 ˚F

to +160 ˚F and relative humidity of 5% to 100% (non-condensing) without sustaining permanent damage.

The MPDU should be installed in a controlled indoor environment.

Walls, ceilings, floors, or anything near the MPDU™ system should be constructed of non-combustible materials, and a portable fire extinguisher should be located near the unit.

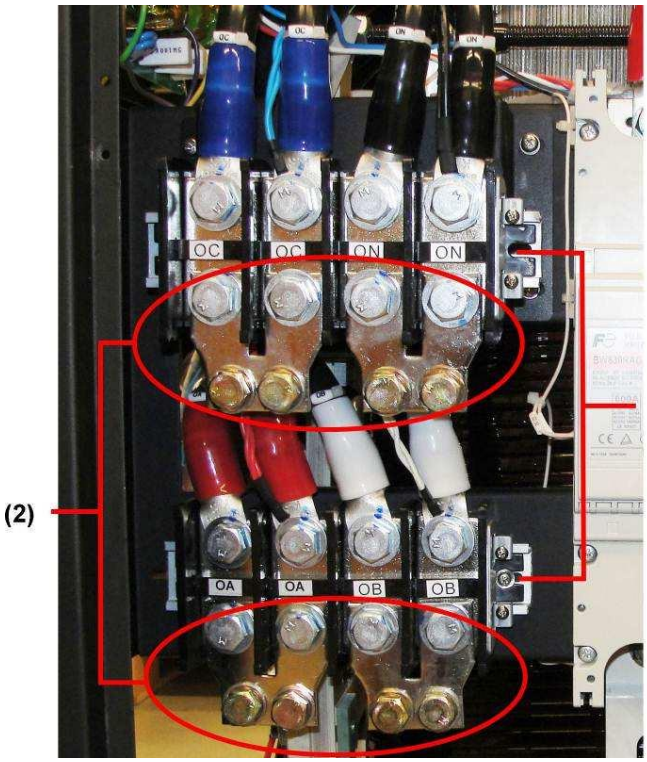
The area surrounding the MPDU™ system should be kept clean. Trash, metallic powders, filings, and other foreign objects can be drawn into the unit and cause damage.

Access to the room where the MPDU™ system is located should be limited to a minimum number of operation and maintenance personnel.

Personnel who operate or maintain the MPDU™ system should be proficient in normal and emergency operational procedures. New personnel should be trained and qualified prior to operating the equipment.

The floor loading capacity of the installation site should be such that it can handle the weight of the MPDU™. The unit should be anchored to the floor with the screws (dia. ½ inch) supplied with the unit, particularly if the unit is in areas where movement may occur (see following section).

2.5 Q-LS Output Connections



1. Q-LS™ Output Terminal Blocks. For parallel connection remove the single-wire connection brackets.
2. Output Connection points to MPDU™.

2.6 MPDU Input Connections

The following steps will guide the proper installation of the MPDU™ system. Any deviation in the setup outlined below may cause serious harm or death to the user and may also void the warranty.

WARNING: Verify that AC input / battery cables are not connected to a live source of power and that all breakers and disconnects are OFF. Failure to do so could cause serious harm or death.

Remove the Input Gland Plate (see *1.4 MPDU Back Panel*) and both side plates.

Terminal Block Locations

The MPDU™ has a terminal block on each side located near the bottom of the unit.

Front View

Figure 12

Input Installation

Left Terminal Block

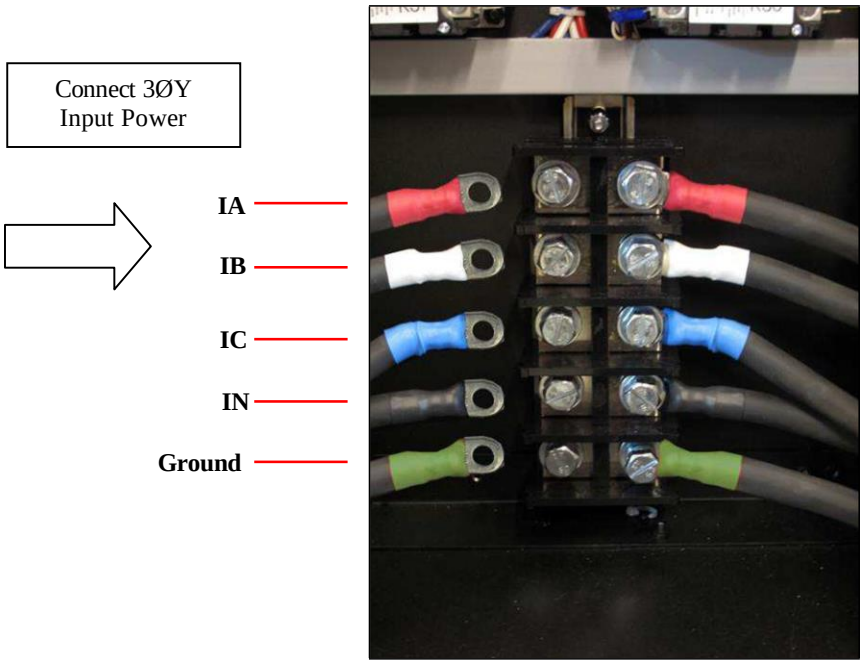


Fig 13.0

Right Terminal Block

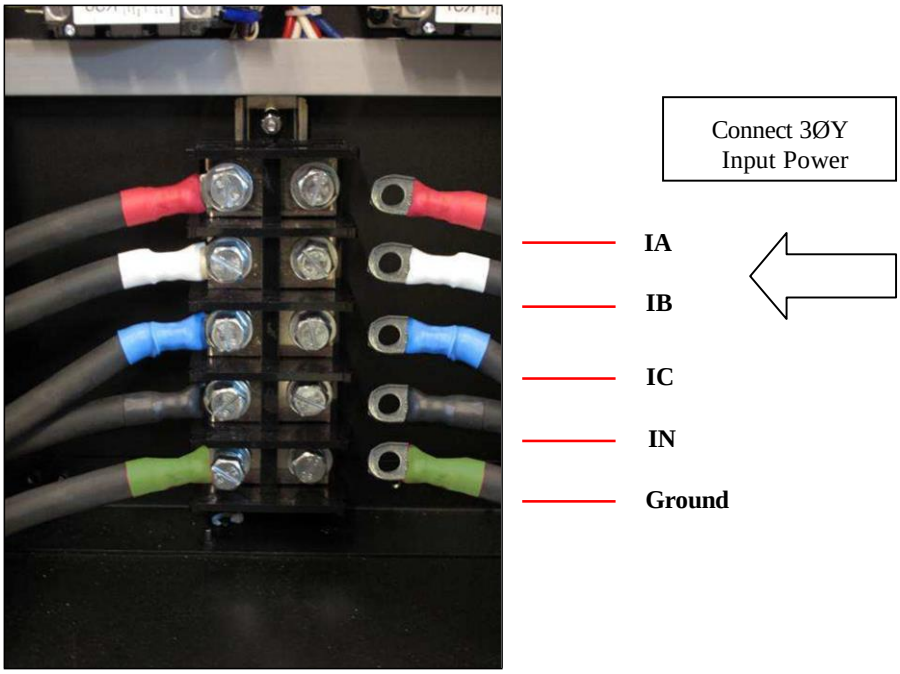


Fig 14.0

2.7 Q-LS / MPDU Data Connection

Install the MPDU data cable by plugging it into the Q-LS and MPDU RJ-45 data communication ports.

Fig 15.0

Q-LS System (Front)

MPDU Communication Link

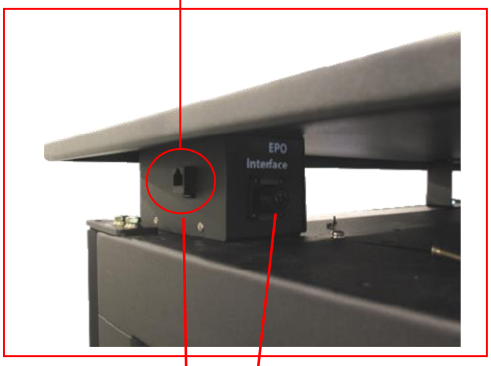


Fig 16.0 - Remote EPO Interface Port

Fig 17.0

Q-MPDU System (Back)

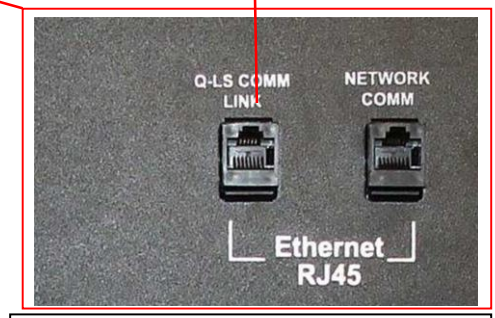


Fig 18.0 -Q-LS Communication Link

3. OPERATION

3.1 Pre-start Re-check

Once all cables are properly connected and the power source is connected to the input terminals, the MPDU system is ready for operation. Before turning ON any switches or breakers, re-check the following items:

All connected loads should be OFF.

