MICROPROCESSOR CAPACITOR BANK CONTROLLER
FOR OVERHEAD ELECTRICAL SYSTEMS
OPERATOR GUIDE

MCBC-500

Revision: 008

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AUTO
MAN
POWER FUSE
OPEN
CLOSE
NEUTRAL
CAPACITOR CONTROL
INCREASE
[YES]
NEXT
CONTROL
FUSE
DECREASE
[NO]
TEST
ETI

GLOSSARY

AUTO Automatic

When the MAN/AUTO switch is in the AUTO position, the MCBC-500 will signal the capacitor bank to open and close in response to changes in the voltage.

CLOSE Close

When the MAN/AUTO switch is in the MAN position, the MCBC-500 will signal the capacitor bank to close when the OPEN/NEUTRAL/CLOSE switch is in the CLOSE position.

CVSP Close Voltage Set Point

When the voltage remains below the CVSP continuously for the amount of time specified by the Delay, the MCBC-500 will clear the open/close signal to the capacitor bank.

Delay Delay

In voltage mode, amount of time the voltage must remain above the OVSP to open or below the CVSP to close. If the voltage falls below the OVSP or above the CVSP, the delay timer resets.

Delt Delta

After the voltage has been above the HVSP or below the LVSP continuously for the amount of time specified by the Duration, each and every change of Delta volts will be logged in the Event Log until the voltage falls below the HVSP or above the LVSP.

Dura Duration

When the voltage remains above the HVSP or below the LVSP continuously for the time specified by the Duration, the MCBC-500 will log a High or Low voltage event in the event log and begin tracking Delta voltage changes.

Event Log Event Log

Chronological listing of significant activity of the MCBC-500

HVSP High Voltage Set Point

When the voltage remains above the HVSP continuously for the amount of time specified by the Duration, the MCBC-500 will log a high voltage event in the event log.

Lock Out Lock Out

When ten (10) close events occur within a 24-hour period, the MCBC-500 will log a LOCK OUT event in the event log and inhibit opening for 24 hours. If three (3) successive lock out events occur, the MCBC-500 will remain in LOCK OUT state until operator intervention.

LVSP Low Voltage Set Point

When the voltage remains below the LVSP continuously for the amount of time specified by the Duration, the MCBC-500 will log a low voltage event in the event log.

MAN Manual

When the MAN/AUTO switch is in the MAN position, the MCBC-500 will signal the capacitor bank to open and close in response to the position of the OPEN/NEUTRAL/CLOSE switch.

NEUTRAL Neutral

When the MAN/AUTO switch is in the MAN position, the MCBC-500 open/close signal to the capacitor bank will not change while the OPEN/NEUTRAL/CLOSE switch is in the NEUTRAL.

OPEN Open

When the MAN/AUTO switch is in the MAN position, the MCBC-500 will signal the capacitor bank to open when the OPEN/NEUTRAL/CLOSE switch is in the OPEN position.

OVSP Open Voltage Set Point

When the voltage remains above the OVSP continuously for the amount of time specified by the Delay, the MCBC-500 will set the open/close signal to the capacitor bank.

The Electronic Technology Inc. (ETI) Microprocessor Capacitor Bank Controller (MCBC-500) is a direct electronic replacement for electromechanical capacitor bank controllers.

The MCBC-500 front panel has been designed out in a similar fashion to the existing electromechanical units. The analog meter has been replaced with a sixteen (16) digit direct sunlight reading LED display unit with alphanumeric capabilities. The **Automatic** and **Manual** switch is positioned to the left of the display while the **Open** / **Neutral** / **Close** switch is positioned to the right of the display. Above and center to the display is the main fuse for the motor drive circuit. Below and center to the display is the main menu (**Next)** button and to the right two (2) additional buttons (**Increase [Yes]**, **Decrease [No]**) for entering options. A **measurement** point is provided for external meter readings and calibration checks.

The housing is NEMA 4X rated, stainless steel, weather-resistant, suitable for all outdoor applications. All components meet industrial grade -40°C to +105°C specifications. Mounting of the MCBC-500 is also identical to previous electromechanical capacitor bank controllers.


