WOODWARD

Product Manual 40152
(Revision E, 8/2013)
Original Instructions

EM-35
Analog Driver

Installation and Operation Manual

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:

www.woodward.com/publications

The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.

Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

Revisions—Changes in this publication since the last revision are indicated by a black line alongside the text.

Manual 40152

Contents

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Important Definitions

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

⚠WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE

Battery Charging Device

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Regulatory Compliance

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, and D or non-hazardous locations only.

This equipment is suitable for use in Class I, Division 1, or Zone 1 applications when placed in an approved explosion-proof enclosure (see Figure 3-2).

Units installed in an approved explosion-proof enclosure must be wired in accordance with Class I, Division 1, or Zone 1 wiring methods and in accordance with the authority having jurisdiction.

Wiring must be in accordance with Class I, Division 2 wiring methods and in accordance with the authority having jurisdiction.

Connect the ground terminal to earth ground.

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division or Zone applications.

⚠AVERTISSEMENT

RISQUE D'EXPLOSION—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, applications Division ou Zone.

Chapter 1.
General Information

Description

This manual describes the installation, calibration and operation of the EM-35 analog driver. The EM (electric motor) 35 driver is an electric actuator driver for use with a three-phase, brushless, dc motor. The electric motor/actuator operates a rotary fuel metering valve.

The EM-35 analog driver is housed in a watertight, corrosion resistant sheet metal enclosure. Optionally, it can be ordered in a Class 1, Division 1, Groups C and D, explosion proof enclosure.

EM-35 Analog Driver Operation

The driver contains an analog position controller that receives a demand signal via a 4–20 mA input. The feedback signal is generated by a brushless resolver that is mounted on the fuel metering valve. The resolver is excited with a 1 kHz signal and its output is modulated by the rotation of the valve. The resolver output is demodulated by a R/D converter. A 4–20 mA output is provided, permitting an external device to monitor the feedback signal.

The remote driver contains the brushless dc motor driver which must be located within 30 m (100 ft) of the actuator/valve assembly. This is necessary to maintain a high quality position sensing signal that controls the commutation of the motor. A brushless, three phase position sensor (field director) provides this signal at the high ambient temperatures expected at the valve (149 °C/300 °F).

An analog velocity controller is used to reduce the effect of friction in the valve. A brushless, three phase tachometer is mounted on the motor shaft before the gearbox. The ac tachometer signal is demodulated using the commutation signals to provide the velocity feedback.

The driver contains fault detection circuitry which provides the status of the 4–20 mA interface, position controller, driver and feedback to the shutdown logic. Any fault condition or an external shutdown command will disable the output (removing power to the motor) and the valve return spring will close the valve. An override input is provided to temporarily disable a shutdown caused by a position error or demand input fault during start-up.

