

Touch Command[®] Digital Control Systems User Manual



LOAD BANKS WITH THE DIGITAL SOLUTION[®]

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1.0 System Description

Each Load Technology digitally controlled load bank contains a *Load Bank Controller*, 0 to 8 *I/O Control Modules*, and 1 to 16 *Load Step Control Modules*. The Load Bank Controller is a dual processor based system that provides the primary controls, metering, and communication links into the system.

A load bank system can contain 0 to 8 *I/O Control Modules*. These modules provide the safety and main I/O control in the system (i.e. internal power control, fan(s) control, etc). Smaller systems may not use any of these modules, while more complex system will use a number of these devices.

The control of each of the load elements (the Load Steps) is provided for by the *Load Step Control Modules*. A simple system may contain only one of these modules while more complex systems will contain many of them. Both the *I/O Control Modules* and the *Load Step Control Modules* are commanded and controlled by the Load Bank Controller.

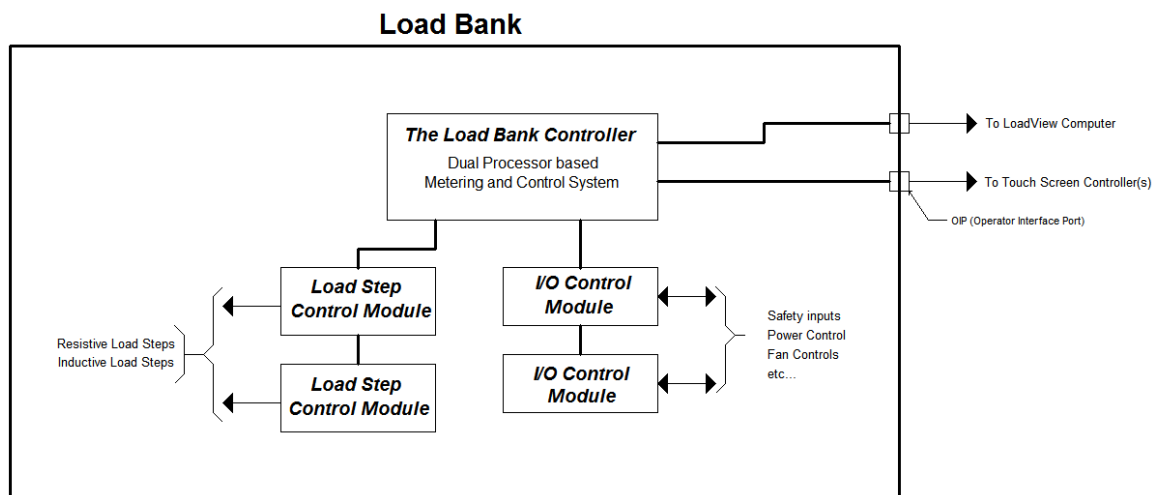


Figure 1 - Load Bank System Diagram

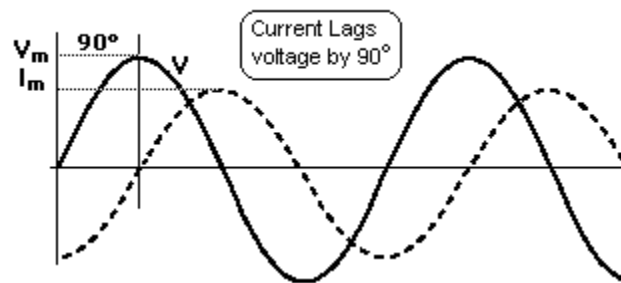
The load bank can be controlled via a connected computer that is running the LoadView program or a "Touch Screen Controller" connected via the "OIP" port (the Operator Interface Port). The OIP port is a multi-drop RS-485 network that allows up to 5 Touch Screen Controllers to be connected to the system.

2.0 Functional Overview

The main function of a load bank is to place an electrical load on a power source, usually a generator or generator system or a UPS (Uninterruptible Power Supply). This is known as the *Test Source*. The electrical load is provided by the resistive elements contained within the load bank. These elements are designed to provide accurate and stable loads over the full operating conditions of the load bank. Resistive elements are sized by the amount of *real power* (KW - kilowatts) they absorb at a given voltage. In load bank lingo, each of these elements is known as a *load step*.

Inductive load banks can be used in conjunction with resistive load banks to supply a "reactive" load. This reactive load is provided via the inductive elements within the load bank - the inductive *load steps*.

Inductors "react" with the source and load in this manner. When a pure reactive load is connected to an AC power source, the current drawn is 90° out of phase with the voltage. The current lags the voltage in an inductor.



As can be seen, the instantaneous power ($V \cdot I$) can change sign. When V is positive and I is negative, or V is negative and I is positive, the power is negative. At all other portions of the cycle, power is positive. Therefore, at some portions of the cycle the inductor absorbs energy, at the other portions it returns energy. In a pure inductor the sum of the energy absorbed and returned in a cycle is zero. Since the *real power* is the integration of the instantaneous power over a given cycle, the real power in a pure inductor is zero. Note, however, that current must still flow to transport energy to/from the reactive loads. This current will cause some real power to be lost in the form of I^2R heating in the alternator windings, wires, contactors, etc... This current forms the *reactive power*. Inductive load steps are sized by the amount of *reactive power* in KVAR (kilovolt-amp-reactive) that they provide at a given voltage and frequency.

This is why the alternator of a genset is commonly sized for the *apparent power* (KVA), but the engine is sized for the *real power*. The real power is the power delivered to the load, for example the output shaft of a motor.

However the alternator must supply the current for both the real power and the transport power (the reactive power).

The power triangle indicates the relationship between each of these power measurements.

KW - the *real power* (or *average power*) supplied to the load.

$$KW = \frac{1}{T} \int_0^T p dt$$

Where p is the instantaneous power.

KVA - the *apparent power* is made up of the *real power* and the power seen by the transport system (the *reactive power*).

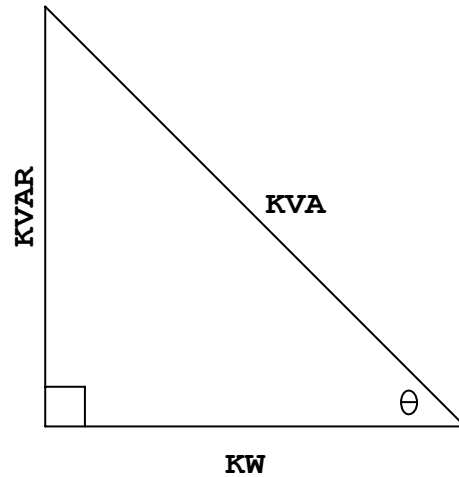


Figure 2 - The Power Triangle

KVAR - the *reactive power* (kilovolt-amp-reactive). A lagging power factor indicates an inductive load.

As shown, there is a vector relationship between each of these power measurements. The phase angle, theta θ , indicates the phase shift between the voltage and current seen by the power source. This is normally expressed as **Power Factor (pf)**, which is the ratio between the *real power* (KW) and the *apparent power* (KVA).

$$\text{PowerFactor} = pf = \cos \theta = \frac{KW}{KVA} \quad \text{Theta } \theta \text{ is the phase angle between the current and voltage waveforms.}$$

2.1 The Power Meter System

The Digital Control Electronics system is a dual-microprocessor system. The "A" processor performs all of the control and interface functions necessary to operate the load bank. The second processor, "B", performs the *Power Meter* functions - the **metering**. The metering system is responsible for measuring the output of the voltage and current sensors and making all required calculations.

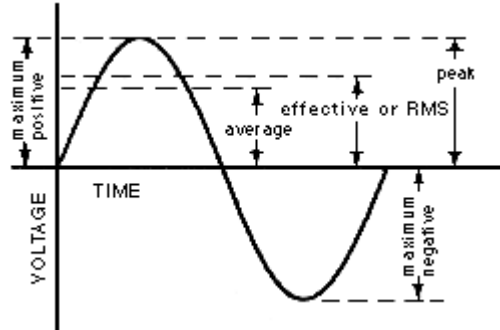
The *metering* system scans each of the voltage (V_1 , V_2 , and V_3) and current (A_1 , A_2 , and A_3) at a high sample rate. The real power for each phase is calculated from the instantaneous power by:

$$KW = \frac{1}{T} \int_0^T p dt$$

The metering system is a *true rms* measurement system. The *rms* (root-mean-square) value of each voltage and current channel is computed as shown. These computations are updated at this high sample rate. The calculations are completed at each zero crossing of the phase "A" voltage channel.

$$V_{rms} = \sqrt{\frac{1}{T} \int_0^T V^2(t) dt}$$

Note: When comparing or calibrating the voltage and current measurements of the *metering* system, be sure to use a *true rms* reading DVM. Many DVMs are *average reading* meters -- they will give accurate readings only if the measured signal is a pure sinusoid.



The voltage measurement system is capable of measuring voltages as high as 660 V_{rms} at a crest factor of 1.414. As the measured voltage decreases the maximum crest factor allowed increases -- the limit is the peak voltage.

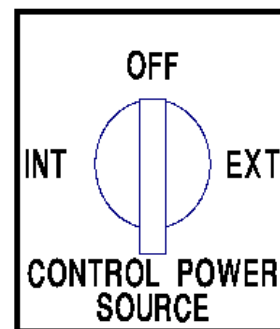
2.2 Other measurements

In addition to the voltage, current, and power measurements described above, the system also measures various temperatures, safety/interlock switches, control voltage, frequency, and rotation.

2.2.1 Control Power

Power must be supplied to the digital electronics, the contactors, and the internal cooling fan motor(s). This power is known as the *Control Power*. The power bus connected to the load resistors (or inductors) is known as the *Load Power*.

The motors used to drive the cooling fan(s) in the load bank can range from none at all to 10 HP depending on the size of the load bank. Add in the power required to operate the electronics and contactors and the load can quickly approach 10 KW. If the *Load Power* and *Control Power* are connected together, the minimum load that can be placed on the *Test Source* is this 10 KW amount.



If the system you are testing is relatively small with respect to the capacity of the load bank, this minimum load could be significant. For this reason, many of Load Technology's load banks, primarily portable load banks, are capable of operating from a separate external *Control Power* source.

Place the Control Power Source switch in the EXT position and connect the control power as indicated in your system's documents. When in this position, the *Load Power* is disconnected from the *Control Power* thus removing the minimum loads from the load being placed on the *Test Source*. External *Control Power* will be required for certain testing requirements (i.e. 400 Hz testing, non-standard voltages, single-phase testing on a three-phase load bank, etc...).

Note also that if you are testing a power source that is intermittent, or subject to widely varying voltage, you should run external Control Power. Otherwise the system will shut down when the *Load Power* drops low enough to trip out the electronics system. This will not damage the load bank, but will complicate your testing process as all loads will be dropped and fan(s) turned off when the electronics system resets.

2.2.2 Safeties and Interlocks

The system monitors safeties, interlocks, and temperatures to ensure the safe and proper operation of the load bank. Before the load bank can apply loads, the internal 24 VAC control power system must be powered up and the cooling fan(s) turned on. Bringing the load bank to the *On* state is a process that is started when the fan(s) are commanded on. The following is the process followed when starting the load bank (Fan On):

1. The system will ensure that a control voltage that is valid for the load bank is present, and select the appropriate settings. Valid control voltage varies based on the type of load bank being used. The control power transformer is turned on. If a valid control voltage is not found, an error message will be shown and the process will be stopped.
2. The system will then ensure that the internal 24VAC control power is present. If the 24VAC is not detected within a specific time, an error message will be shown and the process stopped.
3. If the load bank is capable of single-phase versus 3-phase operation, the proper settings will also be made based on the type of control voltage applied.
4. The rotation of the control power will be sensed to ensure that the fan motor operates with the correct rotation (for 3-phase operation). The appropriate controls are activated to turn on the cooling fans. If the fan voltage is not detected, or the fan overloads trip, an error message will be shown and the process will be stopped.

5. Once the fan(s) are turned on, the system will wait for airflow to complete the process. A differential pressure switch detects airflow. If airflow is not detected in the allotted time, then an error message will be shown and the process stopped.

Once this entire process is followed without error, the system is considered to be in the *On* state - fan(s) running and ready to apply loads. The system will also ensure that maintenance doors are closed and fan doors are open on load banks that have maintenance and fan doors.

Whenever the load bank is in the *On* state (the internal control power and fan(s) are on), the following parameters are constantly monitored:

- Control Voltage
- Control Frequency
- Load Voltage
- Load Frequency
- Load Current (in Inductive Load Steps)
- Fan overloads
- Fan on contactors
- Fan doors (where applicable)
- Maintenance doors (where applicable)
- Air Flow
- Temperature limits

The system measures temperatures from four thermocouples, these are:

1. Exhaust Temperature - The temperature of the air exhausted from the unit.
2. Intake Temperature - The temperature of the incoming air.
3. Cabinet Temperature - The internal temperature within the cabinet.
4. Ambient Temperature - The temperature of the incoming cooling air.
5. Inductor Temperature - The temperature of the inductors.

2.2.2.1 Error Messages

The following is a complete list of the possible error messages produced by the system monitor:

BiDir node inactive! - This fault indicates that one of the I/O Control Modules is not responding. These I/O Control Modules (also known as the BiDirectional Controller) stopped responding and therefore the safety interlocks cannot be processed.

Cntrl over voltage! - This fault indicates that the *Control Voltage* has exceeded the maximum allowed voltage. The actual voltage will depend on the type and configuration of the load bank. This value is normally set to be 10% above the nominal running voltage. Note that on dual voltage machines, the nominal voltage is the currently operating voltage (i.e. 240 or 480).

Control voltage unstable! - This error indicates that the *Control Voltage* has not been stable for a sufficient time prior to commanding the load bank on. The system requires that the control voltage be stable (change less than 5% for 1.5 seconds). Since many of Load Technology's load banks are capable of operating on a wide range of voltages, the system must ensure that it is turning on at the right control voltage. If this error occurs, wait for the *Control Power* source to be stable then try again.

