Honeywell

R7999A,B
ControLinks™ Controller

FEATURES

- **Fast burner setup via PC or laptop.**
- **Fuel, air, FGR profile download capability.**
- **Two independent fuel profiles with or without FGR.**
- **7 to 24 point profiles.**
- **Programmable behaviors of all actuators during Purge and Standby.**
- **Programmable behavior of nonselected fuel actuator.**
- **Independent lightoff and minimum modulation positions.**
- **Wide power voltage input range (50/60 Hz); two models cover global applications.**
- **Auto/Manual input.**
- **Manual mode firing rate input.**
- **Pluggable controller to wiring subbase.**
- **Multipurpose communications port.**
- **Field-configurable device.**
- **Integrated boiler shock protection algorithms:**
  - **— Water temperature low fire hold.**
  - **— Stack temperature low fire hold.**
  - **— FGR and low fire hold.**
- **Selectable FGR hold based on stack temperature.**
- **Programmable behavior of FGR actuator during purge.**
- **Maximum modulation limit capability.**
- **Remote reset input.**
- **Automated actuator endpoint seeking process.**
- **UL, FM, CSA, CE Approved, CSD-1 and NFPA acceptable.**

APPLICATION

The R7999 ControLinks™ Controller uses the latest microprocessor-based technology to simultaneously control up to four actuators. The device, when used with the ML7999 Universal Parallel Positioning Actuators, represents a value-added replacement of mechanical cam and linkage assembly controlling the relationship between fuel, airflow and flue gas recirculation (if used) on a power burner. The Honeywell ControLinks™ System consists of the R7999 ControLinks™ Controller, Q7999 Universal Subbase and ZM7999 commissioning software.

The R7999, with one communications port, provides communications capabilities similar to those found in the 7800 SERIES controls.

CONTENTS

65-0238-4

- **Negative/flatline FGR.**
- **Nonvolatile memory stores operating history and current lockout and alarm status.**
- **Six light-emitting diodes (LED) provide:**
    — **System status.**
    — **Fault information.**
    — **Status of four actuator channels.**

Safety Features
- **Class C operating software system.**
- **Fail-safe feedback potentiometer circuitry.**
- **Curve verification algorithms.**

- **Step size enforcement during commissioning.**
- **Point plausibility algorithms.**
- **Password protected.**
- **Weld-resistant algorithm for LCI-LCO contact set.**
- **Dual time base.**
- **Built-in self-test and safety relay circuits.**
- **Component anti-swap protection.**
- **Off curve checking algorithm.**
- **1 million cycle count.**
- **250,000 hour count.**

SPECIFICATIONS

Model:
R7999A,B ControLinks™ Controller, consisting of a four-channel actuator drive Input/Output (I/O) and hardware interface for a variety of burner controllers.

Electrical Ratings:
Input Power:
    R7999A: 100 to 120 Vac (+10/-15%), 50/60 Hz (±10%), 10VA maximum.
    R7999B: 200 to 240 Vac (+10/-15%), 50/60 Hz (±10%), 10VA maximum.
Outputs:
Limit/Control OUT (LCO):
    R7999A: 120 Vac, 8.0A run, 42A inrush (UL).
    R7999A: 120 Vac, 6.0A run; 26A inrush (CE).
    R7999B: 240 Vac, 4.0A run, 26A inrush (CE).
Alarm (ALR):
    R7999A: 120 Vac, 1A pilot duty (UL).
    R7999A: 120 Vac, 1.0A at PF = 0.4, 6A inrush (CE).
    R7999B: 240 Vac, 1.0A At PF = 0.4, 6A inrush (CE).
High Fire (HFP):
    R7999A: 120 Vac, 1A pilot duty (UL)
    R7999A: 120 Vac, 1A at PF = 0.4, 6A inrush (CE).
    R7999B: 240 Vac, 1A at PF = 0.4, 6A inrush (CE).
Light-Off Position:
    R7999A: 120 Vac, 1A pilot duty (UL)
    R7999A: 120 Vac, 1A at PF = 0.4, 6 A inrush (CE).
    R7999B: 240 Vac, 1A at PF = 0.4, 6A inrush (CE).

A-1, F1-1, F2-1, FG-1:
    Source: 4.25 to 5.25V minimum at 5 mA (counterclockwise [CCW] drive command).
    Sinking: 0 to 0.6V maximum at -5 mA (Clockwise [CW] drive command).
A-2, F1-2, F2-2, FG-2:
    Source: 4.25 to 5.25V minimum at 5 mA (Clockwise [CW] drive command).
    Sinking: 0 to 0.6V maximum at -5 mA (Counterclockwise [CCW] drive command).

Inputs:
Limit/Control In (LCI)
    R7999A: 120 Vac, 8A run, 42A inrush (UL).
    R7999A: 120 Vac, 6A run, 26A inrush (CE).
    R7999B: 240 Vac, 4A run, 26A inrush (CE).
Fuel 1 Select (FS1):
    R7999A: 120 Vac at 2 mA (UL/CE).
    R7999B: 240 Vac at 2 mA (CE).
Fuel 2 Select (FS2)
    R7999A: 120 Vac at 2 mA (UL/CE).
    R7999B: 240 Vac at 2 mA (CE).
Remote Reset (RR): 5V at 5 mA.
Feedback Potentiometer input (per channel):
    CW: 5 Vdc at 1 mA.
    S: 5 Vdc at 1 mA.
    CCW: 5 Vdc at 1 mA.

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:
1. Your local Honeywell Automation and Control Products Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care
   1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386
In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Scarborough, Ontario M1V 4Z9.
International Sales and Service Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.