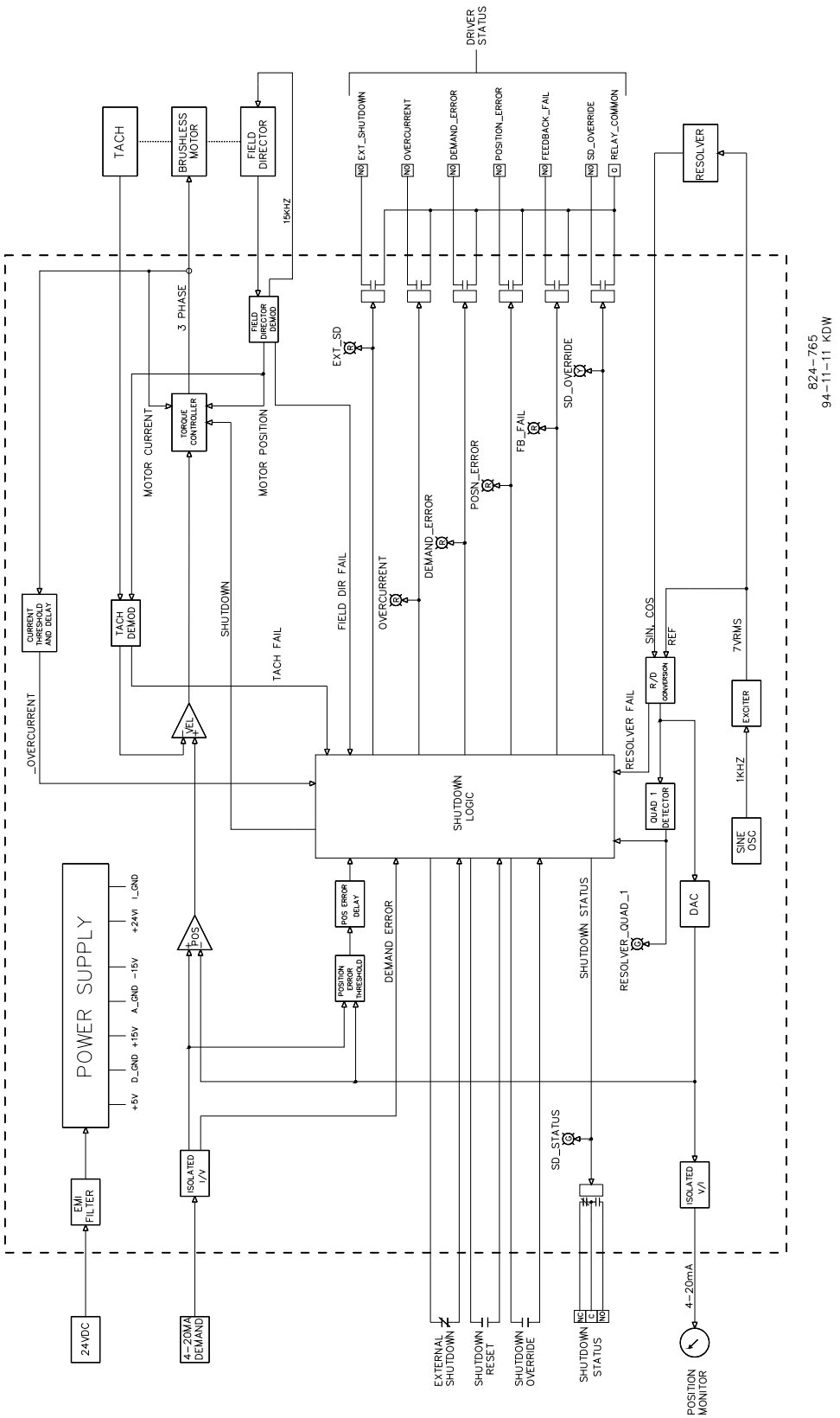


Figure 1-1. EM-35 Analog Driver Functional Block Diagram

Chapter 2.
Installation

Unpacking

Be careful when unpacking the EM-35 driver. Check the devices for signs of damage such as bent or dented case and loose or broken parts. If damage is found, notify the shipper immediately. The devices may be stored in their original shipping containers until they are ready for installation. Protect the devices from weather and from extreme humidity or temperature fluctuations during storage.

Power Requirements

The EM-35 driver requires a 28 Vdc, 25 A input power supply. The maximum steady state driver input current is 4.5 A continuous with 25 A peaks for 50 ms.

Location Considerations

Carefully study this chapter before choosing a location for the EM-35 driver. Wiring and grounding considerations may influence the selection of a location for the device.

Consider the following general requirements when selecting the location:

- Adequate ventilation for cooling
- A location that will provide an operating temperature range of –20 to +60 °C (–4 to +140 °F)
- Space for servicing
- Protection from direct exposure to sunlight, water, or to a condensation prone environment
- Protection from high-voltage or high-current devices which produce electromagnetic interference
- Avoidance of vibration

See Figure 2-1 for the overall dimensions and mounting hole locations for the EM-35 Driver standard enclosure and Figure 2-2 for the explosion proof version.

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division or Zone applications.

⚠AVERTISSEMENT

RISQUE D'EXPLOSION—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, applications Division ou Zone.

IMPORTANT

To maintain the IP56 rating of the enclosure, conduit hubs shall be installed on gland plates and shall be CSA or UL Certified as Type 4 or IP56.

Electrical Connections

Shielded Wiring

All shielded cable must be twisted conductor pairs with either a foil or a braided shield and should not exceed 164 pF/m (50 pF/ft). All signal lines should be shielded to prevent picking up stray signals from adjacent equipment. Connect the shields as shown in the plant wiring diagram (Figure 2-3). Wire exposed beyond the shield must not exceed two inches. The other end of the shield must be left open and insulated from any other conductor. Do not run shielded signal wires with other wires carrying large currents. See manual 50532, *EMI Control for Electronic Governing Systems*, for more information.

Installations with severe electromagnetic interference (EMI) may require shielded cable run in conduit, double shielded wire, or other precautions. Contact Woodward for more information.

Plant Wiring

Figure 2-3 is the plant wiring diagrams for the EM-35 driver when conduit is used for all wire runs. If conduit is not used, the shields from all of the cables (with the exception of the motor shield) must be connected to the ground studs or ground screws in the bottom of the chassis. The wiring between the EM-35 driver and the EM actuator and resolver must be limited to 30 m (100 ft) and must be low capacitance (46 pF/m or 14 pF/ft) cable where indicated in Figure 2-3. If the resolver cable length is less than 6 m (20 ft), standard shielded cable may be used, but should not exceed 164 pF/m (50 pF/ft).

Power wiring between the motor and the driver must be three conductor, 5.0 mm^2 (10 AWG), shielded wire to prevent EMI emissions. The shields must be terminated to the ground screw in the motor wiring cavity and to the terminal block in the driver chassis. This wiring must not exceed 30 m (100 ft) maximum length, to minimize voltage drop. Any extra motor wire in the installation should be cut off and discarded, not coiled.

IMPORTANT **Units installed in an approved explosion-proof enclosure must be wired in accordance with Class I, Division 1, or Zone 1 wiring methods and in accordance with the authority having jurisdiction.**

IMPORTANT **Coiled wire will cause an inductance which could be greater than that of the motor.**

Driver Calibration

Minimum and maximum flow calibration is achieved using the resolver feedback. In order to make drivers interchangeable, four simple adjustments are needed during field installation. No field rigging is required. If you have difficulty calibrating the driver, call Woodward.

