Released

Product Manual 26518V2
(Revision E, 6/2018)
Original Instructions

MicroNet TMR® 5009FT
Fault-Tolerant Steam Turbine Control

Installation / Hardware Manual

Manual 26518 consists of 4 volumes (26518V1, 26518V2, 26518V3, 26518V4).

Volume 2

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 *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, 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 *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, 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 Out-of-date translations are marked with ⚠.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— A bold, black line alongside the text identifies changes in this publication since the last revision.

Manual 26518V2

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Illustrations and Tables

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Important Definitions

This is the safety alert symbol 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.

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

European Compliance for CE Marking:
These listings are limited only to those units bearing the CE Marking.

EMC Directive	Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC)
Low Voltage Directive:	Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits.

North American Compliance:
These listings are limited only to those units bearing the CSA identification.

CSA:	CSA Certified for Ordinary Locations for use in Canada and the United States Certificate 2291171

Special Conditions for Safe Use:

This equipment is to be installed by professional service personnel according to the instructions given in this manual.

Wiring must be in accordance with the authority having jurisdiction. PERMANENTLY CONNECTED EQUIPMENT requires the special considerations to satisfy the CEC and the Canadian deviations to IEC 61010-1, including overcurrent and fault protection as required.

This device is considered permanently connect and requires a fixed wiring installation. Protective Earth Grounding is required by the input PE terminals. (See Installation Chapter).

A disconnection device is not supplied with the system. A disconnecting switch or circuit breaker shall be included in the building installation. It shall be in close proximity to the equipment and within easy reach of the operator. This device shall be clearly marked as the disconnecting device for the equipment. The disconnecting switch or circuit breaker shall not interrupt the protective earth conductor.

To ensure stability and to prevent accidental tipping, lift equipment only as described in the installation chapter and bolt the system cabinet to the building structure before operation of the equipment.

125 Vdc digital Input connections located on FTM104-1A, FTM104-1B,
FTM104-2A, and FTM104-2B (Woodward # 5453-276) are not to be connected on CSA certified systems or on systems requiring compliance with the European Low Voltage Directive.

Measurement inputs are classified as permanently connected IEC measurement Category I and are designed to safely withstand occasional transient overvoltages up to 707 Vpk.

⚠WARNING	**To avoid the danger of electric shock, do not use measurement inputs to make measurements within measurement categories II, III, or IV.**

The system CCT and 5009 Control Chassis CPU contain single cell primary batteries. These batteries are not to be charged and are not customer replaceable.

⚠WARNING **The control cabinet contains hazardous live voltages. Only individuals who have received proper training should open the cabinet door and perform service. Equipment should be isolated or disconnected from hazards live voltages before servicing.**

This equipment is intended to be installed in a metal cabinet or enclosure. See manual 26167, Volumes 1 & 2, for installation requirements related to CE Marking requirements.

Safety Symbols

 Direct Current

 Alternating Current

 Both Alternating and Direct Current

 Caution, risk of electrical shock

 Caution, refer to accompanying documents

 Protective conductor terminal

 Frame or chassis terminal

Chapter 1.
General Information

The technical documentation for the 5009FT control system consists of the following volumes:

Volume 1—provides information on system application, control functionality, fault tolerant logic, control logic, PID setting instructions, and system operation procedures.

Volume 2—provides hardware descriptions, mechanical and electrical installation instructions, hardware specifications, hardware troubleshooting help, and basic repair procedures.

Volume 3—provides installation procedures for the 5009FT control's personal computer based interface software program (CCT), information on all CCT features and modes (Configure, Service and Run).

Volume 4—provides details on installation and operation of the optional operator control station, if provided with your system. It contains a list of the control's Modbus® * registers and tag names.

*—Modbus is a registered trademark of Schneider Automation Inc.

Active 5009FT System part numbers are covered in Volume 1 of this manual and in Appendix B.

This volume provides hardware description, installation, and troubleshooting information for the Woodward 5009FT Control System. It includes:

- A list of all system hardware
- A description of all hardware
- Mechanical installation instructions
- Electrical installation instructions
- Troubleshooting Guide, including diagnostic tests
- Maintenance procedures (module replacement)

This hardware manual applies to all 5009FT control systems but does not include information that is unique to your system only.

Appendix A – Control Wiring Diagram

Chapter 2.
Hardware Description

Introduction

The 5009FT digital control system can be provided in a number of hardware configurations; with different power supply configurations with or without a 17” Touchscreen PanelPC CCT (Configuration and Commissioning Tool). An optional 17” PanelPC Operator Interface IFIX Touchscreen HMI is available. Because this manual addresses all configurations, many of the following hardware descriptions may not apply to your 5009FT system. Refer to Table 2-1, **Appendix A** for a complete listing of standard and optional system components.

The system is shipped disassembled and must be installed in a metal cabinet as dictated in 26167V2. After a control system is received, each item must be located and installed via this manual’s instructions and **Appendix A**. Precautions to eliminate Electrostatic Discharge must be followed any time parts are handled or entering the cabinet containing the MicroNet system.

This manual will reference the Woodward MicroNet TMR manual 26167 Volumes 1 and 2. The 5009FT is a derivative of the MicroNet TMR, and the only difference is that the 5009FT is a pre-configured MicroNet TMR System.

