OTS

OUTLET TEST SYSTEM

User Manual

Version: 4, April 2024

Designed and manufactured in Australia by Ampcontrol Pty Ltd

AMPCONTROL®

WARNING!

The **warning** symbol highlights a potential risk of **injury or death**.

Please share these warnings with other operators.

CAUTION!

The **caution** symbol highlights a potential risk of **damage to equipment**.

Please share these cautions with other operators.

NOTE

The **note** symbol highlights **key information**.

Please share these notes with other operators.

ENVIRO

The **enviro** (environmental) symbol highlights areas which may have an impact on the surrounding **fauna and/or flora**.

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Before You Begin

Thank you for purchasing the Ampcontrol OTS.

WARNING!

In the interests of **safety and correct equipment operation**, please take the time to read and understand the content in this manual.

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TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

1 SAFETY AND OTHER WARNINGS

For safety reasons, the OTS must be installed, operated and serviced only by competent personnel. Please read and understand this instruction manual completely before installing, operating or servicing this equipment. Failure to install or operate this instrument in accordance with the instructions contained in this manual may create hazardous operating conditions.

1.1 Safe Use of Equipment

The equipment supplied has been designed and manufactured to ensure safe operation. The equipment must only be used within the design parameters.

The instructions within this manual must be observed as an aid towards achieving the safest possible installation.

Persons responsible for installation, maintenance, or operation, must observe the following instructions:

1.1.1 Changes to Equipment

Changes in the design and modifications to the equipment are not permitted. Unauthorised changes made to the hardware or operating firmware will void the manufacturer's warranty and may compromise the integrity of the system into which it is installed and other connected equipment.

1.1.2 Equipment Knowledge

Experience with, or understanding of, this equipment is essential for the safe installation and removal of the equipment. Therefore, please read and understand this manual prior to use. Competency based training courses are recommended and are available on request.

1.1.3 Manual Handling

Precautions have been taken to ensure all equipment is safe to handle and free from sharp edges. However, care should always be taken when handling enclosures and gloves should be worn.

1.1.4 Installation

Correct operation and safety depend on the Outlet Test System and associated equipment being installed correctly. Mechanical and or electrical installation and maintenance of plant and equipment must only be carried out by appropriately qualified personnel and must be tested thoroughly prior to operation.

1.1.5 Operation

The OTS is not a primary safety device; it is periodically operated to ensure the correct operation of an outlet’s earth leakage, earth continuity, earth fault lockout and frozen contactor protection functions. It is therefore necessary that it is operated only by trained and competent personnel who can correctly interpret and verify the test results obtained through the use of the OTS.

2 RECEIVING AND STORAGE

2.1 Receiving

All possible precautions are taken to protect the equipment against damage or losses during shipment; however, before accepting delivery, check all items against the packing list or bill of loading. If there is evidence of physical damage, notify Ampcontrol immediately.

Notify Ampcontrol immediately in the case of any discrepancies to the packing list. Keep a record of any claims and correspondence. Photographs are recommended.

Where practicable do not remove protective covers prior to installation unless there are indications of damage. Boxes opened for inspection and inventory should be carefully repacked to ensure protection of the contents or else the parts should be packaged and stored in a safe place. Examine all packing boxes, wrappings and covers for items attached to them, retain and store any approval documentation for your safety file as applicable prior to wrapping being discarded.

2.2 Inspection

Equipment that is found to be damaged or has been modified away from its published specifications must not be used. Please contact Ampcontrol if the equipment is suspected to be different than that ordered or if it does not match the published specifications.

2.3 Storage after Delivery

When the equipment is not to be installed immediately, proper storage is important to ensure protection of equipment and validity of warranty.

All equipment should be stored indoors between 0-40 ˚C, preferably on shelves and protected from moisture and sunlight.

2.4 Unpacking of Equipment

The method of packing used will depend on the size and quantity of the equipment. The following cautions should be interpreted as appropriate.

CAUTION!

Take care when unpacking crates as the **contents may have shifted during transport**.

ENVIRO

The disposal of packaging materials, replaced parts, or components must comply with environmental restrictions without polluting the soil, air or water.

Ensure that any timber and cardboard used as **packaging is disposed of in a safe and environmentally responsible manner**.

Where possible, dispose of all waste products i.e. oils, metals, plastic and rubber products by using an approved recycling service centre.

3 PRODUCT OVERVIEW

3.1 Description

The Ampcontrol Outlet Test System (OTS) provides a fully automated outlet testing facility. The OTS completely eliminates paper-based record keeping by concurrently updating a historical database with the latest test data.

The OTS is comprised of an OTS module, embedded within the outlet electrics, and an OTS Comms Module, mounted on the door to provide Bluetooth connectivity to the outlet tester.

All tests are initiated wirelessly via the OTS Application Software, which is installed on compatible Bluetooth enabled devices. Each outlet is able to be individually targeted.

All local test records are managed within the OTS Application Software until the tablet performs an authorised sync with the AWARE cloud storage. When this occurs all local test reports are uploaded to the cloud, and then all Assets and Users are refreshed for selected site. All OTS test records can be accessed by anyone with internet access and authorisation (user account).

The OTS will test earth leakage, measuring both the contactor opening time in addition to the true earth leakage clearing time (time for back EMF voltages to fall below ELV), earth continuity (both series and shunt), earth fault lockout, and the frozen contactor protection functions of the outlet.

3.2 Key Features

The OTS has the following key features:

- Fully automated, outlet protection function testing
- Wireless outlet testing
- Earth Leakage (EL) protection testing (contactor operating and back EMF clearing times)
- Earth Continuity (EC) protection tests (series and shunt)
- Earth Fault Lockout (EFLO) protection testing
- Frozen Contactor (FC) protection testing
- Test data logging (Uploads to cloud storage)
- DIN rail mounted

3.3 Application

The OTS System can be installed into Ampcontrol Substations, Distribution Boards and Outlet Control Boxes. The OTS greatly simplifies the statutory testing process, performing a hands-free automated testing function whilst simultaneously providing a comprehensive record management tool.

3.4 Supplementary Documents

The OTS User Manual is expected to be read in conjunction with the following documents:

- MAG-199 OTS Application User Manual
- MAG-204 OTS Dashboard User Manual

4 INSTALLATION

4.1 General Warnings

These instructions have been designed to assist users of the OTS with installation.

Before the OTS can be installed, there are a number of things that need to be considered and understood to prevent incorrect or unsafe operation of the OTS or the system into which it is installed.

Along with relevant competence, and an understanding of the target application, the following points should be considered:

4.1.1 Ensure that the information provided in this user manual is fully understood.

It is extremely important that the limitations and functionality of the Outlet Test System are understood to prevent incorrect installation or use, creating a potentially dangerous risk. If in doubt as to the nature of the limitations or their implication, consult a competent authority such as a supervisor or Ampcontrol technical representative.

4.1.2 Ensure that the application into which the OTS is being installed has been properly defined, designed and approved.

Any system intended to mitigate the risk of injury needs to be properly designed and implemented. Such a system must be the result of structured risk analysis with the outcomes used to define the system requirements. These requirements, in turn, will guide the choice of instrumentation, logic solvers and actuators needed to implement the system. Understanding the needs of the system will ensure proper selection of equipment.

4.1.3 Ensure that the OTS will properly perform the required functions within the system design.

It is important to understand how the OTS is intended to interact with other equipment within a system. For safe and reliable use, it is crucial that neither the OTS logical operation nor its signalling be compromised by incompatibilities with connected equipment.

4.1.4 Modifications of any form to the Outlet Test System are prohibited.

If modifications of any form are made to the OTS, the equipment may no longer be fit for use. If any modifications or damage to the OTS is evident, do not use the equipment and contact Ampcontrol for advice.

4.2 Mandatory Installation Practices

The following information must be adhered to when installing the OTS. Failure to adhere to this information may give rise to unsafe operation.

Using the OTS in a manner that exceeds its electrical or functional specifications, or in a way that is contrary to its operating restrictions, may create risks to personnel and/or equipment resulting in injury or death.

- The OTS must be supplied by a regulated voltage within the specified range
- The installation of the OTS must be carried out by suitably trained and qualified personnel
- Identification labels fixed to the OTS must not be damaged, removed or covered
- The installation is to be in accordance with the relevant installation Standards/Codes of Practice
- Modifications must not be made to any part of the OTS. Modifications to its construction will render the unit non-compliant
- Complete and accurate records of the installation must be retained for warranty purposes

4.3 Mechanical Installation Information

The OTS is comprised of an OTS Test module and an OTS Comms Module.