Fan did not start! - This fault is generated when the system turns on the fan control contactor(s) and does not sense it closing. This error will only be generated as the fan is being commanded on. The most probable cause for this fault is a failed RAC or RBC contactor. Once the fan is operational, an RAC or RBC failure will generate a "RAC or RBC failure" message.

Fan door(s) closed! - If the fan door(s) are detected as being closed while the load bank is in the *On* state, this message will be displayed and the fans will be turned off. Not all load banks have fan doors.

Invalid control voltage - As stated previously, the load bank requires a valid Control Voltage (\pm configured tolerance bands) before the system can turn on. If no valid control voltage is detected, this error will be displayed. What control voltages are valid is completely dependant on your load bank model and options.

Load over current - This message can only occur on a system that contains inductive load steps. It indicates that an excessive current has

been detected in the inductive load steps of the load bank. Since the current in the inductor is a function of both the applied voltage and frequency (the lower the frequency the higher the current), both the voltage and frequency are monitored to prevent an over current condition. When this fault occurs, the load bank's fan is turned off and all loads are dropped.

Load over voltage! - This error indicates that an excessive voltage was applied to the resistive load steps. This trip point is normally configured to be +10% of the nominal running voltage. The system will not allow an excessive voltage to be applied for any extended period of time, thus protecting the load elements.

Loss of control power! - This fault occurs when the load bank is in the *On* state and the 24 VAC control power is not present. This normally occurs as a side effect of another error that shuts down the fan controls.

Low Cntrl voltage! - This fault occurs when the load bank is in the *On* state, and the control voltage is sensed to be below the minimum for the given operational mode. The minimum is normally configured to be 10% below the nominal running voltage.

Low Frequency! - It indicates that the load bank was in the *On* state and detected a frequency that is below the minimum. The minimum frequency is normally configured to be 40 Hz. This error will most often occur if the power source sags excessively when hit with an increased load.

Maintenance door(s) opened. - This fault indicates that the load bank was in the *On* state and the maintenance doors were detected as being open. Again not all load banks have maintenance doors - normally found on trailer units.

No AirFlow! - This error indicates that no airflow has been detected in the required time since the fan was turned on. It does not indicate a failure of the fan to turn on, but rather indicates a failure of the fan's ability to produce airflow. A fan failure, an airflow pressure switch failure, or a heavily restricted air inlet can cause this fault.

No control power, check CtrlPwr fuses - This error indicates that the load bank turned on the control power transformer but did not detect the 24 VAC control power. Blown control power fuses will most likely be the cause of this fault.

Reset fan overloads! - This fault indicates that the fan is commanded on, and the thermal overloads are detected as open. Check the overloads and try again.

Temperature limit n at $xxx.x$ - This fault indicates a temperature reading (n) has exceeded its maximum. The actual temperature is shown as ($xxx.x$).

3.0 The Touch Screen Controller



Figure 3 - Typical Touch Screen Controller in Hand Held config. with Magnetic Mount



Figure 4 - Touch Screen Controller in Nema4x Portable Case configuration

The Touch Screen Controller provides all of the interfaces and controls required to completely operate the load bank. As its name implies, the Touch Screen Controller contains a 320x240 graphics display with an integrated touch screen.

The Touch Screen Controller is connected to the load bank using a standard CAT-5 (Category 5) cable. This interface is implemented as a multi-drop RS-485 network. The system is currently designed to allow up to 5 Touch Screen Controllers to be connected to the OIP (Operator Interface Port).

The Touch Screen Controller is normally powered from the CAT-5 cable. In cases where the cable length is excessive (more than 350'), or multiple Touch Screen Controllers are connected on a long cable, external power may be needed. In these cases, power can be supplied via the "Aux Power" Connector.

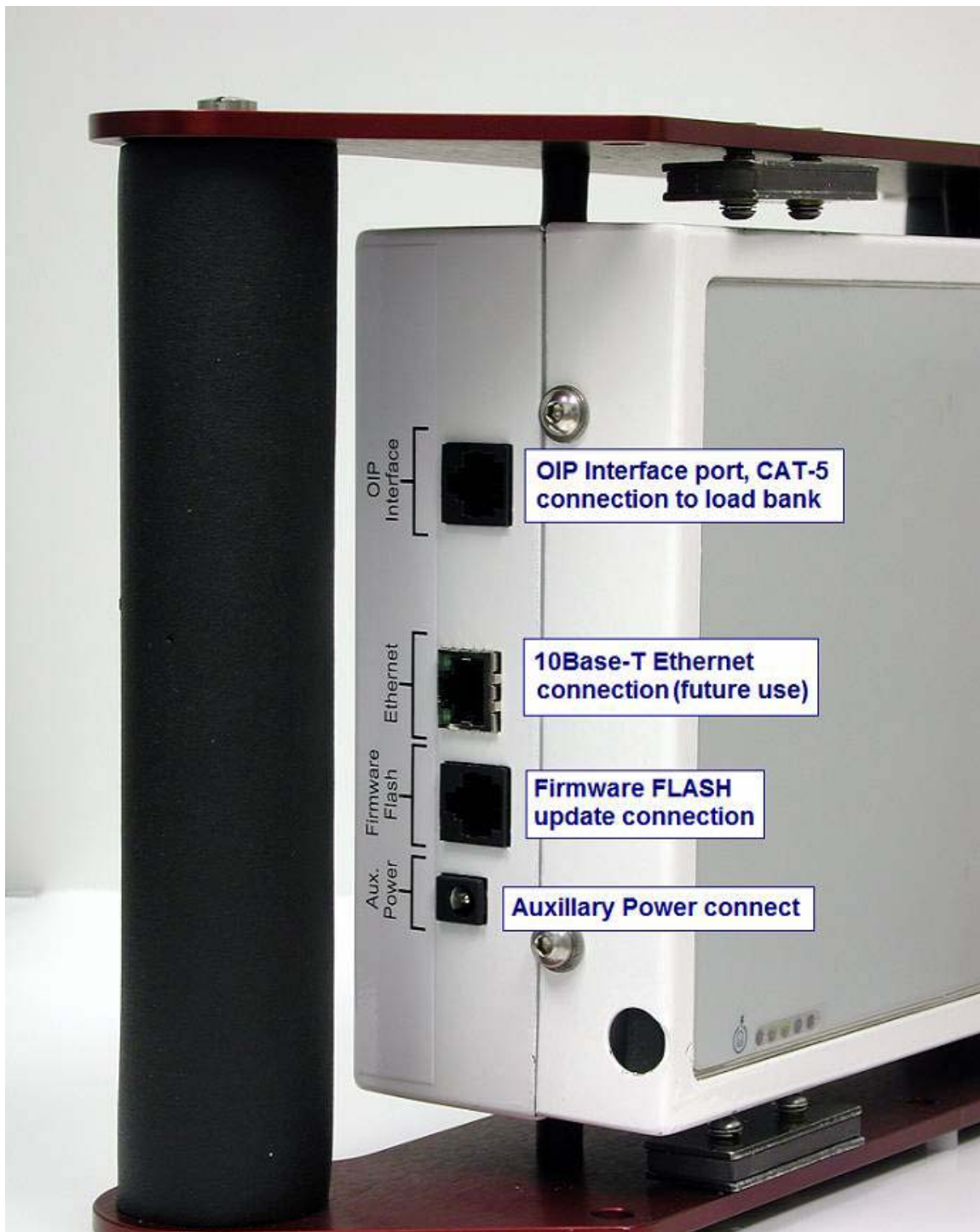


Figure 5 - Touch Screen Controller Connections

The "Firmware FLASH" connector is provided to allow for updating of the Touch Screen Controller's software (the firmware). The 10Base-T Ethernet connection is for future systems that are interfaced using TCP/IP Ethernet connections.

When the Touch Screen Controller is connected to the load bank and control power is provided to the load bank, then pressing the Power On/Off switch will toggle the power on/off. When the Touch Screen Controller is on it will automatically turn on the power to the load bank electronics system.

3.1 The Touch Screen

Integrated into the 320x240 graphics LCD display is a touch screen interface. There are various visual components, menus, buttons, etc., that are designed into this interface.

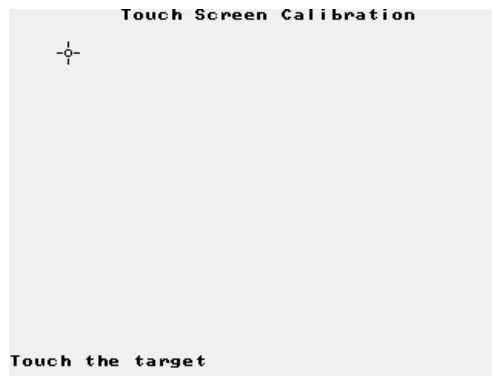
These components have been designed to allow for operation via finger tip touches on the screen. Pressing the screen with the tip of your finger, as opposed to the pad of your finger, will give better results. The larger the area being pressed, the more force required to sense the touch. A rubber or plastic stylus, such as those used for Palm or Pocket PC type devices, can also be used for more precise control. Never use a metal or extremely sharp object as the front plastic cover, or even worse the touch screen itself, could become damaged.

3.1.1 Touch Screen Calibration

In order to know the location of the each point on the screen, the Touch Screen Controller must calibrate the touch screen to the LCD. This calibration is performed at Loadtec when the system is brought up. Under normal circumstances, the touch screen will not need to be calibrated again. There may be occasions, typically after installing new firmware, when the touch screen calibration will need to be performed again.

This simple procedure is initiated by touching the screen while turning on the power (press the Power On/Off switch). When the Touch Screen Controller powers up, it will sense that the screen is being touched and enters the touch screen calibration mode. Simply release the touch on the screen to start the procedure.

**Release touch to start the
touch screen calibration...**



Simply touch and release (click) the target on the screen. After the first target is clicked, it will be removed from the screen and second target will be drawn. Click the second target and repeat the process for the third target.

Figure 6 - Touch Screen Calibration

Once all three of the target points have been clicked, the system will display the screen shown. The data points shown are the coordinates of each of the points that were touched. These values will vary as you will normally not touch the screen in the exact location. Furthermore, this calibration procedure also compensates for any miss-alignment of the touch screen to the actual LCD screen underneath.



3.2 The Front Panel Switches

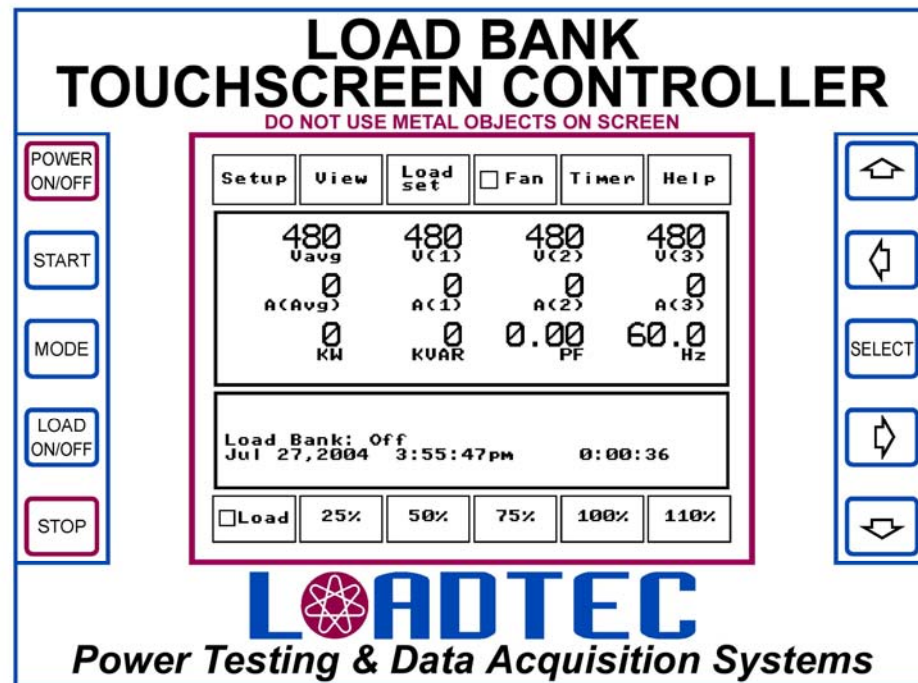


Figure 7 - Touch Screen Controller (Front Panel)

The Touch Screen Controller's front panel contains 10 special function switches as shown above. These switches provide shortcuts to some of the system's functions, and a way to operate the system in case of touch screen failure.

3.2.1 Power On/Off Switch



The Power On/Off switch is used to toggle the power on and off. The Touch screen controller must be connected to the load bank and control power must be available. When the Touch Screen Controller is powered on, the load bank control electronics are also forced on. Turning the Touch Screen Controller's power on is not the same as turning on the fan(s). The fan(s) must be on and internal 24VAC control power present (load bank in the *On* state) before loads can be applied.

3.2.2 The Start Switch



Before the load bank can place loads on the *Test Source*, it must first be in the *On* state. The load bank is said to be in the *On* state when the internal 24 VAC control power is powered up, the internal cooling fan(s) are running, and airflow has been detected. Pressing the Start switch begins the fan startup procedure if the fans are not already running.

3.2.3 The Mode Switch



The Mode switch is used to cycle between frequency (Hz), KVA, and Rotation (Rot) on the *Data Panel*.

3.2.4 The Load On/Off Switch



This switch is used to toggle the load On/Off. It is only active when the load bank is in the *On* state. When load steps are on, pressing this key will cause the system to save the current load setting in an internal memory, then turn off all load steps, thus dropping the load. If this key is pressed again, then the load settings are restored. The normal use of this key is to command the load to its desired setting, then toggle that setting On/Off with this key, thus providing a pre-defined block load.

3.2.5 The Stop Switch

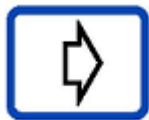


This switch actually has two functions. If a test sequence is running, then pressing this key will stop the test sequence and drop the load. If no test sequence is running when this key is pressed, and load bank is in the *On* state, then it will be commanded off. Thus turning off the fans and dropping the load. In essence the key "Stops" the current action be it a test sequence or manual testing.