IMPORTANT **DO NOT attempt to adjust the resolver or potentiometers R26 or R34.**

Use the four following procedures to calibrate your EM-35 analog driver (refer to Figure 2-4):

Demand Calibration

1. Shut down driver using external shutdown.
2. Connect a voltmeter between TP25 and AGND.
3. For demand = 4.00 ±0.01 mA, adjust R165 for TP25 = minimum flow voltage *.
4. For demand = 20.00 ±0.02 mA, adjust R166 for TP25 = maximum flow voltage *.
5. Repeat the last two steps to check for adjustment interaction.

* These voltages are recorded during valve calibration. The test data is supplied with each valve.

Monitor Calibration

1. Shut down driver using external shutdown.
2. Connect a mA meter to the monitor output.
3. Note normal position of calibrate meter jumper (JPR 8).
4. Move CAL MON Jumper to "CAL" location (JPR 7).
5. Observe that DS9 turns on.
6. Connect a voltmeter between TP10 and AGND.
7. For demand = 4.00 ±0.01 mA, adjust R160 for TP10 = 0.00 ±0.01 V.
8. For demand = 4.00 ±0.01 mA, adjust R169 for output = 4.00 ±0.01 mA.
9. For demand = 20.00 ±0.02 mA, adjust R130 for output = 20.00 ±0.01 mA.
10. Repeat the last two steps to check for adjustment interaction.
11. Move CAL MON jumper to JPR8.
12. Observe that DS9 turns off.

Position Error Threshold Calibration

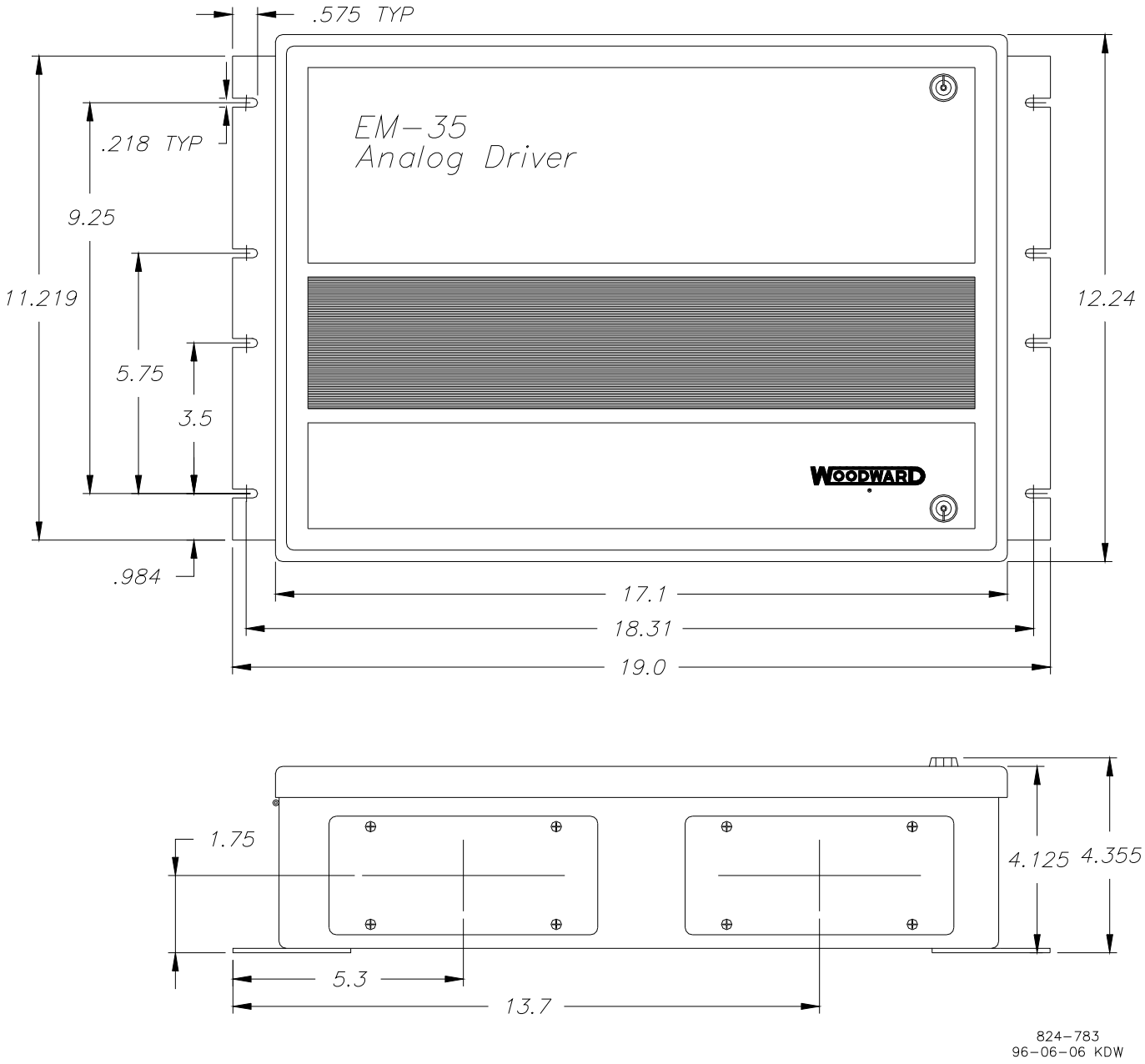
1. Activate reset switch continuously during this procedure.
2. Place a jumper across R9 on the control board.
3. Shut down driver using external shutdown.
4. Connect a voltmeter between TP25(+) and TP30(–) AGND.
5. Adjust demand for TP25 (+) and TP30(–) = desired positive threshold *.
6. Adjust R55 until DS3 turns on (this only has to be adjusted once).
7. Adjust demand for TP25(+) and TP30(–) = desired negative threshold *.
8. Observe that DS3 turns on.