AUTO
MAN
POWER FUSE
OPEN
CLOSE
NEUTRAL
CAPACITOR CONTROL
P/N 331000
SN
ID
INCREASE
[YES]
CONTROL
FUSE
NEXT
DECREASE
[NO]
TEST
ETI

The control panel is purposely similar to the electromechanical units that the MCBC-500 replaces.

2.1 Switches

Two (2) toggle switches permit the operator to select between automatic and manual modes (AUTO/MAN) and to open, neutral, close the capacitor switch (OPEN/NEUTRAL/CLOSE). The OPEN/NEUTRAL/CLOSE switch is valid only when the AUTO/MAN switch is in the MAN position.

2.2 Buttons and LED Display

Three (3) buttons (NEXT, INCREASE [YES], DECREASE [NO]) provide access to a menu of status and configuration options.

A sixteen (16) digit direct sunlight reading LED display unit with alphanumeric capabilities replaces the analog meter. Whereas the analog meter displayed the present voltage only, the LED displays status and configuration of the MCBC-500 as well as the present voltage.

2.3 Optical (Infrared) Port

An optical (infrared) port provides for remote communications with the MCBC-500 from a PC with ETI MCBC-500 remote interface software for Microsoft Windows.

2.4 Fuses

Two (2) fuses (10A TRM10 POWER FUSE, 1A MDL1 CONTROL FUSE) protect the MCBC-500.

2.5 Test Port

A qualified technician can use the measurement port (TEST) to verify the MCBC-500's voltage readings.

3.1 Initialization

When the MCBC-500 is connected to power, it will initialize itself for operation. During the first few seconds of the initialization, the MCBC-500 will display

E.T.I. Capacitor Bank Controller

This message should scroll across the LED for several seconds. When the initialization message has scrolled off the LED, the MCBC-500 should immediately display the next message.

3.2 Diagnostics

3.2.1 Operating Parameters

Operating parameters are stored in the EEPROM and loaded into SRAM at power up. When the MCBC-500 detects an error loading parameters from EEPROM, it displays the following message and loads the default parameters from the program memory.

Setup Error: Resetting please wait

3.2.2 Clock

After loading operating parameter from either EEPROM or program memory, the MCBC-500 interrogates the real-time clock. If the clock indicates a self-diagnostic error, then the MCBC-500 displays and resets the clock.

Clock Error: Resetting please wait

3.3 Ready

When the operating parameters are loaded and the clock is operational, the MCBC-500 displays the state and voltage.

state vvv.v

where: state is OPEN, CLOSED, FAULT, LOCK
vvv.v is the present voltage

This section describes the display available to the operator. Each screen is identified as “view only” or “view/edit”. “View only” displays contain status information which cannot be changed by the operator. “View/edit” displays contain configuration information that can be changed by the operator.

All displays, including “view/edit” displays, begin in “view” mode. In “view” mode, the operator presses the NEXT key to move to the next display. On the following pages, displays are listed in the order in which they appear to the operator. For a flowchart of the displays, please refer to Appendix A.

In “view” mode, the operator presses the INCREASE [YES] key to select edit mode.

The operator changes the value of the field being edited by pressing the INCREASE [YES] and DECREASE [NO] keys. The operator returns to “view” mode by pressing the NEXT key.

On displays which contain multiple editable fields (for example, the date and time display), the field being edited blinks. The operator moves to the next field by pressing the NEXT key.

In “view” mode, the operator presses the DECREASE [NO] key to set the parameter to its default. The MCBC-500 prompts the operator to confirm selecting the default. The operator confirms selecting the default by pressing the INCREASE [YES] key.

Because the MCBC-500 is a real-time device, some values may change while displayed.

4.1 State and Voltage (view only)

State is one of OPEN, CLOSED, FAULT, LOCK OUT.

This indicates the state of the MCBC-500, but does not necessarily indicate the state of the capacitor switch.

OPEN STATE

The MCBC-500 will be in the OPEN state (i.e., calling for OPEN from the capacitor switch) when one of the following conditions exists:

(a) the AUTO/MAN switch is set to AUTO and
the mode is set to VOLTAGE and
the voltage was greater than the Open Voltage Set Point
for longer than the Delay

(b) the AUTO/MAN switch is set to AUTO and
the mode is set to TIME and
the present time is either
greater than OPEN TIME 1 and less than CLOSE TIME 1 or
greater than OPEN TIME 2 and less than CLOSE TIME 2
for the present day-of-the-week

(c) the AUTO/MAN switch is set to MAN and
the OPEN/NEUTRAL/CLOSE switch is set to OPEN

(d) a remote unit (PC with interface software) has requested an OPEN event.