All breakers should be OFF.

Ensure that there are no packaging materials, tools, or other foreign materials inside or on top of the units.

Replace side panels and gland plate.

3.2 Operating Procedure

Startup Procedure

To start the MPDU™ system in normal operating mode,

1. Turn ON the Q-LS™ system.
2. Push the EPO Delay button.
3. Turn ON the MPDU Logic Power Breaker.
4. Turn ON the MAIN INPUT breaker. The MPDU Main Power Status LED on the front panel will illuminate, indicating that the power input to the MPDU system is live.
5. The MPDS™ software will boot up and start on the Touchscreen. Once the software has loaded, the MPDU is ready for operation.
6. Turn on desired secondary breakers.
7. Sequence the trainer power up by pushing the Trainer Power ON/OF button. This will activate the PLC, turning on receptacles in the order programmed in the PLC.

Shutdown Procedure

To shut down the MPDU™ system,

1. Sequence down by pushing the Trainer Power ON/OFF button.
2. Turn OFF the MPDU Logic Power Breaker.
3. Turn OFF the MAIN INPUT breaker. The MPDU Main Power Status LED on the front panel will darken, indicating that the power input to the MPDU system has been shut OFF.

4. TOUCHSCREEN

The Touchscreen provides user access to the MPDS™ desktop software. This software monitors input and battery power from the Q-LS™ system and provides PLC status.

4.1 MPDS™ Software User Guide

Refer to the MPDS™ Software User's Guide.

5. PROGRAMMABLE LOGIC CONTROLLER (PLC)

5.1 PLC Overview

NOTE: This section is intended as a reference only. The information herein may refer to specific PDUs that vary from the others.

The PDU has an integrated OPTO-22 SNAP-PAC-R2™* Programmable Logic Controller (PLC) used to monitor external status events and control the distribution of system power.

*Refer to 1595_SNAP_PAC_R_series_Users_Guide.pdf **(**See MPDS CD**)**

5.2 PLC Inputs

There are two banks of thirty-two (32) input ports in the PLC for a total of sixty-four (64) input status ports.

Smoke and Heat Detect

Fifty (50) input ports are used to monitor the status from the twenty-five (25) DB9 connectors on the rear panel of some PDU configurations.

Each DB9 connector is wired as follows:

Pin 1: +24 VDC
Pin 2: Smoke detection
Pin 3: Temperature detection
Pin 4: +24 VDC return
All other pins are left blank.

The PLC is programmed to disconnect outputs associated with smoke detectors as per table 5.

Smoke Alarm-Table 5**

Unit Number	Description	AC Disconnect Panel	Overheat/Smoke Interface Panel
Unit 1	Fuselage	J24, 25, J26	D17
Unit 11	HCS CABINET	J11	D1
Unit 12	ACS CABINET	J12	D2
Unit 8	IOC Cabinet 1	J13	D9
Unit 9	IOC Cabinet 2	J14	D10
Unit 10	IOC Cabinet 3	J15	D11
Unit 13A2	MCDS Bay 2 PDU 1	J20,J21,J22, J23	D3 or D4
Unit 14A1	VMS Bay 1	J16, J17, J18	D5, D6, D7or
Unit 15	IG Cabinet	J19	D12
Unit 16A1	SUPFS Cabinet 1	J1, J2, J3, J36, J37, J38, J39, J40, J41	D13, D14, or D15
Unit 19	TSAS Cabinet	J4	D16
Unit 20	AeDTE	J27, J28	D18 (J27 and J28 both turn off)

***NOTE: Overheat alarms do not disconnect output power. An alarm will sound during overheat detection.**
****NOTE: This table is an example and may vary from system to system.**

User Control

A single input status line is used to provide the state of the front panel "Trainer Power ON/OFF" button. This button is polled by the internal PLC program and is used for user input to the PLC.

5.3 PLC Control

Depending on the MPDU variety, the PLC uses a combination of High Density and standard I/O modules to control the relays and contactors in the lower section of the MPDU.

5.4 Additional Information

PLC Programming

A default program is loaded into the PLC during the FAT process. The following example program may be used as a base for more complex control using the PLC. The program was developed using Opto22 PAC BASIC development tools further information may be found on the Opto22 website www.opto22.com

PAC Project – Refer to 1700_PAC_Control_Users_Guide.pdf **(**See MDPS CD**)**

PLC Network Interface

PAC Manager – Refer to 1704_PAC_Manager_Users_Guide.pdf **(**See MPDS CD**)**

6. PLC SOURCE CODE EXAMPLE

Programmable Logic
Factory Test Code Example
for
The Boeing P-8A MPDU
by
David Spencer
Systems Engineer

6.1 Introduction

The PLC is programmed through the OPTO-22 PAC Control Basic™ Integrated Development Environment (IDE) using a high level modified flowchart programming language. The software can be developed using a standard Microsoft Windows operating system with the PAC Control Basic software installed. Communication to the PLC module is via the Ethernet/TCP/IP interface on the MPDU front panel Ethernet Maintenance port. This document provides an example of flowchart and source code programmed at the factory for initial testing of the system. The pre-programmed default IP address for the PLC is 10.10.10.102. The default subnet mask for the PLC is 255.0.0.0.

Scope

This document covers an example PLC code for the Boeing P-8A MPDU system. This code is intended to be used as a simple guide of how the system may be programmed and performs a simple ON and OFF sequence of the unit relays, as well as monitoring input signals from the smoke and over temperature detectors. This document is not meant to be the final code used in the system and may not demonstrate the most effective programming methods for system setup. Items listed in the following section may not reflect all system configurations.

Components

The following table gives the listing of the components used in the PLC configuration:

```
TITLE:     Bill of Materials
STRATEGY:  Boeing P-8 control
DATE:      12/21/10   TIME: 17:50:42

_____________________________________________________________________
_____

Brains
    1  SNAP-PAC-R2(SNAP-PAC-R2)

Digital Input Modules
    2  SNAP-IDC-32: 10 - 32 VDC

Digital Output Modules
    1  SNAP-ODC-32-SRC: 5 - 60 VDC Source
```

```
    7  SNAP-OAC5: 12 - 250 VAC

Analog Input Modules

Analog Output Modules

Totals
Total Brains: 1
Total Modules: 10

NOTE: Controllers, power supplies, and mounting racks are not specified.
```

6.2 I/O Mapping

Three different types of modules are used for input/output control in this system.

1. All AC relays are controlled by four (4) channel modules located in slots 0 – 12 on the component rack.

2. Slot 13 contains a four (4) channel DC output module for the Piezo alarm and Trainer ON/OF switch LED control

3. Slots 14 and 15 contain high-density, 32-channel input modules for sensing the smoke and over temperature detectors as well as the Logic Switch contacts.

Example I/O mappings are found in Appendix A. This appendix shows each mapped I/O by name, module and channel for each digital point used. The 'MOD' column gives the rack module location. The "CH" column gives the channel within the module.

6.3 Smoke Alarm Table

The Smoke Alarm Table shows the connection relationship of AC Disconnect Panels to corresponding Overheat/Smoke Interface panels. When an Overheat/Smoke Interface Panel alarm is activated, the connected AC Disconnect Panel will turn OFF.

