

## Microprocessor Rapper/Vibrator Controls For Electrostatic Precipitators Model MRC-NT

An electrostatic precipitator cannot operate efficiently if its internal components are not kept free of excessive particulate buildup. Maximum precipitator efficiency can only be achieved if discharge and collecting electrodes are kept clean. Excessive particulate buildup on the collecting and discharge electrodes due to insufficient rapping causes sparking to occur at lower and lower power levels. This in turn decreases the precipitator's ability to collect particulate, and results in higher outlet emissions. Over-rapping, on the other hand, causes re-entrainment (the re-introducing of previously collected particulate back into the gas stream) that also reduces efficiency and increases outlet emissions.



Typical 3' by 4' by 10" wall mounted outdoor enclosure.

Redkoh Industries' Microprocessor Rapper/Vibrator Control (MRC-NT) is an advanced microprocessor energization system designed specifically for electrostatic precipitators. It is designed to provide maximum flexibility of device intensity and timing for electrode cleaning. This results in operationally clean electrodes producing low emission levels, and minimum re-entrainment virtually eliminating opacity puffs.



Interior view of wall mounted enclosure..

The electronics are designed for compact size, long life, low power consumption, and high availability. Nonvolatile memory keeps all field programmed parameters active. Power outages of any duration will not affect the MRC's memory. The control is easily field programmed for rapper cycle

time, vibrator on/off time, intensity, repetitive "raps", master intensity, and a

host of other operating parameters. This results in an extremely high level of system flexibility with minimal user training or effort. The MRC is designed for both back-fitting existing rapper/vibrator controls, as well as complete control replacement. The MRC will control low voltage (120 and 240 volt, AC or DC), magnetic impact (solenoid type) rappers, as well as electric vibrators such as Syntron and Eriez vibrators, and air solenoid valves for pneumatic devices.

### Control Parameters

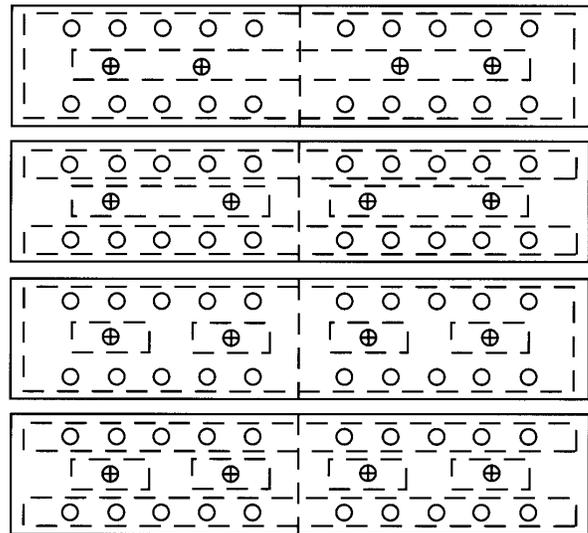
The following are the operator programmable control parameters of the MRC system:

**Cycle Clock** - An MRC can have any number of cycle clocks. Each cycle clock controls a chosen group of rappers. The timing of the cycle clock is the time period between consecutive energization of the same rapper in a rapper group. For vibrators, the cycle clock time is the vibrator on-time.

A rapper group is any number of rappers or vibrators controlled by a cycle clock. A rapper group could consist of all the rappers or vibrators in a precipitator field, associated with an individual T-R, or in a precipitator chamber, or any chosen number regardless of their location on the precipitator (Figure 1). The cycle clock is programmable between one second and 100 hours in one-second increments. Upper and lower limits of cycle clock timing can be pre-programmed into the MRC.

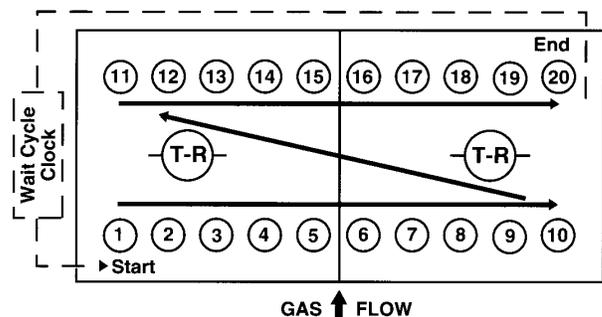
**Wait Cycle Clock** - each cycle clock has a counterpart wait cycle clock. The wait

**Figure 1 - Various Types of Rapper Grouping**



Each group of rappers within the dotted lines represents a type of "rapper group". Up to 99 rapper groups can be programmed.

cycle time is the time period between energization of the last rapper in a rapper group and the re-energization of the first rapper in the same group (Figure 2). The wait cycle clock for rappers is programmable from zero seconds (no wait) to 100 hours in one-second increments. For vibrators the wait cycle clock time is the repetition time and is also programmable from one second to 100 hours.