CLOSED STATE

The MCBC-500 will be in the CLOSED state (i.e., calling for a CLOSE event from the capacitor switch) when one of the following conditions exists:

(a) the AUTO/MAN switch is set to AUTO and
the mode is set to VOLTAGE and
the voltage was less than the Close Voltage Set Point
for longer than the Delay

(b) the AUTO/MAN switch is set to AUTO and
the mode is set to TIME and
the present time is either
greater than CLOSE TIME 1 and less than OPEN TIME 2 or
greater than CLOSE TIME 2
for the present day-of-the-week

(c) the AUTO/MAN switch is set to MAN and
the OPEN/NEUTRAL/CLOSE switch is set to CLOSE

(d) a remote unit (PC with interface software) has requested a CLOSE event

LOCK OUT STATE

The MCBC-500 will be in the LOCK OUT state (i.e., blocked OPEN) when ten (10) cycles (OPEN and CLOSE events) occur within a 24-hour period. When the MCBC-500 enters the LOCK OUT state, it will log the LOCK OUT as an event in the event log. The LOCK OUT will last for 24-hours, during which the MCBC-500 will remain in the OPEN state. When the MCBC-500 returns to normal operating mode, it will log the UNLOCK event in the event log. The operator may override the LOCK OUT using the AUTO/MAN and OPEN/NEUTRAL/CLOSE switches or the remote interface. The operator may cancel the LOCK OUT by selecting an alternate operating mode (e.g., VOLTAGE) from the menu or the remote interface.

If three (3) successive LOCK OUT events occur, then the MCBC-500 will remain in LOCK OUT until overridden by an operator. Two (2) LOCK OUT events are successive if the second event occurs within 24 hours after the first event returns to the normal operating mode.

While the MCBC-500 is in LOCK OUT state, it will blink a red light on the bottom of the unit.

4.2 Unit ID and Version (view only)

Vn.nn mm-yy

where: #### is the four (4) digit unit ID
n.nn is the software version ID
mm-yy is the software date (month and year)

4.3 Cycle Cap Bank (view only)

Cycle Cap Bank

When selected, this function performs an OPEN and a CLOSE to verify the operation of the MCBC-500. If the unit is in the OPEN state when this function is selected, it will close and then open. If the unit is in the CLOSED state when this function is selected, it will open then close. After the MCBC-500 has been cycled, it will be in the same state in which it was when this function was selected.

4.4 Date and Time (view/edit)

mm-dd-yy hh:nn

where:	mm is the month	(01-12)
	dd is the day	(01-31)
	yy is the year	(00-99)
	hh is the hour	(00-23)
	nn is the minute	(00-59)

The operator always may set the month to any value within its full range (1-12). When the operator changes the month, the MCBC-500 will verify the day is within range for the new month. If the day is greater than the maximum possible for the month, then the MCBC-500 will decrease the day to the maximum.

The operator may set the day of the month to any value up to the maximum day for the given month and year. Months 1, 3, 5, 7, 8, 10, and 12 (January, March, May, July, August, October, and December) always have 31 days. Months 4, 6, 9, and 11 (April, June, September, and November) always have 30 days. Month 2 (February) has 29 days on leap years and 28 days on all other years; the operator always may set the day to 29, but the MCBC-500 will decrease it to 28, if necessary, after the operator has set the year.

The operator always may set the year to any value within its full range (00-99). Years between 97 and 99, inclusive, are in the twentieth century (1997-1999). All other years (00 through 96 inclusive) are in the twenty-first century (2000-2096).

The earliest date selectable is January 1, 1997 (01-01-97). The latest date selectable is December 31, 2096 (12-31-96).

The operator may set the hour and minute to any values within their full ranges, 00-23 and 00-59 respectively. The hour and minute values do not affect each other or any other value.

When a parameter displays at its maximum value, pressing the INCREASE button will wrap to the lowest value. When a parameter displays at its minimum value, pressing the DECREASE button will wrap to the highest value.

There are no default values for date and time.