Smoke Alarm -Table 1**

Unit Number	Description	AC Disconnect Panel	Overheat/Smoke Interface Panel
Unit 500	Support Equipment cabinet	J1	EPO Out
Unit 1	Fuselage	J24	D17 (J24, J25, and J26 all turn off)
		J25	D17 (J24, J25, and J26 all turn off)
		J26	D17 (J24, J25, and J26 all turn off)
Unit 11	HCS CABINET	J11	D1
Unit 12	ACS CABINET	J12	D2
Unit 8	IOC Cabinet 1	J13	D9
Unit 9	IOC Cabinet 2	J14	D10
Unit 10	IOC Cabinet 3	J15	D11
Unit 13A2	MCDS Bay 2 PDU 1	J20	**D3 or D4** (J20, J21, J22, and J23 all turn off)
	MCDS Bay 2 PDU 2	J21	**D3 or D4** (J20, J21, J22, and J23 all turn off)
	MCDS Bay 2 PDU 3	J22	**D3 or D4** (J20, J21, J22, and J23 all turn off)
	MCDS Bay 2 PDU 4	J23	**D3 or D4** (J20, J21, J22, and J23 all turn off)
Unit 13A1	MCDS Bay 1 (Shared Power with Bay 2)		
Unit 14A1	VMS Bay 1	J16	**D5, D6, D7, or D8** (J16, J17, and J18 all turn off)
Unit 14A2	VMS Bay 2 (Shared Power with Bay 1)		**D5, D6, D7, or D8** (J16, J17, and J18 all turn off)
Unit 14A3	VMS Bay 3	J17	**D5, D6, D7, or D8** (J16, J17, and J18 all turn off)
Unit 14A4	VMS Bay 4	J18	**D5, D6, D7, or D8** (J16, J17, and J18 all turn off)
Unit 15	IG Cabinet	J19	D12
Unit 16A1	SUPFS Cabinet 1	J1	**D13, D14, or D15** (J1, J2, J3, J36, J37, J38, J39, J40, and J41 all turn off)
Unit 16A1	SUPFS Cabinet 1	J36	
Unit 16A1	SUPFS Cabinet 1	J37	

Unit 16A2	SUPFS Cabinet 2	J2	**D13, D14, or D15** (J1, J2, J3, J36, J37, J38, J39, J40
Unit 16A2	SUPFS Cabinet 2	J38	
Unit 16A2	SUPFS Cabinet 2	J39	
Unit 16A3	SUPFS Cabinet 3	J3	**D13, D14, or D15** (J1, J2, J3, J36, J37, J38, J39, J40
Unit 16A3	SUPFS Cabinet 3	J40	
Unit 16A3	SUPFS Cabinet 3	J41	
Unit 19	TSAS Cabinet	J4	D16
Unit 20	AeDTE	J27	D18 (J27 and J28 both turn off)
	AeDTE	J28	

***NOTE: Overheat alarm does not shut down power to the affected cabinet. Alarm will sound during overheat period.**

****NOTE: This table is an example and may vary from system to system.**

6.4 Flowchart

Programs for the PLC are termed "Strategies." A strategy is made up of one to sixteen charts. Each chart runs independently, but may be controlled by functions in other charts. The example shown below consists of two charts. The first chart shows the 'Main' routine, which is the basic test program for sequencing the relays ON and OFF. The second chart monitors the smoke and over temperature signals and controls the relays, but is independent of the Main chart.

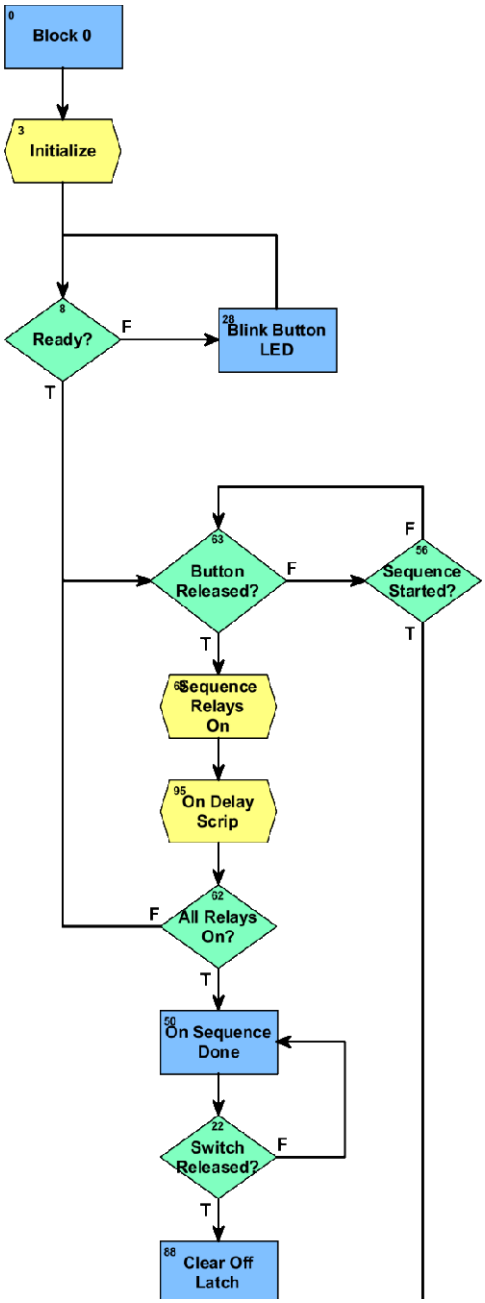
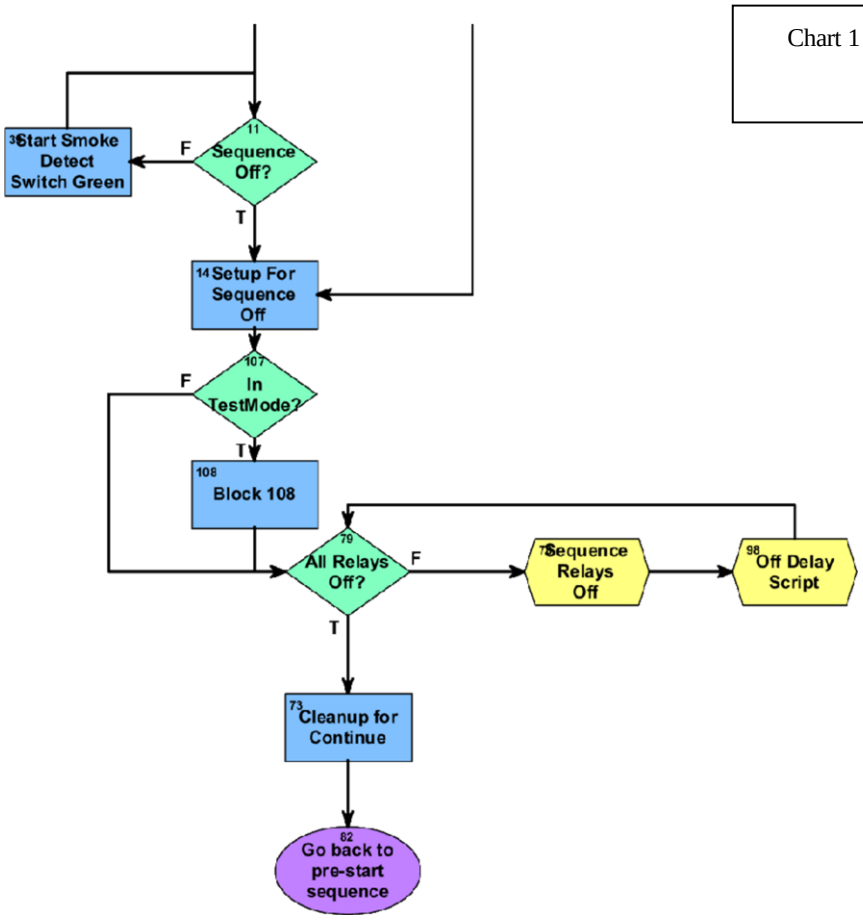


