Model M3660REM
Regenerative Energy Monitor

Customer Reference Manual

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Bonitron, Inc.
Nashville, TN

An industry leader in providing solutions for AC drives.

ABOUT BONITRON

Bonitron designs and manufactures quality industrial electronics that improve the reliability of processes and variable frequency drives worldwide. With products in numerous industries, and an educated and experienced team of engineers, Bonitron has seen thousands of products engineered since 1962 and welcomes custom applications.

With engineering, production, and testing all in the same facility, Bonitron is able to ensure its products are of the utmost quality and ready to be applied to your application.

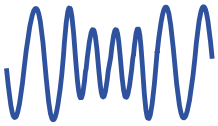
The Bonitron engineering team has the background and expertise necessary to design, develop, and manufacture the quality industrial electronic systems demanded in today's market. A strong academic background supported by continuing education is complemented by many years of hands-on field experience. A clear advantage Bonitron has over many competitors is combined on-site engineering labs and manufacturing facilities, which allows the engineering team to have immediate access to testing and manufacturing. This not only saves time during prototype development, but also is essential to providing only the highest quality products.

The sales and marketing teams work closely with engineering to provide up-to-date information and provide remarkable customer support to make sure you receive the best solution for your application. Thanks to this combination of quality products and superior customer support, Bonitron has products installed in critical applications worldwide.

AC Drive Options

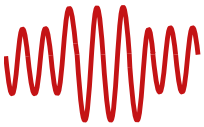
In 1975, Bonitron began working with AC inverter drive specialists at synthetic fiber plants to develop speed control systems that could be interfaced with their plant process computers. Ever since, Bonitron has developed AC drive options that solve application issues associated with modern AC variable frequency drives and aid in reducing drive faults. Below is a sampling of Bonitron's current product offering.

World Class Products



Undervoltage Solutions

Uninterruptible Power for Drives
(DC Bus Ride-Thru)
Voltage Regulators
Chargers and Dischargers
Energy Storage



Overvoltage Solutions

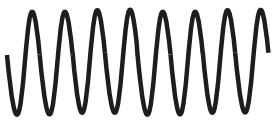
Braking Transistors
Braking Resistors
Transistor/Resistor Combo
Line Regeneration
Dynamic Braking for Servo Drives

Common Bus Solutions

Single Phase Power Supplies
3-Phase Power Supplies
Common Bus Diodes

Portable Maintenance Solutions

Capacitor Formers
Capacitor Testers



Power Quality Solutions

12 and 18 Pulse Kits

Green Solutions

Line Regeneration

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1. INTRODUCTION

1.1. WHO SHOULD USE

This manual is intended for use by trained personnel responsible for integrating, installing, maintaining, troubleshooting, or using this equipment with any AC drive system.

Please keep this manual for future reference.

1.2. PURPOSE AND SCOPE

This manual is a user's guide for the model M3660REM. It will provide the user with the necessary information to successfully connect and operate the M3660REM.

In the event of any conflict between this document and any publication and/or documentation related to any associated hardware (capacitor bank, etc.), the latter shall have precedence.

1.3. MANUAL VERSION AND CHANGE RECORD

The initial release for this module is Rev 00a.

Figure 1-1: M3660REM

1.4. SYMBOL CONVENTIONS USED IN THIS MANUAL AND ON EQUIPMENT

	Earth Ground or Protective Earth
	AC Voltage
	DC Voltage
 DANGER!	DANGER: Electrical hazard - Identifies a statement that indicates a shock or electrocution hazard that must be avoided.
 DANGER!	DANGER: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.
 CAUTION!	CAUTION: Identifies information about practices or circumstances that can lead to property damage, or economic loss. Attentions help you identify a potential hazard, avoid a hazard, and recognize the consequences.
 CAUTION!	CAUTION: Heat or burn hazard - Identifies a statement regarding heat production or a burn hazard that should be avoided.

2. PRODUCT DESCRIPTION / FEATURES

The Bonitron M3660 Regenerative Energy Monitor is a system analysis tool designed to assist system integrators and end users in the proper sizing of their braking solution: whether that's optimizing an existing resistive solution or replacing it with a regenerative one.

The M3660REM monitors the voltage and current seen by the load resistor; this allows it to characterize a braking Event by measuring the peak and average currents as well as calculating the total energy in the Event. This can be helpful information for system engineers to verify that the braking chopper and/or load resistor are appropriately sized and rated for the requirements of the application.