3.2.6 The Arrow Switches and Select



Under normal operation, only the up and down arrows provide shortcut functions. In this case the up arrow causes the load to be "Jogged Up" and the down arrow causes the load to be "Jogged Down". The jog functions are only available when the load bank is in the *On* state. When the jog function is used, the commanded load is jogged up or down by the currently configured *Jog Value* setting (See section 4.1.2 User Setup).



A planned software update to the Touch Screen Controller will be to allow for operation in the case of a failed touch screen. In this case the Select switch will be used to turn on a "mouse" cursor on the screen. This cursor will be positioned over the desired button or control on the screen by using the arrow switches. Pressing the "Select" switch again while the "mouse" cursor is on will cause the selected control on the screen to be activated. As of this writing, this "Limp Mode" of operation has not been written into the software, but will be added in a future update.



3.3 The LCD Screen

The LCD screen can either be a monochrome or a 256 color 320 x 240 pixel QVGA (Quarter VGA) graphics screen. The color version of the LCD is only available in a "transmissive" array and as such is not suitable for use in high ambient light conditions (i.e. direct sunlight). In indoor applications the color screen works quite well. The monochrome screen is a "transflective" type device and thus works very well in high ambient light conditions as well as low light conditions.

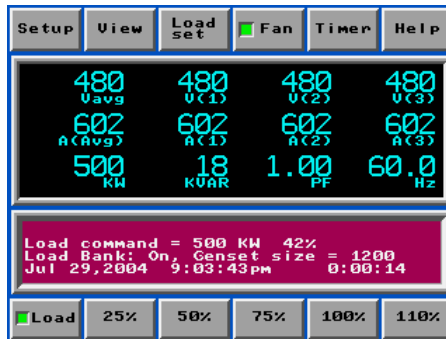


Figure 9 - Main Screen (color)

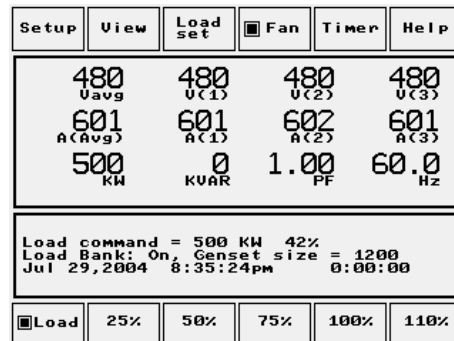


Figure 8 - Main Screen (monochrome)

The operation of the system from either the color or monochrome screen is virtually identical. The color screen offers a "3-D" "Windows" look and feel, while the monochrome screen has more of a flat "2-D" look.

From this point forward, most screens will be shown using the monochrome display since the function is the same for both and the monochrome screen is more common.

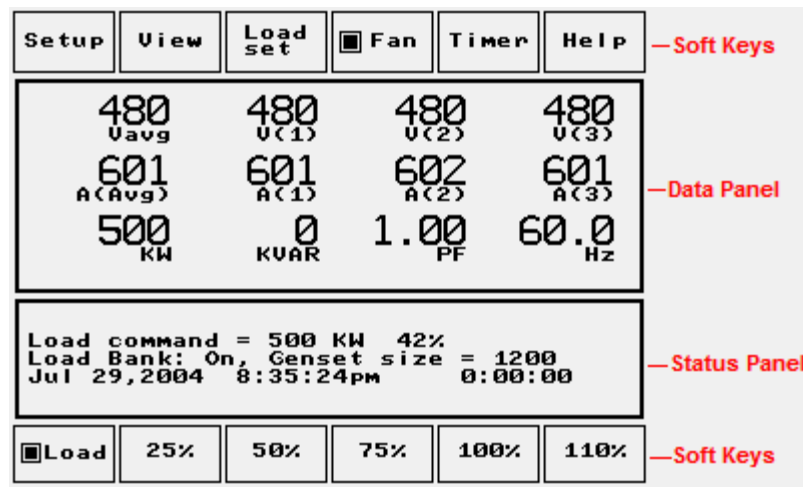


Figure 10 - Main Screen layout

The LCD screen is divided into the two main panels and two rows of buttons (the Soft Keys).

3.3.1 The Data Panel

The *Data Panel* is the larger of the two panels on the main screen. This is where all of the measurements from the metering system are displayed.

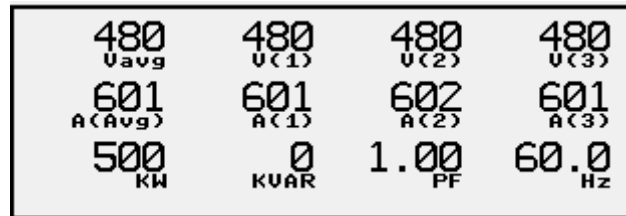


Figure 11 - The Data Panel

3.3.2 The Status Panel

The other panel, the smaller one, on the main screen is the *Status Panel*. This is where status type information is shown (i.e. the current state of the load bank, load setting, date/time etc...). The *Status Panel* is also used when in the Manual Load Control mode to show the individual load step settings.

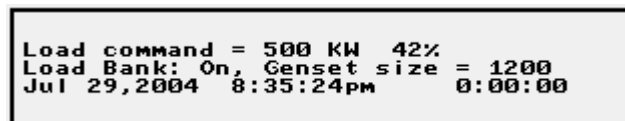


Figure 12 - The Status Panel

3.3.3 The Soft Keys

At the top and bottom of the LCD screen are two rows of buttons that are referred to as "Soft Keys". They are called this because their function is controlled by the software. In the current version of software, the upper keys remain fixed except for the "Load Set" button.



Figure 13 - Upper Soft Keys

The "Load Set" button will become the "Stop Test" button when a test sequence is running. Note that the "Fan" button also contains an On/Off indicator. When the load bank is in the *On* state, this indicator will be marked. On the color screen, this appears as a multi-colored LED where yellow indicates the fans are turning on, and green indicates that the load bank is in the *On* state.

The row of buttons on the bottom of the screen is made up of the Load On/Off button and the load "Preset" buttons.

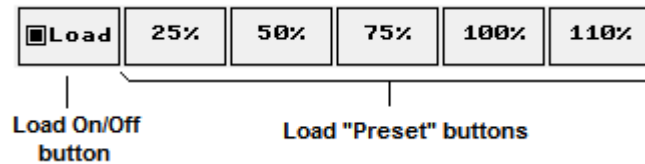


Figure 14 - Lower Soft Keys

In the example shown, the Load is indicated as being "On" and the "Preset" buttons are set to 25, 50, 75, 100, and 110 %. The actual value of load commanded by these buttons is configured via the User Setup screen. In the example shown, pressing the 50% button will cause the load to be commanded to 50% of the configured "Genset Size". The Genset Size parameter is configured in the Test Setup Window. Pressing the "Load" button has the same effect as the "Load On/Off" switch on the front panel. It toggles the load on and off each time it is pressed.

3.4 Touch Screen Components

There are numerous types of visual components that are designed into the graphics of the LCD screen. Many of these components cause some action when they are "clicked" (touched and released). These components include: Buttons, Hot Spots, Numeric Entry fields, Check Boxes, and Selection Groups. Most components will provide an audible feedback when they are "clicked". This touching then release mechanism is very similar to "clicking" a control, a button for example, with a mouse.

3.4.1 The Button Component

The most common type of component is the button. A button is shown on the monochrome screen as a rectangular shape with a name in it. On the color screen the button will look very similar to a button on a typical Windows screen of a personal computer.



The example button shown is the "Fan" button. When the screen is touched anywhere within the button, it will be shown as being pressed. This is indicated on the monochrome screen as a reverse color. If the screen is then released, the action associated with that button will be performed -- in this case the fan will be toggled on/off.



Note that buttons can also contain status indicators. In the case of the Fan button, the indicator is used to show the current state of the fan. When the status box is checked (filled in) then the fan is on.



3.4.2 The Hot Spot

There are some places on the screen that are defined as "Hot Spots". These areas will cause an action to take place when the hot spot is "clicked" (touched and released). In the current design, hot spots are only used on the *Data Panel* and allow for shortcut methods of setting load commands or selecting the data display mode.

For example, the bottom right display item on the *Data Panel* can be cycled between showing the frequency (Hz), KVA, or phase rotation. The figure below indicates all of the "Hot Spots" on the *Data Panel*.

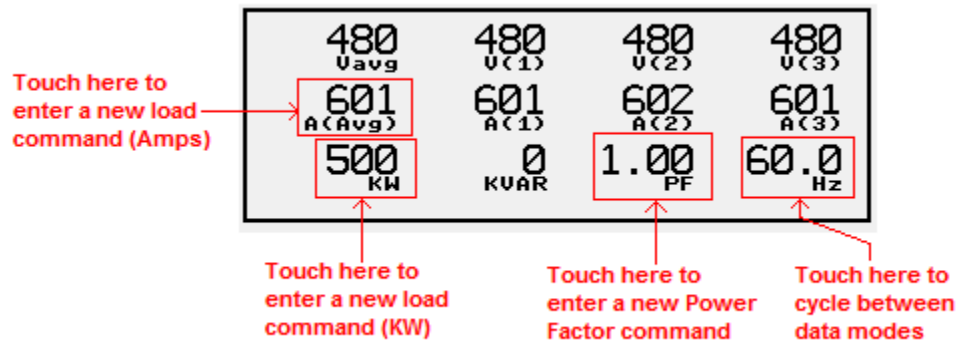
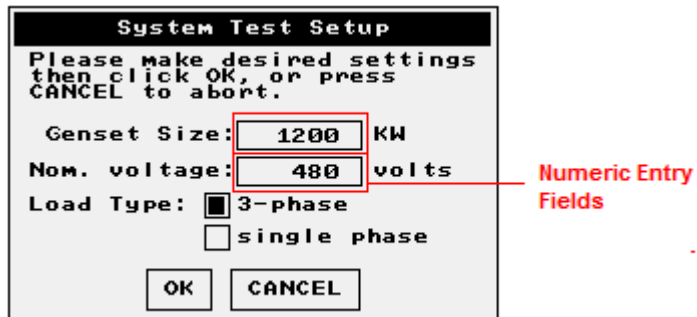


Figure 15 - Data Panel Hot Spots

3.4.3 The Numeric Entry Field

Numeric Entry Fields are used to define data items that can be changed by the user. In the example shown, both the "Genset Size" and "Nom. Voltage" variables are Numeric Entry Fields.

Simply touch the screen anywhere inside the outline of the field and the Numeric Entry Keypad will be shown allowing the data to be entered. In our example above, touching and releasing the screen anywhere inside the box that surrounds the 1200 (the Genset Size) will open the Numeric Entry Keypad allowing a new Genset Size to be entered.



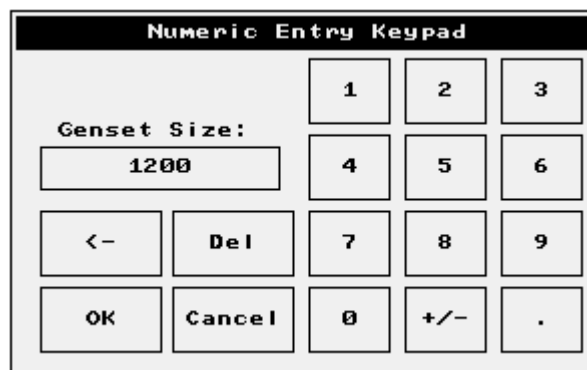
The screenshot shows a 'System Test Setup' dialog box. It contains the following fields and controls:

- Genset Size:** A numeric entry field containing '1200' followed by 'KW'. This field is highlighted with a red box, and a red line points from the text 'Numeric Entry Fields' to it.
- Nom. voltage:** A numeric entry field containing '480' followed by 'volts'.
- Load Type:** Two radio button options: '3-phase' (selected) and 'single phase'.
- Buttons:** 'OK' and 'CANCEL' buttons at the bottom.

Text inside the dialog: 'Please make desired settings then click OK, or press CANCEL to abort.'

3.4.3.1 The Numeric Entry Keypad

Since there is no numeric keypad on the Touch Screen Controller, one must be drawn on the screen any time a numeric entry needs to be made. This numeric entry is performed via the Numeric Entry Keypad.



The screenshot shows a 'Numeric Entry Keypad' dialog box. It contains the following elements:

- Genset Size:** A label followed by a numeric entry field containing '1200'.
- Keypad Buttons:** A grid of buttons including:
 - Numbers 1 through 9.
 - 0, +/-. (plus/minus), and . (decimal).
 - Navigation and editing buttons: '<-' (left arrow), 'Del' (delete), 'OK', and 'Cancel'.

Figure 16 - The Numeric Entry Keypad

The keypad shown was displayed in response to clicking the Genset Size Numeric Entry Field (see previous example). Simply touch the required buttons to enter the desired value. The value shown will be changed in a calculator style of entry as each numeric button is pressed.

OK - The OK button is used to accept the number entered and exit the Numeric Entry Keypad window. In our example, the new value entered would be placed in the "Genset Size" variable.

< - the Back Arrow button is used to simply delete the last entered number not the entire field. If the Back Arrow button is pressed after entering only one digit, the value will return to the original value when the Numeric Entry Keypad screen was opened.

Del - Press the delete (Del) button to delete all of the numbers entered and return to the original value.

Cancel - Press the cancel button to exit the Numeric Entry Keypad and ignore the changes. In our example shown above, pressing the Cancel button will simply exit the Numeric Entry Keypad window and leave the Genset size unchanged even if a new value had been entered.

3.4.4 The Check Box

☐ single phase

A Check Box is used to enable/disable an item. In the example shown, if the box is checked, then "single phase" is selected. The Check Box can be "clicked" (touched then released) by touching the box or the text.

3.4.4.1 The Selection Group

Check Boxes are most often grouped together in a Selection Group.