Chart 1 – Main Routine
Part 1

Chart 1 – Main Routine
Part 2



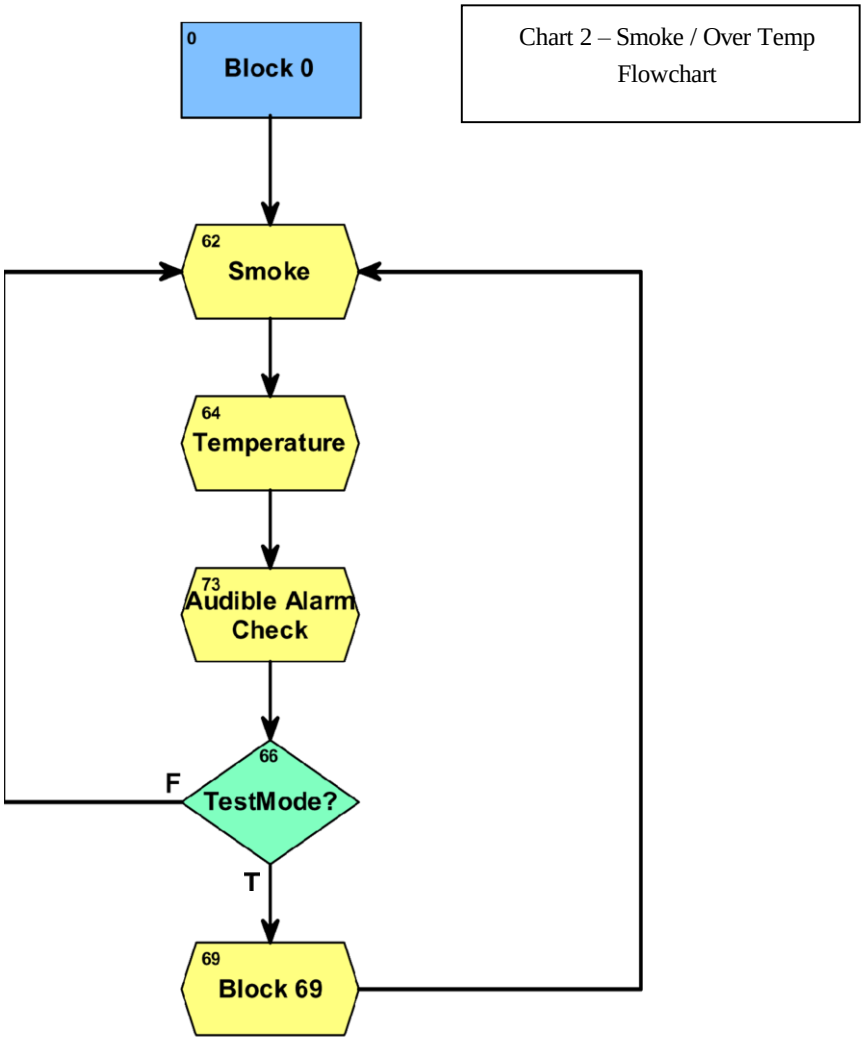


Chart 2 – Smoke / Over Temp Flowchart

Chart 3 – VMT PLC EPO

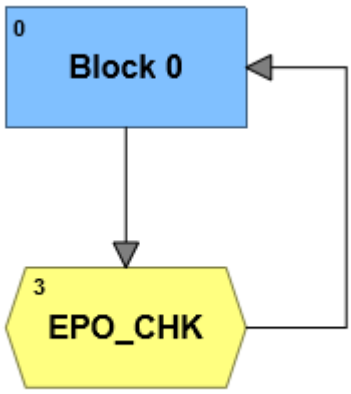


Chart 4 – VMT Button Check

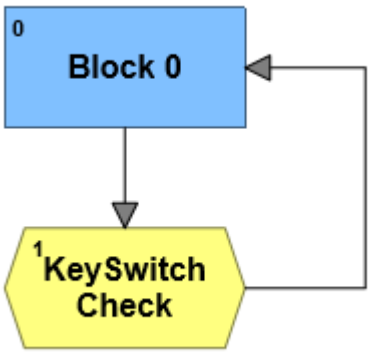


Chart 5 – VMT PLC Smoke Detector

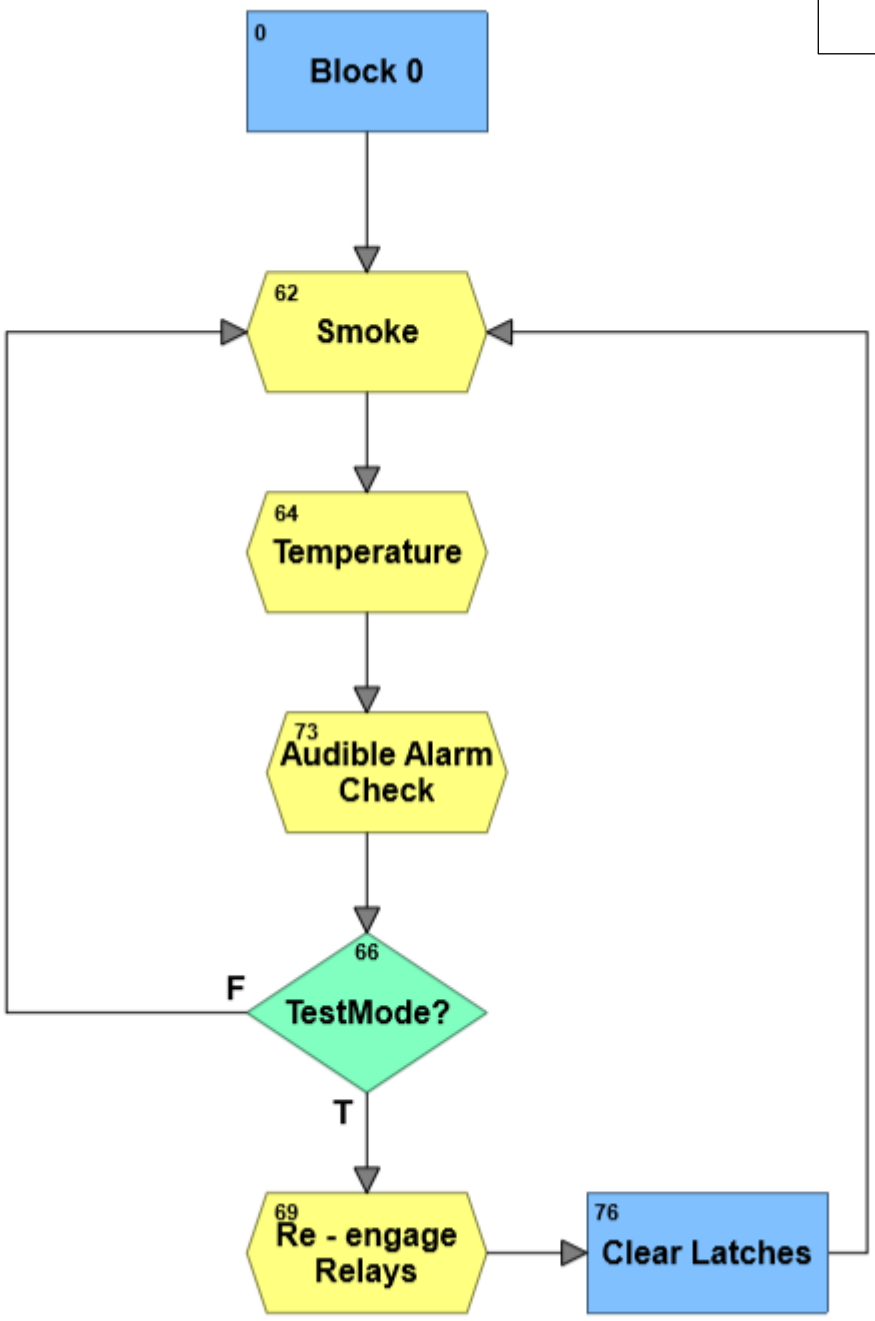


Chart 6 – VMT PLC Smoke Detector

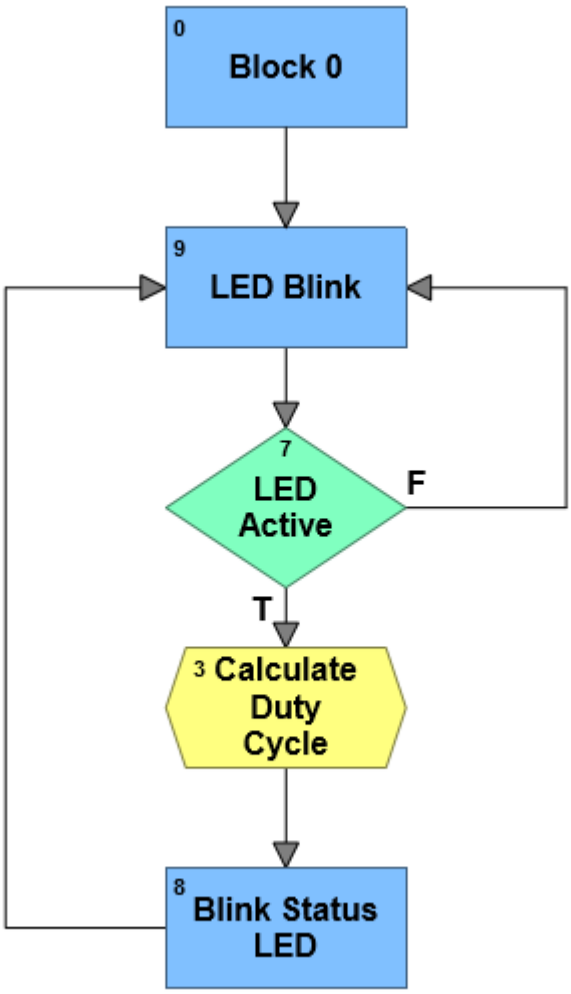


Chart 7 – VMT PLC Powerup

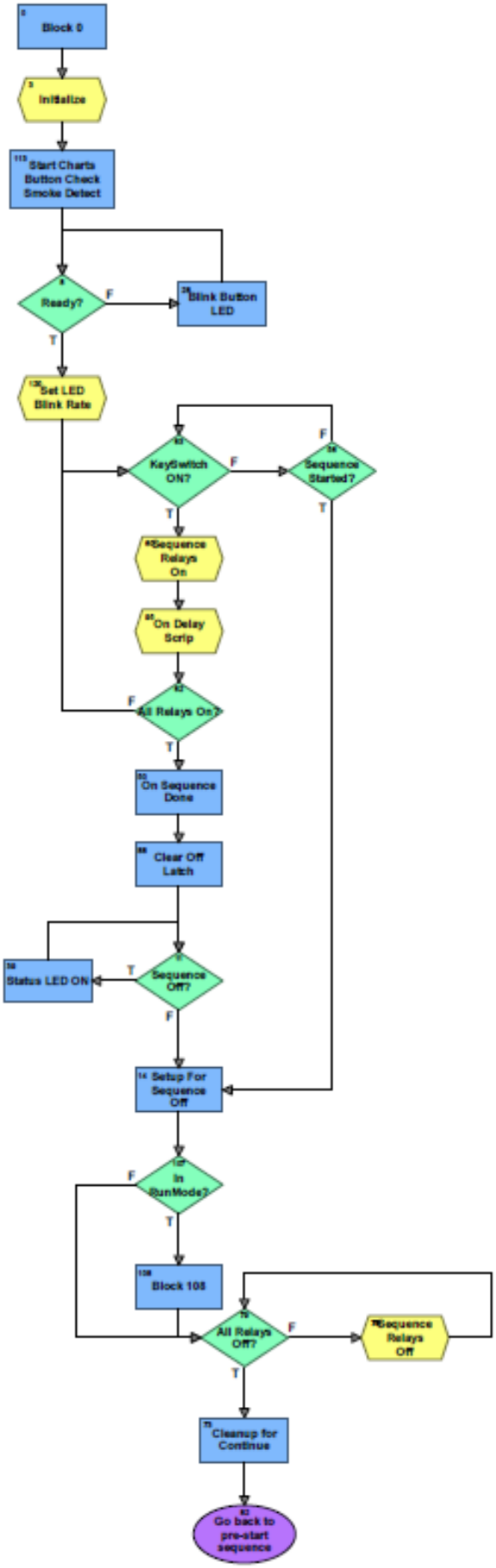
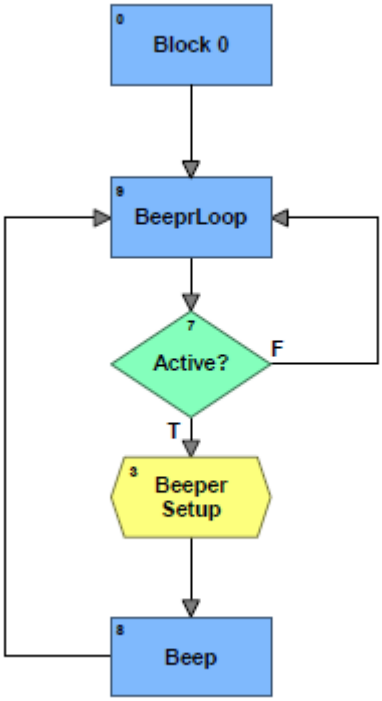


Chart 8 – VMT PLC Beeper Chart



Main Routine Program Functions/Indications

1. Unit startup and initialization.
2. When the unit is ready, the program sounds a half second beep, followed by a quarter second delay, followed by a quarter second beep.
3. The "Trainer Logic Power" button LED flashes green at a quarter second rate.
4. When the "Trainer Logic Power" key switch is pressed, the relays begin sequencing ON starting with relay K1.
   Pressing the switch during the ON sequence will cause the sequence to abort and sequence down. The sequence delay rate is set to 1 second (0.5 second in TestMode*).
5. Once the ON sequence is complete, the detector routines are enabled and the smoke and over temperature inputs are monitored. The "Trainer Logic Status" button LED is lighted and is not flashing.
6. This is the normal mode for system operation.
7. If an over temperature event occurs, the beeper sounds twice every five seconds.
8. If smoke is detected, the beeper sounds three times every five seconds and the relays specified in the Smoke Alarm chart are turned OFF.
9. If both smoke and temperature events occur simultaneously, three beeps will sound every five seconds and the specified relays (Smoke Alarm Table) will be turned OFF.
10. If the 'Trainer Logic Power' button is pressed, the relays are sequenced OFF beginning with K40 and sequence down at a half second delay rate.

*Test mode is enabled by opening the black fuse holder located on the PLC panel inside the upper right section of the MPDU.

In the event of a smoke alarm, the unit should be sequenced down, the event cleared (reset the detector), and then powered back up. In test mode, clearing the event will turn the associated relays back on automatically. Delay times may be altered in the initialization block on the Main routine chart.

Programming the PLC

See MNL152—MPDS TouchScreen Management and Remote Access User's Guide and MNL153—Cold Start User's Guide for additional programming information.

Source Code

Appendix B gives a module-by-module listing of the source code generated for the factory test program strategy. While this code may be useful for system operation, it is intended as an example program and a template for building customer specific applications.

Appendix A – I/O Mapping

TITLE: Block Instructions for WTT, TSSC, PTT