2.1. RELATED PRODUCTS

BRAKING TRANSISTORS

- M3575T – Standard Duty Braking Transistor (up to 600A)
- M3452 – Heavy Duty Braking Transistor (up to 1600A)

BRAKING RESISTORS

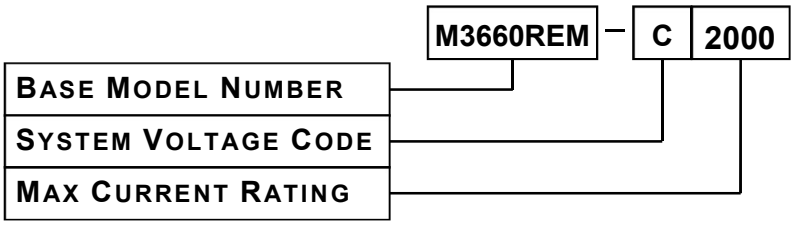
- M3575R – Standard Duty Braking Resistors (up to 30A)
- M3775R – Various Duty Load Banks (up to 1600A)

REGENERATIVE BRAKING

- M3545 – Single or 3- Phase Line Regen (up to 15A)
- M3645 – Three Phase Line Regen (up to 300A)

2.2. PART NUMBER BREAKDOWN

Figure 2-1: Example of Part Number Breakdown



BASE MODEL NUMBER

The base model number for all Regenerative Energy Monitors is M3660REM.

SYSTEM VOLTAGE RATING

The System Voltage rating indicates the maximum AC system voltage for which the unit is designed to operate.

Table 2-1: System Voltage

RATING CODE	SYSTEM VOLTAGE
C	Up to 600VAC

MAX CURRENT RATING

The max current rating indicates the maximum DC load current the unit can measure.

2.3. GENERAL SPECIFICATIONS

Table 2-3: General Specifications Table

PARAMETER	SPECIFICATION
System Voltage	Up to 600 VAC
Braking Current	200A / 2000A DC
Controls	Six display soft keys
Display	Four line, eighty character LCD (4x20)
Unit Size (H x W x D)	13.4" x 11.6" x 6.0"
Weight	6 lbs.
Storage Temp	-20°C to + 65°C
Humidity	Below 90% non-condensing
Atmosphere	Free of corrosive gas and conductive dust

2.4. General Precautions and Safety Warnings

ELECTROCUTION HAZARD!

- **For use by qualified and trained personnel only!**
- **IMPROPER OPERATION OF THE PRODUCT OR IGNORING THESE WARNINGS MAY RESULT IN SERIOUS BODILY INJURY OR DEATH!**
- **Before connecting the M3660REM to a braking resistor terminals, ensure that the system is powered off.**
- **Never operate this product with the enclosure cover removed.**

DANGER!

- **Never attempt to service this product.**
- **Certain parts inside this product may get hot during operation.**
- **Before connecting this device to any other product, be sure to review all documentation of that product for pertinent safety precautions.**

ANY QUESTIONS AS TO APPLICATION, INSTALLATION, OR SERVICE SAFETY SHOULD BE DIRECTED TO THE EQUIPMENT SUPPLIER.

3. INSTALLATION INSTRUCTIONS

3.1. ENVIRONMENT

While closed, the M3660REM is water, dust, and crush resistant. When open and in operation, the unit should be used only in dry, clean areas. Ensure that the interior of the unit casing is kept dry.

3.2. WIRING AND CUSTOMER CONNECTIONS

The M3660REM is not intended for permanent installation into a drive cabinet; it was designed as a portable unit, to be used as needed. Therefore, it has no installation wiring requirements.

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4. OPERATION

4.1. FUNCTIONAL DESCRIPTION

The M3660REM is an analysis tool to help system designers get a better understanding of the characteristics of their braking Events. It should be attached to the load resistor terminals, not to the DC Bus directly; this way it only measures the actual braking energy.

The REM records the following information about each braking Event it detects:

Date	The Date that the Event occurred: YYYY:MM:DD
Time	Time of Day when the Event occurred: HH:MM:SS
Length	Duration of the Event: MM:SS.ms
Energy	The total Energy dissipated during the Event (in kJ)
Avg Current	The Average Current over the entire Event
Peak Current	The Maximum Current reached during the Event

Note: the max save Length of a single saved Event is 30min; if an Event lasts longer than this limit, it will automatically be split over multiple entries. For example, assume a braking Event that lasted 42m, 27s. This will be saved as 2 Events: the first with a Length of 30mins and the second with a Length of 12m, 27s.

