Automated Cable Test System (ACTS)

for MU 27 pin Cables

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Introduction

The Automated Cable Test System for MU 27 pin cables (ACTS) provides a reliable & repeatable method of qualifying MU cables for in-field use. The system measures conductivity, dielectric isolation between conductors and dielectric isolation from a conductor to chassis ground. All pin combinations are scanned in sequence to detect and identify faults. The test sequence is fully automated and controlled by a user-friendly software package running on an integrated PC. The software interface reports the test results in an easy to read database type table. Based on the results and customer requirements, the cables can be repaired to correct the indicated faults or removed from service. The test sequence is done through a pre-scan if the pre-can passes, the cable is ready to go into service. During the pre-scan test, if a problem is detected with leakage then an automatic "deep scan" will take over. The total pre-scan tact time to test a functional cable is less than 2 minutes. If a "deep scan" is required, the tact time will be different and based on the number of detected faults.

Figure 1 – MU 27 pin Cables

Figure 2 – Test Ports A & B

Specifications

The ACTS meets the following specifications:

- Input supply: 110~120Vac @ 0.75A (fused)

- Output Voltage for Conductor to Conductor Dielectric Tests: 250Vdc +/- 5% @ 20mA

- Output Voltage for Continuity Tests: 12V @ 150mA

- Output Voltage for Conductor to Ground Isolation Dielectric Tests: 250Vdc +/- 5% @ 20mA

- Continuity Test accuracy: +/-5% impedance @ 150mA

- Dielectric Leakage Threshold (pin-pin) : 200K ohm +/- 5% (>210K = Pass, <190K = Fail)

- Dielectric Leakage Threshold (pin-ground): 150K +/- 30%

- Operating Temperature: 0C to + 40C

- USB 2.0 connectivity

- Windows based Software controls test sequences and generates reports

- LED status indicators for "Power" and "Busy" states

Functionality

The unit is powered by 120Vac standard supply plug. The system is connected to an integrated window based PC via an internal USB connection. Software indicates ACTS hardware is present. The user connects each end of an MU 27 pin cable (DUT) to the test ports of the ACTS.

User clicks "Start" on the software interface screen of the PC. The test sequence begins.

The ACTS performs the following test sequence for all conductor pairs indicated in the test program:

1- Pin to Pin Continuity Test.

2- Pre-Scan for Conductor to Conductor Dielectric Isolation.

3- If any pin yields a fault, then that pin is scanned to all the other remaining pins individually in order to determine the subsequent pin or pins involved in the leakage, they will be identified by number to the pin first detected with the leakage.

4- Conductor to Ground Dielectric Isolation.

5- Repeat Steps #1 to #4 for the next Cable Under Test.

*See following section for description of these test steps.

Figure 3 – DUT Cable plugged into Test Ports.

The software records and stores the test results. A unique Serial Number of the cable is generated for the cable.

New Test Sequences can be setup and saved for custom in-house applications.

Test Definitions

The following section defines three types of electrical tests to determine the DUT cables electrical properties. The tests are identified as Continuity, Conductor to Conductor Dielectric Isolation along with Deep-Scan properties and Conductor to Ground Dielectric Isolation.

Continuity

A low voltage current supply of 12V @ 150mA is passed through a conductor (CUT). The impedance of the conductor is measured.

Conductor to Conductor Dielectric Isolation

A voltage of 250V is applied to the Conductor under Test at one Test Port only. The leakage current is measured based on the resulting voltage at the second Test Port.

"Pre-Scan": The isolation of the conductor under test to all other pins are measured. If this test yields a Pass result, no other action will be required.

"Deep-Scan feature": When the "Pre-Scan" indicates there is dielectric breakdown between a conductor under test, then the system will automatically preform a Deep-Scan in order to identify the corresponding leaking pin or pins. On the display screen the associated leaking pin or pins will be displayed with the associated numbers. Thus, the Deep-Scan process checks the individual conductor pairs to indicate where the breakdown has occurred and to which pin the breakdown is associated. When this type of problem occurs with one of the cable, the completion of the test will have an extended duration in order to detect all the problems and annunciate the information on the screen. Consider that: Deep-Scan is a unique and an advance feature of this system

Isolation to Ground

A voltage of 250V is applied to the Conductor under Test at one Test Port only. A dielectric breakdown to chassis ground is detected based on the resulting voltage of the conductor under test at the second Test Port.

Software

The main interface displays test results, status information and controls.