STRATEGY: Boeing P-8 control
DATE: 12/21/10 **TIME:** 17:51:54

CHART: Powerup

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: Initialize (Id: 3)

There are no instructions in this action block.

Action Block: Block 14 (Id: 14)
This action block has no exit.

Start Chart

Chart	Sequence_OFF
Put Status In	Status_toss

Action Block: Start sequence (Id: 1)

Exit to: Block 11 (Id: 11)

Start Chart

Chart	Sequence_ON
Put Status In	RLY_PTR

SCRIPTS

OptoScript Block: Initialize (Id: 3)
Exit to: Block 8 (Id: 8)

```
Relay_Table[0] = &K1;
Relay_Table[1] = &K2;
Relay_Table[2] = &K3;
Relay_Table[3] = &K4;
Relay_Table[4] = &K5;
Relay_Table[5] = &K6;
Relay_Table[6] = &K7;
Relay_Table[7] = &K8;
Relay_Table[8] = &K9;
Relay_Table[9] = &K10;
Relay_Table[10] = &K11;
Relay_Table[11] = &K12;
Relay_Table[12] = &K13;
Relay_Table[13] = &K14;
Relay_Table[14] = &K15;
Relay_Table[15] = &K16;
Relay_Table[16] = &K17;
Relay_Table[17] = &K18;
Relay_Table[18] = &K19;
Relay_Table[19] = &K20;
Relay_Table[20] = &K21;
Relay_Table[21] = &K22;
Relay_Table[22] = &K23;
Relay_Table[23] = &K24;
Relay_Table[24] = &K25;
Relay_Table[25] = &K26;
Relay_Table[26] = &K27;
Relay_Table[27] = &K28;
Relay_Table[28] = &K29;
Relay_Table[29] = &K30;
Relay_Table[30] = &K31;
Relay_Table[31] = &K32;
```

```
Relay_Table[32]  = &K33;
Relay_Table[33]  = &K34;
Relay_Table[34]  = &K35;
Relay_Table[35]  = &K36;
Relay_Table[36]  = &K37;
Relay_Table[37]  = &K38;
Relay_Table[38]  = &K39;
Relay_Table[39] = &K40;


Smoke_Table[0]=&Smoke_1;
Smoke_Table[1]=&Smoke_2;
Smoke_Table[2]=&Smoke_3;
Smoke_Table[3]=&Smoke_4;
Smoke_Table[4]=&Smoke_5;
Smoke_Table[5]=&Smoke_6;
Smoke_Table[6]=&Smoke_7;
Smoke_Table[7]=&Smoke_8;
Smoke_Table[8]=&Smoke_9;
Smoke_Table[9]=&Smoke_10;
Smoke_Table[10]=&Smoke_11;
Smoke_Table[11]=&Smoke_12;
Smoke_Table[12]=&Smoke_13;
Smoke_Table[13]=&Smoke_14;
Smoke_Table[14]=&Smoke_15;
Smoke_Table[15]=&Smoke_16;
Smoke_Table[16]=&Smoke_17;
Smoke_Table[17]=&Smoke_18;
Smoke_Table[18]=&Smoke_19;
Smoke_Table[19]=&Smoke_20;
Smoke_Table[20]=&Smoke_21;
Smoke_Table[21]=&Smoke_22;
Smoke_Table[22]=&Smoke_23;
Smoke_Table[23]=&Smoke_24;

Temp_Table[0]=&OT_1;
Temp_Table[1]=&OT_2;
Temp_Table[2]=&OT_3;
Temp_Table[3]=&OT_4;
Temp_Table[4]=&OT_5;
Temp_Table[5]=&OT_6;
Temp_Table[6]=&OT_7;
Temp_Table[7]=&OT_8;
Temp_Table[8]=&OT_9;
Temp_Table[9]=&OT_10;
Temp_Table[10]=&OT_11;
```

```
Temp_Table[11]=&OT_12;
Temp_Table[12]=&OT_13;
Temp_Table[13]=&OT_14;
Temp_Table[14]=&OT_15;
Temp_Table[15]=&OT_16;
Temp_Table[16]=&OT_17;
Temp_Table[17]=&OT_18;
Temp_Table[18]=&OT_19;
Temp_Table[19]=&OT_20;
Temp_Table[20]=&OT_21;
Temp_Table[21]=&OT_22;
Temp_Table[22]=&OT_23;
Temp_Table[23]=&OT_24;

//,&K2,&K3,&K4,&K5,&K6,&K7,&K8,&K9,&K10,&K11,&K12,&K13,&K14,&K15,&K16,&K17,
&K18,&K19,&K20,&K21,&K22,&K23,&K24,&K25,&K26,&K27,&K28,&K29,&K30,&K31,&K32,
&K33,&K34,&K35,&K36,&K37,&K38,&K39,&K40;
```