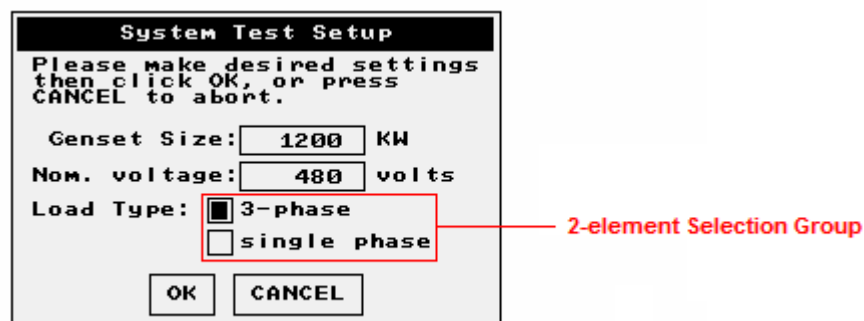


Figure 17 - The Selection Group

In the example shown, the "Load Type:" configuration can be set to either "3-phase" or "single phase". Touching the desired setting will select that item and "deselect" the other one.

4.0 System Setup

There are numerous system parameters that can be modified that effect the operation of the load bank. Many of these parameters will rarely, if ever, need to be modified. Others, like the Test Setup parameters, will likely be changed for each system you test. Unless otherwise noted, all parameters are saved to non-volatile memory and thus remain persistent until changed.

4.1 The Setup Menu

All of the setup functions in the system are accessed via the *Setup Menu*. This menu is displayed when the Setup button on the Main Screen is pressed. From this menu, simply select the desired setup function by pressing the appropriate button. Clicking the "Exit" button closes this menu.

Test Setup is used to change the parameters that are specific to the device being tested.

User Setup is used to change the "User Preferences". These parameters include the scaling of the preset load buttons, the Jog Value and the systems response to a loss of communications with the LoadView computer.

Calibrate is used to access the metering system's calibration. The voltage and current sensors are calibrated via this button.

Panel Setup is used to adjust the parameters that affect the panel itself (the Touch Screen Controller). These parameters include the LCD's contrast adjustment, the colors used (color LCD only), Setting the Clock, the Node Address, Demo Setup, and Network Setup.

Lic. Manager (License Manager) is used to enter or view the registration numbers for the licensed resources within the system.

System Setup is used to adjust the low level system specific parameters. These settings are under password protection and can only be modified under the direction of Loadtec.

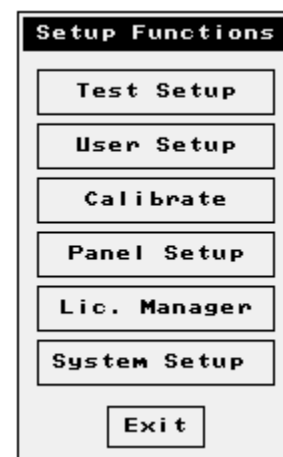


Figure 18 - The Setup Menu

4.1.1 Test Setup

The Test Setup parameters are the parameters that will be changed the most often. In essence, these settings are unique and specific to the *Test Source*. Press **Test Setup** from the *Setup Menu* to access the Test Setup parameters.



Genset size is used to define the size of the system under test. This parameter is used in conjunction with the *Load Preset* values to command the proper load when any of the Load Preset buttons are pressed. In essence, this parameter scales the load bank for the system under test.

Figure 19 - Test Setup

The "Nom. Voltage" setting defines the expected "nominal" voltage from the system under test. This setting is used to make decisions about minimum and maximum voltages and scaling of the load steps.

Warning! - This parameter is used to setup system safeties (i.e. over-voltage trips, fan controls, and high/low voltage controls). Setting it incorrectly can have an adverse effect on your system.

Both the "Genset Size" and "Nom. Voltage" are Numeric Entry Fields -- simply touch them to open the Numeric Entry Keypad and make the required changes.

The *Load Type* parameter is used to inform the load bank of the type of system being tested -- single-phase or three-phase. Certain calculations are performed differently for a single-phase versus three-phase system. Simply touch the appropriate check box to make the desired selection. When you exit this screen, press the **OK** button, the settings will become active. Since they are stored in non-volatile memory, they will remain in place even after the system is turned off.

Pressing the **CANCEL** button will close the window and ignore all changes made.

4.1.2 User Setup

Press **User Setup** from the *Setup Menu* to access the User Configuration screen.

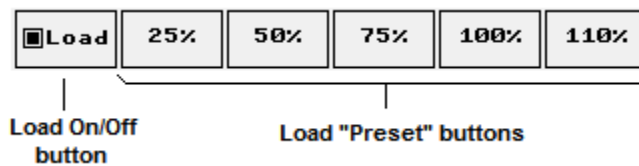
The image shows a 'User Configurations' screen with a black header. Below the header, there are five rows for 'Preset A' through 'Preset E', each with a numerical value in a box followed by a '%' symbol. 'Preset A' is 25.00, 'Preset B' is 50.00, 'Preset C' is 75.00, 'Preset D' is 100.00, and 'Preset E' is 110.00. Below these is a 'Jog Value' field with the value 5.00. At the bottom, there is a 'Shutdown on com loss:' label followed by two checkboxes: 'Yes' (unchecked) and 'No' (checked). At the very bottom are 'OK' and 'CANCEL' buttons.

User Configurations		
Preset A:	25.00	%
Preset B:	50.00	%
Preset C:	75.00	%
Preset D:	100.00	%
Preset E:	110.00	%
Jog Value:	5.00	
Shutdown on com loss: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
OK CANCEL		

The *Preset A* through *Preset E* settings are used to scale the preset soft keys. These soft keys are used to apply a given load. The load applied is expressed as a percentage of the configured Genset size value. The preset buttons are automatically re-labeled with the new values upon exit from this screen.

Figure 20 - User Setup

If the Genset Size is set to 1000 KW and the "25%" is pressed, the load would be commanded to 250 KW (25% or the 1000KW Genset Size).



When all settings have been made, press the **OK** button to close the window and accept the changes. Pressing the **CANCEL** button will close the window and ignore all changes made.

4.1.2.1 Jog Value

The Jog Value setting is used to configure the amount of load that is added or subtracted from the load command when the Jog buttons are pressed. In the example shown, the Jog size is set to 5 KW. In this case the load command is increased by 5 KW when the Up Arrow switch (on the front panel) is pressed, and the load command is reduced by 5 KW when the Down Arrow switch is pressed.

4.1.2.2 Shutdown on com loss

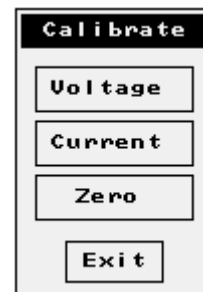
The *Shutdown on com loss* setting is used to configure how the system responds to a loss of communications with the LoadView computer. Loss of com is defined as:

1. Communications with the LoadView computer has been established and operational.
2. The communications stops (i.e. cable is disconnected, LoadView computer turned off, etc...)

When the loss of com occurs, the system can either ignore it, or shutdown. If shutdown is selected, all loads will be dropped and the cooling fan(s) shut off.

4.1.3 Sensor Calibration

The voltage and current measurement system can be calibrated to a measured value. Each channel can be independently calibrated by measuring the values and entering them into the calibration screens. Pressing **Calibrate** from the *Setup Menu* opens the *Calibration Menu*.



4.1.3.1 Voltage Calibration

Press **Voltage** from the *Calibration Menu* to access the Voltage Calibration Window. From this screen, you can either calibrate each of the sensors to measured values or default the coefficients.

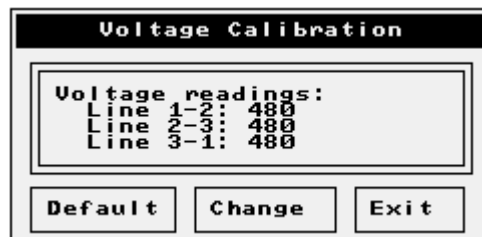
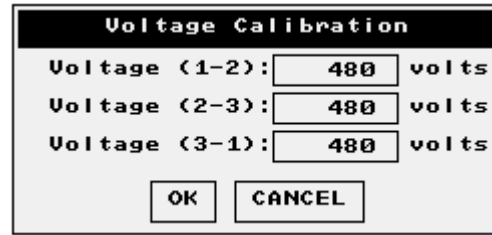


Figure 21 - Voltage Calibration

The upper portion of this window shows the current value for the voltage inputs. Pressing the **Default** button causes the voltage calibration coefficients to be set to their default value. You will be prompted with a window requesting confirmation before any changes are made.

Press the **Change** button to calibrate any/all of the voltage channels. When **Change** is pressed, a window is displayed that contains a Numeric Entry Field for each of the voltage channels. Change these

settings as required. Press the **OK** button to close the window and accept the changes, thus calibrating the voltages. Press the **CANCEL** button to close the window without making any changes.

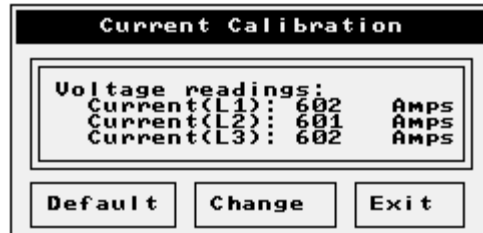


The Voltage Calibration window has a title bar "Voltage Calibration". It contains three rows of input fields: "Voltage (1-2):" with a numeric field containing "480" and the unit "volts", "Voltage (2-3):" with a numeric field containing "480" and the unit "volts", and "Voltage (3-1):" with a numeric field containing "480" and the unit "volts". At the bottom are two buttons: "OK" and "CANCEL".

Press the **Exit** button to close the Voltage Calibration Window.

4.1.3.2 Current Calibration

Press **Current** from the *Calibration Menu* to access the Current Calibration Window. From this window, you can either calibrate each of the sensors to measured values or default the coefficients.

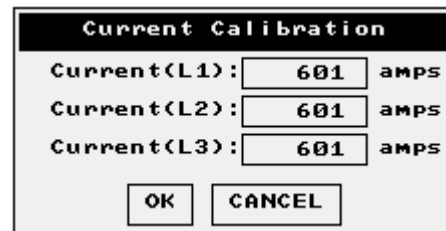


The Current Calibration window has a title bar "Current Calibration". It contains a section titled "Voltage readings:" with three lines: "Current(L1): 602 Amps", "Current(L2): 601 Amps", and "Current(L3): 602 Amps". At the bottom are three buttons: "Default", "Change", and "Exit".

The upper portion of this window shows the current value for the *Current* inputs. Pressing the **Default** button causes the calibration coefficients to be set to their default value. You will be prompted with a window requesting confirmation before any changes are made.

Figure 22 - Current Calibration

Press the **Change** button to calibrate any/all of the current channels. When **Change** is pressed, a window is displayed that contains a Numeric Entry Field for each of the current channels. Change these settings as required. Press the **OK** button to close the window and accept the changes, thus calibrating the currents. Press the **CANCEL** button to close the window without making any changes.



The Current Calibration window (Change mode) has a title bar "Current Calibration". It contains three rows of input fields: "Current(L1):" with a numeric field containing "601" and the unit "amps", "Current(L2):" with a numeric field containing "601" and the unit "amps", and "Current(L3):" with a numeric field containing "601" and the unit "amps". At the bottom are two buttons: "OK" and "CANCEL".

Press the **Exit** button to close the Current Calibration Window.

Perform the following to calibrate each current measurement channel:

1. Place the desired load on the system under test.
2. Wait for readings to stabilize.
3. Measure each phase current via a clamp on current meter or other such device.
4. From the *Current Calibration Window*, press **Change** to change the required channel(s).
5. Exit to save the calibration settings.

4.1.3.3 Sensor Zero

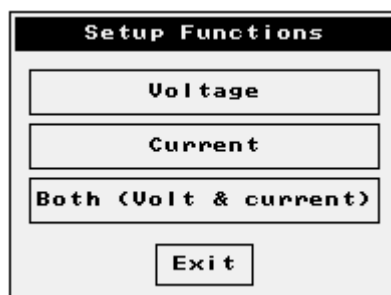


Figure 23 - Sensor Zero

Press **Zero** from the *Calibration Menu* to access the Sensor Zero Window. Sensor zero is used to zero, or "null" the sensor channels.

Press the **Voltage** button to zero the voltage sensors. Press the **Current** button to zero the current sensors.

Press the **Both** button to zero both the voltage and current sensors. Prior to zeroing the voltage or current channel,

ensure that there is no voltage or current applied.

When the measurement channels are zeroed, the system will average the channels then formulate an offset value that is saved in the system. This offset value is used to remove the DC offset from the channel, thus "nulling" them.



Warning! - Zeroing a sensor channel is used to NULL any offsets in the channel. Zeroing voltages or currents when there is real voltage or current applied can yield unpredictable results, as the system may attempt to NULL a real measurement.

4.1.4 Panel Setup

Pressing the Panel Setup button on the *Setup Menu* opens the *Panel Setup Menu*. Items that are configured under the Panel Setup are those configurations that affect the panel (the Touch Screen Controller) directly.

Set Contrast is used to adjust the LCD screen contrast.

Set Colors is only available on color LCD Touch Screen Controllers. This function allows setting of the background and text colors of the Data and Status Panels.

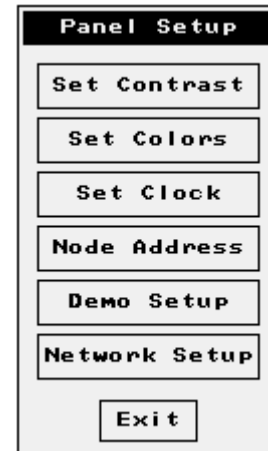


Figure 24 - Panel Setup Menu

Set Clock is used to set the panel and load bank controller's real time clock.

Node Address is used to set the address of the Touch Screen Controller.

Demo Setup -- The Touch Screen Controller can be configured to operate in a demo mode allowing it to be used as a demonstration device. These settings are password protected.

