LOAD BANK
TECHNICAL MANUAL

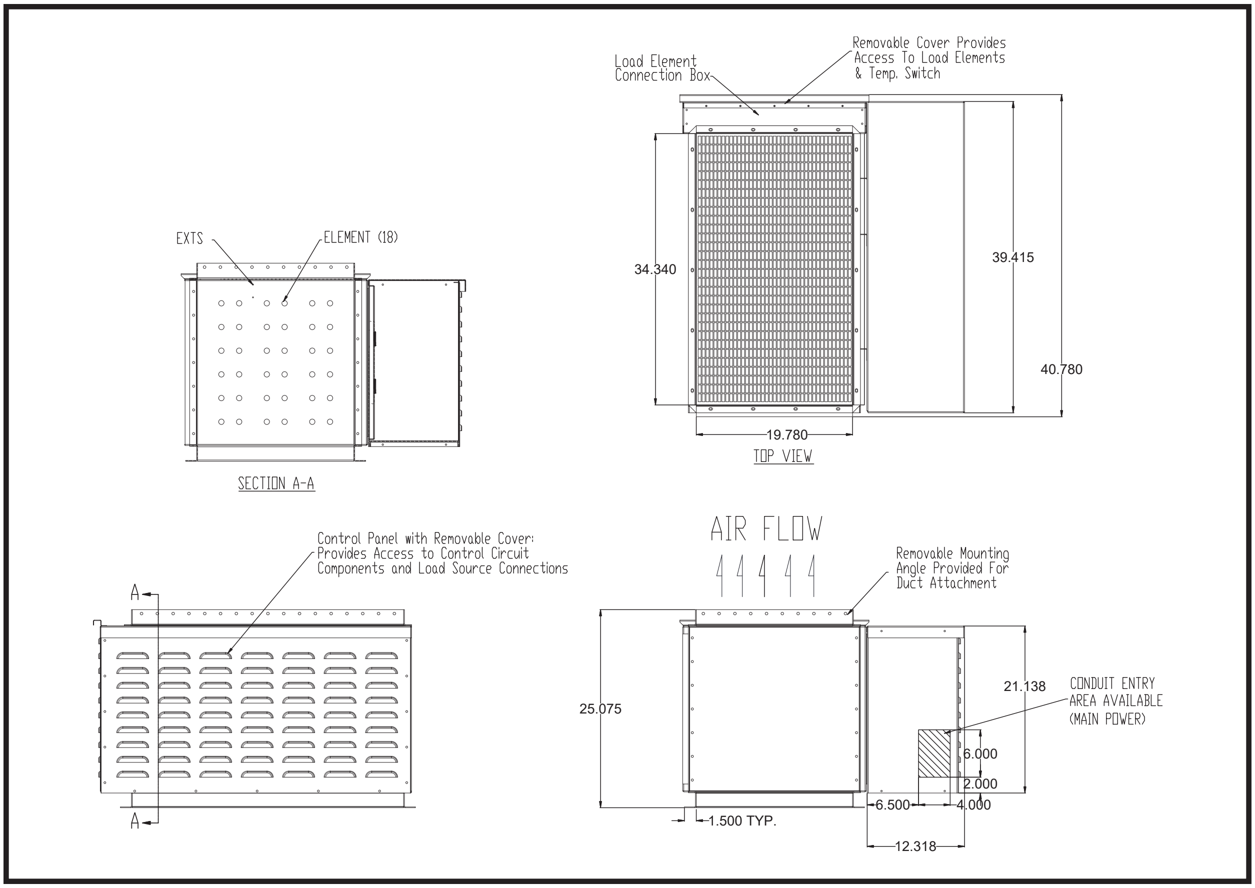
Customer: XXXXXX

Job: XXXXXX-X-X

Model: Vector XX

August 2017

Contents



Part of Typical Pictorial Drawing

DESCRIPTION

Simplex LBD Series Load Banks are a special form of stationary, resistive, forced air-cooled Load Bank which utilizes the air outflow of an engine radiator for cooling of the load elements. They are specifically designed to apply discrete, selectable electrical load to a power source while measuring the response of the generator to the applied load. They also provide a means for routine maintenance exercise to assure long term reliability and readiness of the standby generator. Exercise Load Banks eliminate the detrimental effects of unloaded operation of diesel engine generators.

Simplex LBD Series Load Banks are intended for use with water cooled engine generator sets equipped with unit mounted radiators. These Load Banks are built per customer specifications and can be installed in numerous ways, including direct bolted attachment to the radiator, mounting within an air duct, wall mounting over the air outflow opening, indoors or outdoors.

Power source testing is accomplished by applying resistive load steps at a specific power factor.

Load application is by magnetic contactor. All load branch circuits are protected by 200KAIC class-T fuses.

