LOFA MC536 Programming Manual

Introduction

This document provides general information on LOFA Industries MC536 configuration. MC536 control systems are a very flexible platform for diesel engine control, monitoring, and protection, featuring LOFA's powerful First Fault Diagnostics (FFD). After pinpointing the initial failure, FFD stores it in memory and alerts the end user via a single bright LED. FFD monitors battery charge, low oil pressure, high temperature, overspeed and up to two additional contact closure inputs. The field configurable microprocessor-based solid-state design uses high-power semiconductors instead of outdated electromechanical relays to ensure reliable high-current switching.

The MC536 is field configurable with an inexpensive programmer. Some of the MC536 configurable features include:

- Automatic preheat duration
- Failure indication with shutdown or indication only
- Starter motor protection
- Over-speed shutdown
- Normally open or normally closed shutdown switches

The standard system includes a 12 inch wiring harness terminating into a sealed weatherproof plug. This durable connection performs well in harsh environments and provides efficient installation of custom plug-and-play engine harnesses as well as standard harness extensions.

Warning

When replacement parts are required, LOFA Industries recommends using replacement parts supplied by LOFA or parts with equivalent specifications.

Failure to heed this warning can lead to premature failure, product damage, personal injury or death.

Operation

Turning the control system key to the run position starts a self-test which causes all LEDs to flash three times and enables the fuel run/stop solenoid output. After self-test, the LEDs indicate the state of the inputs they monitor. The normal indications are battery charge and oil pressure on most applications. If these LEDs are not illuminated at this time it may indicate the inputs are not properly connected.

The *Preheat* LED is illuminated when the key switch is turned to the run position if automatic preheat is configured (See Preheat Options). Preheat time varies from application to application. After waiting for the *Preheat* LED to extinguish, the engine is cranked by turning and holding the key switch in the start position until the engine starts. The key switch is spring loaded to return automatically to the run position when released. The *Preheat* LED is illuminated during afterglow if enabled.

Note

The key switch is equipped with a mechanical start locking device. An attempt to re-crank the engine can only be made by turning the key switch to the off position to reset the start locking mechanism.

If the engine is not started within 30 seconds of turning on the system, the fuel run/stop solenoid output is turned off to prevent battery discharge when the key switch is left in the run position. The fuel run/stop solenoid output is turned off after 30 seconds even if preheating. As soon as the key switch is turned to the

start position the solenoid output is enabled. The afterglow cycle begins when the key switch returns to the run position.

Note

If conditions do not warrant preheat, the engine may be started by turning the key to the start position without waiting for the preheat time to expire.

Control system instrument power, including the hourmeter and voltmeter, is provided by the fuel run/stop solenoid output. If the instruments do not power up when the key is turned to the run position, this indicates a problem with the solenoid circuit.

After the engine starts, the control system electronics ignore all shutdown conditions for the first 10 seconds. This delay eliminates the requirement to hold a by-pass override button during starting and allows the system conditions such as oil pressure to normalize. The 10 second timer starts when the key switch returns to the run position.

Note

Starter input is required for correct system operation. If the starter motor input is not activated (connected to battery positive) and the engine is started through another means (i.e. air starter) the engine will shutdown 30 seconds after the key switch is turned to the run position.

To prevent unintentional engine shutdowns caused by intermittent conditions (i.e., pressure spikes, coolant movement) the control system requires a constant 1/3 seconds fault input to cause engine shutdown.

Warning

When used in combination with mechanical float type switches engine vibrations may prevent constant contact closure.

The control system has the ability to shut down the engine for over speed. Over speed is indicated via a blinking *Battery Charge* LED. The control system senses RPM by either the frequency terminal of the alternator or a proximity switch.

Preheat Options

Preheat Output

Preheat is a 20A positve output for control of an external power relay with predetermined preheat and afterglow times. A relay should be selected with appropriate amperage capacity for the installed cold starting aid (glowplug, intake air heater, etc.). Applications using multiple cold starting aids may require multiple relays. An optional external thermistor can be use to disable preheat if the temperature is above 32° F (0° C).

Note

Consult engine documentation when selecting cold starting aid, power relay and heating specifications.