**Figure 2 - Normal Rapping Cycle**

Energization of rappers 1 through 20 corresponds to timing of cycle clock. Time between energization of rapper 20 and re-energization of rapper 1 corresponds to timing of wait cycle clock.

**Rapper Intensity** - there are three ways to adjust rapper/vibrator intensity:

1. Each device individually
2. Each group of devices individually
3. All devices simultaneously

For magnetic impact type rappers, the intensity is measured and adjusted in inches of hammer travel. Electric vibrator intensity is measured and adjusted by percent of rated current. Pneumatic rapper/vibrator intensity is changed by varying the air pressure at the regulator and is not adjustable at the MRC keypad.

**Repetitive Energization** - the rappers/vibrators in each group can be programmed to energize from 1 to 9 times before the next rapper/vibrator in the same group is energized.

**Select** - any rapper/vibrator can be selected to display its operating parameters (intensity, wait and cycle clock number, and wait and cycle clock timing).

**Step** - once a rapper/vibrator has been selected, the control can be advanced sequentially to display all rapper/vibrator parameters, one at a time.

**Repeat** - Repeatedly energizes any chosen rapper/vibrator every 3 seconds, for troubleshooting purposes.

**Sequence** - Energizes all rappers/vibrators in a chosen group at a faster than normal clock time. This rapidly cleans the electrodes associated with a chosen rapper group. It is useful if excessive sparking caused by buildup is noted, or to clean various areas of the precipitator prior to internal inspections.

This parameter also allows all rappers/vibrators in all groups to be energized in sequence at a fast rate, and allows all internal electrode surfaces to be cleaned rapidly during precipitator offline periods.

**Master Intensity** - Allows the intensity of rappers/vibrators in the same group or on the entire precipitator to be increased or decreased simultaneously. This is very useful for fine-tuning the rappers/vibrators during fuel switching.

## Additional Control Features

The following features add to the MRC's flexibility and usefulness in maintaining minimum precipitator outlet emissions:

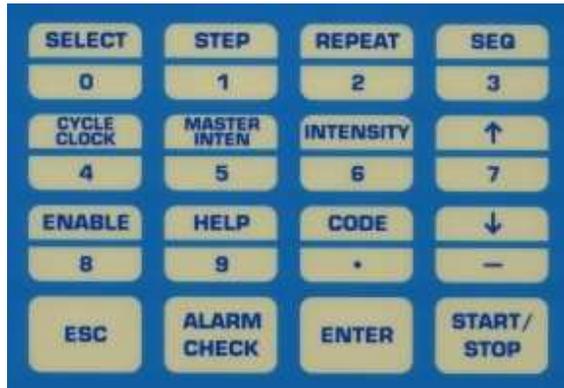
### Multiple Program Storage (Optional)

Six separate and distinct rapper/vibrator programs are available to the user. One is the field programmable Sequence routine that allows rappers to be sequentially energized at a faster time period and a higher lift than normal for maintenance and diagnostic purposes. The other four are mutually exclusive of one another and allow field programming of timing and intensity for such operating conditions as high loads, upset conditions, varying fuel sources, special maintenance routines, etc. Once programmed into memory, the separate programs can be called into use with a few simple keystrokes. The factory default program is always available for immediate recall.

### Field Programming

The MRC's user-friendly interface has been designed to streamline the process of fine-tuning rapper/vibrator operation. All the control functions are accessed through a sixteen key, double function keypad.

Each key is labeled by function, eliminating cross-referencing to a keypad map, and all operating values are displayed digitally. The keypad is a membrane, tactile feel, hermetically sealed unit.



To prevent unauthorized programming of the control, a security code must be entered before control parameters can be changed. Since the keypad is located on the outside front of the control cabinet, there is no need to open the control cabinet to make adjustments, thus increasing operator safety.

For maintenance purposes, any number of rappers/vibrators or cycle clocks can be disabled at any time. This allows repairs to be made without having to shut down the entire control.