* Typically 1.5% of valve travel is recommended, which is approximately 0.200 Vdc. However, it can be set to whatever range the end user desires.

Dither Adjustment

1. Adjust demand to 4.0 ±0.1 mA.
2. Enable driver using reset and override.
3. Insert a screwdriver through the slot in the motor/valve mounting adapter and hold it against the coupling.
4. Rotate R78 CW to determine the feel of the dither.
5. Rotate R78 CCW until the dither movement is just perceptible.

IMPORTANT **Do not adjust potentiometers R26 or R34. A resolver angle position indicator is required for this calibration and they are pre-set at the factory.**



NOTES:
1. RECOMMENDED MOUNTING DIMENSIONS FOR #10 HARDWARE.

Figure 2-1. EM-35 Driver Outline Drawing

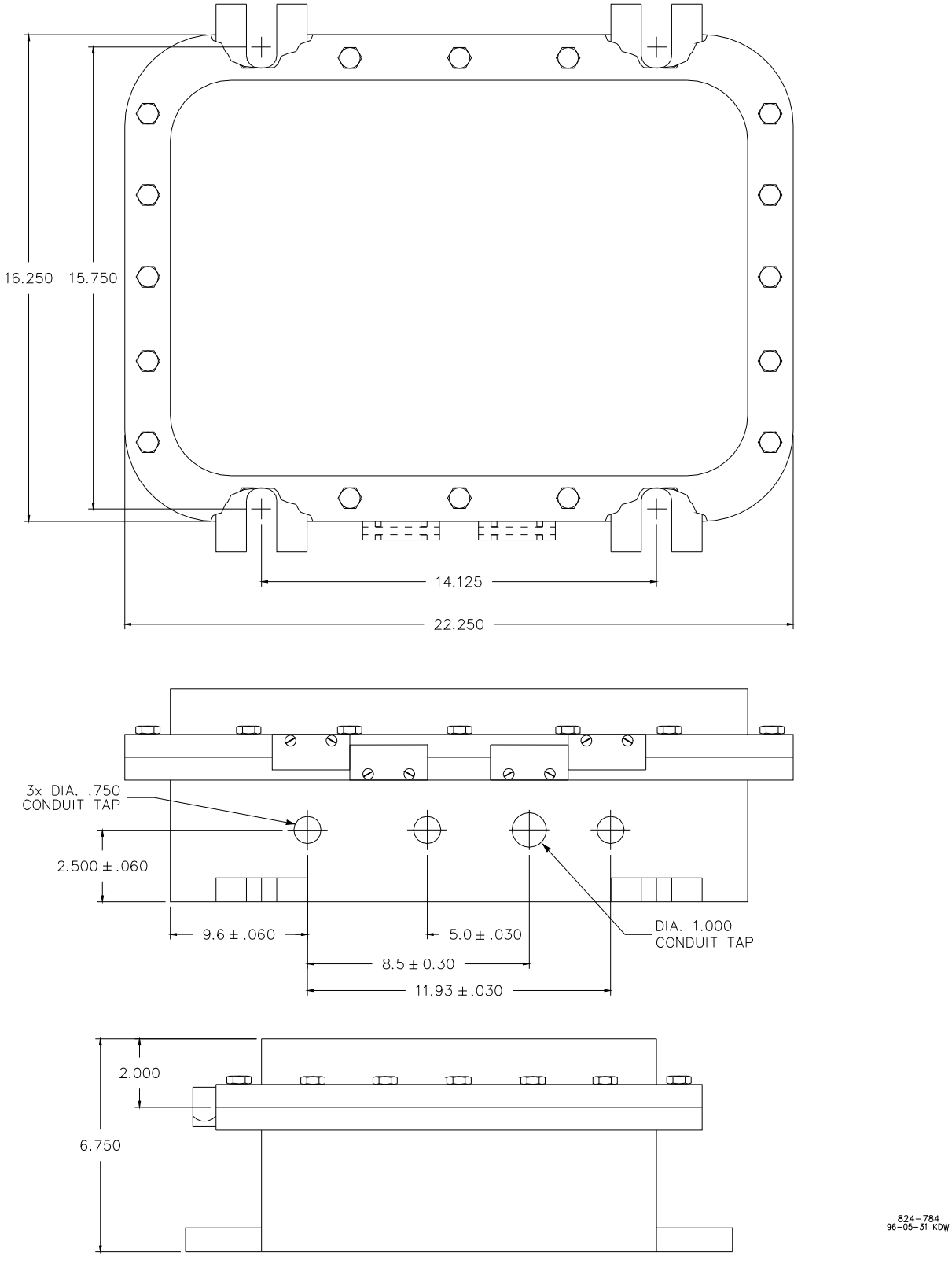
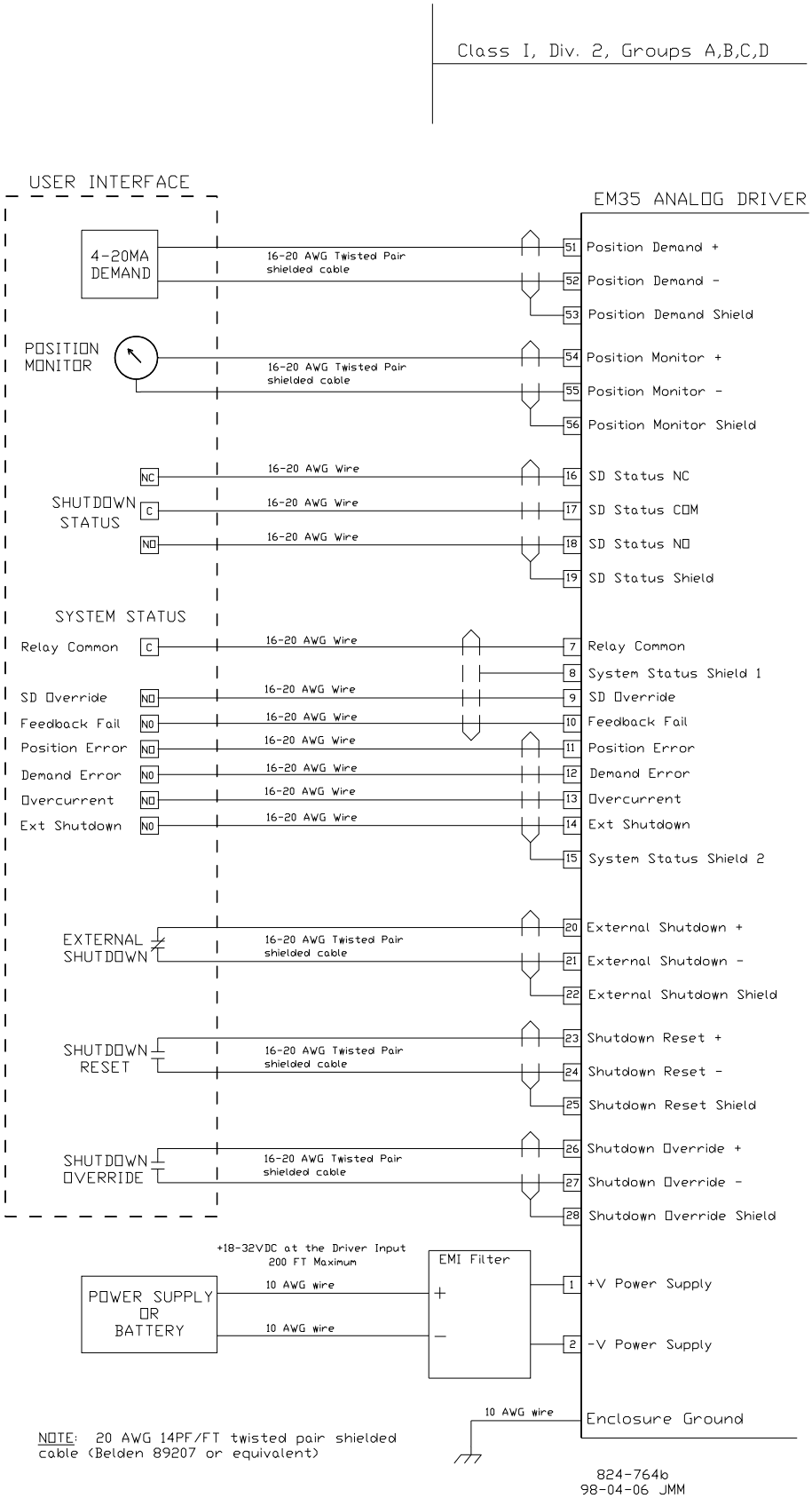