Programming

Programming is accomplished by connecting the *MC536 Programmer* to the MC536. The programmer connects to the 3-position connector on the board and the black wire from the programmer needs to be connected to panel ground.

To enable programming, hold the *Set* button and activate Ignition (15) within 2 seconds. Programming mode is indicated by blinking of all 6 LED followed by all LEDs extinguished. Pressing the *Plus* button moves to parameter 1, *Solenoid Function*, as indicated by the flashing OK LED. No outputs are active during programming.

All programming parameters are selected by the parameter number using *Plus* and *Minus* buttons. Pressing the *Set* button displays the parameter value (e.g. ETR if *Preheat* LED illuminated) and can be changed with the *Plus* and *Minus* button. Pressing *Set* again stores the parameter value and the parameter number is indicated again. All values are indicated binary through the LEDs, where the *OK* LED is the least significant bit. See the tables below for details.

Parameter numbers are represented by flashing LEDs and parameter values are represented by solid LEDs. The parameter values are stored when power is removed at the end of programming.

The following parameter charts define the LED light patterns. The Version 1.0 chart is only for software version 1.0. All other software versions use the Version 1.1 and greater chart.

Note

The software version is indicated by a label on the top of the processor.

Parameters (Version 1.0)

No.	Description	Parameter Number (binary)						Factory Default
		Preheat LED (Amber)	Aux LED (Red)	Temp LED (Red)	Oil LED (Red)	D+ LED (Red)	OK LED (Green)	
1	Solenoid Function	○	○	○	○	○	☼	ETR
2	Overspeed Monitoring	○	○	○	○	☼	○	Disabled
3	Preheat Time – 10s	○	○	○	○	☼	☼	0
4	Preheat Time – 1s	○	○	○	☼	○	○	0
5	Start Frequency - 1000s	○	○	○	☼	○	☼	0
6	Start Frequency - 100s	○	○	○	☼	☼	○	2
7	Start Frequency – 10s	○	○	○	☼	☼	☼	0
8	Overspeed Frequency – 1000s	○	○	☼	○	○	○	0
9	Overspeed Frequency – 100s	○	○	☼	○	○	☼	0
10	Overspeed Frequency – 10s	○	○	☼	○	☼	○	0
11	Temperature Switch/Sensor	○	○	☼	○	☼	☼	Switch
12	Temp Switch Fault	○	○	☼	☼	○	○	Ground
13	Oil Switch Fault	○	○	☼	☼	○	☼	Ground
14	Alternator Fault	○	○	☼	☼	☼	○	Ground
15	Aux 2 Switch Fault	○	○	☼	☼	☼	☼	Ground
16	Aux 1 Switch Fault	○	☼	○	○	○	○	Ground
17	Alternator Shutdown	○	☼	○	○	○	☼	Enabled
18	Aux 2 Switch Shutdown	○	☼	○	○	☼	○	Enabled
19	Aux 1 Switch Shutdown	○	☼	○	○	☼	☼	Enabled
20	Programming End	○	☼	○	☼	○	○	

Legend

LED off	○
LED Blinking	☼
LED on	●

Parameters (Version 1.1 and greater)

No.	Description	Parameter Number (binary)						Factory Default
		Preheat LED (Amber)	Aux LED (Red)	Temp LED (Red)	Oil LED (Red)	D+ LED (Red)	OK LED (Green)	
1	Solenoid Function	○	○	○	○	○	☼	ETR
2	Overspeed Monitoring	○	○	○	○	☼	○	Disabled
3	Preheat Time – 10s	○	○	○	○	☼	☼	0
4	Preheat Time – 1s	○	○	○	☼	○	○	0
5	Start Frequency - 1000s	○	○	○	☼	○	☼	0
6	Start Frequency - 100s	○	○	○	☼	☼	○	2
7	Start Frequency – 10s	○	○	○	☼	☼	☼	0
8	Overspeed Frequency – 1000s	○	○	☼	○	○	○	0
9	Overspeed Frequency – 100s	○	○	☼	○	○	☼	0
10	Overspeed Frequency – 10s	○	○	☼	○	☼	○	0
11	Temperature Switch/Sensor	○	○	☼	○	☼	☼	Switch
12	Temp Switch Fault	○	○	☼	☼	○	○	Ground
13	Oil PSI Switch Fault	○	○	☼	☼	○	☼	Ground
14	Alternator Fault	○	○	☼	☼	☼	○	Ground
15	Aux 2 Switch Fault	○	○	☼	☼	☼	☼	Ground
16	Aux 1 Switch Fault	○	☼	○	○	○	○	Ground
17	Oil PSI Switch Shutdown	○	☼	○	○	○	☼	Enabled
18	Alternator Shutdown	○	☼	○	○	☼	○	Enabled
19	Aux 2 Switch Shutdown	○	☼	○	○	☼	☼	Enabled
20	Aux 1 Switch Shutdown	○	☼	○	☼	○	○	Enabled
21	Temp Switch Shutdown	○	☼	○	☼	○	☼	Enabled
22	Programming End	○	☼	○	☼	☼	○	