The Remote Control Panel contains the following controls and indicator lamps:

1. Normal Operation and Over Temperature indicator lamps,
2. 4” Color HMI Controller

This Load Bank is protected against cooling failures (high exhaust air temperature which could damage the Load Bank or present a safety hazard to the operator). The “Normal Operation” lamp illuminates when Control Power is available and the Cooling System is operating properly. When a cooling failure occurs the automatic safety features in the Control System immediately remove the load from the test source and illuminates the “Over Temperature” lamp. The malfunction must be corrected and the Load Bank must be reset by turning the Load Bank “Off” then “On” before the load can be re-applied.

The Load Bank consists of two principal systems:

1. Control System
2. Load System

CONTROL SYSTEM

The Control System allows the operator to apply a desired load to the test source and measure the response of the test source to the load. This system also contains the circuitry utilized to disconnect the Load Bank from the test source in the event of cooling failures and/or improperly positioned operating controls. Common serviceable components include Control Fuses (F Series), Meter Fuse (MF Series), and Power Fuses (F Series).

Control power is supplied to the Load Bank via the test source and a control power transformer.

LOAD SYSTEM

Simplex Vector Load Banks are built up in fused branch circuits of not more than 70A each and protected by 600V, 200KAIC class-T fuses. All wiring and devices within the branch circuit are rated in accordance with the fuse rating. Branch circuit fusing of the elements virtually eliminates the danger of short circuit of the load elements and consequent catastrophic damage to the Load Bank.

Pow'r Rod Load Elements

Simlpex Pow'r Rod Load Elements are UL recognized. These elements are totally enclosed, sealed and weatherproof. Pow'r Rod elements consist of nickel-chromium resistance wire electrically insulated and sealed within a metallic sheath. The hazard of electric shock to personnel and the danger of short circuit by foreign object penetration are reduced since the elements are electrically dead on the outside. They will not fatigue from engine or air-blast vibrations and will not sag or stretch if overheated. The sheath material is "incolloy", a rustproof nickel alloy with a very high temperature rating (1600°F). These elements do not require a cool down period.

⚠ WARNING ⚠

Never operate or service a Load Bank that is not properly connected to an earthground.

PRIMARY INSPECTION

Preventative visual inspection of the shipping crate and Load Bank must be performed before installation. Physical or electrical problems due to handling and vibration may occur during shipment.

1. If crate shows any signs of damage examine the Load Bank in the corresponding areas for signs of initial problems.
2. Check the entire outside of the cabinet for any visual damage which could cause internal electrical or mechanical problems due to reduced clearance.
3. Rotate and push all switches through all positions to ensure smooth operation.
4. Inspect the bottom of crate/enclosure for any components that may have jarred loose during shipment such as indicator light lenses, switch knobs, etc.
5. Visually inspect element chamber for foreign objects and mechanical damage.

INSTALLATION

Unless stated on drawings consult NEC for proper wire size on all connections.

1. Using the angles provided attach the Load Bank with bolts per specifications. Bottom support for the load element enclosure is recommended.
2. Confirm the test source is properly grounded and ground the Load Bank to its own independent ground.
3. Mount the Remote Control Box in the desired location.

If any problems are observed during Primary Inspection call the Simplex Service Manager at 800-637-8603 (24hrs.)

4. See Control Section Drawing:
   a. Connect customer supplied 24VDC power source as shown.
   b. Connect customer supplied Load Bank Status contacts as shown.
   c. Connect customer supplied High and Low Signal contacts as shown.
   d. If Load Dump control is desired, remove the factory installed jumper and connect customer supplied Load Dump contact as shown.

      Close to run.

      Open to remove load.
5. See Metering Section Drawing:
   a. Place the Current Transformers (CT1, CT2) so as to sense total load and connect them as shown.
   b. Cable the Main Load Bus (MLB) to the load source as shown.

      Cables must pass through Current Transformers (CT1, CT2) as shown for proper meter operation.
6. See Remote Wiring Drawing:
   a. Using RS 485 communications cable (up to 4000’), connect the Load Bank to the Remote Panel as shown.
   b. Connect the power connection on the Load Bank to the Remote Panel as shown.

OPERATION

The screens in this manual are examples. Your screens may vary.

MANUAL LOADING

From the Manual Load screen, engage the Master Load button at the bottom left. Touch individual step buttons to energize steps. Metering and system status is displayed at the top of the screen.

Note that the Master Load switch must be disengaged in order to navigate to other control screens.

To navigate to the System Setup screens, Control Power must be off.

All load screens have several elements in common.

- Load Dump (lower right corner): Drops all load, suspends automatic functions.
- Control Power (top left corner)
- Banner (top): Displays current screen title
- System Status (below Banner): gives indication of Normal Operation or alarms along with various status indicators
- Metering (below System Status)
- System Setup navigation button (lower left corner): Brings up user setup screens. Only available when Control Power is off.