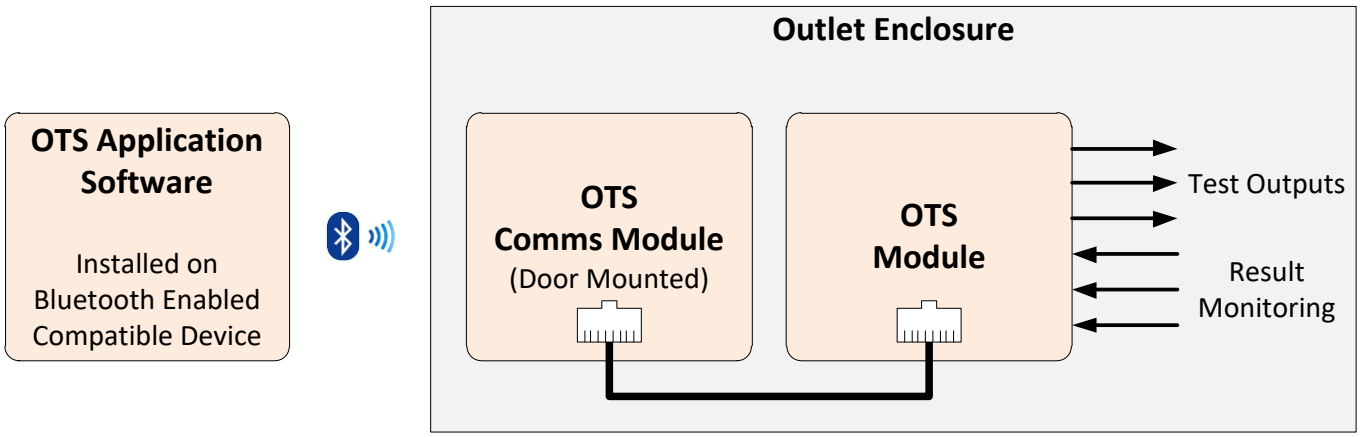

Figure 4-1 OTS System Overview

4.3.1 OTS Mechanical Installation Information

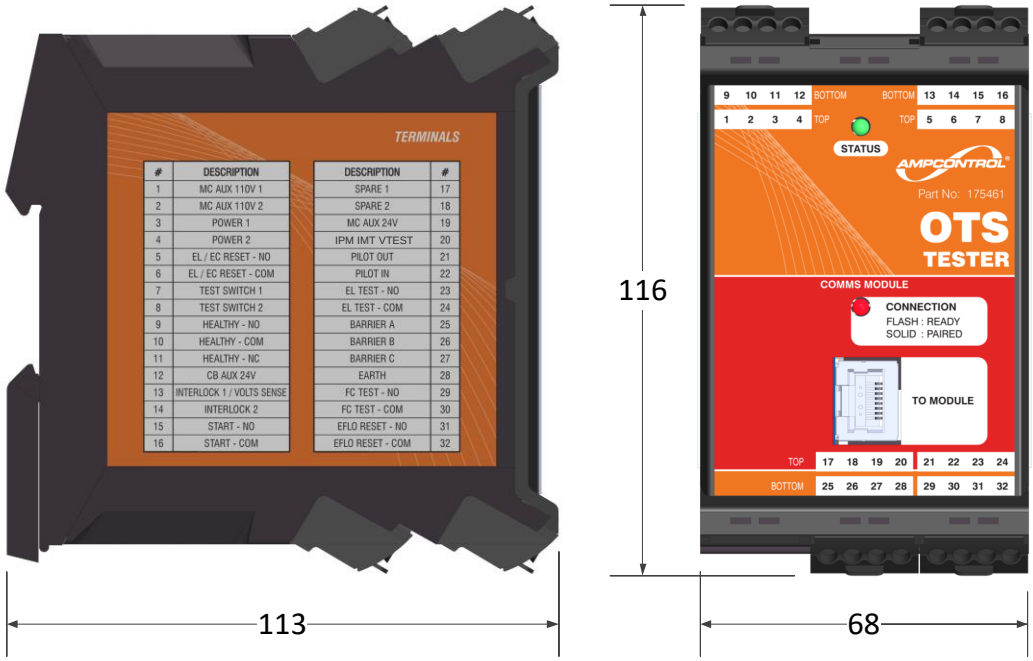

Figure 4-2 OTS Dimensions

The OTS test module performs all the test actuation and measurements. It is a DIN Rail mounted unit that interfaces with the outlet's electrics. The terminal layout and description is shown in Figure 4-3 and Table 1 respectively.

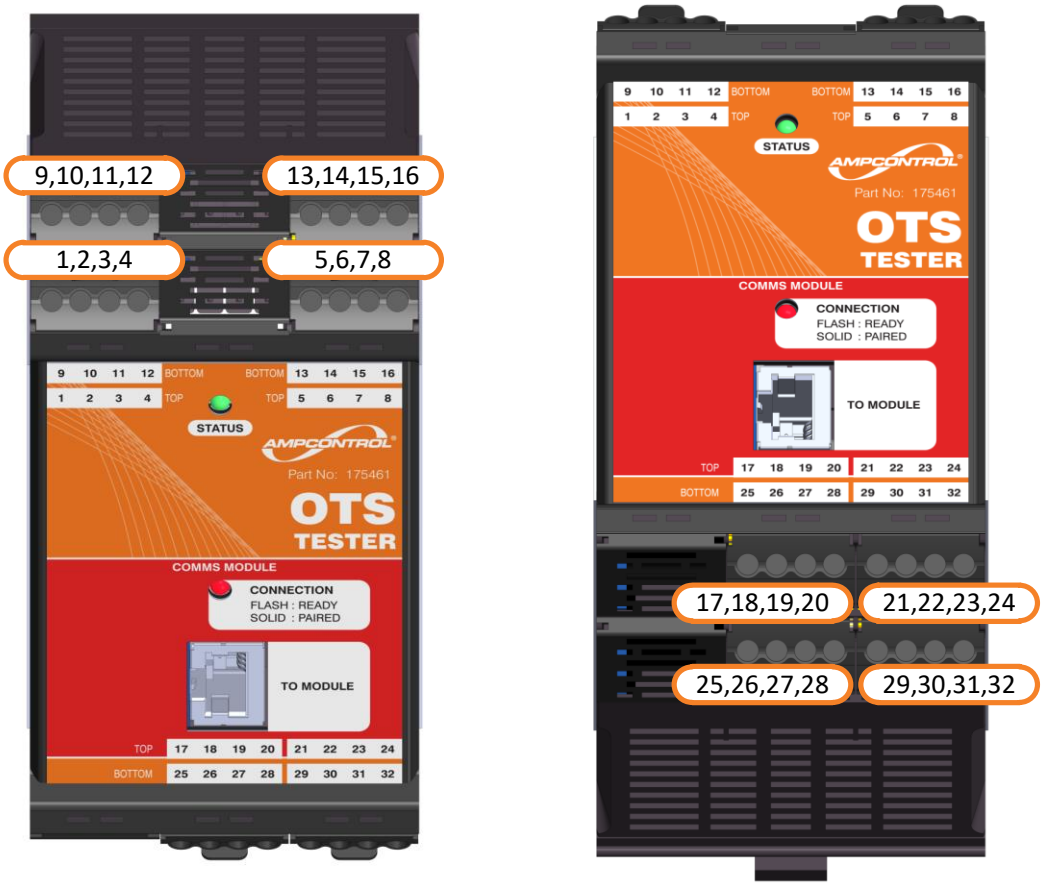

Figure 4-3 OTS Terminal Layout

Table 1 OTS Terminal Designators

Number	Designator
1	MC AUX 110V
2	MC AUX 110V
3	POWER1
4	POWER2
5	EL/EC RESET - N/O
6	EL/EC RESET - COM
7	TEST SWITCH1
8	TEST SWITCH2
9	HEALTHY - N/O
10	HEALTHY - COM
11	HEALTHY - N/C
12	CB AUX 24V
13	INTERLOCK1/V SENSE
14	INTERLOCK2
15	START - N/O
16	START - COM

Number	Designator
17	SPARE
18	SPARE
19	MC AUX 24V
20	IPM IMT V_{TEST}
21	PILOT OUT
22	PILOT IN
23	EL TEST - N/O
24	EL TEST - COM
25	BARRIER A
26	BARRIER B
27	BARRIER C
28	EARTH
29	FC TEST - N/O
30	FC TEST - COM
31	EFLO RESET - N/O
32	EFLO RESET - COM

4.3.2 OTS Comms Module Mechanical Installation Information

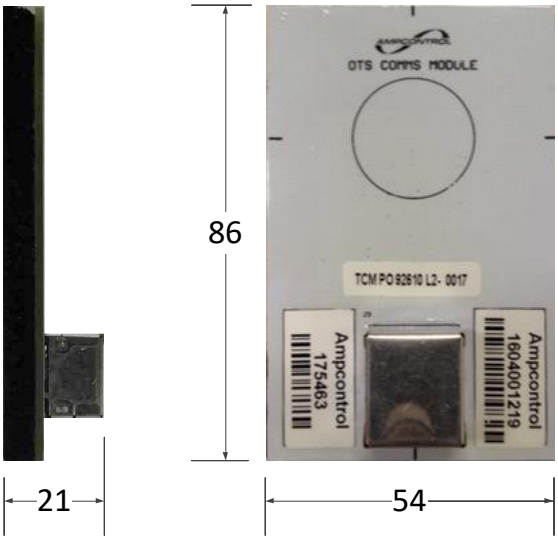

Figure 4-4 OTS Comms Module

The Comms module provides Bluetooth connectivity to the Tester. It is intended to be mounted onto the back of an outlet door or enclosure, covering a 22.5mm OD hole. The hole needs to align with the PCB aerial on the Comms module. Without this hole, the steel of the enclosure would form a shield, preventing Bluetooth communications to the tester. To improve the connectivity of the Bluetooth device, the hole in the enclosure should be positioned such that it faces the location where the testing officer is most likely to stand when initiating the test procedure.

