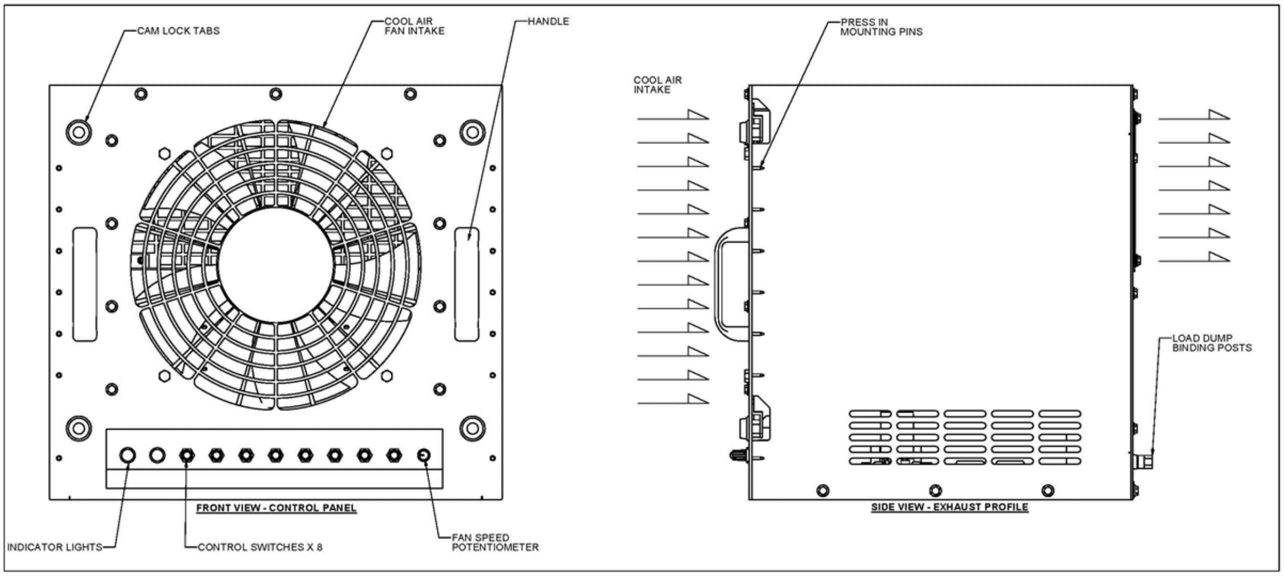
MICROSTAR + LOAD BANK SYSTEM TECHNICAL MANUAL

APRIL 2012

Contents



AIR FLOW AND VISUAL DIAGRAM

DESCRIPTION

Simplex Microstar + load bank units are precision test instruments specifically designed to apply discrete, selectable heat loads to a cooling source. The Microstar + also provides a means for routine maintenance to assure long term reliability of the product and readiness of the building cooling systems. The Microstar + fits a 19-inch server rack of most all types, round/square/hole/threaded/unthreaded.

The cabinet on the Microstar + is rated Environmental Type 1.

The illustrations in this manual are examples only and may differ from your load bank.

Building cooling source testing is accomplished by applying resistive load steps to generate predetermined amounts of heat (KW).

Load application is by magnetic contactor. Load steps 1-5 are protected by 15 amp class-CC fuses, and load steps 6-7 are protected by 20 amp class-CC fuse.

Operating controls are provided locally via the control panel of switches located on the face of the unit. The control system is composed of 24VDC components. Common serviceable components include control fuses and load application fuses. Lamps on the face panel of the load bank indicate the operating status of the Microstar +.

The local control panel contains the following components:

- Green “Cooling Active” Light
- Red “Over Temperature” Light
- On/Off Switch
- Fan Speed Potentiometer
- Load Steps 1-7

The “Cooling Active” lamp, green, illuminates when control power is available and the load may be applied.