On LEFT of screen the following system information is displayed:

- Test Date

- DUT Identification

- Current Test Program

- Enabled Tests within Program

- High/Low Test Switch Status

- Hardware Connection Status

- Software Version

- Duration of Test

- IP Address

Figure 4 – Main Screen, System Information

During the test sequence, active pins are displayed on the left-hand side of the screen showing the system activity in real-time.

When the test sequence is complete, PASS results are displayed in Green the FAIL's pins are listed in Red along with resistance value of the failure shown in Red highlighted area. When dielectric isolation tests

between pins fails, in addition to the "FAIL" Red highlight, the corresponding leaking pin is also listed. In the case of a fault to ground, "GND" is determined then the grounded pin or pins are listed as ground on the display and highlighted in Red.

Figure 2 - Test Results in Main Window

Keyboard

For text entry an On-Screen Keyboard is display. Use keyboard buttons to enter text.

Click Done when finished.

Figure 3 - On-Screen Keyboard, Click Done when finished

User Login

On system startup, the User Login screen is displayed.

Enter operator identification and click Sign In. The operator identification will be saved with each test result. The Main Screen will then be displayed.

In addition to the standard Sign In, click Express to enter "Express Cable Mode". This allows operator to test cables using the default program with minimal setup (see Express Mode section).
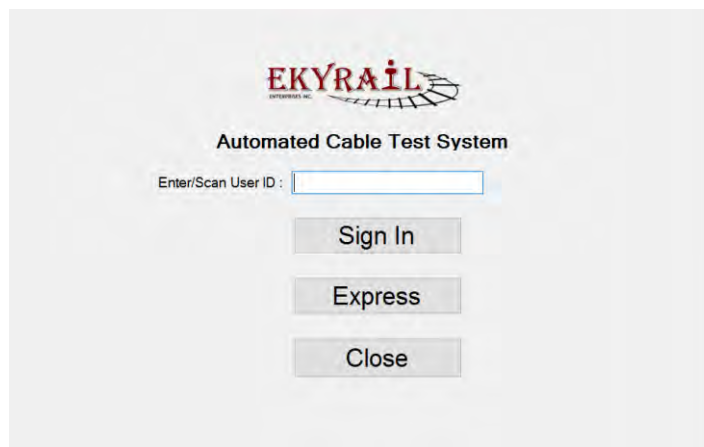
Figure 4 - User Login

Running a Test

To start a test, click the green RUN button in the left hand corner.

Figure 5 - Run Button
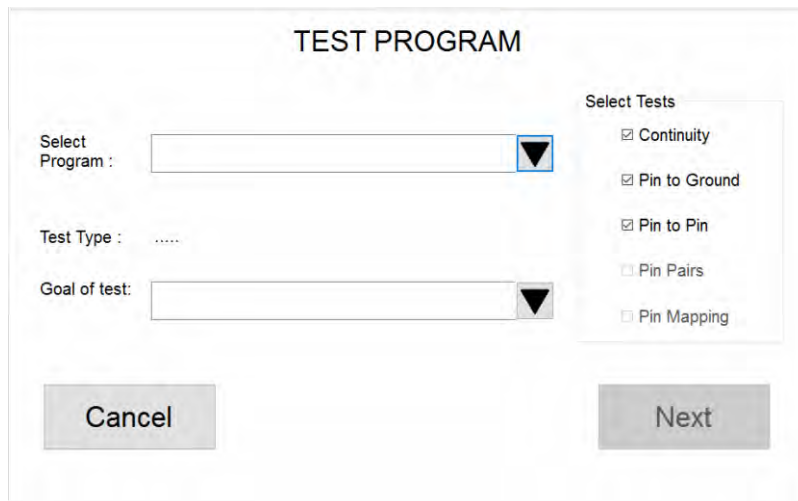
Figure 6 – User must define Test Sequence

Figure 7 - Select Program

Figure 8 - Select Goal of Test

Goal of Test

Goal of Test can be Reception, Deficiency, Final or Quick Test. The selected goal of test will be shown in test report. Based on the selected goal of test, user may be prompted for additional information.

Reception: Cable is received and initially tested before any repairs/maintenance. User is prompted for

Deficiency: Cable is tested after being identified as defective.

Final: Perform Final test before expediting.

Quick Test: No additional information is required from user.

Figure 9 – Reception/Deficiency User can enter additional information

Figure 10 - Special Instruction for User are listed on screen. Cleaning of equipment prior to test may be required.

Figure 11 – Goal of Test Final: user enters repairs performed.