Environmental Ratings:
Temperature Range:
Ambient: -40°F to +140°F (-40°C to +60°C).
Storage: -40°F to +150°F (-40°C to +65°C).
Humidity:
5 to 95 percent relative humidity, noncondensing.
Vibration:
   0.0 to 0.5g continuous (V2 level).

Mounting: Mounts on Q7999 Universal Subbase.

Enclosure: NEMA1/IP40.

Accessories: 32002515-001 Three-Pin Electrical Connector
   (RS-485).
   QM4520A1006 RS-232/RS-485 Converter.
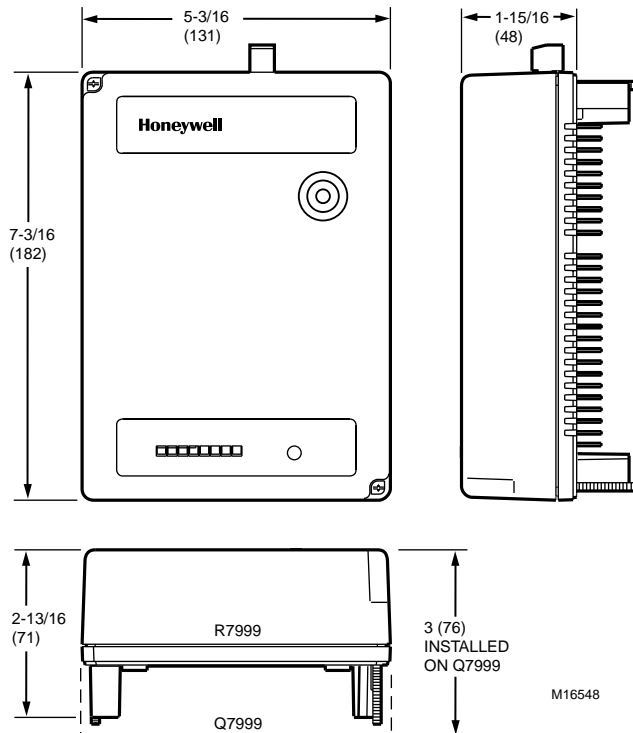   32005354-001 Port Expander.
   S7999A1002 Display Module.

Dimensions: See Fig. 1.

**Fig. 1. Approximate dimensions of R7999
ControLinks™ Controller in in. (mm).**

Weight: 12oz (0.35 kg).

Approvals:
Underwriters Laboratories Inc. (UL)(cUL): Component
   Recognized; File Number MH17367.
Factory Mutual (FM).
CE.
CSD-1 and NFPA: Acceptable.

Required Components:
Q7999 Universal Mounting Subbase.
ML7999 Universal Parallel Positioning Actuators (number
   as required by application).
ZM7999 ControLinks™ Software Configuration Tool.

INSTALLATION

When Installing This Product...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

⚠ WARNING

Electrical Shock Hazard.
Can cause serious injury or death.
Disconnect power supply before installation. More than one disconnect can be required to remove line voltage power completely.

Location

Mount the R7999 on a Q7999 Universal Subbase. The subbase is secured to a panel by four number 8 screws. Secure the R7999 to the subbase by tightening the two captive screws.

WIRING

All wiring for the R7999 is connected to the Q7999 Subbase. There is no direct wiring to the controller. Tables 1 and 2 provide the R7999 input and output terminal descriptions, respectively. Table 3 provides the R7999 maximum field wiring lengths. A block hookup diagram for the ML7999 Actuator is shown in Fig. 2 and a typical wiring diagram is shown in Fig. 4.

Earth Ground

Earth ground is required for proper operation of the ControLinks™ system. Earth ground provides a connection between the subbase and the control panel of the equipment. The earth ground must be capable of conducting enough current to blow the fuse or breaker in the event of an internal short.

1. Use wide straps or brackets to provide minimum length, maximum surface area ground conductors. If a leadwire must be used, use 14 AWG copper wire.
2. Make sure that mechanically tightened joints along the ground path are free of nonconductive coatings and protected against corrosion on mating surfaces.

Shield Ground

Connect the shield ground of the ML7999 Actuator(s), Remote Reset, Manual Potentiometer, Controller 4-to-20 mA and Auxiliary 4-to-20 mA inputs to the earth ground strip provided in the Q7999 Universal Subbase. Connect the shield at the controller end only. See Fig. 2.

Table 1. R7999 Input Terminal Description.