CONDITIONS

Condition Block: Block 11 (Id: 11)
Operator Type: AND
TRUE Exit to: Block 14 (Id: 14)
This condition block has no FALSE exit.

Is Logic_Switch **On?**

Is Start_Done **Variable True?**

Condition Block: Block 8 (Id: 8)
Operator Type: AND
TRUE Exit to: Start sequence (Id: 1)
FALSE Exit to: Block 11 (Id: 11)

Is Start_Done **AND?**

Is Logic_Switch
On?

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

CHART: Sequence_OFF

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: Check Button (Id: 10)

There are no instructions in this action block.

Action Block: Block 8 (Id: 8)
This action block has no exit.

Set Variable True
Stop_Done

Turn Off
K1

Stop Chart
Chart Sequence_OFF

Action Block: Wait 1 Second (Id: 3)
Exit to: Block 1 (Id: 1)

Delay (Sec)
Sec_Wait_Time

SCRIPTS

OptoScript Block: Turn Off Relays (Id: 2)

Exit to: Wait 1 Second (Id: 3)

```
// Turn on dynamic relay control
RLY_PTR=Relay_Table[Relay_Count];
TurnOFF(*RLY_PTR);
Relay_Count=Relay_Count-1;
```

CONDITIONS

Condition Block: Block 1 (Id: 1)
Operator Type: AND
TRUE Exit to: Block 8 (Id: 8)
FALSE Exit to: Turn Off Relays (Id: 2)

	Is	Relay_Count
Equal?		
	To	0

Condition Block: Check Button (Id: 10)
Operator Type: AND
TRUE Exit to: Block 1 (Id: 1)
This condition block has no FALSE exit.

	Is	Logic_Switch
Off?		

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

CHART: Sequence_ON

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: Button Open? (Id: 10)

There are no instructions in this action block.

Action Block: Stop (Id: 41)
This action block has no exit.

Set Variable True
Start_Done

Stop Chart
Chart Sequence_ON

Action Block: Stop and sequence OFF (Id: 35)
This action block has no exit.

Stop Chart
Chart Sequence_ON

Start Chart
Chart Sequence_OFF
Put Status In Status_toss

Action Block: Wait 1 Second (Id: 5)
Exit to: All Relays On? (Id: 15)

Delay (Sec)
Sec_Wait_Time

SCRIPTS

OptoScript Block: Block 23 (Id: 23)
Exit to: Wait 1 Second (Id: 5)

```
// Turn on dynamic relay control
```

```
RLY_PTR=Relay_Table[Relay_Count];

TurnOn(*RLY_PTR);

Relay_Count=Relay_Count+1;
```

CONDITIONS

Condition Block: All Relays On? (Id: 15)
Operator Type: AND
TRUE Exit to: Stop (Id: 41)
FALSE Exit to: Button Open? (Id: 10)

	Is	Relay_Count
Equal?		
	To	40.0

Condition Block: Button Open? (Id: 10)
Operator Type: AND
TRUE Exit to: Block 23 (Id: 23)
FALSE Exit to: Sequence Started? (Id: 30)

	Is	Logic_Switch
Off?		

Condition Block: Sequence Started? (Id: 30)
Operator Type: AND
TRUE Exit to: Stop and sequence OFF (Id: 35)
FALSE Exit to: Button Open? (Id: 10)

	Is	Relay_Count
Greater?		
	Than	0

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

CHART: Smoke_Detect

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: Block 62 (Id: 62)

There are no instructions in this action block.

SCRIPTS

OptoScript Block: Block 62 (Id: 62)
This OptoScript block has no exit.

```
if((not Smoke_1) or (not OT_1)) then
  K16=0;
  s_t_alarm=s_t_alarm bitor 0x00000001;

endif

if((not Smoke_2) or (not OT_2)) then
  K17=0;
  s_t_alarm=s_t_alarm bitor  0x00000002;
endif

if((not Smoke_3) or (not OT_3)) then
  s_t_alarm=s_t_alarm bitor  0x00000004;
endif

if((not Smoke_4) or (not OT_4)) then
  K25=0;
  s_t_alarm=s_t_alarm bitor  0x00000008;
endif

if((not Smoke_5) or (not OT_5)) then
  K21=0;
  s_t_alarm=s_t_alarm bitor  0x00000010;
endif

if((not Smoke_6) or (not OT_6)) then
```

```
  s_t_alarm=s_t_alarm bitor  0x00000020;
endif

if((not Smoke_7) or (not OT_7)) then
  K22=0;
  s_t_alarm=s_t_alarm bitor  0x00000040;
endif

if((not Smoke_8) or (not OT_8)) then
  K23=0;
  s_t_alarm=s_t_alarm bitor  0x00000080;
endif

if((not Smoke_9) or (not OT_9)) then
  K18=0;
  s_t_alarm=s_t_alarm bitor  0x00000100;
endif

if((not Smoke_10) or (not OT_10)) then
  K19=0;
  s_t_alarm=s_t_alarm bitor  0x00000200;
endif

if((not Smoke_11) or (not OT_11)) then
  K20=0;
  s_t_alarm=s_t_alarm bitor  0x00000400;
endif

if((not Smoke_12) or (not OT_12)) then
  K24=0;
  s_t_alarm=s_t_alarm bitor  0x00000800;
endif

if((not Smoke_13) or (not OT_13)) then
  K6=0;
  K7=0;
  K8=0;
  K9=0;
  s_t_alarm=s_t_alarm bitor  0x00001000;
endif

if((not Smoke_14) or (not OT_14)) then
  K10=0;
  s_t_alarm=s_t_alarm bitor  0x00002000;
endif
```

```
if((not Smoke_15) or (not OT_15)) then
  K29=0;
  K30=0;
  K31=0;
  s_t_alarm=s_t_alarm bitor 0x00004000;
endif

if((not Smoke_16) or (not OT_16)) then
  K32=0;
  s_t_alarm=s_t_alarm bitor 0x00008000;
endif

if((not Smoke_17) or (not OT_17)) then
  s_t_alarm=s_t_alarm bitor 0x00010000;
endif

if((not Smoke_18) or (not OT_18)) then
  s_t_alarm=s_t_alarm bitor 0x00020000;
endif


if((not Smoke_19) or (not OT_19)) then
  s_t_alarm=s_t_alarm bitor 0x00040000;
endif


if((not Smoke_20) or (not OT_20)) then
  s_t_alarm=s_t_alarm bitor 0x00080000;
endif


if((not Smoke_21) or (not OT_21)) then
  s_t_alarm=s_t_alarm bitor 0x00100000;
endif


if((not Smoke_22) or (not OT_22)) then
  s_t_alarm=s_t_alarm bitor 0x00200000;
endif


if((not Smoke_23) or (not OT_23)) then
  s_t_alarm=s_t_alarm bitor 0x00400000;
endif
```

```
if((not Smoke_24) or (not OT_24)) then
  s_t_alarm=s_t_alarm bitor 0x00800000;
endif


if((not Smoke_25) or (not OT_25)) then
  s_t_alarm=s_t_alarm bitor 0x01000000;
endif
```

CONDITIONS

There are no condition blocks in this flowchart.