Legend

LED off	○
LED Blinking	☼
LED on	●

Numeric Values

No.	Value (binary)					
	Preheat LED (Amber)	Aux LED (Red)	Temp LED (Red)	Oil LED (Red)	D+ LED (Red)	OK LED (Green)
0	○	○	○	○	○	○
1	○	○	○	○	○	●
2	○	○	○	○	●	○
3	○	○	○	○	●	●
4	○	○	○	●	○	○
5	○	○	○	●	○	●
6	○	○	○	●	●	○
7	○	○	○	●	●	●
8	○	○	●	○	○	○
9	○	○	●	○	○	●
10	○	○	●	○	●	○
11	○	○	●	○	●	●
12	○	○	●	●	○	○
13	○	○	●	●	○	●
14	○	○	●	●	●	○
15	○	○	●	●	●	●

No.	Value (binary)					
	Preheat LED (Amber)	Aux LED (Red)	Temp LED (Red)	Oil LED (Red)	D+ LED (Red)	OK LED (Green)
16	○	●	○	○	○	○
17	○	●	○	○	○	●
18	○	●	○	○	●	○
19	○	●	○	○	●	●
20	○	●	○	●	○	○
21	○	●	○	●	○	●
22	○	●	○	●	●	○
23	○	●	○	●	●	●
24	○	●	●	○	○	○
25	○	●	●	○	○	●
26	○	●	●	○	●	○
27	○	●	●	○	●	●
28	○	●	●	●	○	○
29	○	●	●	●	○	●
30	○	●	●	●	●	○
31	○	●	●	●	●	●

Legend

LED off	○
LED Blinking	☼
LED on	●

Frequency Calculation Formula

Programming starter protection and overspeed RPM requires determining the corresponding frequency (in hertz) on the tachometer input. The tachometer is typically driven by the frequency tap from the alternator. To determine the appropriate frequency use the following formula:

$$Frequncy = \frac{Poles \times RPM \times \left(\frac{CrankDia}{AlternatorDia} \right)}{60}$$

In this formula,

Poles is the number of alternator pole pairs (typically 6)
RPM is the desired RPM
CrankDia is the crankshaft belt pulley diameter
AlternatorDia is the alternator belt pulley diameter

When the tachometer is driven by a proximity switch, use the following formula:

$$Frequncy = \frac{Pulses \times RPM}{60}$$

In this formula,

Pulses is the number of pulses per revolution
RPM is the desired RPM

When using either formula, round up the frequency to next highest multiple of 10.

Parameter Definitions

Solenoid Function

Indicated by the *Preheat LED* where:

Preheat LED on = Energize to Run (ETR) **(Factory default)**
Preheat LED off = Energize to Stop (ETS)

Overspeed Monitoring

Indicated by the *Preheat LED* where:

Preheat LED on = Overspeed Monitoring enabled
Preheat LED off= Overspeed Monitoring disabled **(Factory default)**

Preheat time – 10s

The 10s of the preheat time where

Preheat time = indicated value times 10 seconds **(Factory default=0)**

For example, for 37 seconds of preheat, the 10s value should be '3' indicated by the *OK* and *D+* LEDs illuminated. See the *Numeric Values* table to determine the LED pattern for a particular value.

Note

Preheat duration can not exceed 120 seconds!