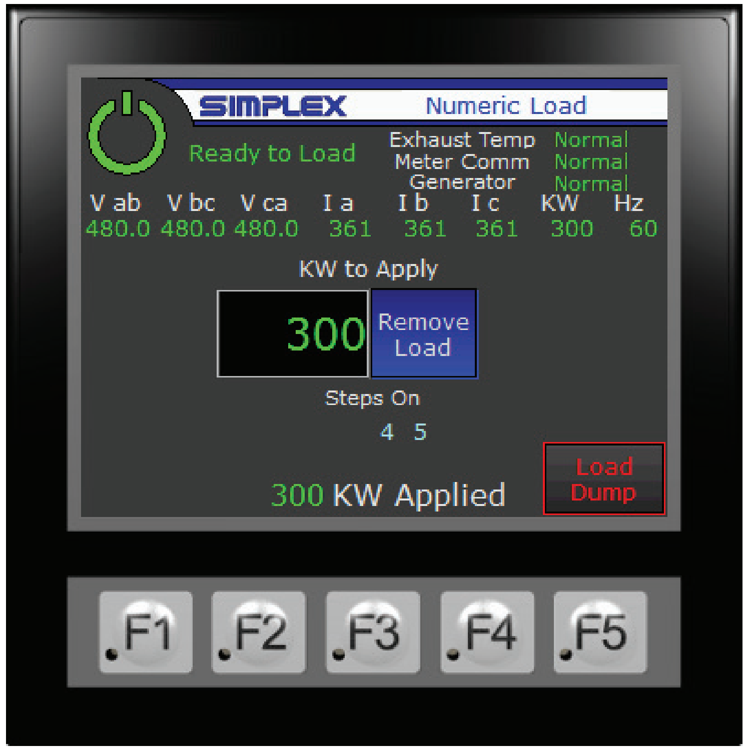
NUMERIC LOADING

From the Numeric Load Screen, enter the KW to be applied and toggle the Apply / Remove button to engage / disengage the load. The PLC logic will determine which steps to apply to make the requested load.

Indicators below Apply / Remove controls display which load steps are currently engaged.

Note that the Apply Load button must be disengaged in order to navigate to other control screens.

To navigate to the System Setup screens, Control Power must be off.



AUTO LOADING

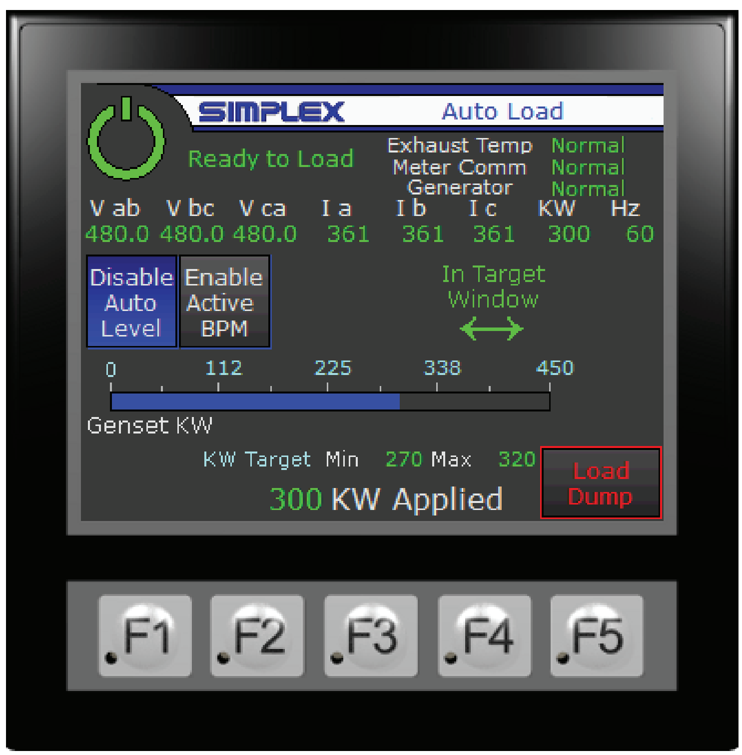
From the Auto Load screen various “automatic” functions may be called and controlled. Generally, these functions are intended to operate the load bank in parallel with another load.

All of these functions operate using User defined “windows” of operation and will adjust load bank load relative to the parallel load to keep the source output level within these defined windows.

Below the metering are buttons to enable / disable the various available automatic functions.

To the right of these buttons is an indicator displaying the current status of the load bank relative to the window.

If the total source output KW is below the target window’s lower setpoint, the load bank will automatically increase its load by steps equal to the load bank’s



resolution (the size of smallest load step) at time intervals programmed by the user in the User Setup screens. To the right of the automatic function buttons an up arrow graphic will display with the message "Stepping Up."

Likewise, if the total KW is above the window's upper setpoint, the load bank will drop load accordingly and the indicator will display a down arrow with a "Stepping Down" message.