The Communications Module must be oriented with the RJ45 port pointing downwards to ensure both LEDs on the Comms Module align with their corresponding position on the external label.

To install the Comms Module, simply pull the plastic off of the high strength adhesive tape and stick it to the back of the door, aligning the circle on the PCB with the hole in the enclosure.

To maintain the IP-rating of the enclosure the included label must be placed externally over the hole. The location of the two LEDs on the OTS Comms Module and label can be seen in Figure 4-5.

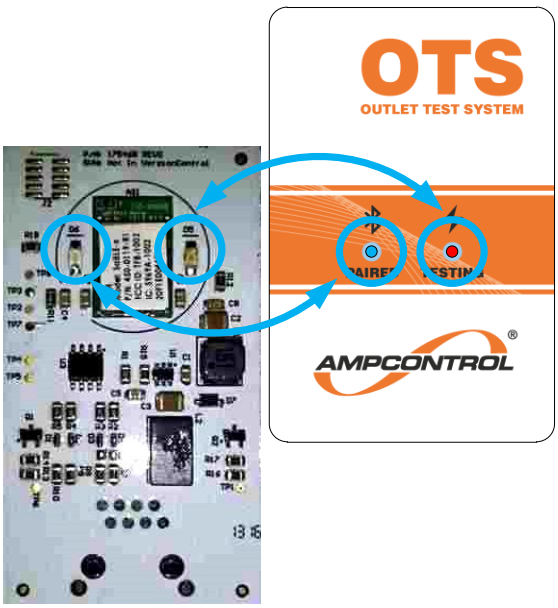

Figure 4-5 OTS Comms Module and External Label

4.4 Electrical Installation Information

A typical installation diagram of the OTS is shown below, Figure 4-6. The following sub-sections provide a more detailed description of each of the individual circuit elements.

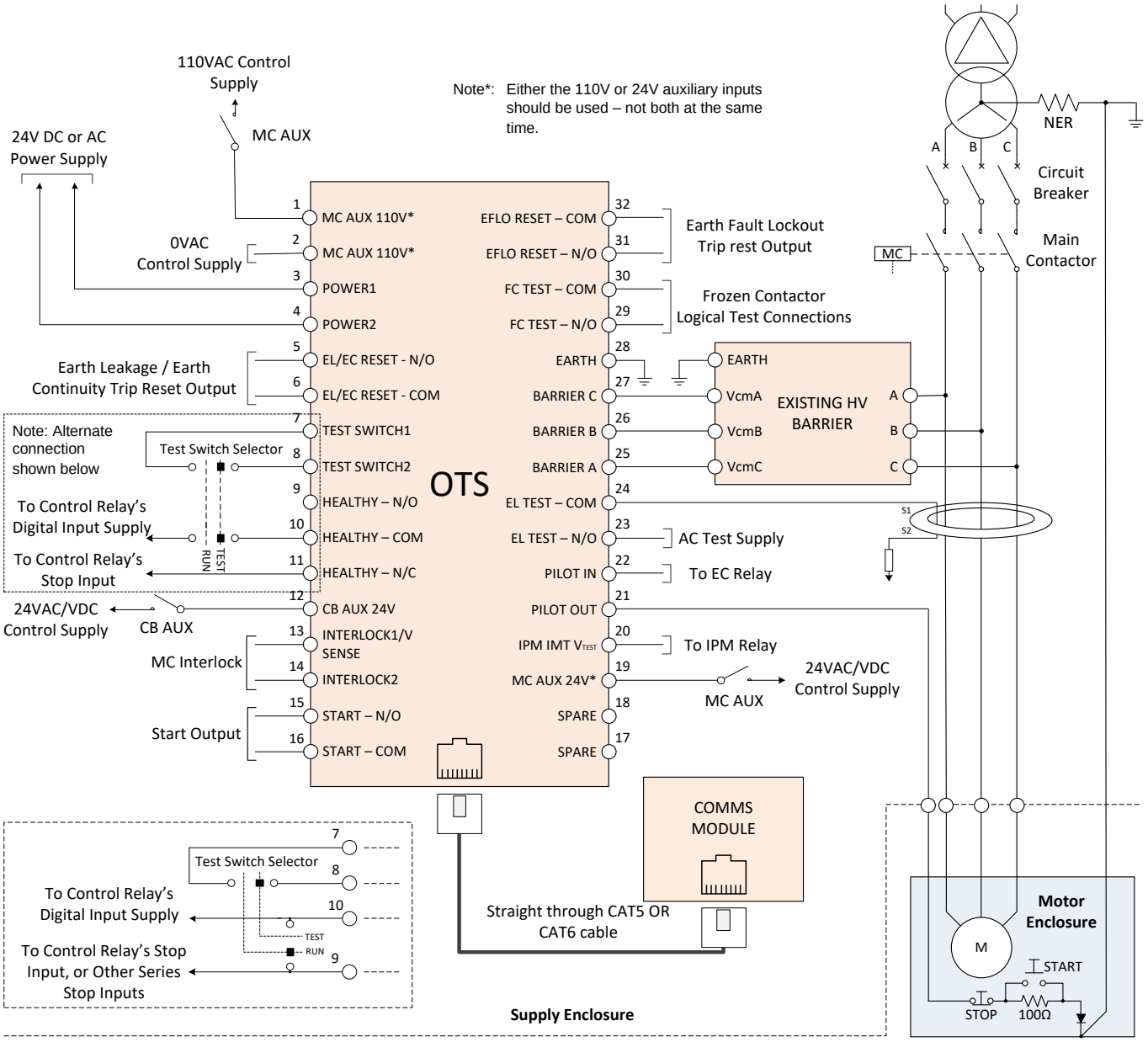

Figure 4-6 Electrical Connections – OTS Circuit Diagram

4.4.1 Power Supply (Terminals 3, 4 & 28)

The OTS Tester requires a regulated 24 VDC or 24 VAC power supply.

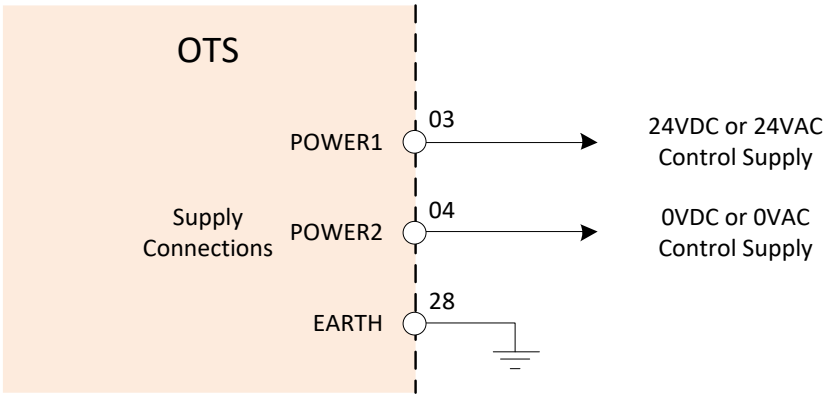

Figure 4-7 Electrical Connections – OTS Power Supply

4.4.2 HV Barrier Connections (Terminals 25, 26, 27)

For an outlet to utilise the EFLO testing properties of the OTS, the OTS Barrier inputs tap into the existing HV barrier outputs of the circuit. This HV Barrier provides the OTS with an interface to the phase conductors.

The high voltage connections to the HV Barrier must be made on the load side of the outlet's contactor / breaking device.