Network Setup -- As stated previously, future Touch Screen Controller systems will communicate on 10Base-T Ethernet networks. The network settings (i.e. IP address, port number, etc...) are accessed by pressing this button.

4.1.4.1 Set Contrast

The contrast of the LCD screen is set by pressing the **Set Contrast** button on the *Panel Setup Menu*. The Contrast Adjust Window will be shown on the screen.

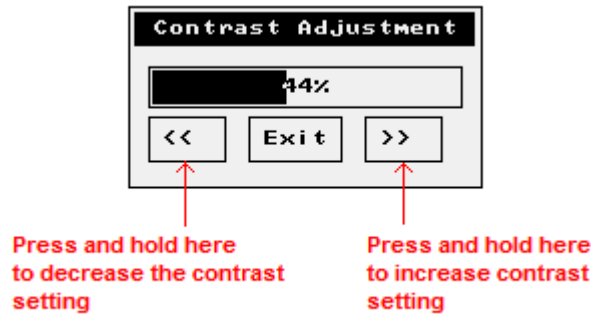
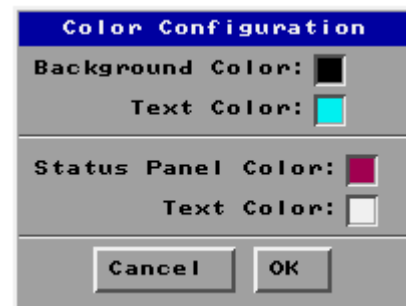


Figure 25 - Setting the Contrast

When the desired contrast setting is achieved, press the **Exit** button. The contrast setting is saved in non-volatile memory and will remain in effect until changed at a later date.

4.1.4.2 Set Colors

The Set Colors function is only available on color LCD versions of the Touch Screen Controller. Press the **Set Colors** button on the *Panel Setup Menu* to access the color controls. Touch the color blocks on this window to open the Color Selection window. The "Background Color" is the color used on the background of the *Data Panel*. The "Text Color" is the color of the text in the *Data Panel*. The *Status Panel* background and text colors are also available by touching the appropriate color box.



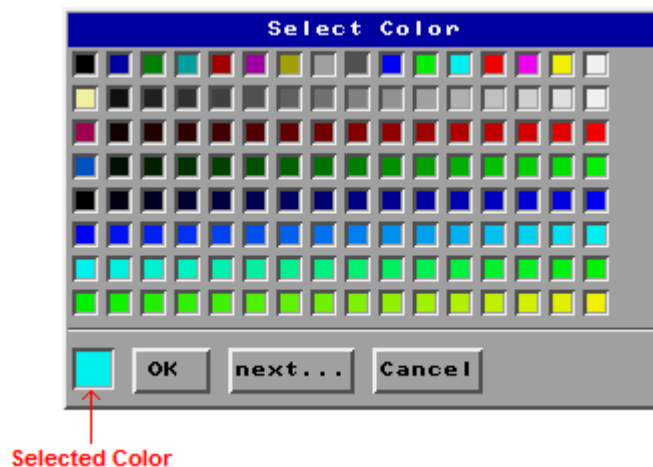


Figure 26 - Color Selection Palette

Select the desired color by touching the appropriate color box from the color palette. Press the **next...** button to show additional color choices. When the desired color has been selected, press the **OK** button. Press the **Cancel** button to close the window and ignore the changes.

4.1.4.3 Set Clock

Built into the hardware of the Load bank and the Touch Screen Controller is a battery backed real time clock. The current date and time are set via the Date/Time Setup Window. Press **Set Clock** from the *Panel Setup Menu* to access this window.



Figure 27 - Setting the clock

Press **SetTime** to set the current time of day. Press **SetDate** to set the date. Press **Exit** to close the window.

4.1.4.4 Node Address

Since the OIP network allows for multiple Touch Screen Controllers to be connected on the network, each controller must have a unique address.



The screenshot shows a screen titled "Node Configuration". Below the title, it says "Please make desired settings then click OK, or press CANCEL to abort." There is a label "Node Address" followed by a text box containing the number "1". At the bottom, there are two buttons: "OK" and "CANCEL".

Figure 28 - The Node Address

This is the network Node Address parameter. It is used to set the address of this node.

Node addresses should start at 1 and continue on for each node connected. Loadtec load banks are designed to operate with up to 5 Touch Screen Controllers (node address 1 through 5). No two controllers on the network can have the same address.

4.1.4.5 The License Manager

The Load Bank Controller electronics must be registered for use. The LoadView interface and High Speed data are separately licensed system options. These settings are accessed via the License Manager Menu. Press **Lic Manager** from the *Panel Setup Menu* to open the *License Manager Menu*.



The screenshot shows a screen titled "License Manager". It contains five buttons stacked vertically: "System Registration", "LoadView License", "HSD License", "View Settings", and "Exit".

Figure 29 - The License Manager

Use this screen to enter the System Registration, the LoadView license, and the High Speed Data license. These registration and license keys are only available from Load Technology Inc. The System's serial number will be required.

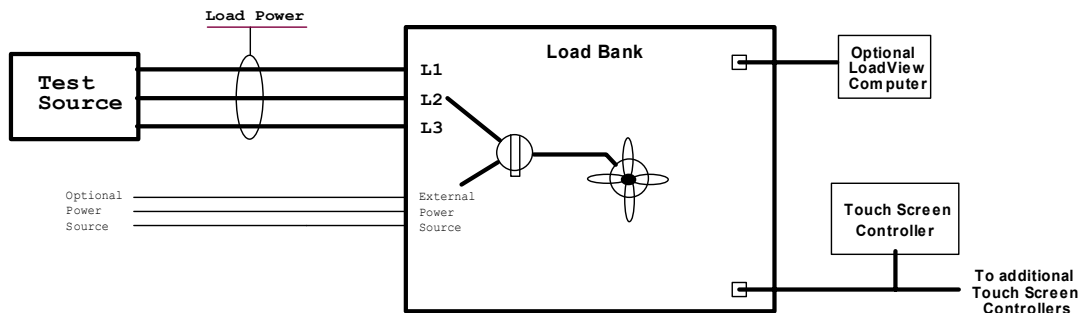
Contact:
Load Technology Inc.
4225 Production Court
Las Vegas, Nv. 89115
1-800-LOADTEC
service@loadtec.com



The screenshot shows a screen titled "Loadtec License Manager". It contains three lines of text: "System Registration: Enabled", "LoadView License: Enabled", and "High Speed Data Lic.: Enabled". At the bottom, there is an "Exit" button.

5.0 Operation

Before testing can begin, the load bank must be connected to the Test Source and optionally an External Power Source. All external peripherals (i.e. The LoadView Computer, Touch Screen Controllers(s), etc...) must also be connected.



The system shown is a simple load bank test system connected to the Test Source (the power system to be tested). As illustrated, the Control Power Source selector switch (not available on all units) is used to select either internal or external *Control Power*.

When internal is selected, the *Control Power* is taken from the *Load Power*. In this mode, the Test Source will see the load of the internal devices (the cooling fan(s), electronics, and contactors).

When external is selected, the Control Power must be provided from an external source. In this mode, the internal loads (cooling fan(s), electronics, and contactors) are isolated from the Test Source.

Whatever the mode, the system cannot be turned on until power is supplied to the internal electronics system. If internal *Control Power* is selected, then the *Test Source* must be turned on.

5.1 Quick Start

Once the system has been connected, and Control Power is present, press the Power On/Off button to turn on the system from the Touch Screen Controller. When the load bank is first turned on, a splash screen is normally displayed on the *LCD screen*.



This screen is the default Loadtec splash screen. A custom splash screen can be loaded to the system; therefore your system may show a different splash screen or none at all. Touch the screen anywhere to close the splash screen and begin operation.

Figure 30 - The Splash Screen

When the Touch Screen Controller is powered on, the connected load bank is also forced on. If the Touch Screen Controller is not connected to a load bank (and is powered from the Aux Power input), or the load bank does not power up (i.e. no Control Power),

then a communication error message will be shown. You must correct the problem before continuing (i.e. supply Control Power, plug in the system, etc...) as no functions can be performed until communications with the system are established.

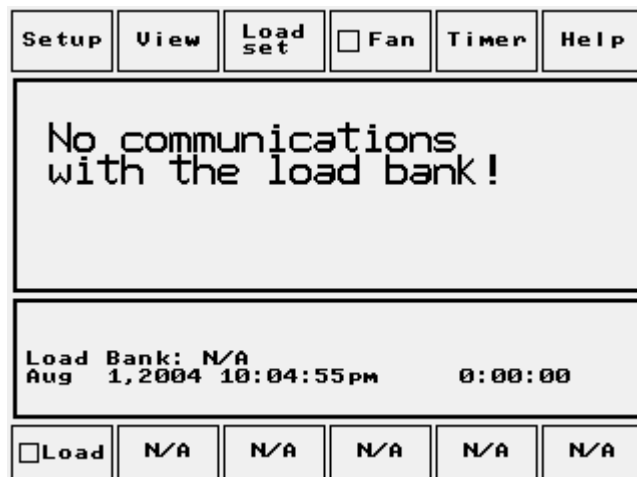


Figure 31 - Communications error

Once power is present and the screen is "touched" to clear the splash screen, a screen similar to the one shown will be displayed.

Setup	View	Load Set	<input type="checkbox"/> Fan	Timer	Help
480 V _{avg}	480 V(1)	480 V(2)	480 V(3)		
0 A(Avg)	0 A(1)	0 A(2)	0 A(3)		
0 KW	0 KVAR	0.00 PF	60.0 Hz		
Load Bank: Off Aug 4, 2004 10:38:51am 0:00:14					
<input type="checkbox"/> Load	25%	50%	75%	100%	110%

The current readings from the metering system are shown in the *Data Panel*. In the example shown, there is 480 VAC being delivered by the *Test Source*. If the *Test Source* is not powered up, do so now. When voltage is present, you are ready to move on to the next step.

5.1.1 Enter Test Setup Data

The next step is to enter the parameters that are specific to the *Test Source* you are testing. Press the **Setup** button to open the *Setup Menu*. Then press the **Test Setup** button to access the Test Setup Window. Enter the size of the *Test Source* you are testing (the Genset Size), its nominal voltage, and type (i.e. 3-phase versus single-phase). Since these parameters are persistent, that is they remain in effect until changed, it is possible that they will already be setup correctly. It is good practice to check these parameters when you first start the system, even if you believe the system was setup correctly previously.

5.1.2 Check the User Parameters

The User Configuration parameters are not as likely to change between systems, but they may. As with the Test Setup parameters, it certainly won't hurt to check to be sure the desired parameters are setup. Press the **Setup** button to open the *Setup Menu*. Then press the **User Setup** button to access the User Setup Window. Change any settings that are not correct.

5.1.3 Turn on the Fan

Before any loads can be applied, the cooling fan(s) and internal control power must be turned on. Pressing the **Fan** button or the **Start** switch on the front panel starts this process. A message such as:

"Turning on at 480 volts"

is shown momentarily on the *Status Panel*. Note that the actual voltage will vary based on your system type and setup.

Once this startup process is completed without error, the system will be in the *On* state. A **"Load Bank: On"** indication will be shown in the *Status Panel* and the indicator in the Fan button (on the screen) will be checked.

5.1.4 Begin Testing

Providing there were no errors, the system is now ready to begin testing -- placing loads on your Test Source. Load control can be performed directly with simple commands or can be part of a pre-programmed Test Sequence. Once your testing is complete, turning the fan(s) off drops all loads, turns off the cooling fan(s), and drops the internal 24 VAC control power.

5.2 Load Control

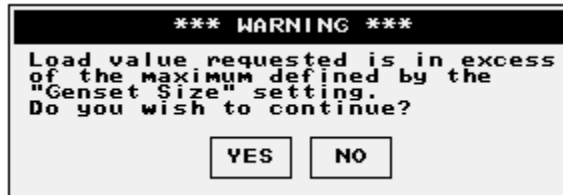
The load bank is designed to place an electrical load on a Test Source and measure the results of those loads and load changes. Once the system is in the *On* state, the commanded load setting can come from any of the following:

1. Direct Load Command - Simple direct entry of the load and/or power factor command.
2. Preset Load setting - Load settings from the configured Load Preset buttons.
3. Manual Load Control setting - Direct load step toggle controls via the Manual Load Control mode.
4. Test Sequence - Load commands executed from one of four pre-programmed Test Sequences.

5.2.1 Direct Load Command

Whenever the system is in the *On* state, load commands can be entered by pressing the Load Set button, then selecting *Set Power*, *Set Amps*, or *Set Power Factor*. A shortcut method of setting these load commands is to simply touch the current values of these parameters on the screen (in the *Data Panel*) then enter the desired value (see section 3.4.2 The Hot Spot).

For example, touching the "KW" reading on screen will open a Numeric Entry Keypad allowing you to enter a new load command in KW. Touching the average amps variable "A(avg)" will allow you to set the load command in amperes. If your load bank also contains inductive load steps, then the power factor can be set by simply touching the Power Factor (PF) value.



If a load command is entered that is in excess of the configured maximum (the Genset Size) then a warning message will be displayed. Pressing the

Yes button will cause the load to be placed on the system. Pressing the **No** button aborts the load setting leaving it unchanged.

5.2.1.2 Direct Power Factor Entry

On systems that contain inductive load steps, the desired power factor can be entered directly much like the direct load command. In fact the desired power factor can be included in the direct load command. For example, entering a load command of "500.85" will place a 500 KW load on the system at a 0.85 power factor. The fractional portion of the load command is the power factor command. In this example, 500 KW of resistive load will be turned on and 310 KVAR of inductive load will be switched on to achieve a 0.85 power factor.