Example (Below):

In the example below, pins 23, 24, 25, 26 and 27 have dielectric breakdown and leakage current flows between these pins.

Figure 12 - Isolation Failure example

In the next example, pins 11, 12, 13, 14, 26 and 27 show continuity failure where the measured resistance of each is indicated (ranging from 0.96R to 1.11R).

Figure 13 - Continuity Failure example

The test result may be saved for future viewing. A hardcopy of the report may also be printed.

Cable Test Report
Program: Cable MU 27 pin
Date: 16/11/2016
SN: 11160017

	Pin to Pin Isolation	Pin to Gnd Isolation
Impedance	600K	1M
Tolerance	5%	5%

CABLE A	CABLE B	CONTINUITY	ISOLATION
1	1	PASS	PASS
2	2	PASS	PASS
3	3	PASS	PASS
4	4	PASS	PASS
5	5	PASS	PASS
6	6	PASS	PASS
7	7	PASS	PASS
8	9	PASS	PASS
9	8	PASS	PASS
10	10	PASS	PASS
11	11	PASS	PASS
12	12	PASS	PASS
13	13	PASS	PASS
14	14	PASS	PASS
15	15	PASS	FAIL(17,23)
16	16	PASS	PASS
17	17	PASS	FAIL(15,23)
18	18	PASS	PASS
19	19	PASS	PASS
20	20	PASS	PASS
21	21	PASS	PASS
22	22	PASS	PASS
23	23	PASS	FAIL(15,17)
24	24	PASS	PASS
25	25	PASS	PASS
26	26	PASS	PASS
27	27	PASS	FAIL 597.39K(GND)

Figure 14 - Example of hardcopy of a test record

Cable Test Report
Program: Cable MU 27 pin
Date: 16/11/2016
SN:

	Pin to Pin Isolation	Pin to Gnd Isolation
Impedance	200K	200K
Tolerance	5%	5%

CABLE A	CABLE B	CONTINUITY	ISOLATION
1	1	PASS	PASS
2	2	PASS	PASS
3	3	PASS	PASS
4	4	PASS	PASS
5	5	PASS	PASS
6	6	PASS	PASS
7	7	PASS	PASS
8	9	FAIL 0.23R	PASS
9	8	FAIL 0.23R	PASS
10	10	FAIL 0.28R	PASS
11	11	FAIL 0.30R	PASS
12	12	FAIL 0.30R	PASS
13	13	FAIL 0.34R	PASS
14	14	FAIL 0.33R	PASS
15	15	PASS	PASS
16	16	PASS	PASS
17	17	PASS	PASS
18	18	PASS	PASS
19	19	PASS	PASS
20	20	PASS	PASS
21	21	FAIL 0.38R	PASS
22	22	FAIL 0.33R	PASS
23	23	FAIL 0.30R	PASS
24	24	FAIL 0.27R	PASS
25	25	FAIL 0.21R	PASS
26	26	PASS	PASS
27	27	FAIL 0.23R	PASS

Figure 9: Example of hardcopy of continuity test

Express Cable Mode

From the Sign In screen, click Express to enter "Express Cable Mode".

In this mode, operator can test cable using the default program.

Simply connect Cable to System and click Run.

In this mode, DUT is stored as "Express".

The default program is "Cable MU 27 pin".

An Advanced User may modify the program named "Cable MU 27 pin". The default program used for Express test will be updated with the new program.

Pause & Step Back

When running a test, the "Pause" button is used to suspend test.

The "Step Back" button allows operator to perform a test step over. When stepping back, some results are erased to be recorded again.

To redo a test step:

- Click "Pause" (once)

- Click "Step Back" until the test step to redo is highlighted.
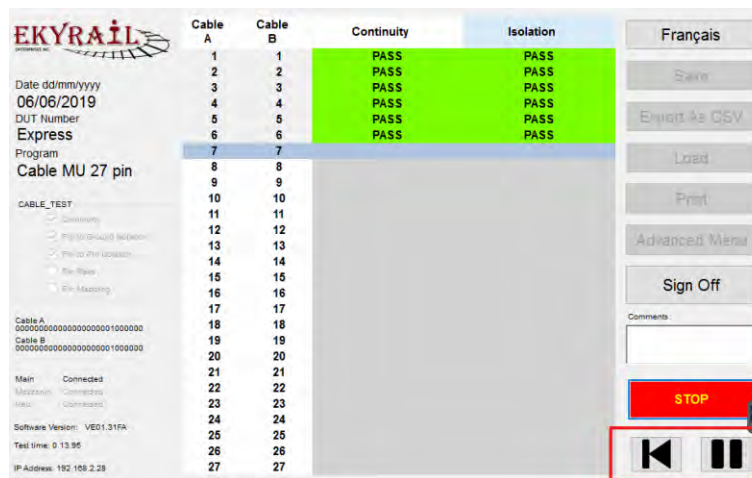
- Click "Continue" (Play) button