Figure 2-2. EM-35 Outline Drawing (Explosion Proof)


Class I, Div. 2, Groups A,B,C,D
USER INTERFACE
EM35 ANALOG DRIVER
4-20MA DEMAND
16-20 AWG Twisted Pair shielded cable
51 Position Demand +
52 Position Demand -
53 Position Demand Shield
POSITION MONITOR
16-20 AWG Twisted Pair shielded cable
54 Position Monitor +
55 Position Monitor -
56 Position Monitor Shield
SHUTDOWN STATUS
NC
C
NO
16-20 AWG Wire
16 SD Status NC
17 SD Status COM
18 SD Status NO
19 SD Status Shield
SYSTEM STATUS
Relay Common
7 Relay Common
8 System Status Shield 1
SD Override
Feedback Fail
Position Error
Demand Error
Overcurrent
Ext Shutdown
9 SD Override
10 Feedback Fail
11 Position Error
12 Demand Error
13 Overcurrent
14 Ext Shutdown
15 System Status Shield 2
EXTERNAL SHUTDOWN
16-20 AWG Twisted Pair shielded cable
20 External Shutdown +
21 External Shutdown -
22 External Shutdown Shield
SHUTDOWN RESET
16-20 AWG Twisted Pair shielded cable
23 Shutdown Reset +
24 Shutdown Reset -
25 Shutdown Reset Shield
SHUTDOWN OVERRIDE
16-20 AWG Twisted Pair shielded cable
26 Shutdown Override +
27 Shutdown Override -
28 Shutdown Override Shield
+18-32VDC at the Driver Input
200 FT Maximum
EMI Filter
POWER SUPPLY OR BATTERY
10 AWG Wire
10 AWG Wire
1 +V Power Supply
2 -V Power Supply
10 AWG Wire
Enclosure Ground
NOTE: 20 AWG 14PF/FT twisted pair shielded cable (Belden 89207 or equivalent)
824-764b
98-04-06 JMM