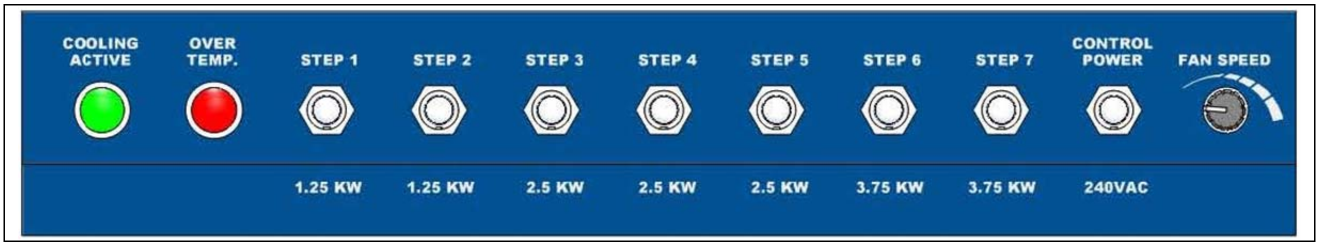
DESCRIPTION - Continued

The Microstar + is protected against cooling failure (loss of cooling air flow, high temperature intake, or high exhaust air temperature, all of which could damage the Microstar + or present a safety hazard to the operator.) When a cooling failure occurs the automatic safety feature in the control system immediately remove all load. The malfunction must be corrected and the system must be reset by turning the Microstar + “Off” then “On” before the load can be re-applied.

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 Microstar + from the test source in the event of cooling failure and/or improperly positioned operating controls.

Control Power (24VDC) is supplied internally via the load source through the power supply. The fan starts with the power on switch. The fan speed is controlled via a potentiometer in conjunction with a current transformer located on the load wires. Once the current transformer detects a high enough amp draw, the range on the potentiometer allows for higher fan speeds.



CONTROL PANEL DIAGRAM

COOLING SYSTEM

The load elements in the Microstar + are cooled by a forced air system consisting of a one fan system. The fan motor is energized by the on switch on the control panel and protected by control fuses.

LOAD SYSTEM

The Load System consists of independently controlled resistive load elements specifically designed for the Microstar +. The Load steps are protected by 200,000aic,600VAC fuses.

Simplex Resistive Load Elements conservatively operate at approximately half the maximum temperature rating for the alloy (1080˚F vs. 1920˚F).

See Parts Legend Drawing for specific elements used.

These elements are rigidly supported by high-temperature, ceramic-clad, stainless-steel support rods. Element-to-element short circuits are virtually eliminated. The elements are assembled in the element chamber in a fashion such that each element can be serviced without disturbing adjacent trays.

PRIMARY INSPECTION

Preventative visual inspections of the shipping crate and Microstar + is advised. Physical or electrical problems due to handling and vibration may occur. Never apply power to a Microstar + before performing this procedure. The following Nine Point/30 minute inspection is recommended before installation, as part of other 50hour/6month maintenance schedule and whenever the Microstar + is relocated:

1. If the crate shows any signs of damage examine the Microstar + 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. Inspect all cam locks for smooth and safe operation.
4. Flip all switched to ensure smooth operation.
5. Check cooling system by inspecting the fan. Check fan blades and fan shroud for stress fractures.
6. Inspect all relays, timers, and control module by opening removing the cover. Make sure all components are secure in their bases and safety bails are in place. Spot check electrical connections for tightness. If any loose connections are found inspect and tighten all remaining connections.
7. Examine all accessible internal electrical components such as fuses, contactors and transformers. Check lugged wires at the components.
8. Inspect bottom of crate/enclosure for any components that may have been jarred loose during shipment such as indicator light lenses, switches, etc.
9. Visually inspect element chamber for foreign objects, broken ceramic insulators, and mechanical damage.

If any problems are observed during Primary Inspection call the Simplex Service Manager at 217-483-1600 (24hrs.)

INSTALLATION

The Microstar + is to be installed into a 19 inch server rack, EIA-310D. This is achieved by lining the pushpins with the corresponding holes in the rack, then use turn the cam lock keys to press lock the load bank into position. The load elements in the Microstar + are cooled by a forced air system which takes air in the front and discharges through the rear of the device. The Microstar + must be installed with appropriate clearances on the intake and exhaust sides of the panels.