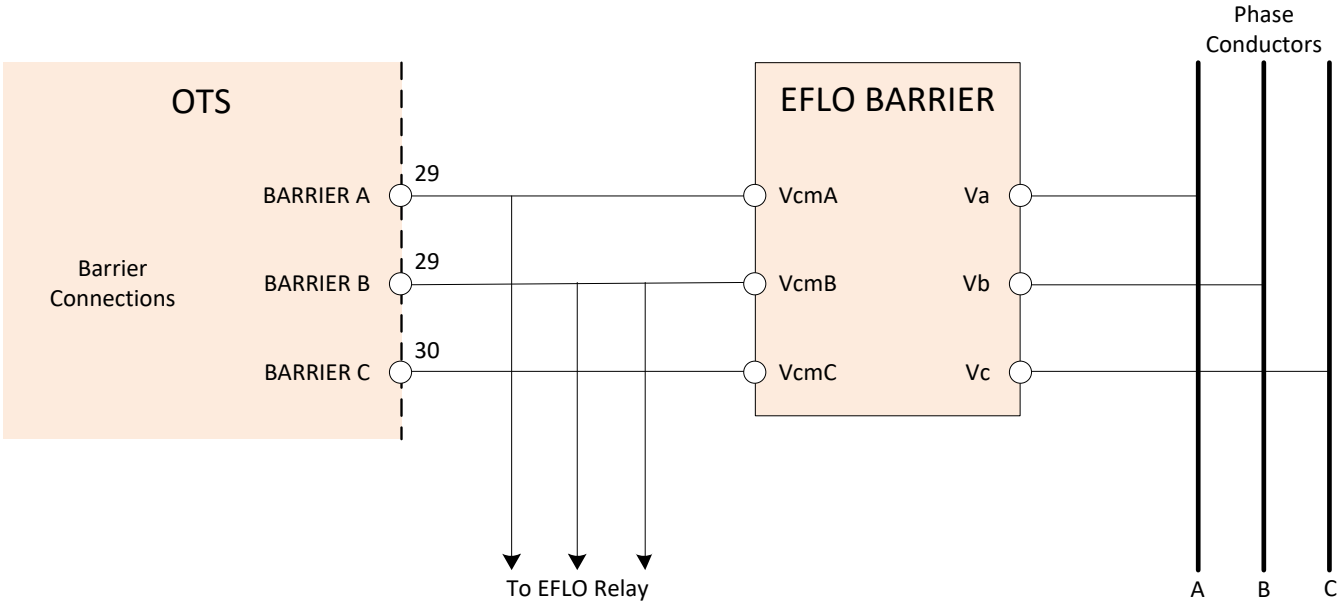

Figure 4-8 Electrical Connections: HV Barrier

4.4.3 Comms Module Connections (RJ45 Port)

The OTS Tester interfaces with the user's compatible tablet via the OTS Comms Module. The Comms Module is connected to the Tester via a standard CAT5 or CAT6 cable (straight-through RJ45 termination).

CAUTION!

This Comms Module Connection Ports **are not standard Ethernet ports.** These cores carry voltages that will damage an incompatible device if connected.

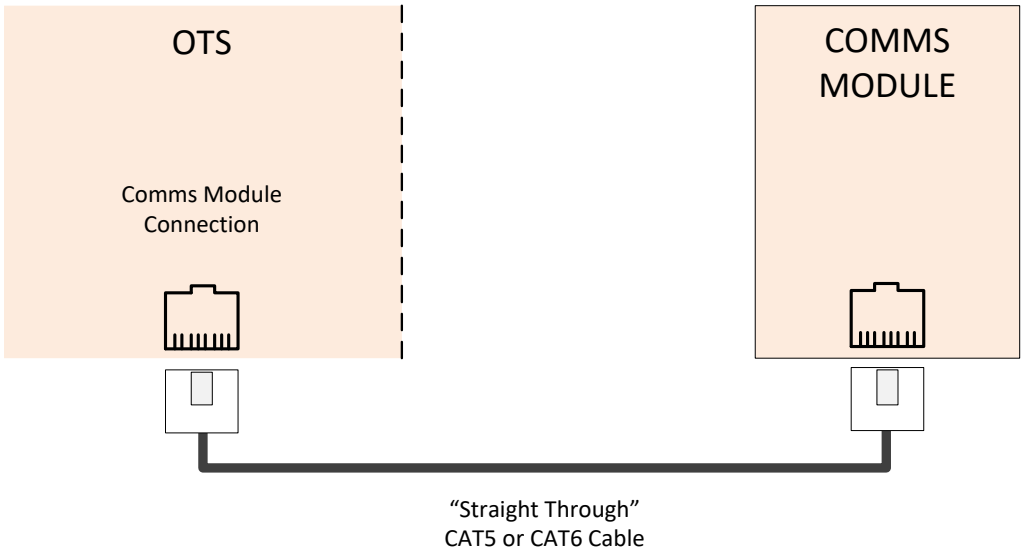

Figure 4-9 Electrical Connections: Comms Module

4.4.4 EL Test Connections (Terminals 23 & 24)

The Earth Leakage Test works by closing an internal normally open contact for the duration of the test. This contact is intended to be wired in parallel to an existing earth leakage test circuit that passes an AC current through the outlet's earth leakage toroid.

NOTE

The installer is responsible for ensuring that the test resistance is of a suitable magnitude to provide a meaningful test.

It is recommended that the resistance value is chosen such that the test current is between 110 % and 120 % of the trip level of the earth leakage protection relay (AS/NZS 2081 Appendix E4, AS/NZS 4871.1:2012 Clause 2.6.2.4).

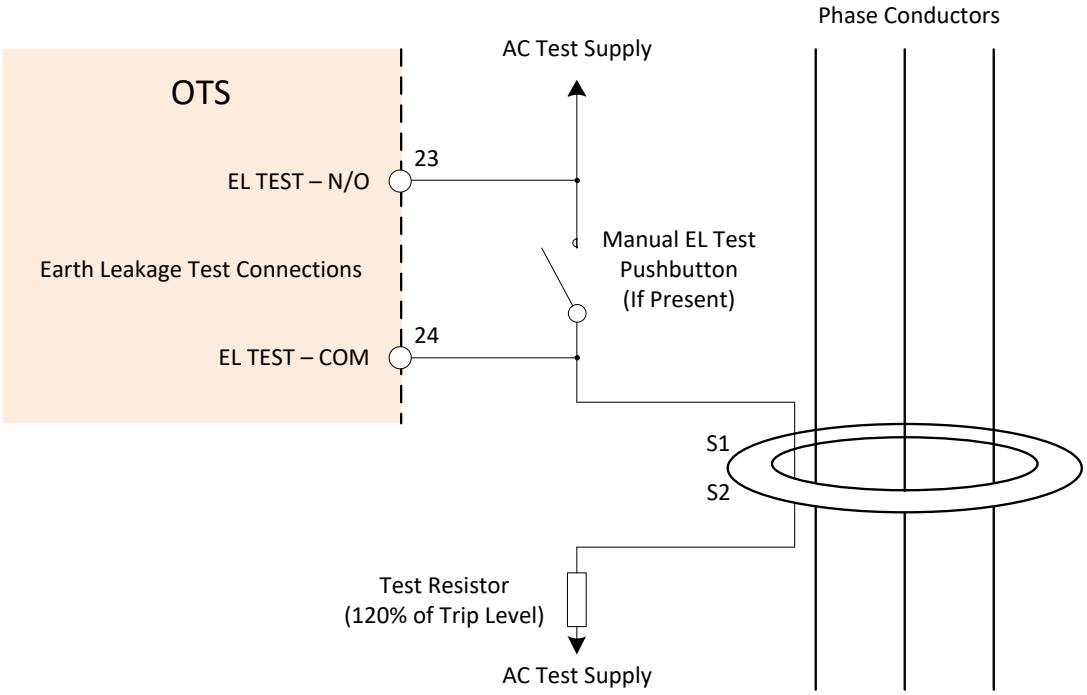

Figure 4-10 Electrical Connections – EL Test

4.4.5 MC Auxiliary Input Connections (Terminals 1 & 2 or 19)

The MC Auxiliary Input provides feedback to the OTS on the current position of the outlet's contactor / breaking device. The OTS Tester provides two options for monitoring the MC Auxiliary. The first option is used in 110 VAC control circuits, as shown in Figure 4-11. The second option is to use the MC AUX 24 V input, as shown in Figure 4-12. This input is used with 24 VDC or 24 VAC control supplies. The MC AUX 110 V and the MC AUX 24 V input do not require a load to be present; the voltage input can connect directly to the input (via the contactor's auxiliary contact).

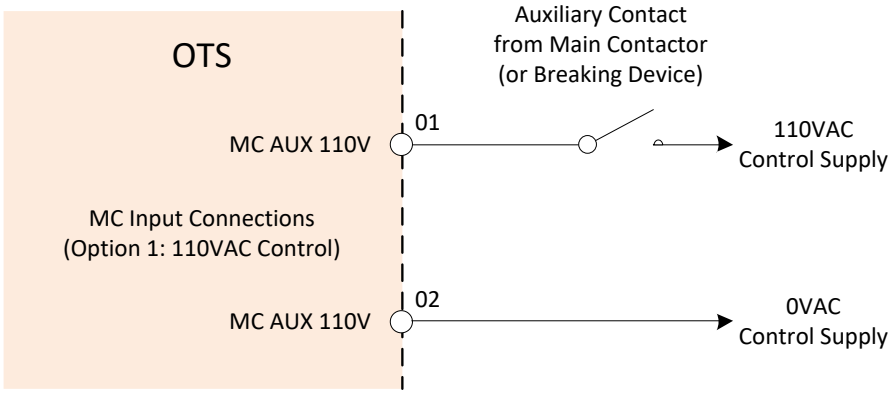

Figure 4-11 Electrical Connections – MC Auxiliary Input (Option 1)

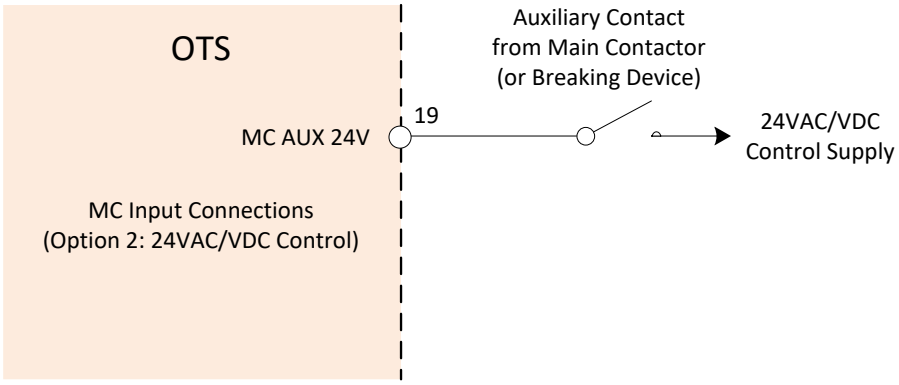

Figure 4-12 Electrical Connections – MC Auxiliary Input (Option 2)

NOTE

The negative rail of the 24 V control supply must be the same reference as the OTS supply in order for the OTS to detect the voltage level.