Name (Abbreviation)	Terminal Number	Description
Ground (G)	2	Earth ground.
Line Power (L1)	1	Line Voltage Power: 100 to 120 Vac, 50/60 Hz (R7999A) or 200 to 240 Vac, 50/60 Hz (R7999B), 10 VA maximum power consumption. NOTE: NOTE: The Fuel Air control must be on the same phase as the burner control.
Power Supply Neutral L2 (N)	3	Power Supply Neutral.
High Fire (HF)	10	Purge Position is activated by line voltage ac signal. Upon activation of the input, R7999 commands the air damper to the programmed purge position. NOTE: 120 Vac, 2 mA maximum or 240 Vac 2 mA maximum per device model type. NOTE: NOTE: LF and HF may not be energized at the same time. Operation will be halted if the condition is introduced and will not start if the condition exists at power up.
Main (MV)	11	Main Valve Input, activated by line voltage ac signal. Activation of this input releases the R7999 to position all actuators to the programmed position curve. Maximum values same as High Fire. Improper insertion of the main valve input during the sequence can cause lockouts, recycles or initiate holds.
Auto/Manual (AM)	4	Auto/Manual Input, activated by line voltage ac signal. Activation of this input during the Modulate phase of the RUN state changes the input control variable from the CMA(+/-) to the MNC input. Maximum values same as High Fire.
Low Fire (LF)	12	Low Fire is activated by line voltage ac signal. Upon activation, R7999 commands the air damper to the programmed Light-Off position in addition to causing the selected fuel actuator to move to the light-off position. Maximum values same as High Fire. NOTE: NOTE: LF and HF may not be energized at the same time. Operation will be halted if the condition is introduced and will not start if the condition exists at power up.
Limit/Ctrl In (LCI)	13	Line voltage input that signals limits are satisfied and that a demand exists to run the burner. Provides power to energize Burner Control. Voltage present equates to function selected.
Controller Input (CmA+)	39	Firing Rate input: 4 to 20 mA positive input from temperature or pressure controller.
Controller Input (CmA-)	40	Firing Rate input: 4 to 20 mA negative input from temperature or pressure controller.
Manual Ctrl (MNC)	36/38	Use for manual control potentiometer. Resistance range: 0 to 5000 ohms, ±10%. 200 ohms or less equates to the 4.0 mA controller input. 4500 ohms or more equates to the 20 mA controller input. Use linear interpolation for all other values. Programmable also as the maximum modulation limit, if so configured.
Fuel 1 Select (FS1)	5	Line voltage input that selects fuel 1 when activated. Voltage present equates to function selected.
Fuel 2 Select (FS2)	6	Line voltage input that selects fuel 2 when activated. Voltage present equates to function selected.
Feedback Air Damper (CW) (S) (CCW)	17 18 19	Provides position feedback for the Air actuator: (CW) Clockwise rotational endpoint of the feedback potentiometer. (S) Variable resistance signal from potentiometer. (CCW) Counterclockwise rotational endpoint of the feedback potentiometer.
Feedback Fuel 1 (CW) (S) (CCW)	22 23 24	Provides position feedback for the Fuel 1 Actuator: (CW) Clockwise rotational endpoint of the feedback potentiometer. (S) Variable resistance signal from potentiometer. (CCW) Counterclockwise rotational endpoint of the feedback potentiometer.
Feedback Fuel 2 (CW) (S) (CCW)	27 28 29	Provides position feedback for the Fuel 2 Actuator: (CW) Clockwise rotational endpoint of the feedback potentiometer. (S) Variable resistance signal from potentiometer. (CCW) Counterclockwise rotational endpoint of the feedback potentiometer.
Feedback FGR (CW) (S) (CCW)	32 33 34	Provides position feedback for the FGR Actuator: (CW) Clockwise rotational endpoint of the feedback potentiometer. (S) Variable resistance signal from potentiometer. (CCW) Counterclockwise rotational endpoint of the feedback potentiometer.
Temperature Sensor (XmA+)	37	Configurable Sensor Input: 4 to 20 mA positive input from temperature sensor. For the temperature input application the endpoints are programmable from -40°F to +1400°F. Minimum span must exceed 100°F.
Temperature Sensor (XmA-)	38	Configurable Sensor Input: 4 to 20 mA negative input from temperature sensor.
Remote Reset (RR)	35/38	Remote Reset Input. A cycled contact on this terminal indicates a reset condition. Normally-open momentary switch.

Table 2. R7999 Output Terminal Description.

Name (Abbreviation)	Terminal Number	Description
Limit/Ctrl OUT (LCO)	14	Line voltage output that signals limits are satisfied and that a demand exists to run the burner and R7999 is operational. Provides power to energize Burner Control.
Alarm (ALR)	7	Alarm Output.
High Fire (HFP)[a]	8	High Fire Proved normally open contact is activated when the HF input terminal has been energized and the R7999 has successfully moved the air/fuel damper (and FGR, if so configured) to the programmed Purge Position.
Low Fire (LFP)[a]	9	Low Fire Proved normally open contact is activated when the LF input terminal has been energized and the R7999 has successfully moved the Air, selected fuel, and FGR damper to the programmed Light-Off Position.
A-1	15	A-1: Output when combined with A-2 is used to modulate the Air damper. The resultant push-pull current flow of the two outputs causes the motor to advance, reverse, or hold.
A-2	16	A-2: Output when combined with A-1 is used to modulate the Air damper. The resultant push-pull current flow of the two outputs causes the motor to advance, reverse, or hold.
F1-1	20	F1-1: Output when combined with F1-2 is used to modulate the Fuel 1 valve. The resultant push-pull current flow of the two outputs causes the motor to advance, reverse, or hold.
F1-2	21	F1-2: Output when combined with F1-1 is used to modulate the Fuel 1 valve. The resultant push-pull current flow of the two outputs causes the motor to advance, reverse, or hold.
F2-1	25	F2-1: Output when combined with F2-2 is used to modulate the Fuel 2 valve. The resultant push-pull current flow of the two outputs causes the motor to advance, reverse, or hold.
F2-2	26	F2-2: Output when combined with F2-1 is used to modulate the Fuel 2 valve. The resultant push-pull current flow of the two outputs causes the motor to advance, reverse, or hold.
FG-1	30	FG-1: Output when combined with FG-2 is used to modulate the FGR damper. The resultant push-pull current flow of the two outputs causes the motor to advance, reverse, or hold.
FG-2	31	FG-2: Output when combined with FG-1 is used to modulate the FGR damper. The resultant push-pull current flow of the two outputs causes the motor to advance, reverse, or hold.

[a] HFP and LFP are not fail-safe outputs. Authorities having jurisdiction may require additional contacts on the air damper to prove HFP and LFP.