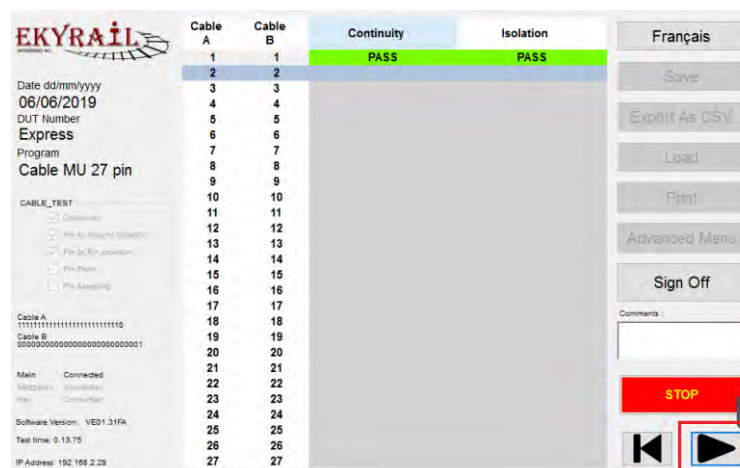**Figure 15 - Pause & Step Back Buttons**

Figure 16 - Continue (Play) Button

Setup

The Test Program setup page allows the user to configure custom cable tests to adapt the system to any cable of 27 pins or less. Each Test Program can be saved to a "TestRecord.xml" file which catalogs all saved programs for future use.

The Continuity Test parameters are customizable. User can set end to end connection points, maximum impedance and tolerance. Cable A & Cable B columns identify pin numbers of an internal wiring. Impedance unit is OHM and Tolerance unit is %. Test result is "Pass"/" Fail" based on measurement below or above maximum impedance set by the user. Where continuity measurement is above maximum impedance within & the tolerance, the test result will be displayed as "Pass (Tolerance)". This result indicates a marginal result.

Figure 10 – Test Setup Page

The Pin to Pin Isolation and the Pin to Ground Isolation Tests are also customizable. User sets minimum impedance and tolerance. Cable A identifies a pin number of wire under test. Impedance unit is OHM and Tolerance unit is %.
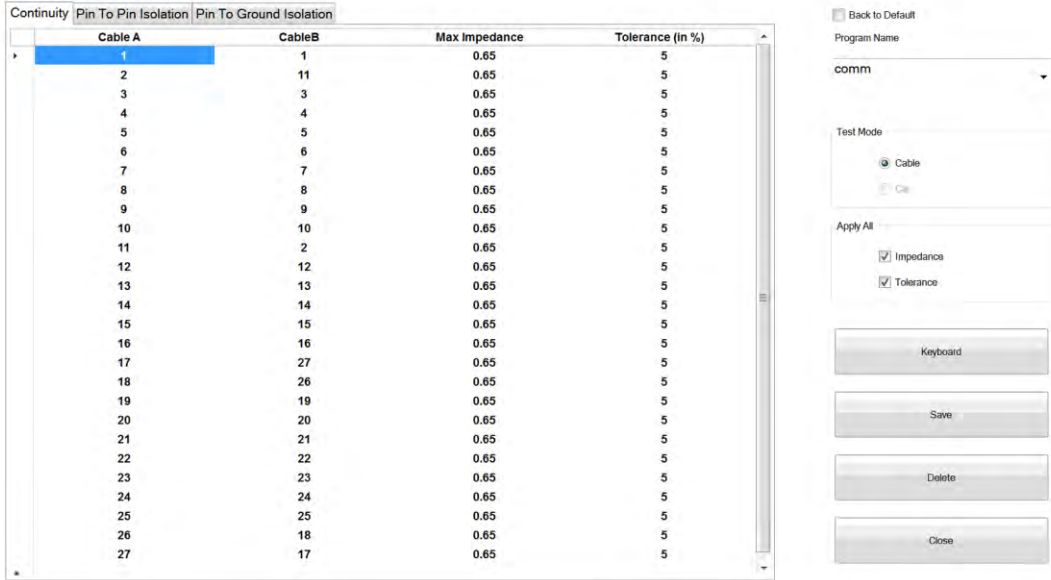

Figure 11 – Test setup page continued

In this case, where isolation is below minimum impedance and within the set tolerance, the test result will be "Pass (Tolerance)".