4.5 Day-of-the-Week (view only)

Day of week: DDD

Where: DDD is one of MON, TUE, WED, THU, FRI, SAT, SUN.

The day of the week is calculated from the date. January 1, 1997 (01-01-97) is WED.

4.6 Cycle Count (view only)

Cycles: NNNN

Maximum 9999
Minimum 0

This is the count of CLOSE events.

4.7 Mode (view/edit)

Mode: xxxxx

Mode is one of VOLTAGE (typical default), TIME, or LOCK OUT.

In VOLTAGE mode, OPEN and CLOSE events occur in response to high and low voltages, respectively.

In TIME mode, OPEN and CLOSE events occur at specified times. Each day of the week, Monday through Sunday, has four (4) times associated with it, two (2) OPEN times and two (2) close times.

In LOCK OUT mode, CLOSE events do not occur. LOCK OUT mode lasts for 24 hours. When LOCK OUT mode expires, the MCBC-500 returns to VOLTAGE mode. If three (3) successive LOCK OUT events occur, the MCBC-500 will remain in LOCK OUT state until operator intervention. To inhibit operation indefinitely, the MAN/AUTO switch can be left in the MAN position.

4.8 Mode Parameters

4.8.1 Voltage Mode

4.8.1.1 Open Voltage Set Point (view/edit)

Open at: 1--.-v

Maximum	140.0V
Default	125.0V (typical)
Minimum	100.0v or Close Voltage Set Point, whichever is greater

The operator can set the Open Voltage Set Point to any value less than 140.0V and greater than the Close Voltage Set Point. The MCBC-500 will call for an OPEN when the voltage is greater than the Open Voltage Set Point for longer than the Delay.

4.8.1.2 Close Voltage Set Point (view/edit)

Close at: 1--.-v

Maximum	140.0V or Open Voltage Set Point, whichever is less
Default	118.0V (typical)
Minimum	100.0V

The operator can set the Close Voltage Set Point to any value greater than 100.0V and less than the Open Voltage Set Point. The MCBC-500 will call for a CLOSE when the voltage is less than the Close Voltage Set Point for longer than the Delay.

4.8.1.3 Delay (view/edit)

Delay: ----s

Maximum	9999 sec
Default	30 sec (typical)
Minimum	1 sec

The MCBC-500 will call for an OPEN when the voltage is greater than the Open Voltage Set Point for longer than the Delay.

The MCBC-500 will call for a CLOSE when the voltage is less than the Close Voltage Set Point for longer than the Delay.

4.8.1.4 Defaults

Default values are set at the factory. They are stored in program memory and can be changed by authorized ETI personnel ONLY.

The customer may specify custom defaults at the time of the order.

Typical defaults are:

OPEN	125.0 Volts
CLOSE	118.0 Volts
DELAY	30 Seconds

4.8.2 Time Mode

4.8.2.1 Day-of-the-Week

This is not a parameter, but a selector for a set of open/close times.

In Time Mode, each day-of-the-week has four (4) times associated with it, two (2) open times and two (2) close times. The times are order-dependent; i.e., Open Time 1 must be the earliest time, Close Time 1 must be later than Open Time 1, Open Time 2 must be later than Close Time 1, and Close Time 2 must be later than Open Time 2.

Press INCREASE to enter day-of-the-week selection mode. In selection mode, press either INCREASE or DECREASE to select a day-of-the-week. Press NEXT to exit selection mode.

Press DECREASE to edit the time mode parameters for the selected day.

Any of the time settings may be disabled. The disable value is between hours 23 and 0. That is, you can disable a time setting by pressing either INCREASE when the hour is 23 or DECREASE when the hour is 0. When the setting is disabled, pressing INCREASE sets the hour to 0 and pressing DECREASE sets the hour to 23.

4.8.2.2 Open Time 1 (view/edit)

Open 1: hh:nn

Maximum	23:59 or Close Time 1, whichever is less
Default	none
Minimum	00:00

Open Time 1 must be the earliest of the four (4) times for the specified day-of-the-week.

4.8.2.3 Close Time 1 (view/edit)

Close 1: hh:nn

Maximum	23:59 or Open Time 2, whichever is less
Default	none
Minimum	00:00 or Open Time 1, whichever is greater

Close Time 1 must be after Open Time 1 and before Open Time 2 for the specified day-of-the-week.