Table 3. R7999A,B Maximum Wiring Lengths.

Terminal Name	Wiring Length (Maximum)	Wire Type	Minimum/Maximum Wire Size
Ground (G)	Short as possible[a]	[b]	[b]
Line Power (L1)	No Restriction[c]	[b]	[b]
Power Supply Neutral L2 (N)	No Restriction	[b]	[b]
High Fire (HF)	100 Feet	[b]	[b]
Modulate (MOD)	100 Feet	[b]	[b]
Low Fire (LF)	100 Feet	[b]	[b]
Limit/Ctrl Input (LCI)	No Restriction	[b]	[b]
Limit/Ctrl Output (LCO)	No Restriction	[b]	[b]
Controller input (CmA+) Controller input (CmA-)	1000 Feet[d]	Belden 9502, 2-conductor, 100% shield coverage, 300V 80C (UL 2464, CSA PCC FT 4) or equivalent.	18 to 24 AWG
Manual Ctrl (MNC)	10 Feet[d]	Belden 9502, 2-conductor, 100% shield coverage, 300V 80C (UL 2464, CSA PCC FT 4) or equivalent.	18 to 24 AWG
Fuel 1 Select (FS1)	No Restriction	[b]	[b]
Fuel 2 Select (FS2)	No Restriction	[b]	[b]
Actuator Interface (A1, F1-1, F2-1, FG-1) (A2, F1-2, F2-2, FG-2) (CW) (S) (CCW)	100 Feet[d]	Belden 9535, 5-conductor, 100% shield coverage, 300V 80C (UL 2464, CSA PCC FT 4) or equivalent.	18 to 24 AWG
Configurable Sensor (XmA+) Configurable Sensor (XmA-)	1000 Feet[d]	Belden 9535, 2-conductor, 100% shield coverage, 300V 80C (UL 2464, CSA PCC FT 4) or equivalent.	18 to 24 AWG
RS485 DDL Commissioning port	10 Feet[e]		18 to 24 AWG

[a]Use wide straps or brackets to provide minimum length, maximum surface area ground conductors. If a leadwire must be used, use 14 AWG copper wire. Make sure that all mechanically tightened joints along the ground path are free of nonconductive coatings and protected against corrosion on mating surfaces.

[b]Follow local and NEC 1 codes.

[c]Implies no limitations beyond voltage (current times resistance) drop considerations versus wire size constraints.

[d]Requires ground shield at controller end. See Fig. 2, 4.

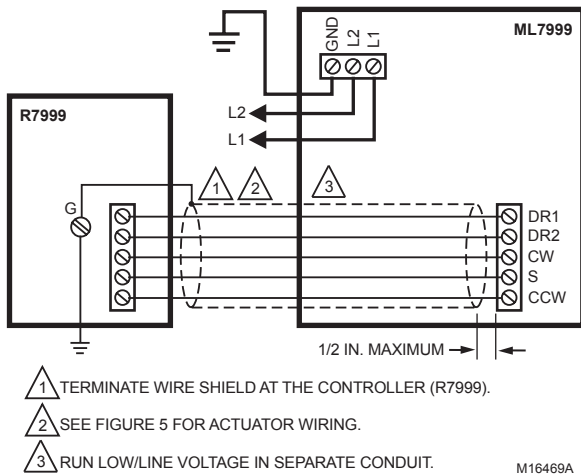[e]Ground shield to digital ground terminal C at controller end and and PC or laptop end.

①TERMINATE WIRE SHIELD AT THE CONTROLLER (R7999).

②SEE FIGURE 5 FOR ACTUATOR WIRING.

③RUN LOW/LINE VOLTAGE IN SEPARATE CONDUIT.

M16469A

Fig. 2. R7999/ML7999 hookup block diagram.

OPERATION

The R7999 ControLinks™ Controller provides communication capabilities similar to those found in the 7800 SERIES equipment. Fault annunciation is available through a connection to the communication data output (DDL). Operating history is kept in nonvolatile memory as is the current lockout status.

The ZM7999 ControLinks™ Commissioning Software tool is necessary for the field commissioning prior to operation. Refer to the configuration software help screens for commissioning procedures.

The R7999 ControLinks™ Controller tracks the firing rate input value and drives the ML7999 Actuators according to the commissioned profile and maintains the relative programmed positions.

⚠ WARNING

Explosion Hazard.
Improper configuration can cause fuel buildup and explosion.
The ZM7999 ControLinks™ Commissioning Software is to be used only by experienced and/or licensed burner-boiler operators and mechanics.

Operators of this software may move fuel and/or air actuators to positions that can create hazardous burner conditions. Improper user operation can result in property loss, physical injury or death.

The R7999 must go through an Initiate state whenever the fuel select switch is changed.

The R7999 has the following operating states:

1. Non-Configured State. The controller is shipped from the factory in this condition and will not respond to any input other than the DDL port (configuration tool port).

2. Commissioning State. The controller enters this state once communications with a configuration tool is established. Actuators are placed in pseudo-manual control mode during this state. Commands from the configuration software increment or decrement motor positions. The R7999 write the values for the valve and damper positions, as a function of firing rate, during this state.

3. Initiate State. This state exists for a minimum of ten seconds after an internally- or externally-initiated reset. The R7999 performs internal checks during this state.

4. Standby State. This state occurs whenever the LCI input (terminal 13) is not active. All actuators move to the Programmed Standby Stop Position (PSTP) or return to the light-off position, except for the FGR actuator, which moves to the closed position.