Preheat time – 1s

The 1s of the preheat time where

Preheat time = indicated value in seconds (Factory default=0)

For example, for 37 seconds of preheat, the 1s value should be '7' indicated by the *OK*, *D+* and *Oil* LEDs illuminated. See the *Numeric Values* table to determine the LED pattern for a particular value.

Note

Some software versions have bugs which prevents resetting the preheat time to zero. Contact LOFA Industries for help resolving this issue.

Start Frequency – 1000s

The 1000s of the start frequency in hertz (cycles per second) where

Start frequency = indicated value times 1000 hertz (Factory default=0)

See the *Frequency Calculation Formula* to determine the frequency for a particular RPM. See the *Numeric Values* table to determine the LED pattern for a particular value.

Note

Start frequency can not be programmed greater than 1990 hertz!

Start Frequency – 100s

The 100s of the start frequency in hertz (cycles per second) where

Start frequency = indicated value times 100 hertz (Factory default=2)

See the *Frequency Calculation Formula* to determine the frequency for a particular RPM. See the *Numeric Values* table to determine the LED pattern for a particular value.

Start Frequency – 10s:

The 10s of the start frequency in hertz (cycles per second) where

Start frequency = indicated value times 10 hertz (Factory default=0)

See the *Frequency Calculation Formula* to determine the frequency for a particular RPM. See the *Numeric Values* table to determine the LED pattern for a particular value.

Overspeed Frequency – 1000s

The 1000s of the overspeed frequency in hertz (cycles per second) where

Overspeed frequency = indicated value times 1000 hertz (Factory default=0)

See the *Frequency Calculation Formula* to determine the frequency for a particular RPM. See the *Numeric Values* table to determine the LED pattern for a particular value.

Note

Overspeed frequency can not be programmed greater than 1990 hertz!

Overspeed Frequency – 100s

The 100s of the overspeed frequency in hertz (cycles per second) where

Overspeed frequency = indicated value times 100 hertz **(Factory default=0)**

See the *Frequency Calculation Formula* to determine the frequency for a particular RPM. See the *Numeric Values* table to determine the LED pattern for a particular value.

Overspeed Frequency – 10s

The 10s of the overspeed frequency in hertz (cycles per second) where

Overspeed frequency = indicated value times 10 hertz **(Factory default=0)**

See the *Frequency Calculation Formula* to determine the frequency for a particular RPM. See the *Numeric Values* table to determine the LED pattern for a particular value.

Note

Some software versions have bugs which prevents resetting the overspeed frequency to zero. Contact LOFA Industries for help resolving this issue.

Temperature Switch / Sensor

Indicated by the *Preheat LED* where:

Preheat LED on = Temperature switch **(Factory default)**
Preheat LED off = Temperature sensor (PT1000)

PT1000 enables temperature dependent preheat where preheat is inactive until the temperature falls below 32° F (0° C).

Temp Switch Fault

Indicated by the *Preheat LED* where:

Preheat LED on = Ground is fault **(Factory default)**
Preheat LED off = Open is fault

Oil PSI Switch Fault

Indicated by the *Preheat LED* where:

Preheat LED on = Ground is fault **(Factory default)**
Preheat LED off = Open is fault

Alternator Fault

Indicated by the *Preheat LED* where:

Preheat LED on = Ground is fault **(Factory default)**
Preheat LED off = Battery is fault

Aux 2 Switch Fault

Indicated by the *Preheat LED* where:

Preheat LED on = Ground is fault (Factory default)
Preheat LED off = Open is fault

Aux 1 Switch Fault

Indicated by the *Preheat LED* where:

Preheat LED on = Ground is fault (Factory default)
Preheat LED off = Open is fault

Oil PSI Switch Shutdown

Indicated by the *Preheat LED* where:

Preheat LED on = Ground is fault (Factory default)
Preheat LED off = Open is fault

Alternator Shutdown

Indicated by the *Preheat LED* where:

Preheat LED on = Shutdown enabled (Factory default)
Preheat LED off= Shutdown disabled

Aux 2 Switch Shutdown

Indicated by the *Preheat LED* where:

Preheat LED on = Shutdown enabled (Factory default)
Preheat LED off= Shutdown disabled