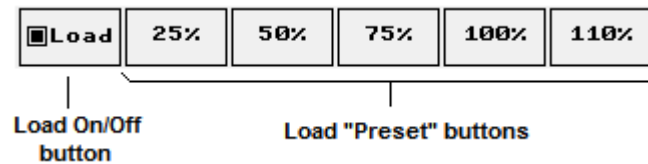
Once a power factor command has been entered, it will remain persistent until either the fan(s) are turned off or a new power factor command is entered. In our example of 500 KW @ 0.85 power factor, the 0.85 becomes the power factor command. When a new load command is entered, if there is no power factor included (the fractional portion is zero), then the previous power factor command will be used. Following our previous example, if a load command of "700" is entered, the load will be changed to 700 KW with enough inductive load to maintain a 0.85 power factor -- 465 KVAR in this case.

5.2.1.2.1 Power Factor Only Command

If you wish to change only the power factor command and leave the current load command (KW) unchanged, simply touch the current power factor value on the *Data Panel* (or press **Load Set** and **Set Power Factor**). Then enter the desired power factor via the Numeric Entry Keypad. The inductive load (KVARs) will be changed to provide the entered power factor. The load command (KW) will remain unchanged. This will become the new power factor command.

5.2.2 Preset Load Setting

Load commands can also be entered by using any of the 5 Preset Load buttons shown on the bottom of the screen.



Simply press 25% to set the load to 25% of the configured Genset Size. Press 50% to set to 50% and so on. Remember these buttons are set to the percentage values that are configured via the User Configuration Window (see section 4.1.2). The Genset Size parameter is configured via the Test Setup Window (section 4.1.1). If a power factor command has been previously entered, it will remain in effect when the preset load buttons are used -- power factor commands are only available in systems that contain inductive load steps.

5.2.3 Manual Load Control

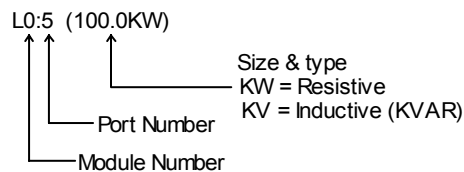
The load bank is constructed using any number of Load Step Control Modules. Each of these modules is capable of controlling up to 16 load steps. A maximum of 16 Load Control Modules can be used in a given system. Therefore a load bank could theoretically be constructed that contains 256 different load steps. The load steps can be arranged to include both resistive and inductive load elements. Each load bank is constructed according to its load requirements and thus the number and type of load steps will vary between systems.

These individual load steps can be controlled when in the Manual Load Control mode. Press the **View** button followed by the **Manual Load Control** button to enter the Manual Load Control mode. When in this mode, the *Status Panel* is used to show up to 8 individual load steps at a time. The Load Preset Buttons are re-labeled to be used to navigate through the list of load steps.

Setup	View	Load Set	<input checked="" type="checkbox"/> Fan	Timer	Help
480 V _{avg}	480 V ₍₁₎	480 V ₍₂₎	480 V ₍₃₎		
1063 A _(Avg)	1063 A ₍₁₎	1063 A ₍₂₎	1063 A ₍₃₎		
750 KW	466 KVAR	0.85 PF	60.0 Hz		
<input checked="" type="checkbox"/> L0:4 (50.0KW) <input checked="" type="checkbox"/> L0:5 (100.0KW) <input type="checkbox"/> L0:6 (100.0KW) <input checked="" type="checkbox"/> L0:7 (200.0KW)		<input checked="" type="checkbox"/> L0:8 (200.0KW) <input checked="" type="checkbox"/> L0:9 (200.0KW) <input type="checkbox"/> L0:10 (200.0KW) <input type="checkbox"/> L0:11 (200.0KW)			
<input checked="" type="checkbox"/> Load	PgDn	PgUp	Top	Btm	Exit

Figure 32 - Manual Load Control

As shown, the *Status Panel* lists up to 8 load steps and indicates if they are on or off. Since a system can have many more than 8 load steps and a maximum of 8 steps can be shown in the *Status Panel*, it will often times be necessary to have numerous "pages" of load steps. Navigation through these pages is accomplished via the page down (**PgDn**), page up (**PgUp**), **Top**, and bottom (**Btm**) buttons. If you are at the top of the list, then the PgUp button will not be active and not shown. If you are at the bottom of the list, then the PgDn button will be disabled.



The load steps' labels are made up of the Module Number, the Port Number, the size, and type of load step. In the example shown above, the load step is connected to port #5 of the first Load Step Control Module. It is a resistive load step that provides 100 KW of load.

To toggle a load step on/off, simply touch the load step label on the screen. A load step with its check box marked indicates that that step is

currently turned on. Note that you can still use the direct load command functions while in the Manual Load Control mode to directly set the desired load. Press the **Exit** button to exit from the Manual Load Control mode and return the *Status Panel* to its normal use.

5.2.4 Test Sequence Load Control

There are four Test Sequences built into the load bank controller software. These tests allow a series of up to 12 load commands to be pre-programmed into the system and executed when required.

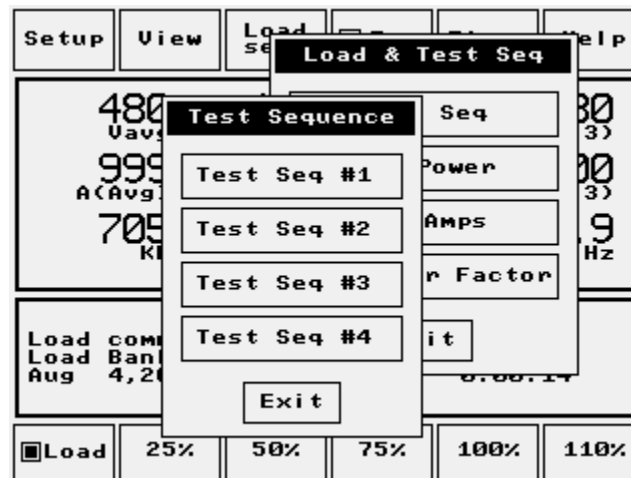


Figure 33 - Test Sequence Menu

Press the **Load Set** button followed by **Test Seq** to access the *Test Sequence Menu*. This menu provides access to the 4 test sequences. Press the appropriate button to access the desired test sequence. Press **Exit** to close the menu without accessing any of the test sequences.

5.2.4.1 The Test Sequence Edit Window

Selecting any of the test sequences from the Test Sequence Menu opens the Test Sequence Edit Window.

Test Sequence #1		
Step	Load	Time (min)
1	500.00	1.0
2	750.00	3.0
3	750.90	1.0
4	750.85	1.0
5	800.00	1.0
6	900.00	5.0
7	0.00	0.0
8	0.00	0.0
9	0.00	0.0
10	0.00	0.0
11	0.00	0.0
12	0.00	0.0

Run Edit Exit Help

Figure 34 - Test Sequence Edit Window

In the example shown, test sequence #1 is opened in the edit window. From this window, test sequence #1 can be edited or executed (run). Press the **Run** button and the test sequence will begin executing at step #1. In the example shown, the load will be commanded to 500 KW for 1 minute.

Setup	View	Stop Test	<input checked="" type="checkbox"/> Fan	Timer	Help
480 V _{avg}	480 V(1)	480 V(2)	480 V(3)		
601 A(Avg)	601 A(1)	602 A(2)	601 A(3)		
500 KW	0 KVAR	1.00 PF	60.0 Hz		
Load command = 500 KW 42% Test seq. #1 at step #1 - 0:00:39 Aug 4, 2004 2:53:43pm 0:00:14					
<input checked="" type="checkbox"/> Load	25%	50%	75%	100%	110%

When a test sequence is running, a status indicator is shown on the *Status Panel*.

Test seq. #1 at step #1 - 0:00:39

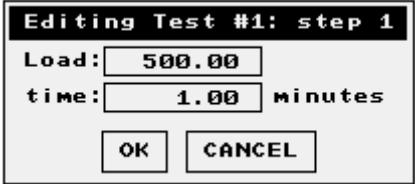
This message indicates that test sequence #1 is running at step #1 and has 39 seconds left (in step #1). The time will count down to zero at which time the load will be moved to the next step -- step #2 in this case. This

process will continue until either all 12 steps have been run, or a zero time value is encountered. In our example, the test will end after step #6 has completed since the time value at step number 7 is zero.

While a test sequence is running, the **Load Set** button is re-labeled as **Stop Test**. Pressing the **Stop Test** button aborts the current test sequence and drops the load. The fan will be left on. Pressing the Stop switch on the front panel will have the same affect. Pressing the Stop switch when there is no test sequence running will drop the load and turn off the fan.

To edit a test in the edit window, simply use the arrow key on the right of the window to highlight the desired step, and then press the **Edit** button.

A step edit window will be opened that allows for setting the load and time for the given step. Simply touch the Numeric Entry Fields and enter the desired values. Press the **OK** button to accept the new numbers and move to the next step. Press the **CANCEL** button to abort the edits and make no changes.



Editing Test #1: step 1

Load: 500.00

time: 1.00 minutes

OK CANCEL

Note that on a load bank with inductive load steps, entering a load value with a fractional portion can be used to set the desired power factor. For example, setting "Load" to 500.85 commands 500 KW at a 0.85 power factor.

Test sequences are stored in non-volatile memory and will remain persistent until changed at a later date.

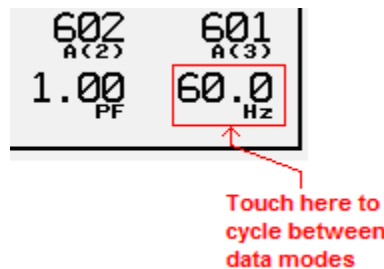
5.3 Metering Data

The *Data Panel* section of the LCD screen displays the current values being measured by the metering system. The following is a definition of the metering system channels:

Channel	Function
V(1-2)	Phase to phase voltage (phase 1 to phase 2)
V(2-3)	Phase to phase voltage (phase 2 to phase 3)
V(3-1)	Phase to phase voltage (phase 3 to phase 1)
V(1-N)*	Phase 1 to neutral voltage
V(2-N)*	Phase 2 to neutral voltage
V(3-N)*	Phase 3 to neutral voltage
A(1)	Phase 1 current
A(2)	Phase 2 current
A(3)	Phase 3 current
V avg	Average voltage (in volts)
A avg	Average current (in amps)
Hz	Frequency of voltage wave on phase 1
KW	The real power
KVA	The apparent power
KVAR	The reactive power (kilovolt-amp-reactive)
Rotation	Load power, phase rotation
PF	Power factor
* Only available on 4-wire Y connected load banks.	

Figure 35 - Metering Data Channels

The table shows all of the data channels measured and calculated by the metering system. Note that the Rotation, frequency (Hz), and KVA values



share a common location on the *Data Panel*. Simply touch one of these readings to toggle to the next mode. Pressing the front panel Mode switch has the same effect.

5.4 The Input Status Window

Additional measured values, digital inputs, and status information can be viewed from the *Input Status Window*. Press the **View** button then select **Input Status** to open the *Input Status Window*. This window contains 4 pages of information. The pages are selected via the next (**Next>>**) and previous (**<<Prev**) buttons. Press the **Exit...** button to close the *Input Status Window*.

5.4.1 Input Status page #1 (Temperatures)

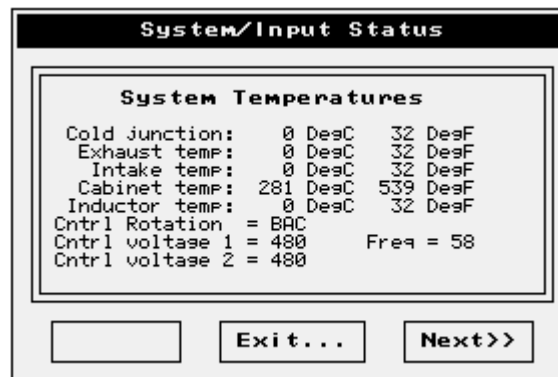


Figure 36 - Input Status Window (page 1)

The first page of the Input Status Screen shows the temperature and control voltage measurements. Not all systems will contain each of the temperatures shown. Those temperatures that are not actually implemented will normally display as 0 (DegC). These temperature measurements are used primarily to ensure the same operation of the load bank. See section 2.2.2 *Safeties and Interlocks* for more information.

Also shown on this page are the control power readings. These are:

- **Cntrl Rotation** - Control Power rotation (only valid for 3-phase power sources).
- **Cntrl voltage 1** - Control Power phase 1 voltage.
- **Cntrl voltage 2** - Control Power phase 2 voltage (should read zero on single-phase Control Power sources).
- **Freq** - Control Power frequency (on phase 1).

If your system is setup to operate on internal *Control Power*, then these readings will mimic the *Load Power* readings (from the metering data). If

external *Control Power* is selected, then these readings indicate the current status of the external *Control Power* source.



Note: The measurement system used to measure the Control Power input is much less sophisticated than the metering system. The Control Power measurements are used by the system to ensure proper voltages are present for operation of the unit. These readings were not intended to be used as metering data -- they use averaging measurement methods (rather than true rms) and are sampled at much slower speeds. Keep this in mind when comparing these numbers to the metering data.

Press the **Next>>** button to move to the next page.

5.4.2 Input Status page #2 (Digital Inputs)

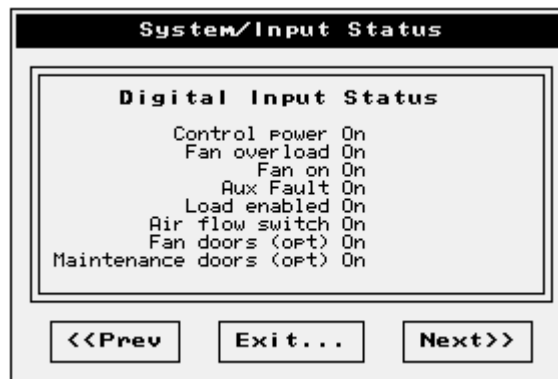


Figure 37 - Input Status Window (page 2)

Page two of the Input Status Screen is used to show the current status of the safety switch inputs. These inputs are used to ensure the proper operation of the system as described in section 2.2.2 *Safeties and Interlocks*. Keep in mind that not all load banks will make use of each of these inputs. For example fan and maintenance doors only exist on trailer mounted load banks. This screen is used primarily for troubleshooting.