### Display Of Operating Conditions and Programmed Parameters

All operating values, and programmed operating parameters, are displayed on a 4 line, by 20 character per line, LCD display.

The operating values (alarm status, rapper/vibrator numbers, intensity, clock number, and clock timing) are continuously displayed.



### Rapper Failure Alarms

The MRC constantly monitors the operation of each rapper/vibrator as it is energized. Should a fault occur (short or open rapper/vibrator coil or field wiring), the single rapper/vibrator is removed from service; the operation of the other rappers/vibrators is unaffected.

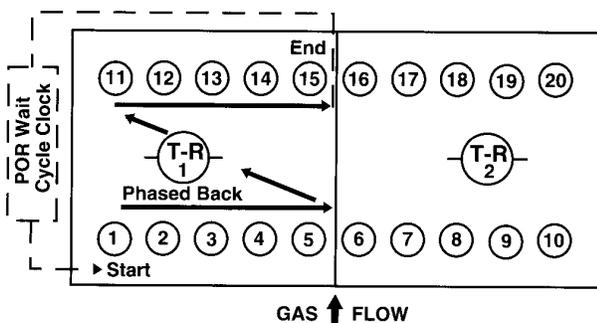
When a rapper/vibrator is automatically or manually removed from service, an alarm code is displayed. By pressing the alarm check key the number of the alarmed rapper/vibrator is displayed. This eliminates the need to search for the non-operative rapper/vibrator by physically "walking" through their cycle. If more than one rapper/vibrator has been automatically or manually removed from service, repeatedly pressing the alarm check key will cause these rappers to be displayed, one at a time, in numerical sequence. Alarm codes are also displayed for failure of microprocessor interface and status of system memory.

### Power Off Rapping (Optional)

Exceptionally tenacious and highly resistive particulate is extremely difficult to remove from the collecting electrodes. By eliminating the electric field that holds this particulate to the collecting electrode, cleaning of the electrodes is substantially easier to accomplish.

As an option, the MRC can be supplied with a Power Off Rapping (POR) feature that automatically reduces (or turns off) power to a transformer-rectifier (T-R), rapidly energizes the rappers on the collecting electrodes associated with the T-R, and when rapping is completed, reenergizes the T-R (Figure 3). All this occurs without disturbing normal rapper/vibrator operation. Each T-R rapper group can be equipped with this POR feature.

**Figure 3 - Power Off Rapping Configuration**



The POR system automatically reduces the power to TR1, rapidly energizes rappers 1-5 and 11-15, reenergizes TR1, and repeats this procedure after the POR Wait Cycle clock time. This automatic procedure can be provided for each TR rapper group.

### Multiple Rapping (Optional)

Typically only one rapper or vibrator is permitted to operate at a time. Where multiple devices are required to operate at the same time an anti-coincidence feature is available to prevent outlet

devices from energizing while upstream devices are energized.

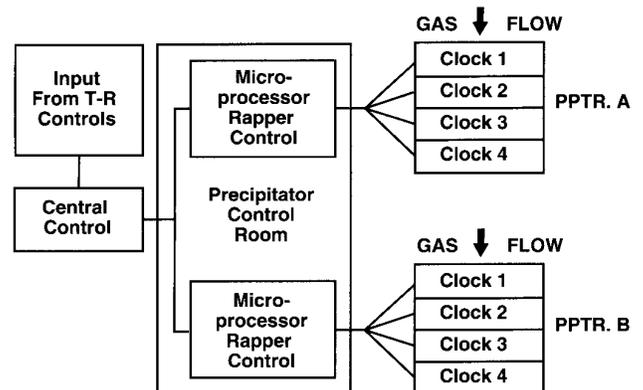
### System Configuration

The hardware of the MRC system can be configured in any number of different ways. For simplicity, all components are usually housed in either a wall-mounted or freestanding cabinet. Each stand-alone MRC system has the capability of being connected to a central precipitator control in the boiler control room or other remote location (Figure 4). Program modifications, alarm notification and automatic data logging can now be performed from the remote location.

### Communications Capability

The MRC is equipped with an Communication Area Network (CAN) data communication port. This port can be used to link the MRC with a central control system remotely located in the boiler control room, with the existing plant computer, or with a DCS/PLC control system via Modbus protocol.

**Figure 4 - MRCs Operating With a Central Control System**



Remote data acquisition and control is obtained through a central control system, or by an existing DCS or PLC.