When checked, the "Apply All" option allows editing all rows simultaneously for Impedance and/or Tolerance. When unchecked, individual cells may be edited one by one.
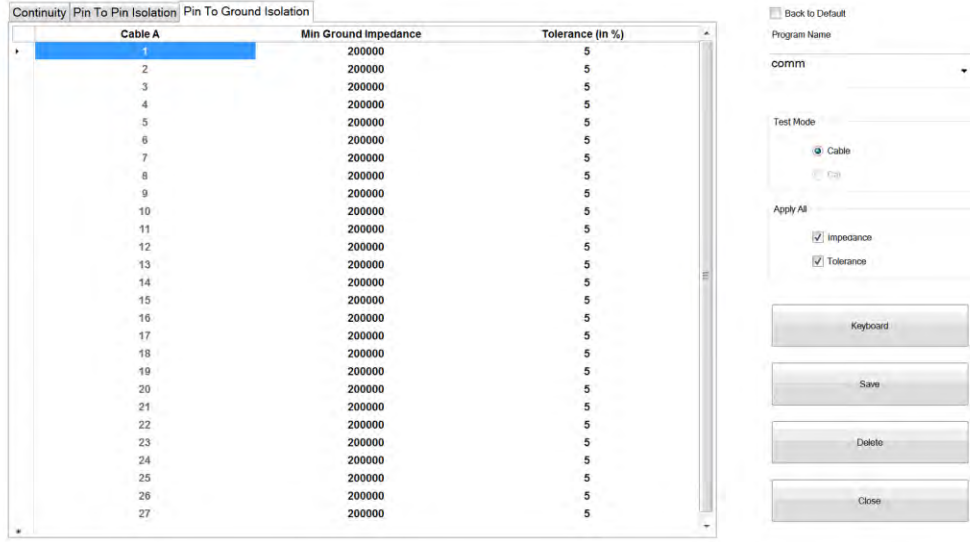

Figure 12 – Test setup page continued

Administrator Credentials

To setup a test sequence for a DUT, click the "Setup" button. The Setup page is restricted to administrator access. A Password prompt will appear. Using the onscreen keyboard enter the password: the default password is "ekyrail" and close the keyboard.

Operator Credentials

When setup operations are complete, use the "Return to operator on Close" checkbox to release administrator credentials. Close the Setup Page.

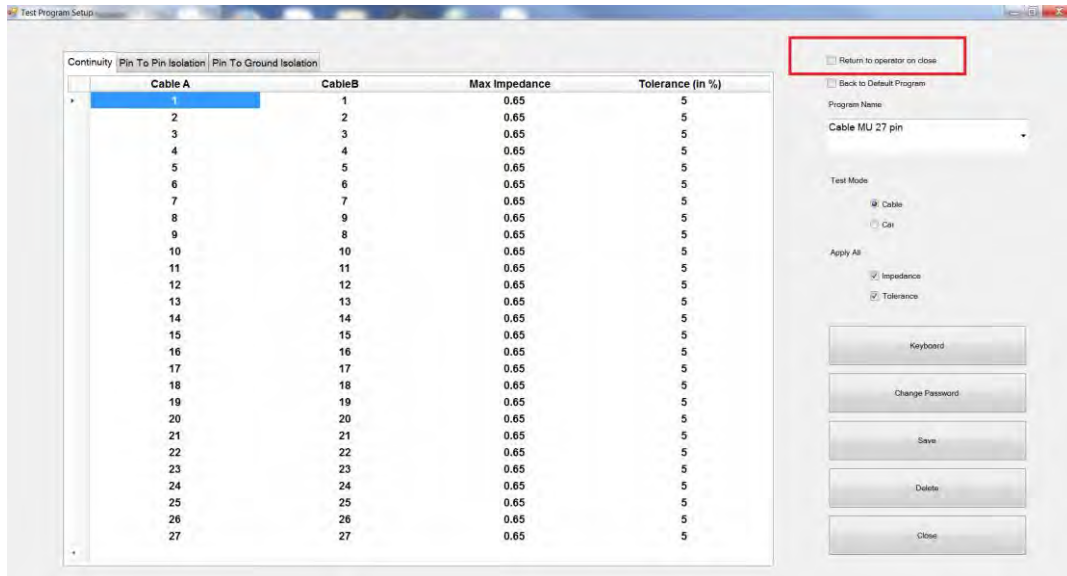To reenter the Setup Page, password will once again be required.