NOTE

Either the 110 V or 24 V auxiliary inputs should be used – not both at the same time.

4.4.6 CB Auxiliary Input Connections (Terminal 12)

The CB Auxiliary Input provides feedback to the OTS of the circuit breakers position. This feedback is used in the frozen contactor test to confirm that the circuit breaker has opened.

This input is used with 24 VDC or 24 VAC control supplies. The input will sense the voltage that is applied to it. When the control voltage is present, this will indicate that the circuit breaker is in the closed position.

The CB AUX 24 V input does not require a load to be present; the voltage input can connect directly to the input (via the circuit breakers auxiliary contact).

NOTE

The negative rail of the 24 V control supply must share the same reference as the OTS supply in order for the OTS to detect the voltage level.

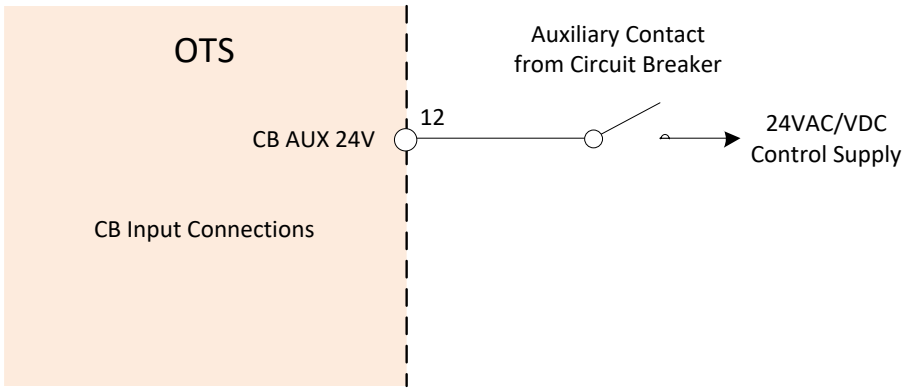

Figure 4-13 Electrical Connections – CB Auxiliary Input

4.4.1 IPM Interface Connections (Terminal 20)

The IPM IMT V_{TEST} input is required when the OTS is performing test on an IPM configured outlet.

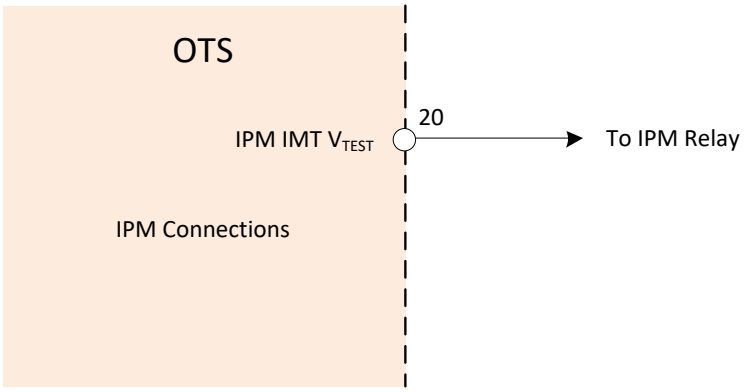

Figure 4-14 IPM Interface Connections

4.4.2 Test Switch Input & OTS Healthy Contact Connections (Terminals 7, 8, 9, 10 & 11)

The Test Switch Input is used to change the Tester into Test Mode. The OTS Tester has been designed to ensure that it does not interfere with the operation of the outlet during its normal operation.

The combination of the Test Switch and the OTS Heathy output is used to ensure that the OTS Tester will not initiate any tests unless it is operating correctly.

For protection relays that use parallel stop inputs (such as Ampcontrol's IPM relay), the interlocking arrangement shown in Figure 4-15 should be used.

For protection relays that use series stop inputs (such as Ampcontrol's PF1 relay), the interlocking arrangement shown in Figure 4-16 should be used.

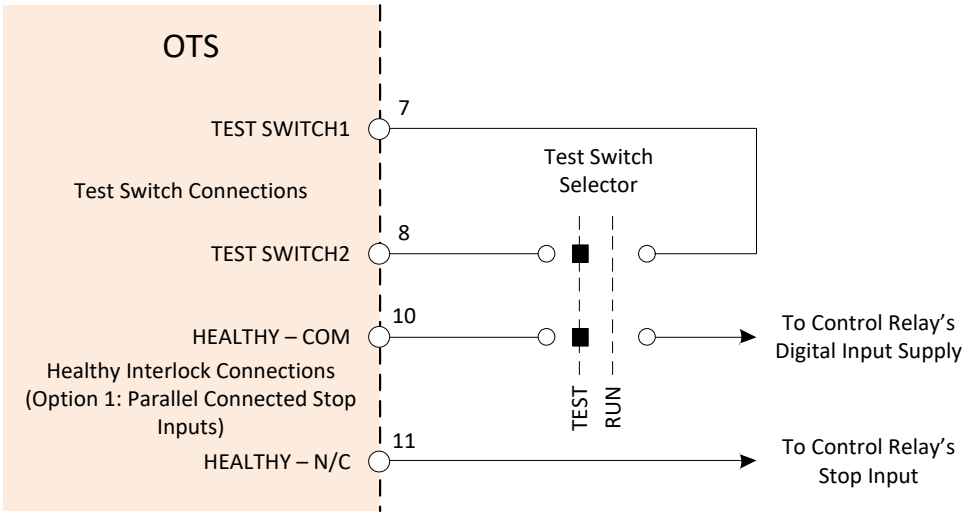

Figure 4-15 Electrical Connections – Test Switch & Healthy Interlock (Parallel Stop Inputs)

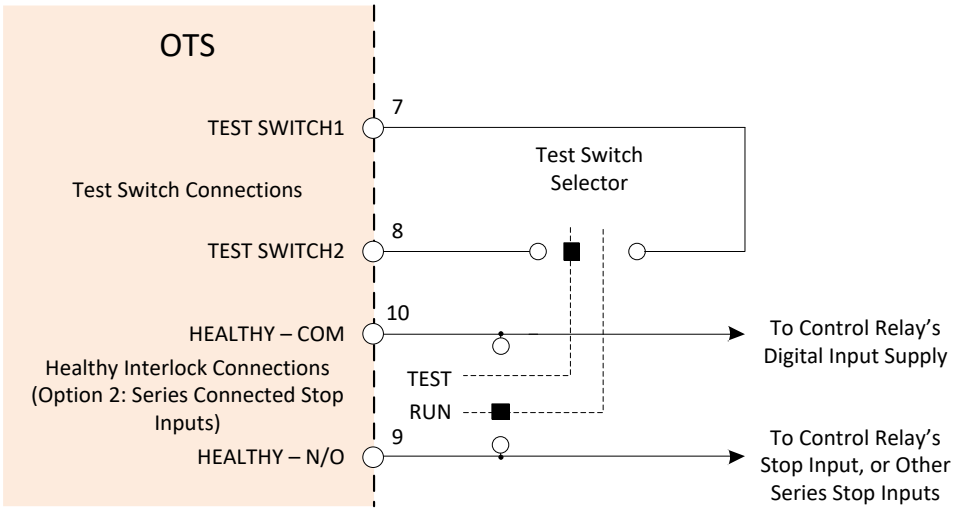

Figure 4-16 Electrical Connections – Test Switch & Healthy Interlock (Series Stop Inputs)

4.4.3 MC Interlock Connections (Terminals 13 & 14)

The MC Interlock is used to ensure that the outlet's contactor cannot be operated during the course of the OTS undertaking the test procedure. This interlock provides an internal contact that is open during the course of the test. Once the test is completed, the contact closes and allows the outlet to operate as normal.

It is important that the interlock contact connection be made in the correct orientation as the INTERLOCK1 / VOLT SENSE terminal (13) is used to monitor the status (voltage) of the permissives for the closing of the Main Contactor. This forms the means of the OTS confirming its control over the tripping and resetting of the protection relays.

NOTE

Terminal 13 must be wired to the source side of the interposing relay supply. Failing to do this will prevent the OTS Tester from sensing the status of the outlet contactor's permissives.