In addition to the individual Event records, the Regen Monitor keeps some running Lifetime Totals:

Number of Events	Total number of Events that have been recorded
Total Duration	Total Duration of all recorded Events
Avg Duration	Average Duration per Event, based on all recorded Events
Total Energy	Total Energy from all recorded Events (in kJ)
Avg Energy	Average Energy per Event, based on all recorded Events (in kJ)
Peak Current	Average of the Peak Current values from all recorded Events
Avg Current	Average Current per Event, based on all recorded Events

4.2. FEATURES

4.2.1. HARDWARE

4.2.1.1. AC POWER INPUT CONNECTOR

The M3660REM is equipped with a standard IEC C14 connector for input power. This connector mates with a standard C13 cable, commonly used with desktop computers, to provide power to the unit.

4.2.1.2. VOLTAGE LEADS

The two voltage cables feature a large claw for easy connection to the load terminals with a finger-safe, 4mm banana plug termination at the unit.

4.2.1.3. CURRENT CLAMP

The provided Pico TA167 200A/2000A Current Probe connects to the BNC terminal on the front panel of the unit.

Figure 4-1: Cables

4.2.2. DISPLAY

The digital display presents the user with information about the present status of the system, including the voltage and current. The display also presents the user with options to control system operation.

4.2.2.1. DIRECTIONAL BUTTONS

Each of the four buttons corresponds to a direction: up, down, left or right. *Up* and *Down* move the cursor among menu items. On screens where numbers are input by the user, the *Left* and *Right* buttons move the cursor, while the *Up* and *Down* buttons change the selected digits. On some screens, certain buttons may have no function at all.

4.2.2.2. ENTER AND CANCEL BUTTON

The green *Enter* button selects menu options. On a menu screen, the red *Cancel* button will return you to the previous menu.

Figure 4-2: Front Panel

4.2.3. SCREENS & MENU NAVIGATION

Many screens are menus allowing access to other screens, or lists presenting a number of options. The presently selected item on the menu is indicated by a '>' cursor. This selection indicator is moved using the *Up* and *Down* buttons. If a line on the menu represents another screen, that screen is accessed with the *Enter* button. The *Cancel* button will return the display to the parent screen.

4.2.3.1. MAIN MENU

4.2.3.1.1. RECORDS

The Records Menu allows the user to view all saved Event information. The Events page shows the most recent 50 Events in chronological order. The Lifetime Stats page shows the aggregated totals of all Events (since the last reset).

4.2.3.1.2. CONFIGURATION

The Configuration Menu contains all the settings that are user adjustable.

Set Date/Time: The user can adjust the full timestamp (Year-Month-Day, Hour-Minute-Seconds) if ever necessary.

Set Current Clamp: The user can swap between 200A and 2000A settings.

 Important!	The Clamp setting in the unit MUST match the Range selector on the Pico probe, otherwise the Current and Energy calculations will be incorrect.

4.2.3.1.3. CLEAR RECORDS

The user can manually erase the saved Event data if desired.