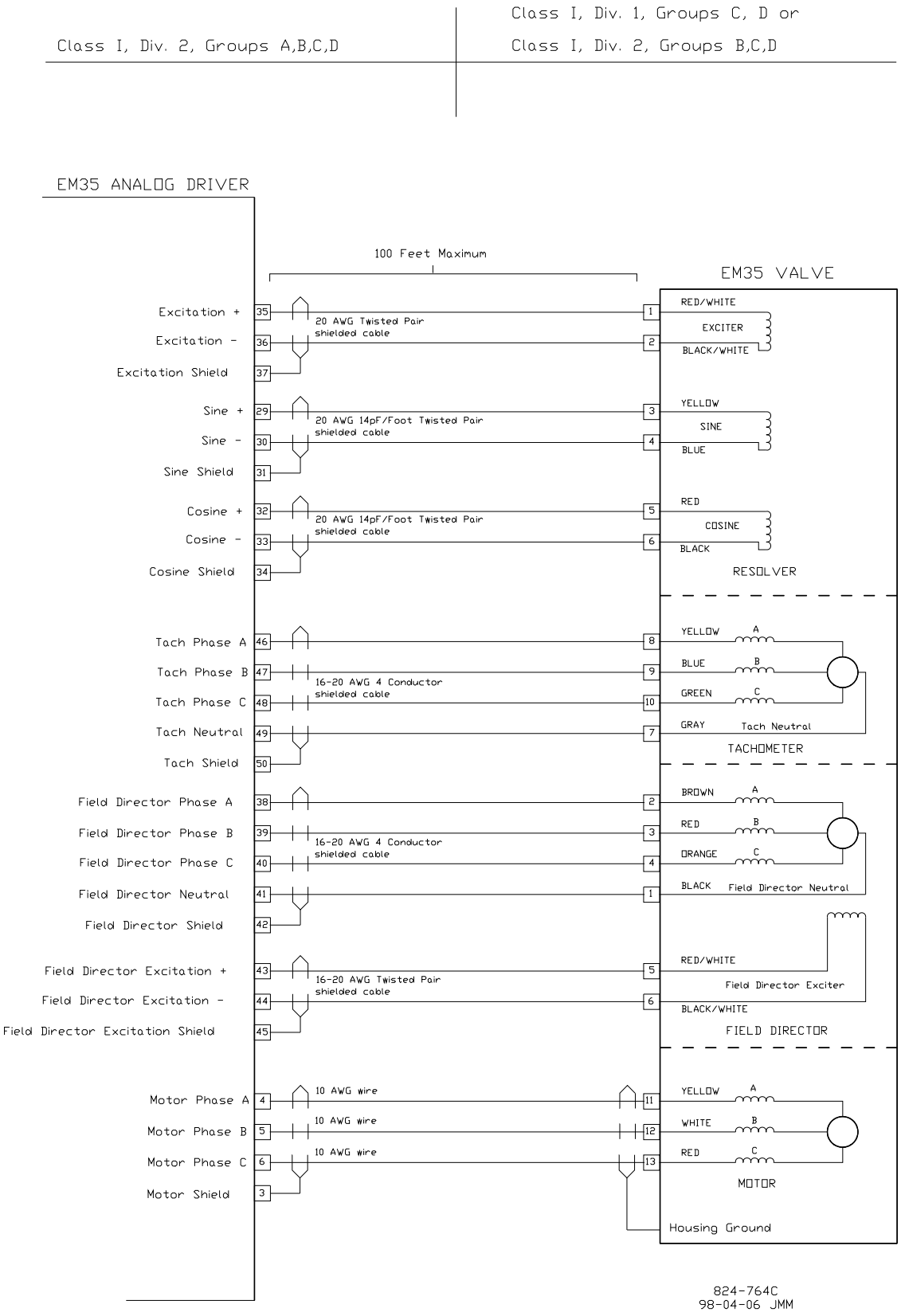


Figure 2-3. Plant Wiring Diagram

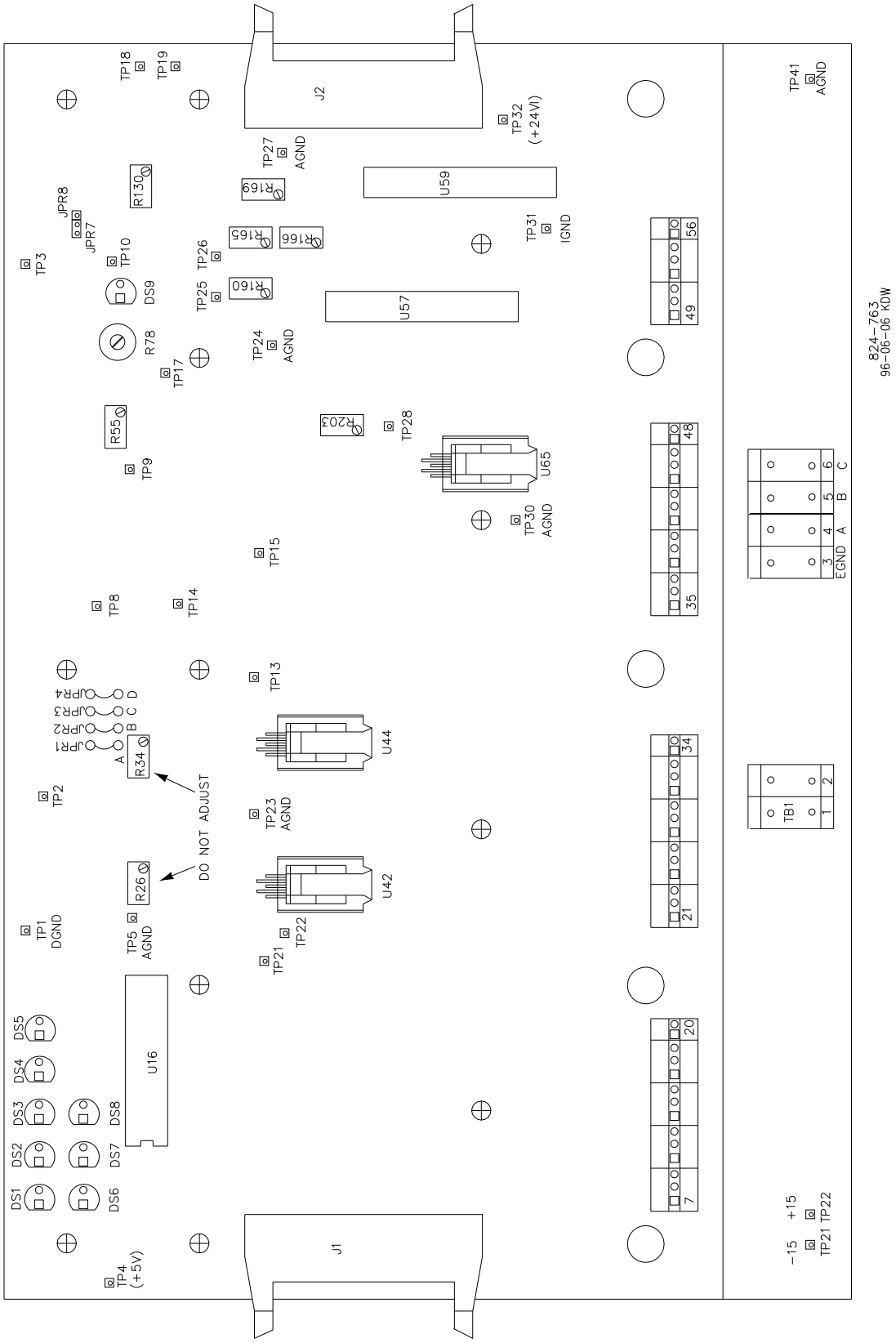


Figure 2-4. EM-35 Driver Adjustment Locations

Chapter 3. Troubleshooting

General

Faults in the governing system are usually revealed as speed variations of the prime mover, but it does not necessarily follow that such speed variations indicate governing system faults. Therefore, when improper speed variations appear, check all components including the prime mover for proper operation.

Faults

Problems with the EM-35/Valve assembly will usually show up as faults in the valve driver. The type of fault is indicated by LED's on the driver circuit board. The circuit board will indicate the following types of failures for Woodward EM-35 Drivers:

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division or Zone applications.

⚠AVERTISSEMENT

RISQUE D'EXPLOSION—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, applications Division ou Zone.

EM-35 Driver Faults		
Fault Type	**Fault Description**	**Remarks**
External Shutdown DS1	Red LED indicates driver was shutdown by an external signal	Opening contact asserts a shutdown
Overcurrent Shutdown DS2	Red LED indicates motor current exceeded the maximum limit	A motor phase is shorted or motor current > 14 A for 500 ms
Feedback Failure Shutdown DS4	Red LED indicates that a feedback device signal has failed	A transducer wire is open
Position Error Shutdown DS3	Red LED indicates that the valve position from the resolver does not match valve demand	Adjustable threshold
Demand Error Shutdown DS5	Red LED indicates that the demand signal is out of range	Demand current < 2.4 mA or > 21.6 mA for 100 ms
Override Alarm DS8	Amber LED indicates that position error and demand error shutdowns are disabled	Used to initialize driver when valve is starting from minimum stop position
Resolver Quadrant Status DS6	Green LED indicates that the resolver is in the correct quadrant	Used during factory adjustment of resolver
Shutdown Status DS7	Green LED indicates that the driver output is enabled	Driven from second contact of status relay

Chapter 4.
Product Support and Service Options

Product Support Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (**EngineHelpDesk@Woodward.com**) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full-Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at **www.woodward.com/directory**.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime.

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option, with the exception that the unit will be returned to you in "like-new" condition. This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:
- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:
- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:
- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact.

Product Training is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact one of the Full-Service Distributors listed at **www.woodward.com/directory**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory published at **www.woodward.com/directory**.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used In Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used In Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used In Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

For the most current product support and contact information, please visit our website directory at **www.woodward.com/directory**.