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

A.1 Block Instructions for VMT

TITLE: Block Instructions for VMT
STRATEGY: VMT_PLC
DATE: 08/10/17 **TIME:** 16:20:55

CHART: BeeperChart

ACTIONS

Action Block: Beep (Id: 8)
Exit to: BeeprLoop (Id: 9)

Blink the LED at a half second rate
Turn On
Beeper

Delay (mSec)
BPR_OnTime

Turn Off
Beeper

Delay (mSec)
BPR_OnTime

Delay (mSec)
BPR_OffTime

Action Block: BeeprLoop (Id: 9)
Exit to: Active? (Id: 7)

There are no instructions in this action block.

Action Block: Block 0 (Id: 0)
Exit to: BeeprLoop (Id: 9)

There are no instructions in this action block.

SCRIPTS

OptoScript Block: Beeper Setup (Id: 3)
Exit to: Beep (Id: 8)

```
//
// LED blink rate
//
// 1 second Period
//
// ratio duty cycle
//

BPR_OnTime = 250;
BPR_OffTime = 128;


If(BPR_Count==0) then
  BPR_Active=0;
  BPR_Count=1;
Else

  BPR_Count=BPR_Count-1;

Endif
```

CONDITIONS

Condition Block: Active? (Id: 7)
Operator Type: AND
TRUE Exit to: Beeper Setup (Id: 3)
FALSE Exit to: BeeprLoop (Id: 9)

Is **Variable True?**	BPR_Active

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

CHART: ButtonCheck

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: KeySwitch Check (Id: 1)

There are no instructions in this action block.

SCRIPTS

OptoScript Block: KeySwitch Check (Id: 1)
Exit to: Block 0 (Id: 0)

```
//
// Debounces KeySwitch
// Without this code, when the EPO was activated and the breaker tripped, the button false
detected
// true and activated a button press sequence.
//

if(KeySwitch) then
 DelayMsec(150);
 if(KeySwitch) then
  ButtonPress=1;
 endif
endif
```

CONDITIONS

There are no condition blocks in this flowchart.

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

CHART: EPO_Chart

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: EPO_CHK (Id: 3)

There are no instructions in this action block.

SCRIPTS

OptoScript Block: EPO_CHK (Id: 3)
Exit to: Block 0 (Id: 0)

```
//
// Checks EPO signal
//   EPO is active low
//   a simple time delay debounce method is used to prevent false positives
//

if(not EPO_SNS and RunMode) then
 DelayMsec(150);
 if(not EPO_SNS) then
  Beeper=1;
  J10=0;
  J11=0;
  J12=0;
  J13=0;
  J14=0;
  J15=0;
  EPO=1;
 endif
endif
```

CONDITIONS

There are no condition blocks in this flowchart.

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

CHART: Powerup

ACTIONS

Action Block: Blink Button LED (Id: 28)
Exit to: Ready? (Id: 8)

Set Variable True
LED_Active

Action Block: Block 0 (Id: 0)
Exit to: Initialize (Id: 3)

There are no instructions in this action block.

Action Block: Block 108 (Id: 108)
Exit to: All Relays Off? (Id: 79)

Stop Chart
Chart Smoke_Detect

Action Block: Cleanup for Continue (Id: 73)
Exit to: Go back to pre-start sequence (Id: 82)

Make sure we don't skip the last relay
Turn Off
J10

We're done so set the flag
Set Variable True
Stop_Done

Prepare to watch for the next button press
Clear Off-Latch
On Point KeySwitch

Set Variable False
ButtonPress

Action Block: Clear Off Latch (Id: 88)
Exit to: Sequence Off? (Id: 11)

Clear the latch (just in case it was held down during the last check)
Clear Off-Latch
On Point KeySwitch

Set Variable False
ButtonPress

Action Block: On Sequence Done (Id: 50)
Exit to: Clear Off Latch (Id: 88)

We've finished the sequence, set the flag to say so
Set Variable True
Start_Done

Action Block: Setup For Sequence Off (Id: 14)
Exit to: In RunMode? (Id: 107)

Notify the user something's happened.
Turn Off
Status_LED

Going down so clear the start done flag
Set Variable False
Start_Done

Decrement Variable
Relay_Count

Action Block: Start Charts Button Check Smoke Detect (Id: 113)
Exit to: Ready? (Id: 8)

Start button check and Smoke Detect charts
Start Chart
Chart ButtonCheck
Put Status In Status_toss

Start Chart
Chart Smoke_Detect
Put Status In Status_toss

Start the LED Chart
Start Chart
Chart Status
Put Status In Status_toss

Turn on the status LED
Turn On
Status_LED

Start Chart
Chart EPO_Chart
Put Status In BPR_Active

Action Block: Status LED ON (Id: 39)
Exit to: Sequence Off? (Id: 11)

Turn off Auto Blink Chart
Set Variable False
LED_Active

The relays have been sequenced so turn the button LED on solid
Turn On
Status_LED

SCRIPTS

OptoScript Block: Initialize (Id: 3)
Exit to: Start Charts Button Check Smoke Detect (Id: 113)

```
//
// Initialize table values here
//

// Relay Table for dynamically addressing relays

// This table sets the order for how relays are turned on
// The program steps increments through the array turning
// on each referenced value in sequence.

// Relay (Kx == Jxx
// K1 - J10
// K2 - J11
// K3 - J12
// K4 - J13
// K5 - J14
// K6 - J15

// Turn all digital outputs off
EPO=0;
Beeper=0;
Status_LED=1;

// Modify this table to change the ON sequence

Relay_Table[0] = &J14; // On First
Relay_Table[1] = &J10;
Relay_Table[2] = &J11;
Relay_Table[3] = &J12;
Relay_Table[4] = &J13;
Relay_Table[5] = &J15;


// Each delay corrisponds to a relay time.
// Change the On_Delay for delay amount AFTER turn on (in SECONDS)
On_Delay[0]= 420;
On_Delay[1]= .5;
On_Delay[2]= .5;
On_Delay[3]= .5;
On_Delay[4]= .5;
On_Delay[5]= .5;

// Change delay time for corrispoinding relay delay time AFTER relay is turned OFF

Off_Delay[0]= .5; // Table 1 - 10
Off_Delay[1]= .5;
Off_Delay[2]= .5;
Off_Delay[3]= .5;
Off_Delay[4]= .5;
Off_Delay[5]= .5;

//
// Smoke table references
//

ClearOffLatch(KeySwitch);

TurnOn(Beeper);   // Initial Power ON Beep Sequence
DelayMsec(500);
TurnOff(Beeper);
DelayMsec(250);
TurnOn(Beeper);
DelaymSec(250);
TurnOff(Beeper);
```

```
MAX_RELAYS=6;

/*
while(not PWR_CHK)
  TurnOn(Beeper);   // Initial Power ON Beep Sequence
  DelayMsec(250);
  TurnOff(Beeper);
  DelayMsec(250);
  TurnOn(Beeper);
  DelaymSec(250);
  TurnOff(Beeper);
wend
*/
TurnOff(Beeper);


LED_Period=1000;  // mS of overall blink rate (1000=1 Second)
LED_DutyCycle=50; // 50% duty cycle
LED_Active=0;
//LED_OnTime=250;
//LED_OffTime=250;
TurnOn(Status_LED);
```

OptoScript Block: On Delay Scrip (Id: 95)
Exit to: All Relays On? (Id: 62)

```
// Delay and Increment

/*
dlytmr=On_Delay[Relay_Count];  // Load delay value to temporary register

IncrementVariable(Relay_Count); // Increment relay index pointer

if(RTest) then
 DelaySec(dlytmr/10);
elseif (dlytmr<1 and not RunMode) then
 DelayMsec(dlytmr*1000);  // use DelaymSec for short delay times
else
 DelaySec(dlytmr);        // use DelaySec for longer delay times
endif
*/
```

OptoScript Block: Sequence Relays Off (Id: 78)
Exit to: All Relays Off? (Id: 79)

```
// Turn OFF dynamic relay control
// Relay_Count=Relay_Count-1;

RLY_PTR=Relay_Table[Relay_Count];

TurnOFF(*RLY_PTR);

// Delay and decrement

dlytmr=Off_Delay[Relay_Count];  // Load delay value to temporary register

DecrementVariable(Relay_Count); // Decrement relay index counter


if(RunMode) then
  if (dlytmr<1) then
    DelayMsec(dlytmr*1000);  // use DelaymSec for short delay times
  else
    DelaySec(dlytmr);        // use DelaySec for longer delay times
  endif
else
 DelayMsec(500);
endif
```

```
  LED_OnTime=250;
  LED_OffTime=500;
  LED_Active=1;
```