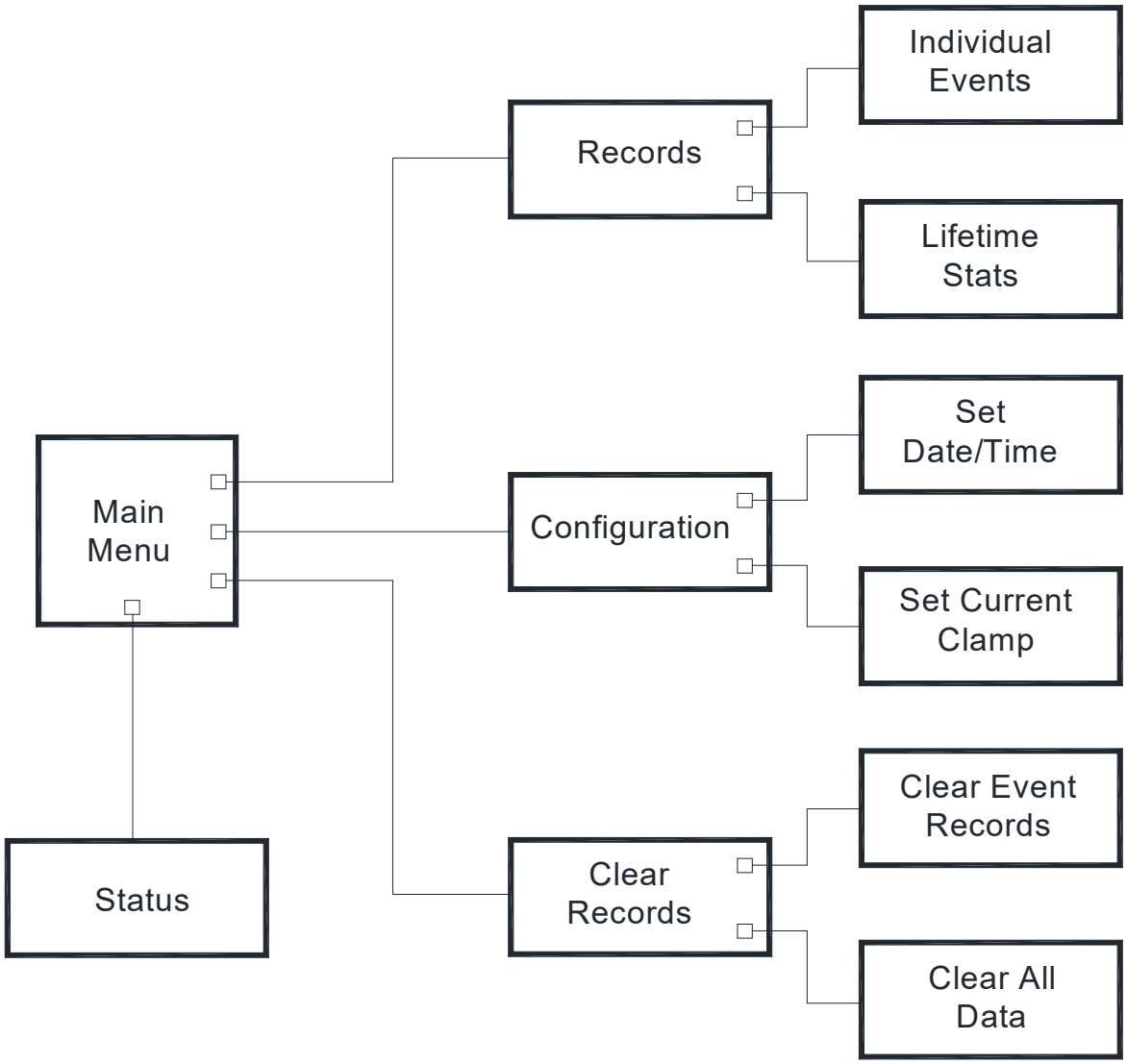
Clear Event Records – This option will erase only the individual Events list. The Lifetime Stats will remain unaffected.

Clear All Data – This will erase ALL Event data, both the individual Events as well as the Lifetime totals.

4.2.3.2. STATUS

This screen shows the general status of the unit. While an Event is being recorded, it will show live data: braking voltage & current and the percent loading.

Figure 4-3: Menu Tree



5. TROUBLESHOOTING

If a problem occurs on start-up or during normal operation, refer to the problems described below. If a problem persists after following the steps below, contact the product supplier or your system integrator for assistance.

Repairs or modifications to this equipment are to be performed by Bonitron approved personnel only. Any repair or modification to this equipment by personnel not approved by Bonitron will void any warranty remaining on this unit.

Table 5-1: Troubleshooting

Display never comes on	• Ensure that the input power cable is connected firmly to the unit and to a functioning power source at the correct voltage. • If both connections and the power supply are good, make sure the input circuit breaker has not tripped.
Unit never goes ACTIVE when a Braking Event occurs	• Check the Voltage cables. Ensure they are firmly connected between the unit and the load and that the polarity is correct.
Incorrect values for the Event Currents and/or Energy are being recorded	• Check the Current Clamp. Verify that the twist-lock connector is firmly seated on the front panel and Clamp's jaws are closed around the load wires. • Make sure the Current Clamp is powered ON and set to the appropriate range. • Verify that the Current Clamp setting in the unit matches the range selector on the Clamp.

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6. ENGINEERING DATA

6.1. RATINGS CHART

Table 6-1: Ratings Chart

Input Voltage	110 - 120VAC
System Voltage	600VAC
Max Braking Voltage	1000VDC
Max Braking Current	2000A

Table 6-2: Dimensions

Height	6 in. (with top closed)
Width	13.4 in.
Depth	11.6 in.

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