5. Processing Demand State. The R7999 enters this state when the LCI has just become active. The R7999 makes sure the firing rate command inputs are valid before advancing to the next state.

6. Run State. The R7999 enters this state when the LCI input is active. The high fire or low fire command from the burner control causes the air actuator and the FGR actuator (if configured) to drive to the purge or light-off positions, respectively. The selected fuel, air and FGR actuators track the firing rate input versus the programmed profile once the main valve terminal is energized.

7. Lockout State. The R7999 enters this state when critical internal faults are detected. The controller retains the lockout state via nonvolatile memory. To exit this state, press the reset button.

8. Alarm Initiate State. Essentially an Initiate state, except that the alarm terminal is energized. A controller will remain in this state as long as the fault exists. The R7999 will automatically restart once the fault is removed. The user may restart the system by pressing the Reset button.

Normal operating sequence for the R7999 is: Initiate (ac power up or internal or external reset), Standby, Processing Demand and Run. The Non-Configured State may also occur.

An LED status panel provides visual status of the operating condition of the R7999 and associated components. See Fig. 3. Table 4 provides the LED condition and meaning. Table 5 provides the Channel Status LED condition and meaning.

At power up, all LED will automatically turn on to verify operation.

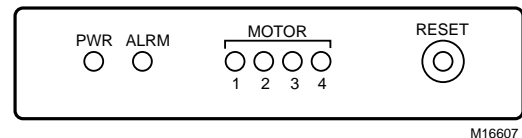If all LED remain on, make sure one fuel select input is made, not two or zero.

Fig. 3. LED Status Panel.

Table 4. R7999 Status LED Blink Patterns.

Power (Green) LED State	Meaning
Always Off	Control has failed, or has no power.
Always On	Control cannot run or communicate until a critical fault has been corrected. This state occurs at each power up or reset. Control is in the Initiate State or Alarm Initiate State or Alarm Hold State. Check that only one fuel has been selected, or that HF and LF are not active at the same time. If HF and LF are active at the same time, the red LED will also be on.
1 short blink every interval	Control is in Postpurge or Standby State.
2 short blinks every interval	Control is in a low voltage condition.
3 short blinks every interval	Control is in the non-configured state.
4 short blinks every interval	Control is in the commissioning state.
Steady medium blink	Control is in the Run State.
Steady fast blink	Control is in manual mode.

A red LED, normally off, indicates a Lockout State when lit.

Table 5. R7999 Channel Status LED Blink Patterns.

Motor (Amber) LED State[a]	Meaning
Always Off	Actuator is not being commanded to move or is not configured.
On	Actuator is in motion.
1 short blink every interval.	Actuator Failure: Failed timing plausibility check.
2 short blinks every interval.	Actuator Failure: Failed actuator ID process.
3 short blinks every interval.	Actuator Failure: Analog/Digital reading of potentiometer out of range.
4 short blinks every interval	Actuator Failure: Potentiometer failure—wiper resistance.
Medium speed blink.	Actuator Warning: Wiper resistance high.

a The four amber motor LED provide status for the individual ML7999 Actuators; e.g., Motor 1 LED is Air Actuator Status, Motor 2 LED is Fuel 1 Actuator Status, Motor 3 LED is Fuel 2 Status, and Motor 4 LED is FGR Actuator Status.

Manual Operation

Place the R7999 in a manually commanded firing rate condition by applying a line voltage signal to terminal 4. The R7999 will derive the desired firing rate control position by the value of the resistance set at terminal 35/36. A 200-ohm value equals minimum modulation; 4500 ohms equals maximum modulation. Linear interpolation exists for all other values.

Commissioning Process

The primary tasks to be accomplished by the commissioning process are as follows:
1. Establish the endpoints of each actuator within the system.
2. Establish the purge position.
3. Establish the lightoff position.
4. Establish minimum and maximum modulation positions.
5. Establish a fuel, air, FGR mixture profile for up to 20 points between the minimum and maximum modulation points for each fuel source within the system.

The commissioning process requires the use of the ZM7999 ControLinks™ Commissioning Software running on a laptop or PC with a minimum operating system of Windows 95. Additional minimum requirements include a Pentium® class processor, or equivalent, with 16megabytes of RAM and a one gigabyte hard drive with 100 megabytes of free hard drive memory. The PC or laptop must have a RS232-to-RS485 converter to communicate with the R7999. Shielded cable is recommended as interface wiring. Fig. 4. shows the 32005354-001 Port Expander RS-232 to RS-485 hookup information.

The R7999 requires the presence of one of the Fuel Select inputs to start communications with the ZM7999 ControLinks™ Commissioning Software. Additional wiring interface requirements include that HF and LF command inputs cannot be activated at the same time.

NOTE: A stack gas analyzer is required to commission the ControLinks™ Control System.

The PC or laptop must have a serial or USB port and an RS-232 to RS-485 converter to communicate with the R7999. If using a USB port, a Keyspan® or Belkin® USB to RS-232 converter is recommended.
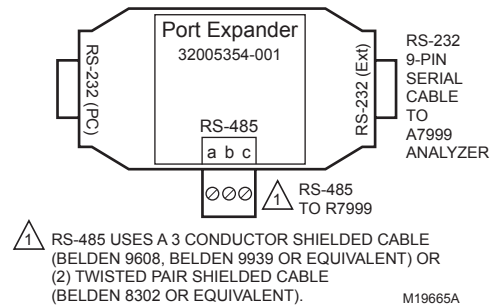

Fig. 4. Connecting the 32005354-001 Port Expander to the R7999 ControLinks™ Controller and the laptop PC.