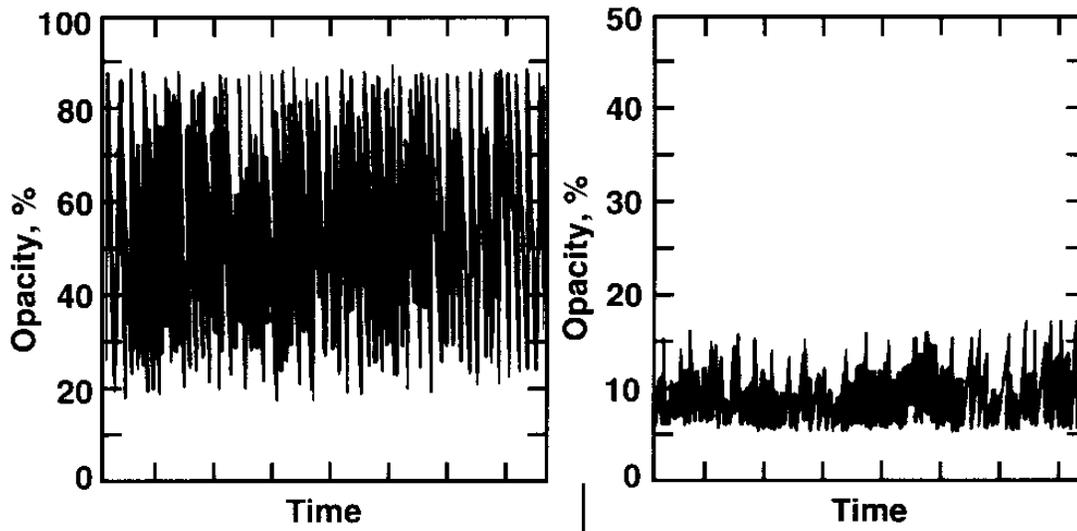
### Operating Temperature

The MRC is designed to operate in an ambient temperature range of 32°F to 140°F. Cabinet heating and air conditioning are available for ambient temperatures outside this range.

### Experience

More than 700 MRCs operating over approximately 50,000 magnetic impulse rappers, electromagnetic vibrators, or air solenoids are currently installed on a wide variety of applications worldwide. Strip chart tracings shown in Figure 5 illustrate typical results the MRC has achieved in minimizing opacity.

**Figure 5 - Typical Opacity Reduction With Use Of MRC-NT**



Left - actual strip chart recording of opacity with analog/mechanical rapper/vibrator control. right - typical opacity recording with the MRC. Significant opacity reduction is achieved

## Remote Data Acquisition and Remote Control Options

Redkoh Industries manufactures a complete line of remote data acquisition and control systems that integrate with the MRC, and our **RK2000 (Microprocessor Transformer Control)**. These systems can be used as a stand-alone system, or to communicate to an existing Distributed Control System or PLC. Three different systems are available depending on site-specific needs.

**CAN-Transceiver** - This device acts as a gateway between the individual TR and rapper controls, and a DCS. It permits data acquisition from, and remote control of, the individual TR and rapper controls through a Modbus interface.

**PrecipCommander** - This is a full scale PC based data acquisition and control system that uses a graphical user interface. It provides magnetic storage of history files as well as timed reports and alarm notification. It also displays line and bar graph representations of multiple electrical levels for instantaneous or trending purposes. Its built-in energy management system automatically saves power on a real time basis. Modbus output to a DCS is also available.

## Specifications

Input Power -----	220 to 575vac, 15amp, 50/60Hz, single phase
Temperature range -----	0°C to 60°C (air conditioning and heating available)
Humidity range -----	0% to 100% non-condensing
Communications -----	Optically isolated
Communications port -----	RS 485 and RS 232
Alarm inputs -----	Optically isolated
Memory type -----	Nonvolatile EEPROM
Control voltage range -----	85 to 132 VAC
SCR gate circuits -----	Optically and transformer isolated
Surge protected -----	Up to 5,000 volts
Printed circuit boards -----	G10, UL approved, environmentally coated
Labels -----	Epoxy ink
Component enclosure -----	NEMA 12 (standard), NEMA 4 and other ratings available. Baked enamel painted; steel and anodized aluminum

Gasketed keypad

RFI and EMI shielded

Modular design

Three-year warranty

All components purchased from U.S. suppliers

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