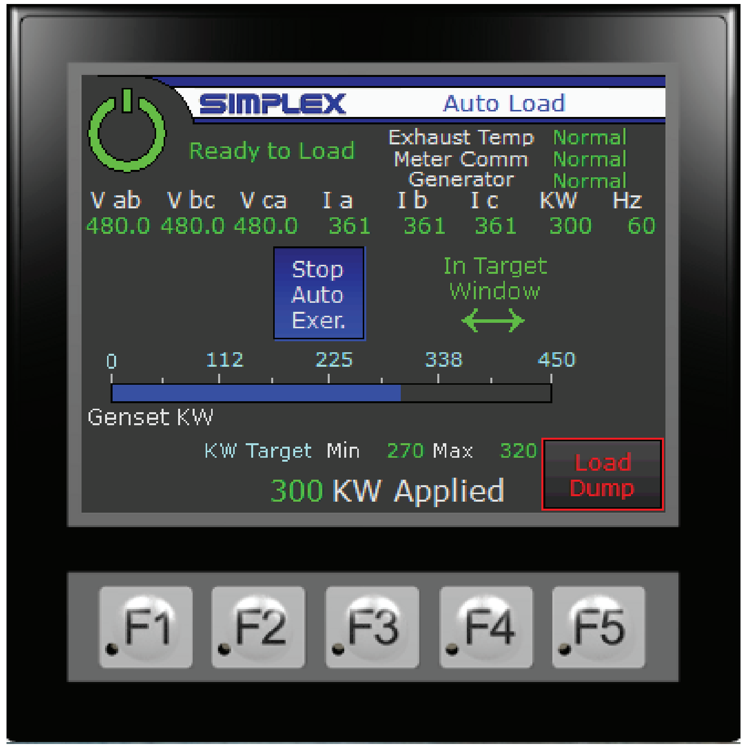
When the total load is above the lower setpoint but below the upper, the system is within the target window and the load bank will maintain its level. An "In Window" message will display.

Below the function buttons and the status indicator is a meter displaying the power output of the source as a percentage of its rated capacity.

Below that are displayed the High and Low setpoints of the current target window.

Auto Load Leveling

- Operation is as discussed above. Load bank will work to level the total system KW as the parallel load fluctuates.
- When in Auto Leveling, the load bank will turn itself on and begin to operate whenever voltage is sensed on the bus.
- In addition to the window High and Low setpoints defining the target window of operation, there is also an Emergency High setpoint. If system KW reaches the Emergency High setpoint, the load bank will step down at a faster (user defined) rate.



Auto Exercise (AEX)

- When triggered either from the HMI or from a customer installed remote switch, AEX will step up to and work to maintain total KW within the AEX window (user programmed in the User Setup screens), again stepping up by the resolution of the load bank at a user defined interval.
- When the trigger is removed, the load bank will step down to zero load and reset AEX mode.

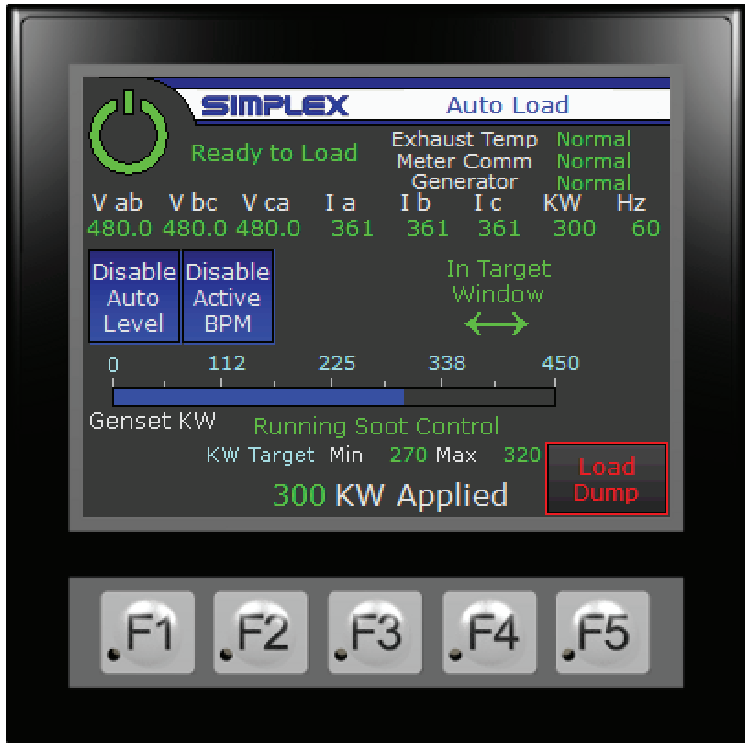
ACTIVE BACK PRESSURE MONITORING / SOOT CONTROL MODE

The load bank's Back Pressure Monitoring (BPM) function works in conjunction with user supplied pressure monitors in a generator's exhaust stack. The load bank responds to two discrete inputs from these sensors, one a warning and one an alarm.