Table 6. RS-485 to R7999 Hookup Data.

RS-485	Connects to R7999
Data+	A
Data-	B
Ground	C

Fig. 5 provides a standard block hookup diagram for the R7999 and associated equipment.

CHECKOUT AND TROUBLESHOOTING

Fault Codes

The R7999 ControLinks™ Controller is designed so that only an unrecoverable internal related fault will cause lockout. The R7999 will recycle when specific external problems are detected and then cleared.

When the R7999 locks out, obtain the fault code (a repeating series of blinks from the POWER LED) by pressing and holding the Reset button or using a laptop in monitor or commissioning mode. To interpret the LED flashes, for example, a Fault 11 would be one slow blink and one fast blink, while a Fault 67 would be six slow blinks followed by seven fast blinks.

See Table 7 for fault codes and descriptions.

M16550E
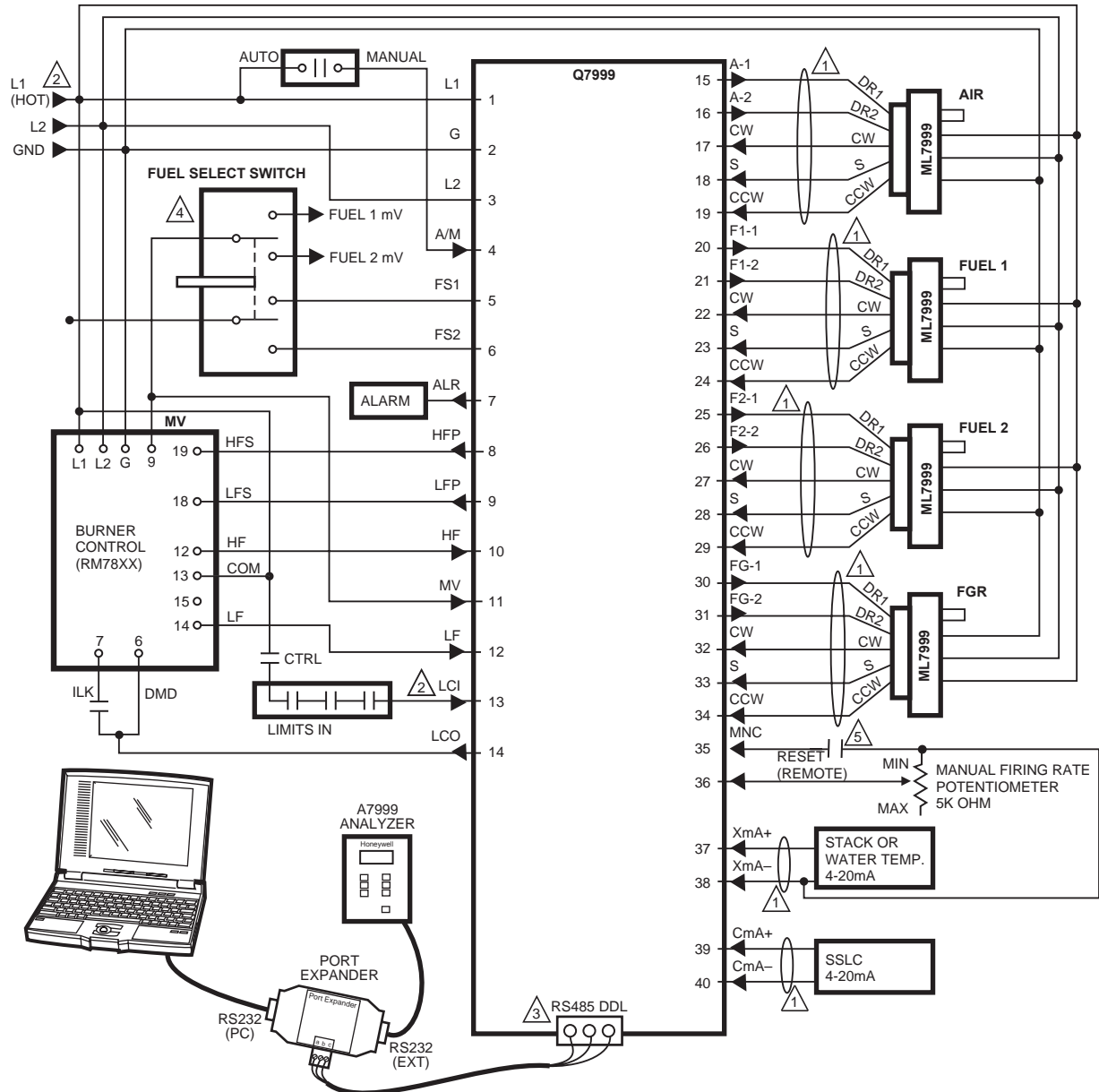
1. GROUND SHIELD TO SUBBASE EARTH GROUND SCREW ON LOW VOLTAGE SIDE OF SUBBASE.

2. FUSE LINE VOLTAGE TO CONTROL SYSTEM WITH TYPE SC15 FUSE OR FUSE LIMIT INPUT WITH TYPE SC5 FUSE.

3. RS-485 DDL CONNECTOR IS ON R7999 CONTROLLER.

4. MUST USE APPROVED FUEL SELECT SWITCH (CENTER OFF POSITION).

5. NORMALLY OPEN MOMENTARY SWITCH.

Fig. 5. Hookup block diagram—R7999 and associated equipment.

Table 7. Fault Listings and Descriptions.