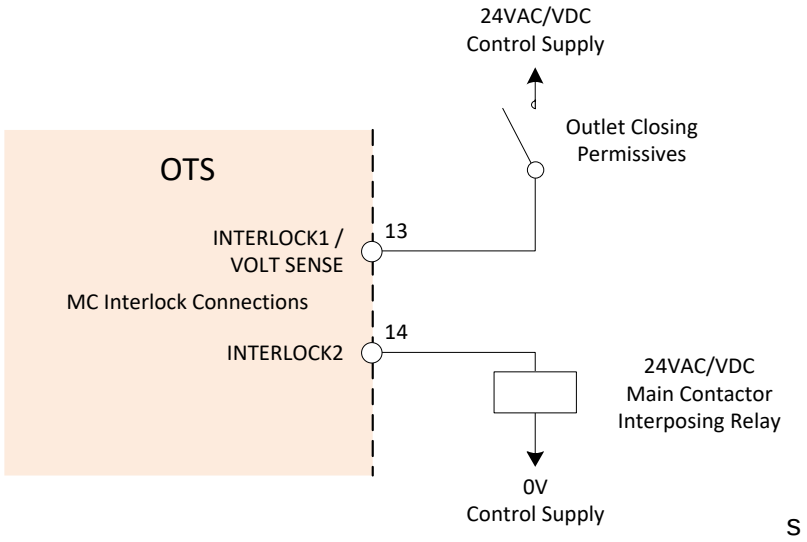

Figure 4-17 Electrical Connections – MC Interlock Connections

4.4.4 EC Test Connections (Terminals 21 & 22)

The Earth Continuity Test works by using internal relays to provide a short circuit and open circuit test. The OTS Tester must be wired in series with the pilot as shown in Figure 4-18.

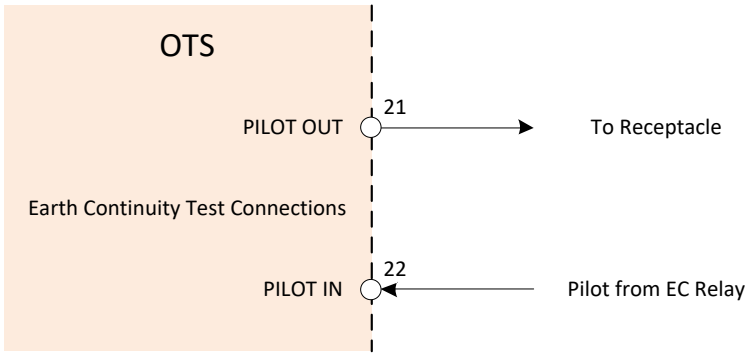

Figure 4-18 Electrical Connections – EC Test

4.4.5 Control Outputs Connections (Terminals 5, 6, 15, 16, 31 & 32)

The OTS uses three control outputs to reset and start protection relays as required during the testing procedure. The outputs should be wired in parallel to the existing control circuitry.

NOTE It is important to note that all of the OTS output relays are internally interlocked to the Test Switch Input and that it is not possible for these outputs to close whilst the test switch is in the open position. This ensures that the operation of the outlet will not be compromised during normal operation.

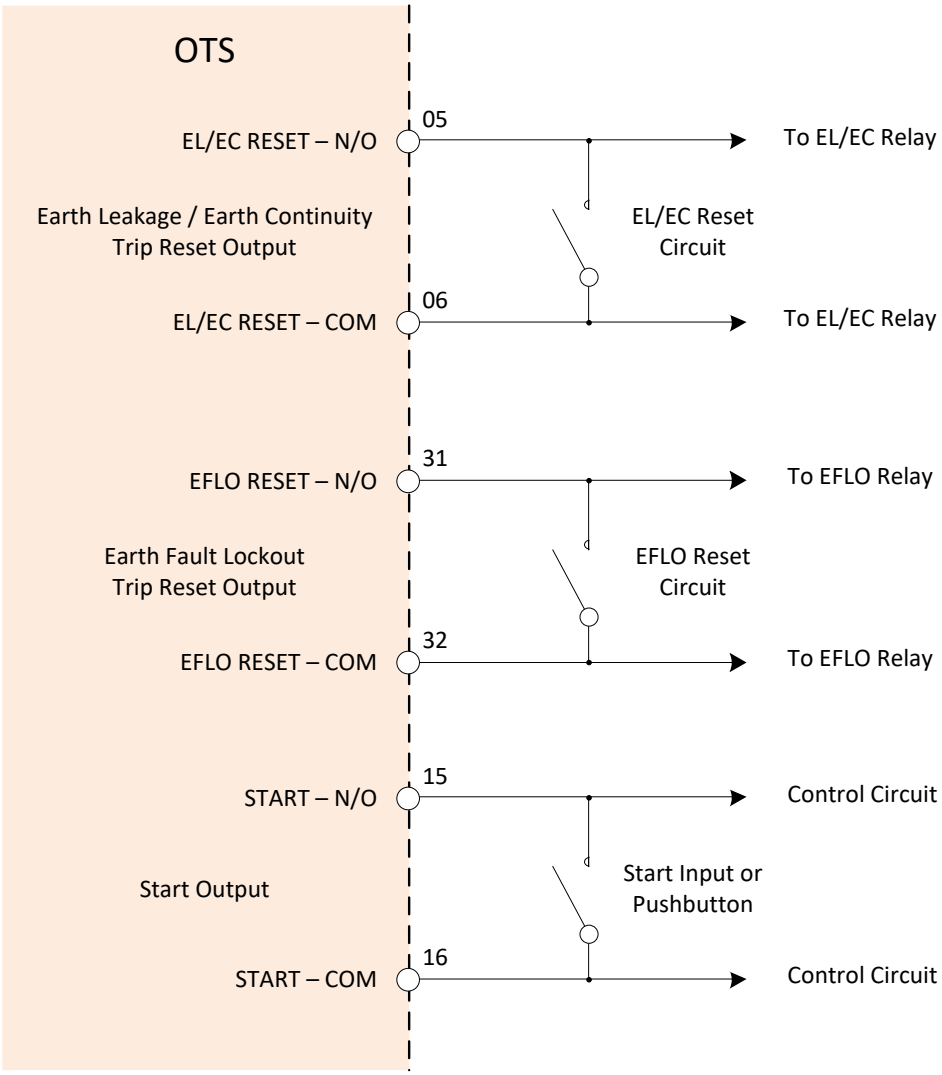

Figure 4-19 Electrical Connections – Control Outputs Connections

4.4.6 FC Test Connections (Terminals 29 & 30)

The Frozen Contactor Test checks the operation of the Frozen Contact Protection Relay by manipulating its MCI input to provide fake open and closed MC states. A logical trip will occur when OTS causes the MC to appear closed while the MC slave contactor feedback is indicating that it should be open. This will result in the FC Protection Relay tripping the upstream circuit breaker.

The FC Test output must be wired in parallel with the auxiliary contact from the main contactor that is used in the MCI input of the FC protection relay.

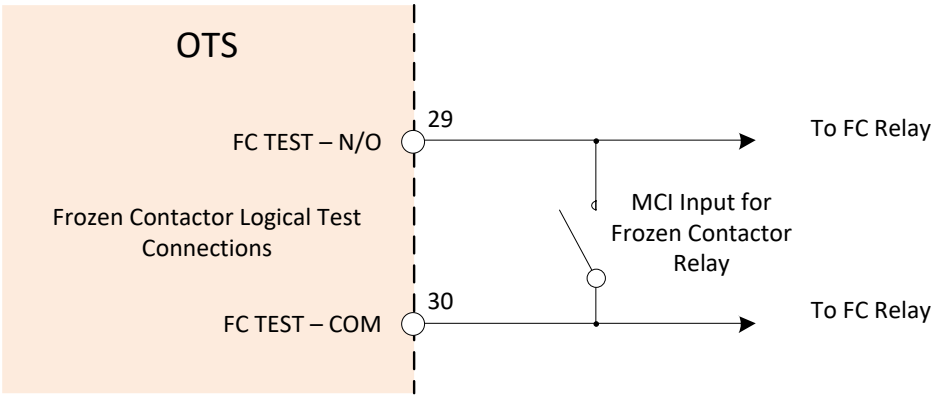

Figure 4-20 Electrical Connections – FC Test

4.4.7 Remaining Connections (Terminals 17 & 18)

These connections are not used by the OTS and should not be terminated.

4.4.8 Removal of OTS Module

The OTS system has no effect on the operation of the outlet / starter during normal operation, this means the OTS can be removed and the outlet will still function as designed. If removing the OTS module, consideration needs to be made towards the interfacing connections. Exact requirements need to be considered from reviewing the electrical schematics. Removal is simple as all terminal plugs are removable and are insulated when removed. The Electrical connections that need to be considered in particular are the following:

- Short out the “PILOT TERMINALS” (21, 22)
- Short out the “INTERLOCK TERMINALS” (13, 14)
- Short out the “HEALTHY TERMINALS” (9, 10)
- NOTE: this is only required if the Healthy Interlock is used in a series stop installation

5 PRODUCT OPERATION

All tests are initiated wirelessly through Bluetooth from the AmpINTEL PowerSAFE OTS software. The AmpINTEL PowerSAFE OTS Application software is compatible with Android versions 4.3 and above. As the OTS application has been developed and tested on the Samsung Galaxy Tab A with Android version 6.0.1, Ampcontrol can only guarantee compatibility with this device.