Press the **Next>>** button to move to the next page.

Press the **<<Prev** button to move to the previous page.

5.4.3 Input Status page #3 (Load bank info)

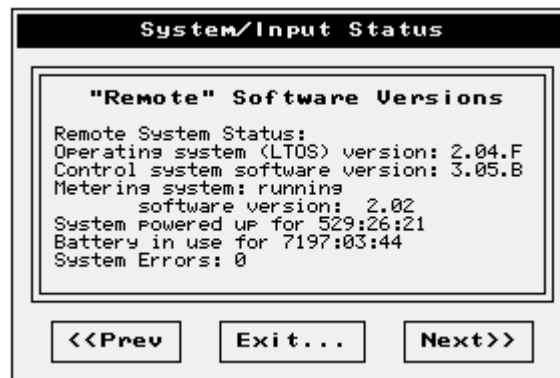


Figure 38 - Input Status Window (page 3)

Input Status Window page #3 is used to show software version numbers and internal status information. When troubleshooting problems, Loadtec's Customer Service representatives will often times need to know the version of your software. All of the version and status information on this page represents information from the load bank itself.

The Operating System indicates the version of LTOS (Loadtec Operating System) that the software was built with. The Control system software version indicates the version of the Load Bank Controller software (the "A" processor). The Metering system indicates if the metering system is running, and the software version number. The metering software operates in the "B" processor.

The "System powered up for" timer indicates the amount of time (in hours: minutes: seconds) that the system has been powered on. This information is useful to Loadtec as a method of tracking MTBF (Mean Time Between Failures).

The battery in use timer gives an indication of how long the current battery has been in use in the system. The difference between this time and the "System powered up for" time indicates the amount of time the system has been in a battery-backed state.

The "System Errors" parameter indicates the number of internal software errors that have occurred in the system. This count is cumulative. This value should never be non-zero. Loadtec has built special diagnostic functions into the system software that provide tracking of any errors that occur. These diagnostic functions are not directly accessible to the user.

Press the **Next>>** button to move to the next page.

Press the **<<Prev** button to move to the previous page.

5.4.4 Input Status page #4 (Touch Screen Controller data)

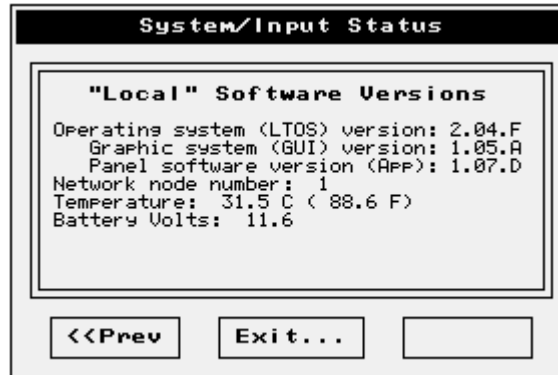


Figure 39 - Input Status Window (page 4)

Page #4 of the Input Status Window is used to show information about the Touch Screen Controller.

The Operating System indicates the version of LTOS (Loadtec Operating System) that the software was built with. The GUI (Graphical User Interface) version indicates the graphics system version that this software was built with. The "Panel software version" indicates the version number of the software currently installed in the Touch Screen Controller.

The Network Node Number indicates the configured node number of this Touch Screen Controller. As described previously (see section 4.1.4.4 *Node Address*), each Touch Screen Controller must have a unique node address.

The Temperature indicates the current temperature inside the Touch Screen Controller near the LCD display. The Battery voltage measurement indicates voltage being supplied to the Touch Screen Controller. This measurement will be used by future battery powered system for battery management functions.

5.5 Messaging System

The Load Bank Controller software maintains a list of system messages; in fact, the list will contain up to the last 99 messages. As the load bank is operated, messages are added to this list. There are two types of messages handled by the system: informative messages (i.e. load bank fan(s) turned on, voltage calibrated, etc...), and system error messages. A system error message will cause the load bank to be shut down and the System Message Window will automatically be opened.

This message list is viewed via the System Message Window. Press the View button followed by the System Message button to access the System Message Window.

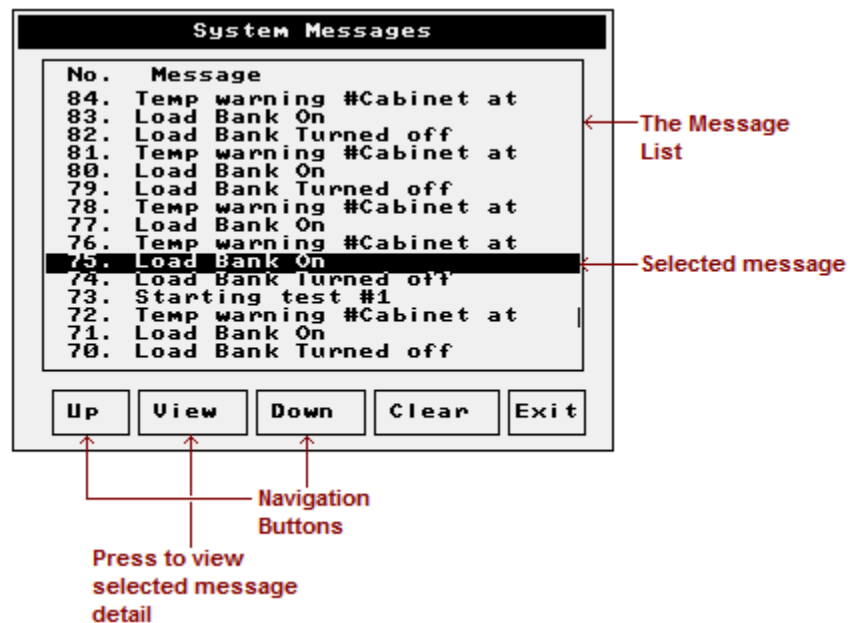


Figure 40 - The System Message Window

Messages are sorted in descending order. The top of the list is the most recent message and thus the bottom is the oldest. Messages will be added to this list as they occur. Once there have been 99 messages recorded, any new messages will cause the oldest message to be deleted. Therefore the system will maintain the most recent 99 messages.

Press the **Up** and **Down** buttons to scroll the messages up and down within the window. Touch any message in the list to select it. The selected message is highlighted in the list -- message #75 in the example above. When a message is selected, the View button will be enabled.

5.5.1 View Message Details

Press the **View** button to view the details of the selected message.



Figure 41 - View message detail

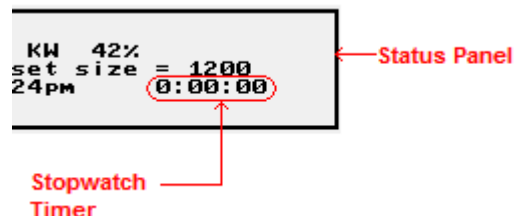
The message detail window shows the entire message -- some messages are longer than what will fit in the message list window. The time and date of the message is also shown. Press the **Exit** button to close the message detail window.

5.5.2 Clear System Message List

The system message list can be cleared by pressing the **Clear** button on the System Message Window. Note that a password is required to clear the system messages.

5.6 The Stopwatch Timer

The built in stopwatch timer provides a generic timer that can be used for timing any event. The current timer value is shown in the *Status Panel*, in the bottom right corner.



Press the Timer button to open the Timer Menu.

Start - Press the Start button to start the timer running.

Stop - Press the Stop button to stop the timer.

Reset - Press Reset to reset the timer value to 0:00:00.

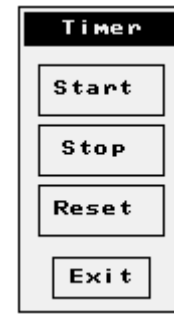


Figure 42 - The Timer Menu

Glossary

Control Power - Control Power is the power source used to provide power for the internal electronics, 24 VAC, and the cooling fan(s). When the control power is taken from the Load Power (the Test Source), the load bank is powered from the Test Source directly. Many of Loadtec's load banks provide a control power source selector switch that allow for a separately supplied external control power source.

Data Panel - The larger of the two panels on the Main Screen is the *Data Panel*. This panel is used to show the current metering data.

Direct Load Command - The mechanism used to directly enter a load or load and power factor command. Direct Load Command is available whenever the load bank(s) are in the *On* state. Simply touch the load reading (KW) on the Data Panel to set the direct load command (in KW) or touch the A(Avg) reading to set the load in amperes.

Genset Size - This is a user-entered parameter that defines the size of the system under test (the *Test Source*). Genset size is accessed via the Test Setup Window (see section 4.1.1 Test Setup). This parameter is used throughout the system for scaling load commands and displaying warning messages when an excessive load command is requested.

Input Status Window - Input Status Window refers to a window that has four different pages of information on temperatures, input port, and software versions (see section 5.4 The Input Status Window).

KVA (Apparent Power) - The complex power that is made up of the vector sum of the real and reactive power:

$$KVA = \sqrt{KW^2 + KVAR^2}$$

In a balanced three-phase system; $KVA = \frac{\sqrt{3} * VI}{1000}$

Where V = the phase-to-phase rms voltage, and I = the rms line current.

KVAR (Reactive Power) - The power required to transport energy to/from the reactive elements of a circuit. It is normally expressed as KVAR (kilovolt-amp-reactive). In AC circuits, it is computed from the voltage and out of-phase current.

KW (Real Power) - The power that does real work (i.e. produces power at a motor shaft). In AC circuits, it is computed from the voltage and the in-phase current. A load that is purely resistive, no reactance, provides only real power load.

Load Power - This is the power bus from the *Test Source*. This is the bus on which the resistive and reactive loads of the load banks will be placed. It can be separated from the Control Power in load banks that have a Control Power Source Switch.

Load Step - Load banks are constructed using discrete load elements know as load steps. Loadtec's load banks can be constructed with resistive and/or inductive load steps. Resistive load steps are resistors that provide a *real power* load (KW) at a given voltage. Inductive load steps provide a reactive power load (KVAR -- kilovolt-amp-reactive) at a given voltage and frequency. The resolution of any load bank is determined by the size of its smallest load step.

Metering Data - Metering Data is the data measured and calculated by the Power Meter system of the load bank control electronics system. It is made up primarily of the phase voltages, currents, and power.

On State - When the load bank is in a state that loads can be applied, they are said to be in the *On State*. To be in this state the internal cooling fan(s) must be on and flowing air and the internal 24 VAC power bus must be operational. It can be thought of as the fan(s) being on, although the process is more complicated than simply turning on the cooling fan(s).

Power Factor - The ratio between the *real power* and the *apparent power*. AC power sources are usually rated in KVA (kilovolt-amp, the *apparent power*), the product of the V_{rms} and I_{rms} , without regard to the *real power* (KW), because higher values of these quantities must be supplied to a circuit whose power factor is less than 1. Thus a power factor of 0.85 means that an apparent power of 1 KVA must be supplied for every 850 W (0.85 KW) of *real power* that is consumed by the circuit.

$$PowerFactor = pf = \cos \theta = \frac{KW}{KVA}$$

Theta θ is the phase angle between the current and voltage in the circuit. The reactive loads most commonly seen in a power system are inductive, thus the current lags the voltage and is said to be a *lagging* power factor. If the reactive elements in the circuit where capacitive, then it would be a *leading* power factor.

Status Panel - The smaller of the two panels on the Main Screen is the *Status Panel*. It is used to display status message, operating modes, the current time/date, and the stopwatch timer. This panel is also used to list the load steps when in the Manual Load Control mode. See section 3.3.2 The Status Panel.

Test Sequence - A built-in pre-defined sequence of load commands that can be executed when required. The system has four such tests. Tests are edited using the Test Sequence Edit Window. Tests are executed by pressing the Run button from within this window.

Test Source - is the power source under test. This is the generator set, bank of generator sets, uninterruptible power supply, or other power source that is to be tested by the load bank. It can be different than the *Control Power* in load banks that are so equipped; otherwise the *Test Source* is also the *Control Power* source.

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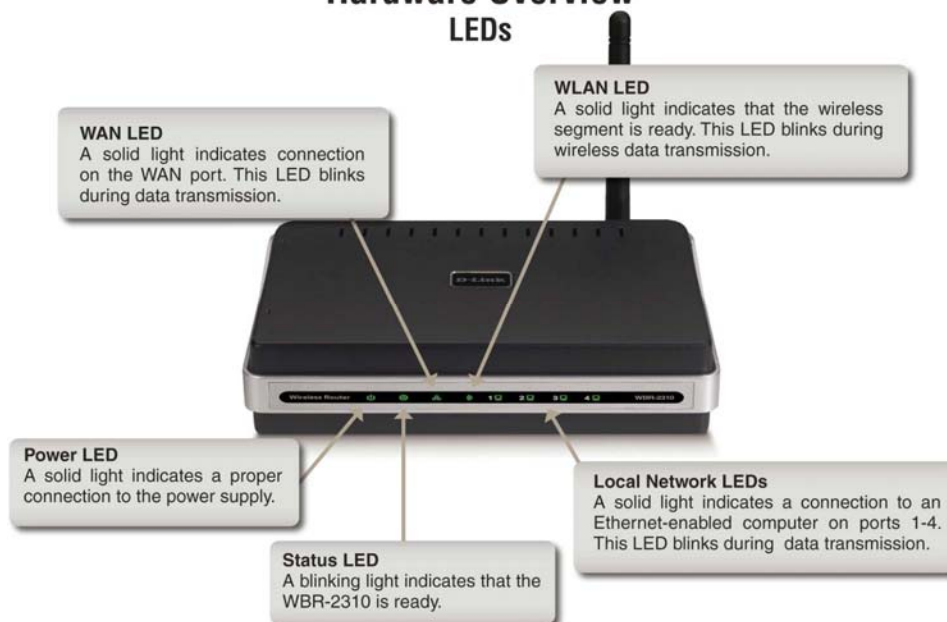
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INTRODUCTION: This document provides details and instructions for a wired network configuration of up to (3) Load Banks with a TouchCommand OIP controller. The device described in this document is also capable of wireless operation but will not be discussed in this document since the TouchCommand OIP controller is not wireless capable. The Load Banks and TouchCommand require a TCP/IP Ethernet network to function. The D-Link WBR-2310 router is used to establish the network structure for the units to communicate.