Fault/ Blink Code	Description	Corrective Action
11	Device is operating properly.	
13	MV input energized at an improper time.	Reset control. Check Burner Control Interface wiring and correct error. This error causes the device to remain in initiate state at power up.
14	HF and LF are energized at the same time.	Reset control. Check Burner Control Interface wiring and correct error. This error causes the device to remain in initiate state at power up.
15	Transition to the requested Burner Control input state is not allowed from the current state. E.g. Standby to Modulate is not allowed.	Reset control. Check wiring to burner control and/or burner control operation. NOTE: NOTE: Moving a RM7800 Run/Test switch to Test will induce this fault during commissioning mode.
21	Internal error—Time Base.	Reset control[a]
22	Internal error—Safety relay.	Reset control[a]
23	Internal error—Safety relay.	Reset control[a]
24	Internal error—Time storage.	Reset control.[a]
25	Internal error—Limited move.	Reset control.[a,c]
26	Internal error—Targeted move.	Reset control.[a,c]
27	Internal error—LVD.	Reset control.[a]
28	Internal error—ISR check.	Reset control.[a]
31	Internal fault—A2D Range.	Reset control.[a] Check actuator wiring; see Channel LED for actuator at fault.
32	Internal fault—A2D cross-matching error.	Reset control.[a]
33	Internal fault—LCO Drive.	Reset control.[a]
34	Internal fault—LCO/I Feedback.	1. Reset control[b]. 2. Terminal 14 has voltage present from external source; correct wiring error. 3. Make sure that short does not exist at terminal 14. Control will need replacement if a sustain fault code 34 exists after steps 1, 2 and 3 are performed.
35	Internal fault—	Reset control.[a]
36	Fuel selection error.	1.Check wiring through fuel select switch. Only one fuel can be selected at any one time. This error causes the device to remain in initiate state. 2. No fuel selected. Correct by selecting fuel.
37	Fault—HFP or LFP output.	Verify correct wiring to burner control; specifically check wiring at LFP and HFP.
38	Internal Fault—Memory curve.	Reset control.[a]
39	Internal Fault—AC sampling.	Reset control.[a]
41	Feedback potentiometer Interface circuit fault—Air.	Verify correct wiring of potentiometer.[a]
42	Feedback potentiometer Interface circuit fault—Fuel 1.	Verify correct wiring of potentiometer.[a]
43	Feedback potentiometer Interface circuit fault—Fuel 2.	Verify correct wiring of potentiometer.[a]
44	Feedback potentiometer Interface circuit fault—FGR.	Verify correct wiring of potentiometer.[a]
45	Feedback potentiometer wiper resistance problem—Air.	Check for loose potentiometer wiring.[a,c]

[a] It is possible that a random external electrical noise has caused a fault checking algorithm to be detected. Resetting the control will allow recalculation of the fault and, if it is not a hard failure, the device will continue to operate. If the condition will not clear, the device must be replaced.

[b]Check ac waveform; severe noise on ac lines can corrupt sampling of ac signals.

[c]Verify actuator total resistance and wiper measurements; check the ability of the actuator to travel full stroke using the manual override buttons in the actuator. Verify input power to the actuator. if actuator is not functioning, replace the actuator.

Table 7. Fault Listings and Descriptions. (Continued)

Fault/ Blink Code	Description	Corrective Action
46	Feedback potentiometer wiper resistance problem—Fuel 1.	Check for loose potentiometer wiring.[a,c]
47	Feedback potentiometer wiper resistance problem—Fuel 2.	Check for loose potentiometer wiring.[a,c]
48	Feedback potentiometer wiper resistance problem—FGR.	Check for loose potentiometer wiring.[a,c]
49	Feedback potentiometer total resistance problem—Air.	Check for loose potentiometer wiring.[a,c]
51	Feedback potentiometer total resistance problem—Fuel 1.	Check for loose potentiometer wiring.[a,c]
52	Feedback potentiometer total resistance problem—Fuel 2.	Check for loose potentiometer wiring.[a,c]
53	Feedback potentiometer total resistance problem—FGR.	Check for loose potentiometer wiring.[a,c]
54	Internal memory function problem—Air.	Repeat actuator ID on-line process.
55	Internal memory function problem—Fuel 1.	Repeat actuator ID on-line process.
56	Internal memory function problem—Fuel 2.	Repeat actuator ID on-line process.
57	Internal memory function problem—FGR.	Repeat actuator ID on-line process.
58	Stuck Reset button.	Turn off remote reset switch; check operation of controller reset button.
61	Actuator(s) not reaching lightoff point.	Check for actuator wiring problems or stuck valves or dampers. Place controller in standby and use actuator manual keys to verify actuator travel.
65	Internal memory fault.	Reset control.[a]
66	Internal Initialization Error.	Reset control.[a]
67	Fuel actuator off curve (selected fuel type).	Check for stuck fuel actuator and/or proper shielding on actuator interface.
68	FGR actuator off curve.	Check for stuck FGR actuator and/or proper shielding on actuator interface.
69	Air actuator off curve.	Check for stuck air actuator and/or proper shielding on actuator interface.
71	Verifies that the Air actuator accepted the offline, online, move counter-clock-wise and move clock-wise commands. Furthermore, all potentiometer tests must be successfully passed to bring an actuator online.	Check wiring of actuator, verify correct ID is being used. Watch actuator LED to verify that the actuator is being brought online. A fast flash in the actuator equals offline status, while a one-second flash equals online status.
72	Verifies that the Fuel 1 actuator accepted the offline, online, move counter-clock-wise and move clock-wise commands. Furthermore, all potentiometer tests must be successfully passed to bring an actuator online.	Check wiring of actuator, verify correct ID is being used. Watch actuator LED to verify that the actuator is being brought online. A fast flash in the actuator equals offline status, while a one-second flash equals online status.
73	Verifies that the Fuel 2 actuator accepted the offline, online, move counter-clock-wise and move clock-wise commands. Furthermore, all potentiometer tests must be successfully passed to bring an actuator online.	Check wiring of actuator, verify correct ID is being used. Watch actuator LED to verify that the actuator is being brought online. A fast flash in the actuator equals offline status, while a one-second flash equals online status.
74	Verifies that the FGR actuator accepted the offline, online, move counter-clock-wise and move clock-wise commands. Furthermore, all potentiometer tests must be successfully passed to bring an actuator online.	Check wiring of actuator, verify correct ID is being used. Watch actuator LED to verify that the actuator is being brought online. A fast flash in the actuator equals offline status, while a one-second flash equals online status.
75	Internal memory fault.	Reset control.[a]
76	Internal checksum error.	Reset control.[a]
82	Actuator secondary fault.	Check actuator wiring. See Channel LED for actuator.
83	Air actuator nonresponsive.	Check actuator wiring and stuck damper/valve.[c]