For the purposes of these load banks, the BPM mode is essentially a sub function Auto Load Leveling. In other words, the system must be in Auto Load Leveling mode before BPM can be engaged.

While it is operating in Auto Load Leveling mode, the load bank will react to inputs from the external pressure sensors as follows:

- If either input is detected, the load bank will shift to "Soot Control" mode, stepping up to the "Soot Burn Target" window as defined by the user in the User Setup screens. The intent is to raise the generator output to a level high enough to increase its exhaust temperature in order to burn out the soot buildup that is the presumptive cause of the increased stack back pressure.
- After the inputs clear, the load bank will maintain load in the "Soot Burn Target" for a user defined time (Soot Burn Duration input in the User Setup screens), after which it will return to its normal Auto Load Leveling operation.
- If the sensor inputs do not clear after a user defined time period of operation in the Soot Burn window (Alarm Shutdown Delay input in the User Setup screens), the load bank will assume that there is some other problem with the sensors or with the system and will step down to zero load.



Active Back Pressure Check

On initial startup of the load bank when BPM is enabled, the load bank will perform an active check for elevated back pressure. It will trigger an AEX cycle using the same window and time delays as those for the AEX function.

- The load bank will step up to the AEX window checking whether the back pressure sensors will trigger at higher load levels.
- If either sensor triggers during this evolution, the load bank will transition into Soot Burn mode.
- If the load bank steps up into the AEX window without either of the sensor triggering, it will immediately step back down to zero, and then transition to normal Auto Load Leveling operation.

INFO SCREEN

When the Control Power is turned off, the Info Screen can be reached from the load control screens via the Setup button in the lower left of the screens.

This screen displays information about the load bank including the Simplex work order number as well as contact information for Simplex parts and service.

From this screen, the User Setup screens may be accessed. The Setup screens are password protected to prevent unwarranted setpoint changes. The password is 4831600.

USER SETUP SCREEN

All user definable setpoints are entered in the User Setup screens.

- Genset KW Capacity: max rated output of the genset or source.
- Auto Start Delay: time delay on startup before the load bank begins to operate in Load Leveling or Active BPM check mode.
- Target Windows: the High and Low setpoints identifying the target windows for Auto Load Leveling, AEX and Soot Burn modes.
- Emergency High KW: Setpoint at which the Load Bank will begin to drop load at the rate defined by the emergency delay rather than the normal step down delay.

- Time Delays:
  - o The Step Up and Step Down delays define the time delay between stepping up / stepping down in Auto Load Leveling and Soot Burn modes.
  - o Emergency Delay is for Emergency High condition.
  - o AEX Step Delay defines delay for both stepping up and stepping down in AEX and Active BPM Check modes.
- CT Ratio: the CT ratio of the external CTs feeding total system current information into the load bank's PLC.
- Generator Overload Protection: An optional measure to mitigate any effects of a genset overload. If genset frequency drops below the Min Freq input for a time exceeding the Delay input, the load bank will drop load in an attempt to prevent an overload shutdown. The lower the setpoint, the less likely that a load drop would occur. If this measure is not desirable for a user's operation, the Min Freq input should be set down close to zero and / or the time delay set to a very high threshold.

GENSET COOLDOWN

An external (user supplied) switch providing input into the load bank's PLC (see drawings for wiring details) will trigger a load bank shutdown. The load bank will step all load down to zero.

⚠ WARNING ⚠

Always remove all power from the load bus and all fan/control power before servicing the Load Bank. Never operate or service a Load Bank that is not properly connected to an earthground.

MAINTENANCE

The Load Bank has been designed to require minimum maintenance. All components have been chosen for a long, reliable life. Two basic intervals of maintenance are required: each operation and every 50 hours or 6 months (whichever comes first).

EACH OPERATION

The air intake openings, cooling chamber, and exhaust screens and louvers must be checked for any obstructions or foreign objects. Due to the high volume of air circulated, paper and other items can be drawn into the air intakes. During Load Bank operation insure that air is exiting from the exhaust side.

The load branches should be checked for blown fuses or opened load resistors. To check the fuses or load resistors, operate the Load Bank from a balanced 3-phase source and check the three line currents. The three current readings should be essentially the same. If a sizeable difference is noted one or more load fuses or load resistors may have malfunctioned.

EVERY 50 HOURS OR 6 MONTHS

Check the tightness of the electrical connections. The expansion and contraction caused by Load Bank operation may result in loose connections. The vibrations caused by the generator set may also loosen electrical connections. If the Load Bank is transported "over the road", the electrical connections should be checked for tightness at a shorter-than-normal time interval. See "Primary Inspection".

⚠ WARNING ⚠

If a failure occurs the corresponding status indicator will be present and the load will be de-energized. Before reapplying a load, the failure must be corrected and the system must be reset by turning the Load Bank "Off" then "On".