Figure 17 - Return to operator on close.

Password Setup

Occasionally, the administrator password must be modified. In the Setup Page, click the "Change Password" button.

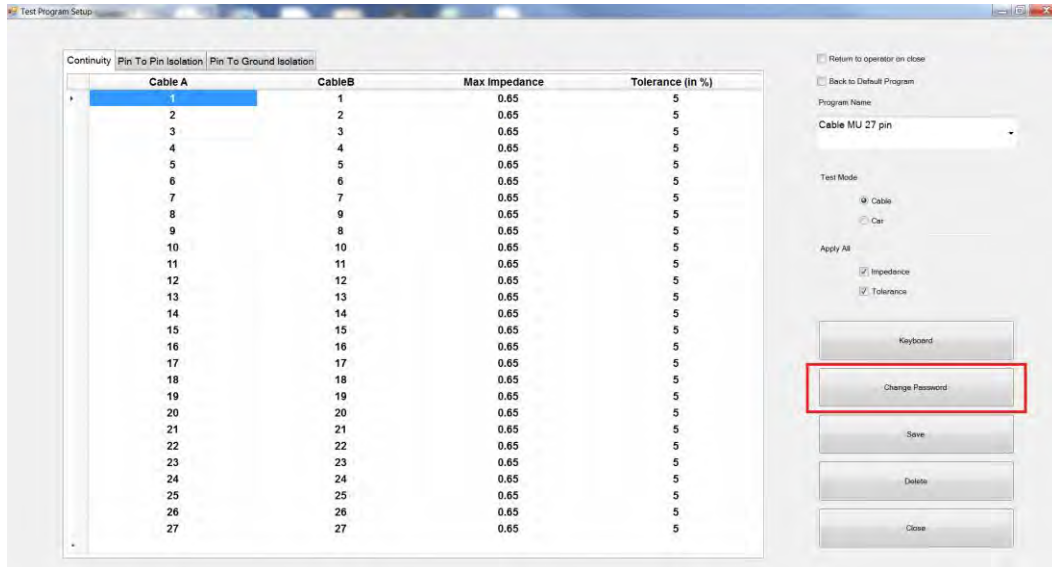Enter the new password and click "Save".
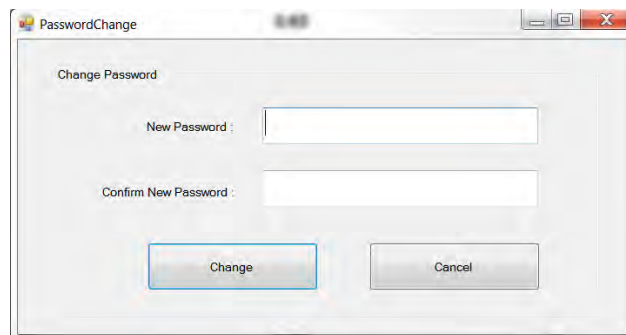
Figure 18 - Change Password.

Figure 19 - Password Change form.

Windows access

To access Windows Desktop to perform tasks such as setting up Network connectivity or installing a printer follow these steps:

- Open onscreen keyboard by pointing cursor to a text input box (example: S/N).
- Press "Windows" button + "L"
- In the windows screen, click "Switch User"
- Log in as Administrator.
- Password: "admin"

Installation of tester

The tester is designed for shop use and is to be installed at eye level in order to allow adequate view of the monitor screen, adequate working space is also needed. This screen is a touch type screen allowing easy use by the operator at all time.

Here are a few recommendations:

1. Because this tester is used for Cable jumper testing, the test unit should be placed in an area where there is adequate area to allow the user space for the movement of the cables.
2. The tester should be place at eye level in order for the operator to adequately view the screen. We recommend that the top of the tester be set between 50 & 52 inches from a level floor area this will meet average height of people using this equipment preventing overbending of the back when applying and removing the cables from the receptacles.
3. Because MU27 pins are to be connected and disconnected in a repetitive way, the tester panel should be fixed on a solid wall or a shop beam that will provide a sturdy support. The tester is provided with a sturdy back panel that is already drilled with 3 mounting holes on each side of the panel for this purpose.

IMPORTANT NOTE: The internal electronics is designed to meet mill spec for temperatures from -40C to + 85C. However, the touch screen has temperature limits of – 0 C to + 40 C which required that the system should not be exposed to extreme climates.