OptoScript Block: Sequence Relays On (Id: 60)
Exit to: On Delay Scrip (Id: 95)

```
  // Turn on dynamic relay control

  RLY_PTR=Relay_Table[Relay_Count]; // get pointer to relay I/O

  TurnOn(*RLY_PTR);                 // Turn on relay

  //ButtonPress=0;


  // Delay and Increment

  dlytmr=On_Delay[Relay_Count];  // Load delay value to temporary register

  IncrementVariable(Relay_Count); // Increment relay index pointer

  if(not IsWithinLimits(Relay_Count,0,MAX_RELAYS)) then
    Relay_Count=MAX_RELAYS;
  endif

  if(RunMode) then
    RelayTimer=dlytmr;  // load and start the relay timer
  else
    RelayTimer=dlytmr/60;  //dlytmr/10;
  endif

  while(KeySwitch and not HasTimerExpired(RelayTimer))

  LED_OnTime=250;
  LED_OffTime=250;
  LED_Active=1;
  /*
  while(not ButtonPress and not HasTimerExpired(RelayTimer))

   Status_LED=1;
   DelayMsec(250);
   Status_LED=0;
   DelayMsec(500);
  */
  wend


  StopTimer(RelayTimer);

  //ButtonPress=0;
```

OptoScript Block: Set LED Blink Rate (Id: 120)
Exit to: KeySwitch ON? (Id: 63)

```
  //
  // Set Status LED blink rate
  //

  LED_Period=500;
  LED_DutyCycle=50;
  LED_Active=1;
```

CONDITIONS

Condition Block: All Relays Off? (Id: 79)
Operator Type: AND
TRUE Exit to: Cleanup for Continue (Id: 73)
FALSE Exit to: Sequence Relays Off (Id: 78)

Are we done yet?
  Is Relay_Count
Equal?
  To -1

Condition Block: All Relays On? (Id: 62)
Operator Type: AND
TRUE Exit to: On Sequence Done (Id: 50)
FALSE Exit to: KeySwitch ON? (Id: 63)

Are we done yet?
  Is Relay_Count
Equal?
  To MAX_RELAYS

Condition Block: In RunMode? (Id: 107)
Operator Type: AND
TRUE Exit to: Block 108 (Id: 108)
FALSE Exit to: All Relays Off? (Id: 79)

Are we in testmode?
  Is RunMode
On?

Condition Block: KeySwitch ON? (Id: 63)
Operator Type: AND
TRUE Exit to: Sequence Relays On (Id: 60)
FALSE Exit to: Sequence Started? (Id: 56)

KeySwitch ON?
  Is KeySwitch
On?

Condition Block: Ready? (Id: 8)
Operator Type: AND
TRUE Exit to: Set LED Blink Rate (Id: 120)
FALSE Exit to: Blink Button LED (Id: 28)

Is KeySwitch Active?
  Is KeySwitch
On?

Condition Block: Sequence Off? (Id: 11)
Operator Type: AND
TRUE Exit to: Status LED ON (Id: 39)
FALSE Exit to: Setup For Sequence Off (Id: 14)

KeySwitch ON?
  Is KeySwitch
On?

Condition Block: Sequence Started? (Id: 56)
Operator Type: AND
TRUE Exit to: Setup For Sequence Off (Id: 14)
FALSE Exit to: KeySwitch ON? (Id: 63)

Have we started sequencing up?
  Is Relay_Count
Greater?
  Than 0

CONTINUE BLOCKS

Continue Block: Go back to pre-start sequence (Id: 82)
Continue At: Blink Button LED (Id: 28)

CHART: Smoke_Detect

ACTIONS

Action Block: Block 0 (Id: 0)
Exit to: Smoke (Id: 62)

There are no instructions in this action block.

Action Block: Clear Latches (Id: 76)
Exit to: Smoke (Id: 62)

Clear All Latches
On I/O Unit VMT_PLC_IO

SCRIPTS

OptoScript Block: Audible Alarm Check (Id: 73)
Exit to: TestMode? (Id: 66)

```
//
// Alarm sounds every 5 seconds
// 2 beeps for temperature
// 3 beeps for Smoke
//
if((sm_alarm or ot_alarm) and HasDownTimerExpired(ALARM_TIMER)) then
  SetDownTimerPreset(5, ALARM_TIMER); // Reset/setup ALARM_TIMER
  TurnOn(Beeper);       // Beep
  DelayMsec(250);
  TurnOff(Beeper);      // No Beep
  DelayMsec(128);
  TurnOn(Beeper);       // Beep
  DelaymSec(250);
  TurnOff(Beeper);      // No Beep

  if(sm_alarm) then     // 3 beeps on smoke alarm
    DelayMsec(128);
    TurnOn(Beeper);
    DelaymSec(250);
    TurnOff(Beeper);
  endif

  StartTimer(ALARM_TIMER);  // start the alarm timer

  if(RunMode) then
    TurnOn(Beeper);
    TurnOn(EPO);    // EPO, OverTemp and SMOKE work the same so just EPO everything
  endif


endif
```

OptoScript Block: Re - engage Relays (Id: 69)
Exit to: Clear Latches (Id: 76)

```
// Test mode enable relays on detector clear
/*
for tmptr=0 to MAX_RELAYS step 1
  RLY_PTR=Relay_Table[tmptr];
  TurnOn(*RLY_PTR);
next
*/
```

OptoScript Block: Smoke (Id: 62)
Exit to: Temperature (Id: 64)

```
//Smoke detect check
// Alarms are active low
```

```
// Relay controll can be added to each signal
// KXXX=0 - turns relay OFF
// KXXX=1 - turns relay ON

/* combination shutdown example
if((not Smoke_5) or (not Smoke_6) or (not Smoke_7) or (not Smoke_8)) then
  K16=0;
  K17=0;
  K18=0;
endif
*/

sm_alarm=0; // reset smoke alarm flags - this byte used to flag other strategies of a smoke
alarm.

if(not SmokeSig) then // Active Low
  sm_alarm=1;
//  BPR_Active=1; // Activate the Beeper
//  EPO=1;    // EPO and SMOKE work the same so just EPO everything
endif
```

OptoScript Block: Temperature (Id: 64)
Exit to: Audible Alarm Check (Id: 73)

```
// Over temperature detect
// Signals are active low

ot_alarm=0; // reset ot alarm flags

if(OvrHeatSignal) then  //Active High
  ot_alarm=1;
  J13=0;  // Turn off associated relays
  J14=0;  //
  //J7=0; // Can not control J7 so we will comment it out for now
endif
```

CONDITIONS

Condition Block: TestMode? (Id: 66)
Operator Type: AND
TRUE Exit to: Re - engage Relays (Id: 69)
FALSE Exit to: Smoke (Id: 62)

Is **Variable True?**	Start_Done
Is **Variable False?**	ot_alarm
Is **Variable False?**	sm_alarm
RunMode Off? Is **Off?**	RunMode

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

CHART: Status

ACTIONS

Action Block: Blink Status LED (Id: 8)
Exit to: LED Blink (Id: 9)

Blink the LED at a half second rate
Turn On
Status_LED

Delay (mSec)
LED_OnTime

Turn Off
Status_LED

Delay (mSec)
LED_OffTime

Action Block: Block 0 (Id: 0)
Exit to: LED Blink (Id: 9)

Turn On
Status_LED

Action Block: LED Blink (Id: 9)
Exit to: LED Active (Id: 7)

There are no instructions in this action block.

SCRIPTS

OptoScript Block: Calculate Duty Cycle (Id: 3)
Exit to: Blink Status LED (Id: 8)

```
//
// LED blink rate
//
// 1 second Period
//
// ratio duty cycle
//

LED_OnTime = (LED_Period * LED_DutyCycle)/100;
LED_OffTime = LED_Period-LED_OnTime;
```

CONDITIONS

Condition Block: LED Active (Id: 7)
Operator Type: AND
TRUE Exit to: Calculate Duty Cycle (Id: 3)
FALSE Exit to: LED Blink (Id: 9)

LED Active?
Is LED_Active
Variable True?

CONTINUE BLOCKS

There are no continue blocks in this flowchart.

Appendix B — Warranty

Note

For warranty information, please refer to the accompanying Q-LS manual, e.g. MNL120.

Contacting Power Innovations International

Customer Support

Questions concerning the operation, repair, or maintenance of this equipment should be directed to the Customer Support Department of PI. When making such an inquiry, please provide the model number, serial number, and detailed description of the issue. To service or repair any product, the customer must obtain Customer Support Ticket number from Customer Support.

Contacting Power Innovations

If there is any question or comment about this product, please feel free to contact us.

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