4.8.2.4 Open Time 2 (view/edit)

Open 2: hh:nn

Maximum	23:59 or Close Time 2, whichever is less
Default	none
Minimum	00:00 or Close Time 1, whichever is greater

Open Time 2 must be after Close Time 1 and before Close Time 2 for the specified day-of-the-week.

4.8.2.5 Close Time 2 (view/edit)

Close 2: hh:nn

Maximum	23:59
Default	none
Minimum	00:00 or Open Time 2, whichever is greater

Close Time 2 must be after Open Time 2 for the specified day-of-the-week.

Press NEXT to move to the log parameters.

4.9 Log Parameters

4.9.1 High Voltage Set Point

Log High: 1--.-v

Maximum	140.0V
Default	128.0V (typical)
Minimum	100.0V

The operator can set the High Voltage Set Point to any value less than or equal to 140.0V and greater than or equal to 100.0V. The High Voltage Set Point should be greater than the Low Voltage Set Point. Typically, the High Voltage Set Point is greater than the Open Voltage Set Point.

4.9.2 Low Voltage Set Point

Log Low: 1--.-v

Maximum	140.0V
Default	117.0V (typical)
Minimum	100.0V

The operator can set the Low Voltage Set Point to any value less than or equal to 140.0V and greater than or equal to 100.0V. The Low Voltage Set Point should be less than the High Voltage Set Point. Typically, the Low Voltage Set Point is less than the Close Voltage Set Point.

4.9.3 Delta Voltage

Log Delta: --.-v

Maximum	40.0V
Default	1.0V (typical)
Minimum	0.0V

The operator can set Delta to any value less than or equal to 40.0V and greater than or equal to 0.0V.

4.9.4 Duration

Duration: -.--s

Maximum	9.99 sec
Default	1.00 sec (typical)
Minimum	0.00 sec

The operator can set the Duration to any value less than or equal to 9.99 seconds and greater than or equal to 0.00 seconds.

The MCBC-500 will log a HIGH event when the present voltage is greater than the High Voltage Set Point for longer than the Duration.

The MCBC-500 will log a LOW event when the present voltage is less than the Low Voltage Set Point for longer than the Duration.

The MCBC-500 maintains a log of up to 3840 events.

The operator may clear the event log entirely (all events deleted) by selecting defaults (DECREASE key in “view” mode). The operator cannot delete fewer than all events. The operator cannot modify events.

Ten (10) distinct events are logged: Power On; Power Off; Mode and/or Parameter Change; Lock Out; Fault; Open; Close; High Voltage; Low Voltage; Delta.

5.1 View Log

Press INCREASE [YES] to begin viewing the log. The MCBC-500 displays the latest log entry. Press DECREASE [NO] to proceed through the log in reverse chronological order. The MCBC-500 will display Start of Log when you press DECREASE [NO] at the earliest entry and End of Log when you press INCREASE [YES] at the latest entry. Each entry will display two screens: the first indicates the event with the date and time it occurred; the second indicates the event with the voltage present at the time of the event. In the case of a parameter change, the second screen will display the previous value instead of the voltage.

5.2 Clear Log

To delete all entries from the event log, press INCREASE [YES] at the CLEAR LOG display. The MCBC-500 displays ABORT CLEAR? Press DECREASE [NO] to confirm deletion of all log entries. Press INCREASE [YES] if you do NOT want to delete all log entries.

5.3 System-Specified Events

The MCBC-500 determines the conditions for which it logs these events. The operator can not alter the conditions for which the MCBC-500 logs these events.

5.3.1 Power On

On mm-dd hh:nn
On Volt 1--.-v

Where: mm is the month (01-12)
dd is the day (01-31)
hh is the hour (00-23)
nn is the minute (00-59)

When the MCBC-500 is connected to power, it logs a Power On event. The log entry includes the date and time of the event.

5.3.2 Power Off

Off mm-dd hh:nn
Off Volt 1--.-v

Where: mm is the month (01-12)
dd is the day (01-31)
hh is the hour (00-23)
nn is the minute (00-59)

When the MCBC-500 is disconnected from power, it logs a Power Off event. The log entry includes the date and time of the event.