[a] It is possible that a random external electrical noise has caused a fault checking algorithm to be detected. Resetting the control will allow recalculation of the fault and, if it is not a hard failure, the device will continue to operate. If the condition will not clear, the device must be replaced.

[b] Check ac waveform; severe noise on ac lines can corrupt sampling of ac signals.

[c] Verify actuator total resistance and wiper measurements; check the ability of the actuator to travel full stroke using the manual override buttons in the actuator. Verify input power to the actuator. if actuator is not functioning, replace the actuator.

Table 7. Fault Listings and Descriptions. (Continued)

Fault/ Blink Code	Description	Corrective Action
84	Fuel 1 actuator nonresponsive.	Check actuator wiring and stuck damper/valve.[c]
85	Fuel 2 actuator nonresponsive.	Check actuator wiring and stuck damper/valve.[c]
86	FGR actuator nonresponsive.	Check actuator wiring and stuck damper/valve.[c]
87	Internal math error.	Reset control.[a]
91	The 4 to 20 mA firing rate input is below 3 mA, Out of Range—Low. (Actuators return to or remain at the minimum modulation point with the alarm on; the control remains operational only to the extent that Minimum Modulation firing operation is allowed.)	Check CmA+-input (Terminals 39 and 40) for proper operation polarity and range. The input must be within 3.0 mA to 21.0 mA. The voltage at this terminal must be within 0.7 to 5.0 Vdc, respectively. Conditional Alarm—Alarm output is energized; controller continues to run.
92	The manual potentiometer rate input is higher than an allowable range, i.e., Out of Range—High. (The actuators move to the maximum modulation point with alarm ON, control will remain operable, yet when MANUAL MODE is selected, maximum modulation and alarm output shall occur.) Auto mode operation is **not** affected.	The Manual potentiometer is out of range high. Make sure a 5000 ohm (±10%) potentiometer is being used and wiring to it is correct. Shielded cable is recommended. Conditional Alarm—Alarm output is energized; controller continues to run.
93	The auxiliary 4-20 mA input must be below 3.0 mA when configured for use. (The actuators return or remain at the minimum modulation point with alarm ON, the control will remain operable only to the extent that Minimum Modulation firing operation is allowed.)	Check XmA+- input (Terminals 37and 38) for proper operation polarity and range. The input must be within 3.0 mA to 21.0 mA. The voltage at this terminal must be within 0.7 to 5.0 Vdc respectively. Conditional Alarm—Alarm output is energized; controller continues to run.
94	After LCO is set by the R7999, the Burner Control must provide a Lightoff or Purge request within 20 seconds. (Controller remains in a processing demand condition indefinitely waiting for valid inputs on the LF, MV and HF inputs; the alarm is sounded after the 20-second period expires.)	Check burner control interface wiring and burner control operation (Terminals 10, 11, 12). The R7999 is waiting for a command via these terminals. Conditional Alarm—Alarm output is energized; controller continues to run.

[a] It is possible that a random external electrical noise has caused a fault checking algorithm to be detected. Resetting the control will allow recalculation of the fault and, if it is not a hard failure, the device will continue to operate. If the condition will not clear, the device must be replaced.

[b] Check ac waveform; severe noise on ac lines can corrupt sampling of ac signals.

[c] Verify actuator total resistance and wiper measurements; check the ability of the actuator to travel full stroke using the manual override buttons in the actuator. Verify input power to the actuator. if actuator is not functioning, replace the actuator.

Wiring Checkout and Error Faults

The ZM7999 commissioning and monitoring tools provides an effective means of an indirect status reading of all line voltage inputs and outputs. Use these tools to confirm wiring. The commissioning tool and monitoring tool environments require that a single fuel select input to be active before proceeding with communications between the tool and controller. Further, simultaneous HF and LF commands from the burner are not allowed and will preclude communications with the tools.

The act of bringing actuators successfully "on-line" verifies the initial wiring between the controller and actuators. See error codes 71 through 74 and/or 54 through 57 for details. Other wiring problems occurring between the actuators and controller, after commissioning, may be annunciated by fault codes 41 through 53 or 61,67,68,69 or 82 through 86.

Burner control wiring interface problems are annunciated by fault codes 13, 14, 15, 34, 37.

The Q7999 Universal Subbase is partitioned into a line voltage section and a low voltage section. Utilize shielded cabling on all low voltage wiring. Keep the earth ground cable shield short as possible for all interface wiring as illustrated by Figure 2.

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