Aux 1 Switch Shutdown

Indicated by the *Preheat LED* where:

Preheat LED on = Shutdown enabled (Factory default)
Preheat LED off= Shutdown disabled

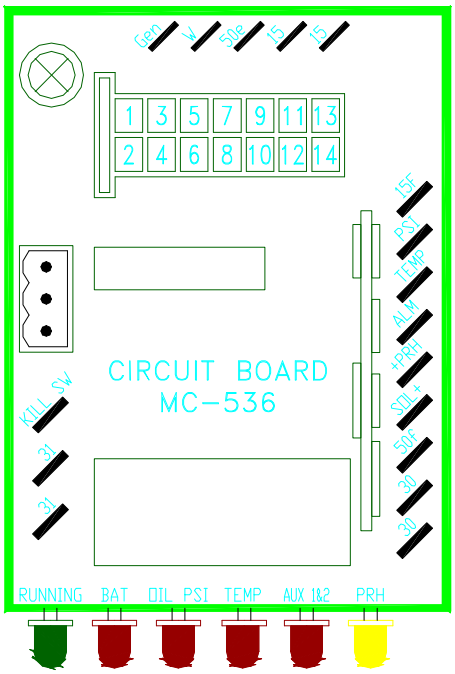
Temp Switch Shutdown

Indicated by the *Preheat LED* where:

Preheat LED on = Shutdown enabled (Factory default)
Preheat LED off= Shutdown disabled

Programming End

After the *Set* button is pressed power must be removed before normal operation is possible. On the next power cycle the new values are active. To exit programming mode without storing the values, *External Stop* must be activated.



Junior Power Timer Pinout (JPT)

Pin	Function
1	D+
3	Aux Switch 1
5	Aux Switch 2
7	Ground (31)
9	Accessory Out (15a)
11	Preheat (VG)
13	Pressure Gauge

Pin	Function
2	Tachometer (W)
4	Temp Sensor/Switch
6	Pressure Switch
8	Solenoid Ground
10	Accessory Out (15a)
12	Solenoid (Mag)
14	Temp Gauge

Power

- Battery+ (30) – 12 or 24VDC
- Ground (31)

Outputs

All outputs are short circuit protected.

- Starter (50f) - 70A
- Solenoid (Mag) - 20A
- Preheat (VG) – 20A
- Alarm (Sig) – 3.5A, active after shutdown
- Accessory (15a) – 20A (active with 15 input)

Inputs

- Accessory (15)
- Start control (50e)
- Temp Sensor/Switch – With PT1000 temperature sensor attached, preheat if temperatures less than 32°F (0°C). With a temperature sensor, the high temperature shutdown occurs at 230°F (110°C).
- Oil Pressure Switch
- Aux Switch 1
- Aux Switch 2
- Tachometer (W) – For starter protection and overspeed monitoring. Pass-through to drive tachometer.
- Alternator excitation/charge indication (D+)
- External Stop (Kill Sw)

Warning

LOFA Industries, Inc. does not recommend using the external stop for emergency stop (E-Stop). The recommended solution is a NC (normally closed) switch wired in series in the solenoid output wire.

Initial Release:	Translated from German, added board drawing.
Revision A: 8-Aug-2005	Corrected programming for Aux Switch 1 and 2. (Parameters were reversed.) Clarified text. Updated charts to better show LED states.
Revision B: 22-May-2006	Added calculation for frequency and changed formatting. Removed section on operation with pushbuttons.
Revision C: 2-May-2007	Corrected light pattern for seven in *Numeric Values* table, added notes on software bugs. Added part number.

Important Safety Information

The warnings in this publication are not all inclusive.

LOFA Industries cannot anticipate every potential hazard.

Appropriate safety rules and precautions should be followed with any tool, work method or operating procedure.

Improper procedures, tools and materials may cause damage or make the equipment unsafe to operate.

Only persons with appropriate training, skills and tools should perform these functions.

Improper operation, maintenance or repair of this product can be dangerous and may result in injury or death.

Do not operate or perform any maintenance or repair on this product until all operation, maintenance and repair information is read and understood.

The information, specifications, and illustrations in this publication are based on information available at the time of publication.

All items are subject to change at any time without notice.