CAUTION!

Ampcontrol cannot guarantee correct operation of the AmpINTEL PowerSAFE OTS application if a non-compatible smart device is utilised.

During a test, the results will be displayed on the tablet and a report will be generated upon completion. These test reports are stored on the tablet until it gains network access. At this point the test reports are uploaded to the dashboard, a site-specific cloud-based storage platform.

Once these reports have been uploaded, all reports except for the most recent will be removed from the tablet. The most recent report is saved on the tablet because, at the beginning of each new connection, the OTS will check to make sure there are no discrepancies between the results obtained from the last test and those stored on the tablet. If there are any differences the test report will be updated to those stored in the OTS. If the reports are different (i.e. the last test was conducted on a different device) a new test report will be generated with the data stored on the OTS. This is of particular use if there were any issues with the tablet or Bluetooth connection during testing.

For more information on the operation on the OTS Android Application or the Dashboard please refer to the relevant user manual.

NOTE

The Bluetooth range is limited to a maximum of approximately three metres (3 m). This distance is an advised maximum, various factors will influence the connection distance.

Table 2 Test Coverage per Operation Mode

Test	Test Process	Measured Values
Earth Leakage Test (Section 5.1)	The OTS utilises the existing EL test circuitry to inject current through the earth leakage toroid. Note: When Back EMF Testing is not selected the outlet's main contactor is locked out to prevent closing / operating during testing.	The OTS will measure: - Voltage on each of the phases prior to trip actuation - Time taken between initiation of the EL current and the opening of the outlet contactor - Time taken for the voltage on the load side of the contactor to fall below extra low voltage if present (Also known as Back EMF which has the potential to increase touch potential voltages)
Earth Continuity Test (Section 5.2)	The OTS applies an open circuit to the pilot and confirms that the fault is detected by the EC protection. The OTS resets the EC relay. The OTS will then apply a short circuit fault to earth on the pilot and confirms that the fault is detected by the EC protection. Note: The outlet's main contactor is locked out to prevent closing / operating during testing.	The OTS will confirm: - An open circuit fault prevents the contactors from closing - A short circuit fault prevents the contactors from closing
Earth Fault Lockout Test (Section 5.3)	The OTS individually shorts each phase to earth (on the low voltage side of an installed barrier) and confirms that the fault is detected by the EFLO protection. Note: The outlet's main contactor is locked out to prevent closing / operating during testing.	The OTS will confirm: - An earth fault on "A phase" prevents the contactors from closing - An earth fault on "B phase" prevents the contactors from closing - An earth fault on "C phase" prevents the contactors from closing
Frozen Contact Test (Section 5.4)	The OTS initiates a FC logical test by applying a short to the MCI input of the FC protection relay and confirms that the fault is detected. Note: The outlet's main contactor is locked out to prevent closing / operating during testing.	The OTS will confirm: - A logical FC trip opens the upstream circuit breaker

5.1 Earth Leakage Protection Function Test

The earth leakage test can be initiated in two variations, with or without Back EMF measurement. When measuring Back EMF the outlet is required to be running and operating in a steady state to ensure that the measurement is accurate. Varying the load, speed or length of a conveyor, or the pump head can cause different results to be measured. These specifics should be recorded in the testing notes section of the report. When testing without Back EMF selected, the outlet is not energised and the outlet needs to be stopped before initiating. When the EL test is initialised, the OTS will energise the existing external EL test circuit. This simulates an EL current to be detected by the outlet's earth leakage toroid.

NOTE

The OTS itself does not generate the test current; it operates in parallel to the existing manual EL test circuit.

Once the earth leakage test is initiated, the OTS will measure the time taken for the outlet to open its contactor or breaking device. In addition, if the Back EMF test is selected, the OTS will also monitor the voltage on the load side of this breaking device to determine the time that it takes for the back EMF generated by the connected load to subside to extra low voltage, (<50 VAC). This represents the true clearing time following an earth leakage fault.

The magnitude of the current that flows through the earth leakage toroid is determined by the design of the test circuit installed. It is the responsibility of the installer to ensure that the value of current is sufficient to provide meaningful results when the earth leakage test is conducted by the OTS.

NOTE

The installer is responsible for ensuring that the EL test current is of a suitable magnitude to provide a meaningful test.

It is recommended that the circuit design is chosen such that the test current is between 110 % and 120 % of the trip level of the earth leakage protection relay (AS/NZS 2081 Appendix E4, AS/NZS 4871.1:2012 Clause 2.6.2.4).

5.2 Earth Continuity Protection Function Test

The earth continuity test consists of two individual tests, the open circuit (series) test and the short circuit (shunt) test.

When the EC series test is initialised, the OTS will open circuit the pilot and confirm that the earth continuity protection relay has tripped. This is detected through the main contactor's permissive circuit dropping out, sensed through the OTS INTERLOCK1 / VOLT SENSE input.

The trip will be reset before the OTS initiates the EC shunt test and shorts the pilot conductor to earth. Confirmation of the EC protection relays ability to detect a shunt trip is similarly measured through the main contactor's permissive circuit dropping out.

5.3 Earth Fault Lockout Protection Function Test

The earth fault lockout test consists of three individual tests, one test for each of the three outlet phases.

To be able to test EFLO, an appropriate EFLO protection relay needs to be installed. The OTS piggy backs on an existing IPM (ITM) and EFL barrier. When an EFLO test is initiated, the OTS will apply a short on the barrier's low voltage connection point of the A phase to earth. The OTS will then confirm that the earth fault lockout protection relay has tripped and is preventing the main contactor permissive circuit from being energised. This is detected through the OTS INTERLOCK1 / VOLT SENSE input.

The EFLO relay will then be reset, and the same test will be applied to the B phase connection. Once this has been completed successfully, the C phase test will then be completed.

5.4 Frozen Contactor Protection Function Test

This tests the installed FC protection relay by creating a logical FC trip. This is achieved when the OTS applies a short to the MCI input of the FC protection relay, initiating a logical FC trip causing the upstream circuit breaker to trip. Confirmation of the trip is detected through the CB feedback input to the OTS, confirming that the upstream circuit breaker physically opens.

5.5 System Configuration

The OTS has been designed specifically to operate with Ampcontrol protection relays. The testing is restricted depending on the configuration of the OTS and the protection utilised on the outlet. The testing allowed, with reference to barrier configuration, can be seen in Table 3. The Configuration of the OTS is achieved through the Tablet application. Refer to the tablet application manual for further details, MAG-199 OTS Application User Manual.

Table 3 Testing Configuration

Relay Type	Configuration	Barrier	EL	EL Back EMF	EC	EFLO	FC
OTS	IPM	ITM 415V/1kV	✓	✓	✓	✓	✓
	PF1	OTS EL/EC (External)	✓	✓	✓		
	PF1 with EFL	EFL	✓	✓	✓	✓	✓
OTS EL-ONLY	IPM	OTS (Internal)	✓	✓			
	PF1	OTS (Internal)	✓	✓			
	PF1 with EFL	OTS (Internal)	✓	✓			
	Discrete EL	OTS (Internal)	✓	✓			

Since the OTS can be configured, there is a possibility it can be configure incorrectly. There are no safety implications as a result from this as shown in Table 7 of APPENDIX A: Test Sequence Issues Due to Incorrect Configuration.

NOTE

It is recommended that the configuration be confirmed every time the tablet is connected to an OTS.

5.6 OTS Version 1 / 2 Compatibility

The OTS has two versions available. The difference between the two versions is only evident when the EFLO test is selected while operating in an IPM controlled outlet. When not operating in an IPM configured outlet there are no restrictions and either version can be installed.

When utilising version 1 of the OTS with an IPM, the EFLO test effectively tests the ability of an IPM to detect a faulty ITM Barrier. This is a result of the interaction between an IPM - ITM during an insulation resistance test. The IPM, if operating correctly, will detect this and trip however it will not be logged as an EFLO trip.

When utilising Version 2 of the OTS in an IPM configured outlet, additional hardware internal to the OTS allows the OTS to test an EFLO fault with the IPM.

The OTS can detect what version is installed and can also detect a failed ITM. Additional notes will be added to the test report generated in these circumstances, see Table 4 below.

Table 4 Test Report Notes

Note Added to Test Report	Further Detail
(None)	No note added, EFLO Test was effective
IPM EFLO Test – OTS TEST hardware only applied fault to simulate loss of ITM; To induce a simulated EFLO fault, a hardware upgrade is required.”	OTS Version 1 used, or ITM V_{TEST} not wired to OTS Version 2
“IPM EFLO Test – ITM Failed to Operate, Recommend inspection of ITM and circuit”	The OTS has detected that the ITM Failed to operate correctly, recommend physical inspection of outlet.