⚠ WARNING ⚠

For continued safety and for maximum equipment protection, always replace fuses with one of equal rating only.

⚠ WARNING ⚠

When troubleshooting Load Bank systems always remove all test source power, fan/control power, anti-condensation heater power, etc.

TROUBLESHOOTING

This section is designed to aid the electrical technician in basic Load Bank system troubleshooting. All of the problems listed can be verified with a basic test meter and/or continuity tester. For safety reasons, when troubleshooting Load Bank systems always remove all test source power, control power, anti-condensation heater power, etc.

COOLING FAILURE INDICATED

1. Over temperature sensor failure
2. Loss of genset exhaust
3. Air restriction (intake or exhaust)

TEST METERS DO NOT OPERATE PROPERLY

1. Meter switch failure
2. Meter multiplier resistor inoperative
3. Improper positioning of meter selector switch
4. Current transformer or current transformer wiring failure
5. Test meter failure
6. Meter fuses open

SOME LOAD STEPS CANNOT BE ENERGIZED

1. Inoperative load step switches
2. Open load step resistor(s)
3. Inoperative load step relays
4. Inoperative load step contactors
5. Open load step fuses

DRAWINGS AND PARTS LIST

The drawings included in this manual are the most accurate source of part numbers for your Load Bank. When ordering replacement parts for Simplex Load Banks, always consult the Parts Legend drawing. When contacting the Simplex Service Department always have your job number and drawing number ready for reference. The Job Number and the Drawing Number are located on each drawing.

APPENDIX A - ABBREVIATIONS USED IN THIS MANUAL

Listed below are abbreviations of terms found on Simplex Load Bank Systems. When following a load bank drawing utilize this guide to define abbreviated system and component names. As this is a master list, drawings and text pertaining to your equipment may not contain all these terms.

AC - Alternating Current

AIC - Ampere interrupting current-Maximum short circuit fault current a component can safely interrupt

AM - Ammeter

AMSW - Ammeter selector switch-Selects any phase for current reading

CF - Control fuse

CFM - Cubic feet per minute-Used to rate fan air flow capacity and load bank cooling requirement

CFR - Cooling failure relay-Normally energized relay in cooling failure sub-system

CPC - Pilot contactor-Contactor that must be energized before load is applied.

CPF - Control power fuse

CT - Current transformer-Transformer used in metering circuits

DC - Direct current

DHF - De-humidity control fuse

DHR - De-humidity control relay

EXTS - Exhaust air temperature switch

FCB - Fan circuit breaker-Circuit breaker in series with fan control power

FCVR - Fan control voltage relay-Normally energized relay on relay sub-panel

FM - Frequency Meter-Monitors frequency of test source

FMC - Fan motor contactor-Controls power to fan motor

FMSW - Frequency meter switch

FPS - Fan power switch-Used to energize cooling system

GFB - Ground fault breaker

GBTR - Ground breaker tripped relay

GPM - Gallons per Minute

HCF - Humidity Control Fuse

HCR - Humidity Control Relay

HMD - Humidistat

HTR - Heater Strips

HVR - High voltage relay

Hz - Hertz-Cycles per second, measurement of frequency

IFCV - Incorrect fan/control voltage

INTS - Intake air temperature switch

K - Relay coil/contact designation

KVA - Kilovolt amperes

KVAR - Kilovolt amperes-reactive

KW - Kilowatts

KWM - Kilowatt meter

KWT - Kilowatt meter transducer

LBA - Load Bank Available Relay

LFR - Loss of Flow Relay

LM - Louver motor

LMC - Louver motor contactor

LR - Load resistive element

LX - Load reactive element

L1 - Line 1

L2 - Line 2

L3 - Line 3

MCB - Main circuit breaker

MF - Meter fuse

MLB - Main line bus

MOT - Motor

NEMA - National Electrical Manufacturer's Association

NSR - Normal Source Relay

ODP - Open, drip-proof-Refers to motor enclosure

OVR - Overvoltage relay-Relay used in overvoltage failure system, located on relay sub-panel

OLR - Overload Relay-Used for motor protection

OPR - Over Pressure Relay

OTR - Over Temperature Relay-Used in overtemperature failure system

PF - Power factor-In resistive only loads expressed as Unity(1.0), in inductive loads expressed as lagging, in capacitive loads expressed as leading

PLC - Programmable Logic Controller

PT - Potential Transformer

PAR - Control power available relay-Relay energized when control power is available

PFM - Power factor meter

PS - Pressure switch-Normally closed switch used to detect fan failure

PSI - Pounds per square inch

PSR - Pump Start Relay

RML - Remote Master Load Relay

RR - Run relay

RS - Remote Load Step Relay

RTM - Running time meter-Keeps time log of equipment use.