- There must be a minimum clearance of 2 feet on the inlet and outlet of the Microstar +
- Never point the exhaust at a nearby surface or object which may be adversely affected by high temperature.
- Consider that multiple Microstar + units and other equipment in the area will create excessive temperature spikes if equally spaced.
- It is important to properly balance the phase legs used to power multiple load banks. Always have the Microstar + installed by trained personnel ONLY.

Failure to properly install the Microstar + may result in substantial damage to or the destruction of the Microstar + and adjacent equipment.

⚠ WARNING ⚠

Do Not allow the Microstar + to operate unattended for an extended period of time

⚠ 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.

SETUP

Consult NEC for proper wire size for all connections unless stated within this manual or on a drawing.

1. Confirm the test source is properly grounded and ground the Microstar + to its own independent ground.
2. Confirm all switches on the local control panel are in the “Off” position.
3. Cable the load source to the Microstar +, balancing the load, as shown.
4. Connect load dump contacts, as shown. *(Load is disengaged when 24VDC).*
5. Start-up the test source and begin analysis.

LOCAL CONTROL

LOAD DUMP

This load bank contains a load dump feature which de-energizes all applied load when customer supplied contacts have a 24VDC supply provided. The contacts, tied to a normally closed relay, are rated at 2A @ 24VDC and should be wired to TB’A’ 4-5. When these contacts are energized all applied load will be de-energized and the load section will be disabled. If desired, the customer may install automatic transfer switch contacts, a manual pushbutton or circuit breaker for this use.

FAILURE DETECTION

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”.

This is a permissive/energize-to-run circuit in which all safety sensors must energize their control relays on normal operation before load can be applied. This system will include a thermoswitch; set at 175° F, tied to a relay that will open all magnetic load contactors if over temperature is achieved.

MAINTENANCE

The Microstar + 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 hour or 6 months (whichever comes first).

Each Operation – The air intake and exhaust screens must be checked for any obstructions or foreign objects. Check fan blades for stress fractures. Due to the high volume of air circulated, paper and other items can be drawn into the air intake. During load bank operation insure that the air is exiting from the exhaust vent.

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 single phase source. If your fuse is blown on any branch you will detect no current. In addition you will not have continuity on the fuse.

⚠ WARNING ⚠

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

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 cooling fan may also loosen electrical connections. If the load bank is transported “over the road”, the electrical connection should be checked for tightness at ta shorter-than normal time interval. See “Primary Inspection”.

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 reason, when troubleshooting load banks system always remove power, fan/control power, etc.

Cooling Fan Motor Will Not Operate

1. Fan/Control power not available/incorrect
2. Inoperative fan motor
3. Fan switch is “Off” or not functioning
4. Restriction of air (intake or exhaust)

Cooling Failure Indicated

Element chamber temperature has exceeded 175˚F:

1. Over temperature sensor failure
2. Fan failure
3. Air Restriction (intake or exhaust)
4. Overvoltage condition present

Some Load Steps Cannot Be Energized

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

⚠ WARNING ⚠

When Troubleshooting Load Bank systems always remove all test source power, fan/control power, etc.

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 subsystem

CPC-Control power contactor

CPF-Control power fuse

CT-Current transformer- used in metering circuits

DC-Direct current

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

HMI-Operator Interface

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

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
MDS-Main Disconnect Switch
MF-Meter fuse
MLB-Main Load Bus

MOT-Motor

NEMA-National electrical manufacturer's association

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

OTR-Overtemperature relay-used in 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

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

PFM-Power factor meter

PS-Pressure switch-switch used to detect fan failure

RR-Reset relay

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

TB-Terminal block

TDR-Time delay relay-relay which times out before contacts change state

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

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

UPS-Uninterruptable power source

V-Voltage

VSR-Voltage sensing relay

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

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

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

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

Single Phase

Current Reading: 150A Voltage Reading: 240V

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

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	$\frac{\text{1.732 x Volts x Amps x PF*}}{1000}$	

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

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

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, SWITCH-ES, 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