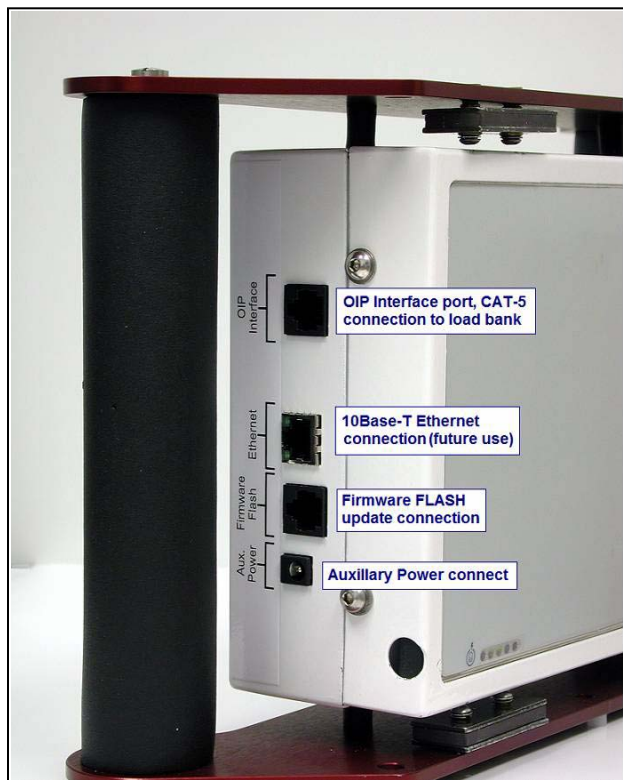
REQUIREMENT: This document will refer to specific details of a D-Link WBR-2310 when describing connections and operation. Other devices can be used, but the device must provide a DHCP server and compatible with IEEE Network Socket standards. Some devices only support Microsoft Winsock protocols and will not operate properly.

DEVICES:

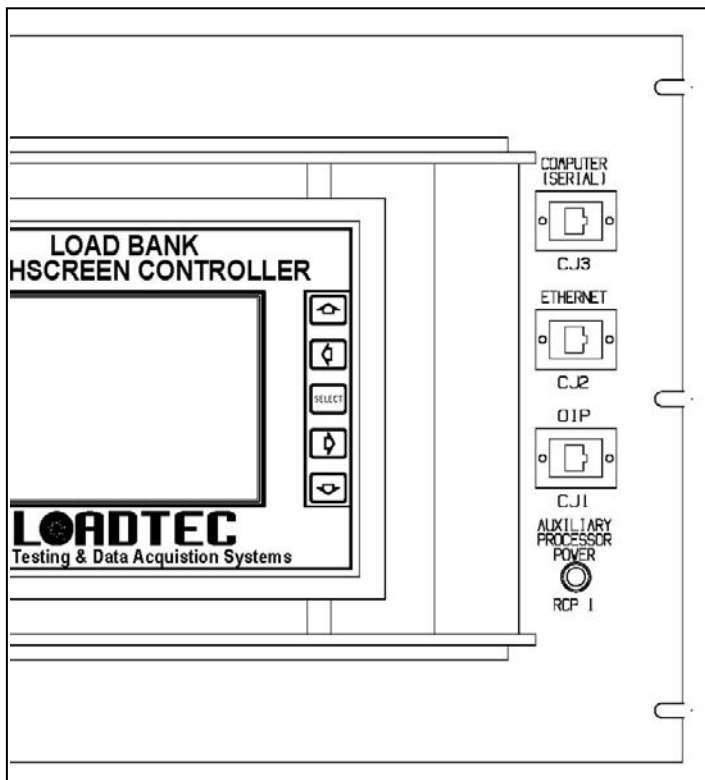
Hardware Overview LEDs



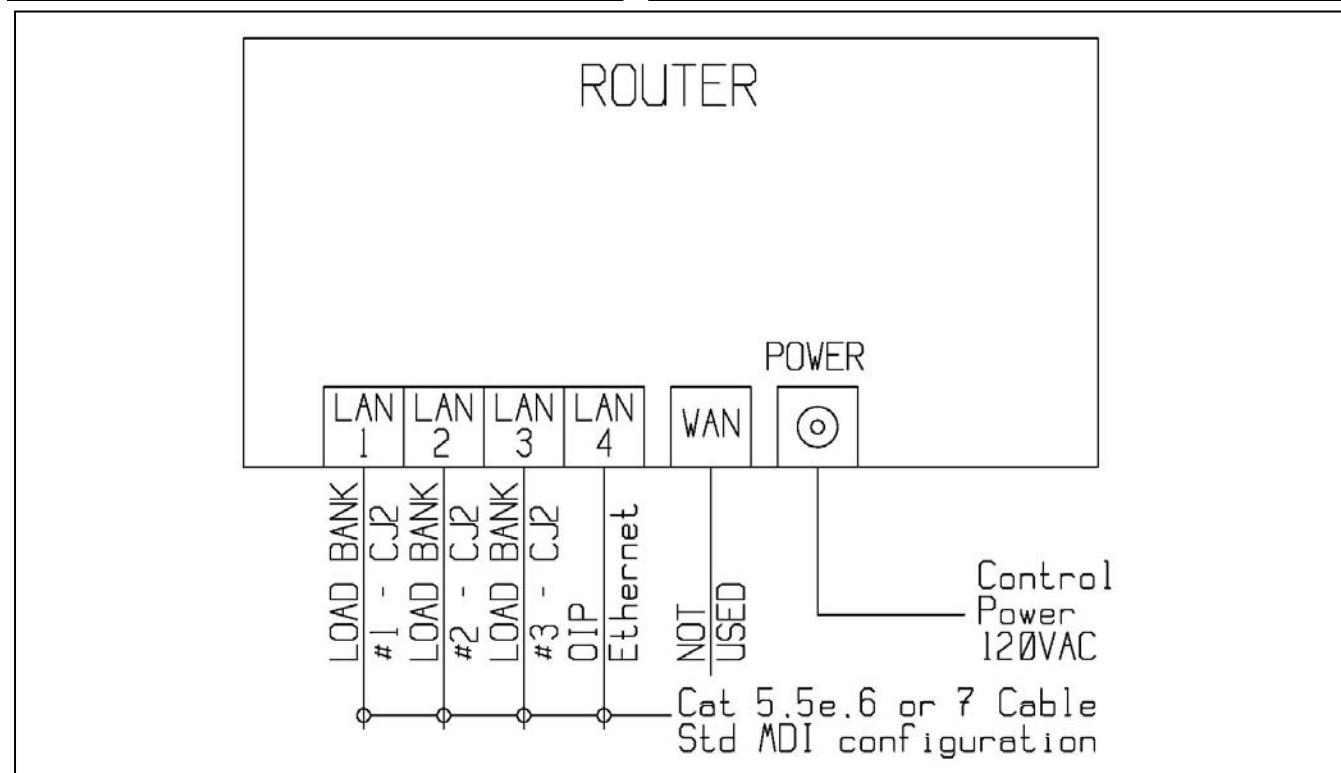
D-LinkWBR-2310 ROUTER



TouchCommand OIP - Connection Detail



Load Bank Control Panel – Connection Detail



Elementary Connection Diagram

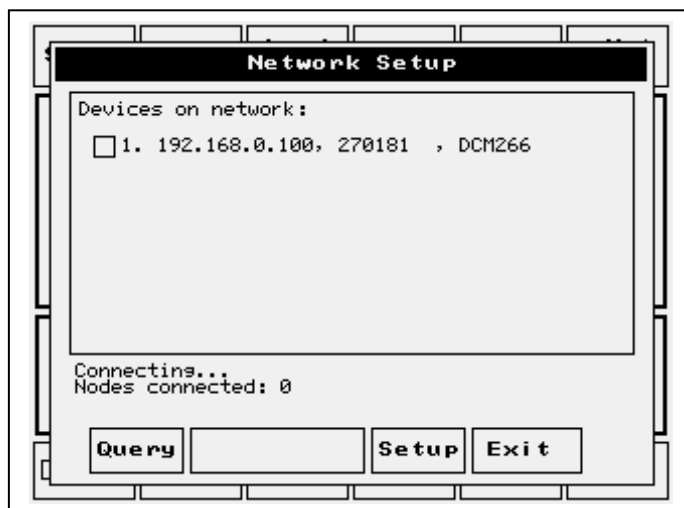
- SET-UP:**
- 1) Locate the Load Banks in the required location and connect the Power Cables of the Load Banks to the test source. (do not power the source)
 - 2) Remove one of the OIP Controllers from the unit mount.
 - 3) Locate the OIP in the desired operating location.
 - 4) Locate the router in a convenient location. It should be located in closer to the Load Bank(s). The connection cable to the OIP should be the longer cable to connect to the Router so it can be located at the test source.
 - 5) Connect the Load Banks CJ2 port using a standard Cat 5 cable to the Router ports as indicate by the Elementary Connection Diagram
 - 6) Connect the OIP Ethernet port using a standard Cat 5 cable to the Router port as indicate by the Elementary Connection Diagram
 - 7) Connect the power adapter to the Router and to a 120VAC source.
 - 8) The Power LED should be illuminated.
 - 9) The Router LED's will go through a series of on-off sequences. When the Status LED continually flashes, the Router is ready for operation.
 - 10) Connect the power adapter to the OIP Auxiliary Power connector and to a 120VAC source.
 - 11) The Power LED should be illuminated and the Processor LED should be flashing. The Link LED should be illuminated on the OIP and the Router port connected to the OIP.
 - 12) Power test source. The control system in the Load Bank will be automatically powered.
 - 13) The Link LED should be illuminated the Router port connected to the Load Bank.
 - 14) The connected Load Banks are now ready to be operate by the OIP as a single unit (system).

- OPERATION:**
- 1) Press the POWER button on the OIP. The LCD display will illuminate the a Logo screen will appear. Touch the screen to clear the opening screen.
 - 2) A screen similar to the following shall appear:

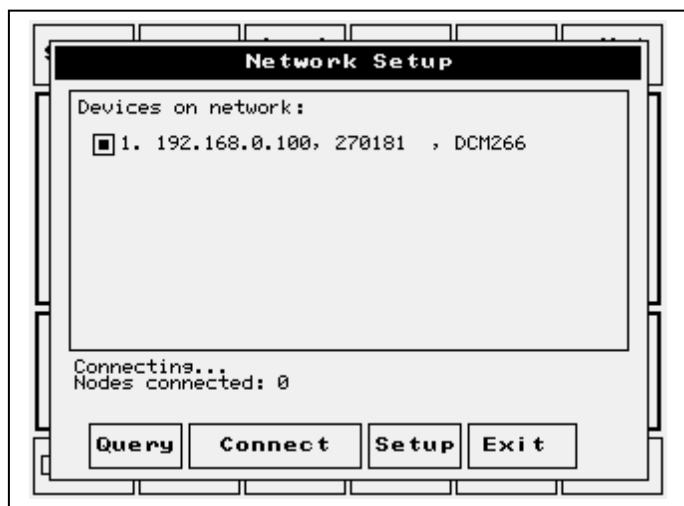
Setup	View	Load set	<input type="checkbox"/> Fan	Timer	<input type="checkbox"/> Net Con
480 Vavg	480 V(1)	480 V(2)	480 V(3)		
0 A(Avg)	0 A(1)	0 A(2)	0 A(3)		
0 KW	0 KVAR	0.00 PF	60.0 Hz		
Load Bank: Off Nov 29, 2008 3:08:46 PM 0:00:00					
<input type="checkbox"/> Load	25%	50%	75%	100%	110%

- 3) Select the Net Con frame in the upper right corner of the screen. This will initiate the network connection of the Load Banks connected to the Router to the OIP.

- 4) A screen similar to the following shall appear:

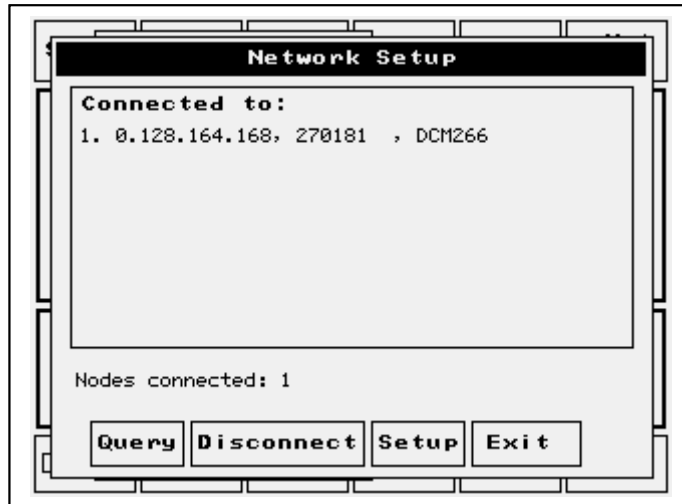


- 5) The Load Banks connected to the Router will appear on this screen.
 6) If the Load Bank(s) does not appear on the screen, check the Cat5 cable connection and the Load Bank has power.
 7) Select the Load Banks the are to be connected buy pressing the empty box in front of the Load Bank descriptor.



- 8) When any of the Load Banks are selected, the CONNECTED box will be enabled. Select this box to connect these units to the OIP.

- 9) After the CONNECTED box is selected, the OIP will connected to the selected unit.
- 10) The next screen will indicate the Load Banks that are connected. Select the EXIT box to go back to the original operating screen



- 11) The system is now ready to operate as a single point of operation. ie: Selecting fan start will start all fans. Refer the Touch Command user manual to for operation as if it were a single unit. See Section 5.1.