5.6.1 Relay Compatibility and Firmware Requirements

The OTS relay is compatible with the following Ampcontrol protection relays:

- ELD V1/2/3 (All Firmware Versions)
- ELM V1/2 (All Firmware Versions)
- ELV V1/2 (All Firmware Versions)
- ELV-PRO (All Firmware Versions)
- ECD (All Firmware Versions, will not work in remote start mode)
- MEC-1 (All Firmware Versions, will not work in remote start mode)
- ECM3 (All Firmware Versions, will not work in remote start mode)
- EFL (Firmware Version V4.3 and newer)
- PF1 (Firmware Version V2.3 and newer)
- IPM (Firmware V12 and newer)

6 OPERATIONAL INTERFACE

This section will give an explanation of the physical location and the operational characteristics of the OTS's interface elements.

6.1 OTS Operational Interface

The OTS has two LEDs and an RJ45 connection port (identified in Figure 6-1). The operation of the LED's is detailed in *Table 5*.

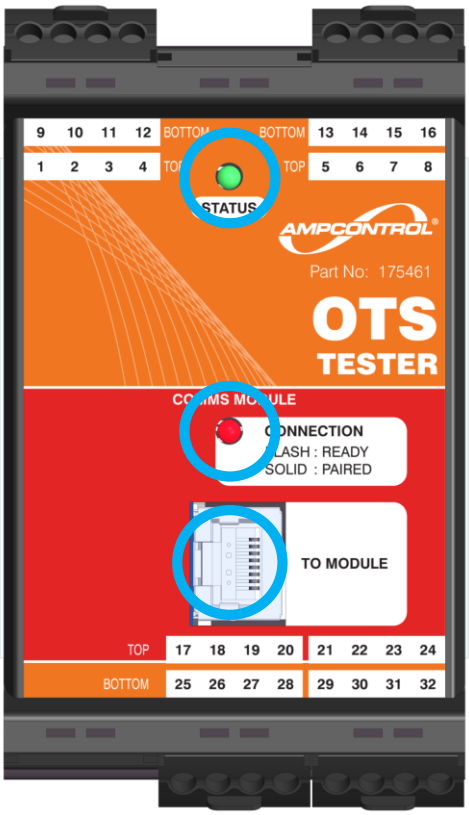

Figure 6-1 OTS Operational Interface

Table 5 OTS Tester Fascia LED Operation

LED		Behaviour		
Name	**Colour**	**Off**	**Flashing**	**On**
Status	Green	Control Power Off	Healthy	Processor Error
Comms	Blue	Not Connected to Comms Module	Ready for Connection to Tablet	Connected to the Tablet

The RJ45 port is designed to connect the OTS Tester to the Comms Module via a straight through CAT5 or CAT6 cable.

CAUTION!

The Comms Module Connection Ports **are not standard Ethernet ports.** These cores carry voltages that will damage an incompatible device if connected.

6.2 OTS Comms Module Operational Interface

If the OTS Comms Module is installed correctly, the two LEDs identified on the left in Figure 6-2 will line up with the label that is installed over the hole on the outside of the enclosure. These LEDs are the Paired LED (left) and the Testing LED (right). The operation of the LED's is detailed in *Table 6*

Figure 6-2 Comms Module Operational Interface

Table 6 OTS Comms Module LED Operation

LED		Behaviour		
Name	**Colour**	**Off**	**Flashing**	**On**
Paired	Blue	Not Connected to Tester	Ready for Connection to Tablet	Connected to the Tablet
Testing	Red	No Testing in Progress	Testing in Progress	Testing Completed

7 SERVICE, MAINTENANCE & DISPOSAL

7.1 Equipment Service

A number of external system-based checks should be completed on a regular basis. These 'routine inspections' must be carried out by suitably trained people with knowledge of the Outlet Test System and the systems into which it is fitted. Routine inspections may take the form of either visual-only checks, or visual and 'hands-on' checks.

7.1.1 Visual Only Inspections

A basic visual inspection focuses on looking at the installation for signs of physical damage, water or dust ingress and the condition of cables and labels. This type of inspection may involve opening cabinets to gain access to the OTS and other equipment. This level of inspection may also include cleaning display windows that have become obscured by dirt.

Observations would typically be:

- Check that equipment enclosures, cable trays, conduits, etc. are in good order with no physical damage
- Check that sealed wall boxes are free from water and dust ingress internally. Door seals are in good condition
- Check that connected cables are free from cuts, abrasions and obvious signs of damage. Cable restraints are in good order and correctly fitted
- Check that labels on equipment, wall boxes and cables are present and in good condition (especially certification labels)
- Check that no modifications have been carried out to installed equipment

7.1.2 Hands-On (Detailed) Inspections

A more detailed inspection would include all of the elements of a visual inspection, plus some checks that cover the integrity of connections, fixtures and fittings.

In addition to basic visual observations, more detailed integrity checks would involve:

- Verify that equipment housings, wall boxes and other mechanical fixtures are secured in place. This includes terminal box lids, tightness of cable glands, integrity of wall-box mountings, security of equipment fixing to walls/DIN rails etc
- Verify all electrical connections are secure with no loose screw terminals or DIN rail terminals not fitted to rails etc

7.2 Equipment Maintenance

WARNING!

The OTS has no user-serviceable parts.

All repairs must be carried out by Ampcontrol only.

If a fault develops, return the unit to Ampcontrol for repair. It is essential that **no attempt be made to repair the unit** as any attempt to dismantle or repair the unit can **seriously compromise the safety of the unit and voids product warranty**.

7.3 Disposal

ENVIRO

The electronic equipment discussed in this manual **must not be treated as general waste**. By ensuring that this product is disposed of correctly you will be helping to prevent potentially negative consequences for the environment which could otherwise be caused by incorrect waste handling of this product.

8 SPECIFICATIONS

Specifications	
Supply	
Regulated Voltage	24 VDC or 24 VAC (50 Hz) ±20 %
Power Supply Requirement	5 VA
Dimensions and Environment	
OTS (H x W x D)	116 x 68 x 113 mm
Comms Module (H x W x D)	86 x 54 x 21 mm
IP Rating	IPX6
Earth Leakage Test	
Test Interface	Current injected through the earth leakage toroid
Measured Entities	Elapsed time between trip initiation and outlet contactor opening **and,** Elapsed time between trip initiation and the back EMF falling below ELV (true clearing time).
Earth Continuity Test	
Test Interface (Series)	Open Circuit pilot.
Measured Entities (Series)	Earth continuity relay initiates a trip.
Test Interface (Shunt)	Short Circuit pilot to earth.
Measured Entities (Shunt)	Earth continuity relay initiates a trip.
Earth Fault Lockout Test	
Test Interface (Phase A)	Shunt EFLO Phase A connection to earth.
Measured Entities (Phase A)	Earth Fault Lockout relay initiates a trip.
Test Interface (Phase B)	Shunt EFLO Phase B connection to earth.
Measured Entities (Phase B)	Earth Fault Lockout relay initiates a trip.
Test Interface (Phase C)	Shunt EFLO Phase C connection to earth.
Measured Entities (Phase C)	Earth Fault Lockout relay initiates a trip.
Frozen Contactor Test	
Test Interface	Short MCI feedback into FC Relay.
Measured Entities	Circuit breaker has been opened.
Find Out More	
For more information on this product, contact Ampcontrol Customer Service on +61 1300 267 373 or *customerservice@ampcontrolgroup.com* or visit the Ampcontrol website: www.ampcontrolgroup.com	

9 EQUIPMENT LIST

Part Number	***Description***
175461	MODULE OTS TESTER
179019	MODULE OTS2 TESTER
175463	MODULE OTS COMMS
176536	MODULE OTS EL-ONLY TESTER
180264	MODULE OTS EL-ONLY TESTER Version 2
175462	MODULE OTS EXTERNAL EL/EC BARRIER
177451	OTS TESTERS TABLET NON-LTE 8IN OTS+CASE

APPENDIX A: Test Sequence Issues Due to Incorrect Configuration

The implications of incorrectly configuring the OTS can be seen below. There are no circumstances that will allow an outlet to incorrectly pass a test. All test sequences will test as normal unless specified in this table. Test selection is also affected depending on the configuration as outlined in the table below.

Table 7 Test Sequence Issues Due to Incorrect Configuration

System Type ID entered	Actual Configuration					
	IPM	**PF1**	**PF1 + EFL**	**Discrete EL + EC**	**Discrete EL + EC + EFL**	**Discrete EL + EFL**
IPM	-	EL and EC test sequence will fail. EFLO and FC tests cannot be selected	All test sequences will fail.	EL and EC test sequence will fail. EFLO and FC tests cannot be selected	All test sequences will fail.	EL, EFLO & FC test sequence will fail. EC test cannot be selected
PF1	EL and EC test sequence will fail. EFLO and FC tests cannot be selected	-	EFLO and FC tests cannot be selected	-	EL & EC test normally. EFLO and FC tests cannot be selected	EC test sequence will fail. EFLO and FC tests cannot be selected
PF1 + EFL	All test sequences will fail.	EFLO & FC test sequence will fail	-	EFLO & FC test sequence will fail	-	EC test sequence will fail

* Discrete EL = ELD / ELV / ELV-PRO
* Discrete EC = ECD / MEC-1 /ECM3