TB - Terminal block

TD-0 - Time Delay Timer-Delay on operate

TD-R - Time Delay Timer-Delay on release

TDR-0 - Time Delay Relay-Delay on operate

TDR-R - Time Delay Relay-Delay on release

TEFC - Totally enclosed, fan cooled-Refers to motor enclosure

TEAO - Totally enclosed, air-over-Refers to motor enclosure

UPS - Uninterruptable power source

V - Voltage

VO - Valve Operator

VOR - Valve Operator Relay

VSR - Voltage sensing relay

WFS - Water Flow Switch

WPS - Water Pressure Switch

WTS - Water Temperature Switch

XCB - Reactive load controlling circuit breaker

APPENDIX B - CALCULATIONS & FORMULAS

The following calculations are used to determine the actual kilowatt load being applied by the Load Bank, when line voltages and currents are known (at 1.0 power factor).

3 Phase

1. Read all three line currents and find the average reading.
2. Read all three line-to-line voltages and find the average reading.
3. Multiply the average current times the average voltage.
4. Multiply the answer of step #3 times the square root of 3 (1.732).
5. Divide the answer of step #4 by 1000. The answer is the actual kilowatts of load being applied by the Load Bank.

Single Phase

1. Determine the line current.
2. Determine the line-to-line voltage.
3. Multiply the line current times the line-to-line voltage.
4. Divide the answer of step #3 by 1000.
5. The answer of step #4 is the actual kilowatts being applied by the load bank.

EXAMPLES

Using line voltages and currents:

3 Phase

Current Readings	Voltage Readings
A_1 = 249A	V_{1-2} = 481V
A_2 = 250A	V_{2-3} = 479V
A_3 = 254A	V_{3-1} = 483V

$$\text{Average Current} = \frac{A_1 + A_2 + A_3}{3} = \frac{249+250+254}{3} = 251\text{A}$$

$$\text{Average Voltage} = \frac{V_{1-2} + V_{2-3} + V_{3-1}}{3} = \frac{481 + 479 + 483}{3} = 481\text{V}$$

$$\text{Kilowatts} = \frac{\text{Volts x Amps x 1.732}}{1000} = \frac{481 \text{ x } 251 \text{ x } 1.732}{1000} = 209.1\text{KW}$$

Single Phase

Current Reading: 150A Voltage Reading: 240V

$$\text{Kilowatts} = \frac{\text{Volts x Amps}}{1000} = \frac{150 \text{ x } 240}{1000} = 36.1\text{KW}$$

The following calculations are used to determine the amount of current when the desired amount of kilowatts is applied at 1.0 power factor.

3 Phase

1. Multiply the desired amount of kilowatts to be applied by 1000.
2. Multiply the operating voltage times the square root of 3 (1.732)
3. Divide the answer of step #1 by the answer of step #2.
4. The answer of step #3 is the average line current with the desired kilowatts applied at 1.0 power factor.

Single phase

1. Multiply the desired amount of kilowatts to be applied by 1000.
2. Divide the answer of step #1 by the operating voltage.
3. The answer of step #2 is the average line current with the desired amount of kilowatts applied at 1.0 power factor.

The following calculations are used to determine a step kilowatt rating at other than a rated voltage. This is accomplished by referencing the load step to a KW value at a known voltage.

1. Determine the new unrated operating voltage.
2. Divide the new operating voltage by the reference voltage.
3. Square the answer of step #2.
4. Multiply the answer of step #3 times the reference kilowatt value of the load step which the new kilowatt rating is desired.
5. The answer of step #4 is the kilowatt rating of the load step at the new voltage.

EXAMPLES

When desired amount of kilowatts is applied at 1.0 PF:

3 Phase

Applied: 50KW   Operating Voltage: 480V

$$\text{Amperage} = \frac{\text{KW} \times 1000}{\text{Volts} \times 1.732}$$

$$= \frac{50 \times 1000}{480 \times 1.732}$$

$$= \frac{50{,}000}{831.36}$$

$$= 60.1$$

Single Phase

Applied: 25KW   Operating Voltage: 240V

$$\text{Amperage} = \frac{\text{KW} \times 1000}{\text{Volts}}$$

$$= \frac{25 \times 1000}{240}$$

$$= \frac{25{,}000}{240}$$

$$= 104.2$$

Determining step KW at other than rated voltage:

Applied: 80KW   Operating Voltage: 450V
Rated Voltage: 480V

$$\text{Step KW} = (\text{Oper. Volt.} \div \text{Rated Volt.})^2 \times \text{Applied KW}$$

$$= (450 \div 480)^2 \times 80$$

$$= .9375^2 \times 80$$

$$= 70.3$$

FORMULAS

		Alternating Current	Direct Current
Kilowatts	1 phase	$\frac{\text{Volts x Amps x PF*}}{1000}$	$\frac{\text{Volts x Amps}}{1000}$
	3 phase	$\frac{\text{1.732 x Volts x Amps x PF*}}{1000}$	
Amperes (KW known)	1 phase	$\frac{\text{KW x 1000}}{\text{Volts x PF}}$	$\frac{\text{KW x 1000}}{\text{Volts}}$
	3 phase	$\frac{\text{KW x 1000}}{\text{1.732 x Volts x PF}}$	
KVA	1 phase	$\frac{\text{Volts x Amps}}{1000}$	
	3 phase	$\frac{\text{1.732 x Volts x Amps}}{1000}$	
Amperes (KVA known)	1 phase	$\frac{\text{KVA x 1000}}{\text{Volts}}$	
	3 phase	$\frac{\text{KVA x 1000}}{\text{1.732 x Volts}}$	
KVAR	1 phase	$\frac{\text{Volts x Amps x }\sqrt{1-PF^2}}{1000}$	
	3 phase	$\frac{\text{1.732 x Volts x Amps x }\sqrt{1-PF^2}}{1000}$	

*Power Factor, expressed as decimal.
(Resistive Load Bank PF is 1.0)

APPENDIX C - TORQUE VALUES

FAN BLADES		
FAN PART NO.	BOLT SIZE	TORQUE FT LBS // IN LBS
13820000	SET SCREW	11.7 // 140
13820500	SET SCREW	11.7 // 140
13821000	SET SCREW	8.3 // 100
13822000	1/4 — 20	7.5 // 90
13823000	1/4 — 20	7.5 // 90
13824000	1/4 — 20	7.5 // 90
13825100	1/4 — 20	7.5 // 90
13826000	1/4 — 20	7.5 // 90
13827500	5/16”	13 // 156
13827600	5/16”	13 // 156
13828000	3/8”	24 // 288

MOTORS, BRACKETS, BUS BAR CONNECTIONS		
BOLT/NUT SIZE	GRADE	TORQUE FT LBS // IN LBS
.250 (1/4-20)	Grade 5, dry	8 // 96
.250 (1/4-20)	Grade 2, dry	5.5 // 66
.312 (5/16)	Grade 5, dry	17 // 204
.312 (5/16)	Grade 2, dry	11 // 132
.375 (3/8)	Grade 5, dry	30 // 360
.375 (3/8)	Grade 2, dry	20 // 240
.437 (7/16)	Grade 5, dry	50 // 600
.437 (7/16)	Grade 2, dry	30 // 360
.500 (1/2)	Grade 5, dry	75 // 900
.500 (1/2)	Grade 2, dry	50 // 600
.562 (9/16) & up	Grade 5, dry	110 // 1320
.562 (9/16) & up	Grade 2, dry	70 // 840

CONTACTORS
See torque values on the front of the contactor.

ELEMENTS/TRAYS		
TERM/NUT SIZE		TORQUE INCH LBS
#6	Rod ends	4
#10	Element Conn.	20
1/4-20	High Voltage	Contact Simplex

MAIN LOAD BLOCKS- ALL SIZES		
CONNECTION	WIRE SIZE	TORQUE FT LBS // IN LBS
LOAD SIDE	4-14AWG	2.9 // 35
LINE SIDE	500MCM-4/0	31 // 375
	3/0-4/0	20 // 240
	2/0-6AWG	10 // 120
	8AWG	3.3 // 40

CIRCUIT BREAKERS		
STYLE	WIRE SIZE	TORQUE INCH LBS
Cutler-Hammer 1-Phase	14-10 AWG	20
	8 AWG	25
	6-4 AWG	27
	3-1/0 AWG	45
Merlin Gerin 3-Phase	14-1/0	50

APPENDIX C - TORQUE VALUES CONT'D

FUSEBLOCKS

MANUF. PART NO.	WIRE SIZE	TORQUE INCH LBS
BM6031SQ, BM6032SQ, BM6033SQ; 600V, 30A	10-18 AWG	20
T60060-2SR 600V, 60A	10-18 AWG	20
T60030-3CR, 600V, 30A T60060-3CR, 600V, 60A 60100-3CR, 600V, 100A	10-14 AWG	35
	8 AWG	40
	4-6 AWG	45
	2-3 AWG	50

MISCELLANEOUS-TERMINALS, METERS, SWITCHES, COILS, RELAYS, XFORMERS

CONNECTION SIZE	TORQUE INCH LBS
4	5
6	10
8	19
10	31
1/4-20"	66

TAPER-LOCK BUSHINGS

BUSHING NUMBER	TORQUE
1008, 1108	55 IN LBS
1210, 1215, 1310, 1610, 1615	15 FT LBS
2012	23 FT LBS
2517, 2525	36 FT LBS
3020, 3030	67 FT LBS
3535	83 FT LBS
4040	142 FT LBS
4545	204 FT LBS
5050	258 FT LBS
6050, 7060, 8065	652 FT LBS
10085, 12010	1142 FT LBS

CAM-LOK STUDS

THREADED STUD	MAXIMUM TORQUE
5/16" – 18	15 FT LBS
1/2" – 13	40 FT LBS