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name

Site Location

Phone Number

Fax Number

Prime Mover Information

Manufacturer

Engine Model Number

Number of Cylinders

Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.)

Power Output Rating

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter

Control Description or Governor Type

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter

Control Description or Governor Type

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter

Control Description or Governor Type

Serial Number

Symptoms

Description

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

Appendix. Specifications

Electrical Characteristics

Position Controller

Bandwidth:	> 5 Hz @ 3 deg p-p input
Dynamics:	fixed tuning—determined for each valve type

Demand Input

Range:	4–20 mA
Limits:	3.5 and 20.5 mA
Impedance:	250 Ω
Isolation:	500 Vrms

Feedback Monitor Output

Range:	4–20 mA
Load:	600 Ω max
Isolation:	500 Vrms

Torque Controller

Bandwidth:	> 1 kHz
Command input:	±10 V (+ = CW viewed from motor shaft end)
Current Scaling:	2.5 A/V
Torque Scaling:	1.8 N·m (16 lb-in/A) @ gear box output
PWM frequency:	50 ±5 kHz

Velocity Controller

Bandwidth:	> 100 Hz
Feedback voltage:	2.15 Vrms ±12% @ 66 rpm, 25 °C (77 °F)
Feedback linearity:	±5%
Feedback ripple:	5% rms
Dither:	Adjustable amplitude

Resolver Exciter

Voltage:	7.07 Vrms ±1%
Current:	30 mA rms max
Frequency:	1 kHz ±50 Hz
Waveform:	Sinusoidal with < 1% harmonic distortion

Resolver/Digital Converter

Type:	Ratiometric
Bandwidth:	> 100 Hz
Resolution:	0.02 deg
Accuracy:	< 0.05 deg over temperature range
Cable sensitivity:	< 0.05 deg @ 30 m (100 ft), 46 pF/m (14 pF/ft)
Range Indicator:	0–90 deg verification (green LED)

System Performance Characteristics

Position range:	60 degrees
Position accuracy:	±0.5 degree over temperature range
Slew time (50 degrees):	150 ms open, 80 ms close at 28 V (100 ms close for 137:1 gear ratio) where slew time = valve travel ÷ maximum slew rate

IMPORTANT

Slew times apply only if the power input voltage at the driver terminals is maintained greater than 28 Vdc.

Relay Ratings

Shutdown Status:	2 A @ 28 Vdc resistive 0.3 A @ 115 Vac resistive
System Status:	0.1 A @ 28 Vdc resistive

System Installation Requirements

Power input:	28 Vdc nominal, 18–32 Vdc operating 4.5 A continuous 25 A peak for 50 ms
Power cable:	5.0 mm² (10 AWG), 61 m (200 ft) max, 3.0 mm² (12 AWG), 30 m (100 ft) max
Motor cable:	3 conductor shielded, 5.0 mm² (10 AWG), 30 m (100 ft) max or 3.0 mm² (12 AWG), 15 m (50 ft) max
Tachometer cable:	4 conductor shielded, 30 m (100 ft) max
Field director cable:	4 conductor shielded & 2 conductor shielded, 30 m (100 ft) max
Resolver excitation cable:	2 conductor shielded, 30 m (100 ft) max
Resolver FB cables (2):	2 conductor shielded, 30 m (100 ft) max, 46 pF/m (14 pF/ft)
Wire termination:	5.0 mm² (10 AWG) max—power & motor wiring 1.0 mm² (16 AWG) max—all control wiring

System EMC Compliance

Radiated susceptibility:	IEC 801-3, Level 3 10 V/m, 26–1000 MHz
Conducted susceptibility:	IEC 801-6, Level 3 10 V, .15–100 MHz, all leads
Radiated emissions:	EN 55011, Class A
Conducted emissions:	EN 55011, Class A
ESD susceptibility:	IEC 801-2, Level 3 8 kV air, 4 kV contact
Fast Transients:	IEC 801-4, Level 3 2 kV direct to power leads 2 kV capacitive to I/O leads
Surge:	IEC 801-5, dc input 500 V common mode 500 V differential mode

Environmental Specifications

Ambient temperature:	–20 to +60 °C (–4 to +140 °F) operating –40 to +85 °C (–40 to +185 °F) storage
Humidity:	US MIL-STD-810D, Method 507.2, Procedure II
Shock:	US MIL-STD-810D, Method 516.3, Procedure I
Vibration:	US MIL-STD-167, Type 1

Enclosure

Corrosion Resistant:	To retain corrosion resistance, use stainless steel (SST) or non-metallic bushings
Ingress Protection:	IP56
Dimensions (HxLxW):	10.48 x 482.60 x 310.90 mm (4.125” x 19.00” x 12.24”) nominal
Cable Entry:	2 gland plates (see IP rating requirement note in installation section)

Hazardous Location

Class I, Division 2, Groups A, B, C, & D, T4

Rated Input:	18 to 32 Vdc (28 Vdc nominal) 4.5 A continuous 25 A peak for 0.05 s 60 °C (140 °F) max. ambient

Revision History

Changes in Revision E—

- Updated Position Error Threshold Calibration procedure (page 5)

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

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PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

Email and Website—www.woodward.com

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