5.3.3 Mode or Parameter Change

When the mode or a parameter is changed, the MCBC-500 logs a change event. This includes the date and time of the change, the mode or parameter that was changed, and the new value of the mode or parameters. The change will display as:

Mode mm-dd hh:nn
Mode was xxxxxxx

Where: xxxxx is one of 'Voltage', 'Time', or 'Lock'
indicates a mode change

OVSP mm-dd hh:nn
OVSP was 1--.-v

CVSP mm-dd hh:nn
CVSP was 1--.-v

HVSP mm-dd hh:nn
HVSP was 1--.-v

LVSP mm-dd hh:nn
LVSP was 1--.-v

DELV mm-dd hh:nn
DELV was --.-v

Where: --.- is a value between 00.0 and 40.0, inclusive
indicates voltage mode; open/close voltage set point, log high/low voltage set point or log delta voltage change

DLAY mm-dd hh:nn
DLAY was ----s

Where: ---- is a value between 0 and 9999
indicates voltage mode delay change

Opn1 mm-dd hh:nn
Opn1 was hh:nn

Cls1 mm-dd hh:nn
Cls1 was hh:nn

Opn2 mm-dd hh:nn
Opn2 was hh:nn

Cls2 mm-dd hh:nn
Cls2 was hh:nn

Where: hh is a value between 00 and 23, inclusive
nn is a value between 00 and 59, inclusive
if time setting was disabled
then 'was hh:nn' will be replaced with 'disabled'
indicates time mode open/close time change

Dura mm-dd hh:nn
Dura was -.--s

Where: -.-- is a value between 0.00 and 9.99, inclusive
indicates a change of the log event duration

5.3.4 Lock Out

Lock mm-yy hh:nn
Lock Volt 1--.-v

Where: mm is the month (01-12)
dd is the day (01-31)
hh is the hour (00-23)
nn is the minute (00-59)

When the MCBC-500 performs more than ten (10) cycles within a 24-hour period, it places itself in Lock Out mode and indicates the Lock Out in the event log.

5.4 User-Specified Events

The operator determines the conditions for which the MCBC-500 logs these events. The operator can alter the conditions for which the MCBC-500 logs these events. See the Status and Configuration Section.

5.4.1 Open

Open mm-yy hh:nn
Open Volt 1--.-v

Where: mm is the month (01-12)
dd is the day (01-31)
hh is the hour (00-23)
nn is the minute (00-59)

When an OPEN event occurs, the MCBC-500 logs the event along with the date, time, and present voltage.

5.4.2 Close

Clos mm-yy hh:nn
Clos Volt 1--.-v

Where: mm is the month (01-12)
dd is the day (01-31)
hh is the hour (00-23)
nn is the minute (00-59)

When a CLOSE event occurs, the MCBC-500 logs the event along with the date, time, and present voltage.

5.4.3 High Voltage

High mm-yy hh:nn
High Volt 1--.-v

Where: mm is the month (01-12)
dd is the day (01-31)
hh is the hour (00-23)
nn is the minute (00-59)

The MCBC-500 will log a HIGH event when the present voltage is greater than the High Voltage Set Point for longer than the Duration.

5.4.4 Low Voltage

Low mm-yy hh:nn
Low Volt 1--.-v

Where: mm is the month (01-12)
dd is the day (01-31)
hh is the hour (00-23)
nn is the minute (00-59)

The MCBC-500 will log a LOW event when the present voltage is less than the Low Voltage Set Point for longer than the Duration.

5.4.5 Delta

Delt mm-yy hh:nn
Delt Volt 1--.-v

Where: mm is the month (01-12)
dd is the day (01-31)
hh is the hour (00-23)
nn is the minute (00-59)

The MCBC-500 will log a DELTA event when the present voltage read differs from the previous voltage read by at least Delta.

Appendix A: The Menu Flowchart

- Status and Voltage
- Unit ID and Version
- Cycle Cap Bank?
- Date and Time
- Day-of-the-Week
- Cycle Count
- Operating Mode

Operating Parameters

Voltage Mode

- Open Voltage Set Point
- Close Voltage Set Point
- Delay

Time Mode

- Day-of-the-Week
- Open Time 1
- Open Time 2
- Close Time 1
- Close Time 2

Log Parameters

- High Voltage Set Point
- Low Voltage Set Point
- Delta
- Duration
- View Log
- Clear Log