Table 2-1. System Components

Designation	Description	Qty	Remarks
U1	Main chassis	1	Standard
U2	Power Chassis	1	Standard
PSM1, PSM2	Main Power Supply Module	2	Standard
A1	Kernel Power Supply Module	3	Standard
A2	CPU Module	3	Standard
A3	MPU & Analog I/O Module	3	Standard
A4	Discrete I/O Module (24 In/12 Out)	3	Standard
A5	Analog HD I/O Module	3	Optional
A6	Actuator Controller Module	2	Optional
FTM103-1, 2	Analog Termination Module	2	Standard
FTM104.1A, 1B, 2A, 2B	Discrete Termination Module (F/T Relay–Discrete In)	4	Standard
FTM105-1, -2	Analog HD I/O Termination Module	2	Optional
FTM106-1, -2	Actuator Controller Termination Module	2	Optional
CCT	Touchscreen PanelPC with Toolkit Software	1	Optional
HMI	Touchscreen PanelPC with IFIX Software	1	Optional
ETH1, ETH2	Hirschmann 8-Port Ethernet Switch	2	Standard
W101-1	Power Chassis to Main Chassis Cable (1 ft/30 cm)	1	Standard
W101-2	Power Chassis to Main Chassis Cable	1	Standard
W102-A, -B, -C	Ethernet Cable (7’)	6	Standard
W103-A, -B, -C	Analog I/O Cable	6	Standard
W104-A, -B, -C	Discrete I/O Cable	6	Standard
W104-1AB, -2AB	FTM to FTM Cable (6”/15 cm)	6	Standard
W105-A, -B, -C	Analog Cable	6	Optional
W106-A, -B	Actuator Controller Cable	2	Optional
W107-1, -2	Ethernet Cable (10’)	2	Standard

Main Control Chassis

The main chassis of the 5009FT consists of three six-slot kernel sections. Each kernel section is isolated from the other two. With this configuration the failure of any one section will not cause a shutdown.

Each kernel section includes a kernel power supply, a CPU, an analog combo I/O module, and a discrete I/O module. Optionally an integrating actuator module (Position Controller) and/or a High Density Analog I/O module may be included. Slot-to-slot logic and power connections are made through an etched-circuit motherboard located on the back of the chassis. The motherboard and modules are all VERSA module Eurocard (VME) type. I/O connections are made through cables from the front of the modules to termination modules in the cabinet. See **Appendix A** for an overview of the main chassis, control modules, and termination modules.

From a module connector standpoint, any I/O module can be installed in any of the chassis slots designated for I/O modules. However, when the application software is designed, each module is assigned to a specific slot, thus the software expects each specific I/O module to always be in its designated slot.

The 5009FT control chassis is cooled by forced air. In order not to starve modules of air flow, either a module or a blank module must be installed and secured in each slot. Cooling fans are located on the top of the main chassis; with one fan per 6-slot card rack. The power supply chassis contains two cooling fans: one on top and one on the bottom of the chassis. These fans run any time the 5009FT chassis is powered up.

See Woodward MicroNet TMR manual **26167** Volume 1, Chapter 3, Section 1 for more details on the Main Chassis.

System Power Supplies (PSM1 and PSM2)

The 5009FT main control power supply chassis uses redundant power supplies. A motherboard located on the back of the power supply chassis allows the two power supplies to form a redundant power system providing six separately regulated 24 Vdc, 6 A outputs to the control. Power output regulation, including line, load, and temperature effects, is less than +5%.

When redundant power supplies are running, current-sharing circuitry balances the load to reduce heat and improve the reliability of the power supplies. In the event that one supply needs replacement, this feature also ensures hot replacement of the power supplies without disrupting the operation of the control.

⚠WARNING — **When hot swapping a Power Supply, avoid reaching into the chassis opening, as the top and bottom fan blades will be exposed.**

Input power connections are made to the main power supply through terminals on the front of the power supplies. For convenience, the user input power connections are made through panel mounted Phoenix type terminal blocks. See **Appendix B**. A standard 50-pin ribbon cable is used for connecting the power supply chassis to the 5009FT control chassis. As redundancy to this, a wire harness cable connects power from the back of the power supply chassis to the back of the main chassis.

A set of two main power supplies are provided with each system. Different models of power supplies allow the control to interface with different input source voltages.

Main power supplies are available in the following models:
AC/DC – 88–132 Vac or 100–150 Vdc
HVAC/DC – 180–264 Vac or 200–300 Vdc

See Woodward MicroNet TMR manual **26167** Volume 1, Chapter 4, Sections 1–3 for more details on the Main Power Supplies.

Module Descriptions

Physical Description

All chassis mounted control modules are VME-type (VERSA module Eurocard) modules.

Modules slide into card guides in the 5009FT control's chassis and plug into the motherboard. All modules have their circuitry on a single printed-circuit board. Each module has a front panel extending from the bottom to the top of the cabinet.

The modules are held in place by two screws: one at the top and one at the bottom. Also at the top and bottom are two handles which, when toggled, move the modules out just far enough for the boards to disengage the motherboard connectors. Each module is protected with a molded plastic cover to prevent accidental component damage.

Kernel Power Supply Module (Kernel A/B/C: A1)

The 5009FT contains three kernel power supply modules. Each kernel section (A, B, and C) will contain one kernel power supply module. The kernel power supply will be located in the first slot of each kernel section. This module receives 24 Vdc from the MicroNet main power supplies and regulates it to 5 Vdc, 10 A for the rest of the kernel section and also creates a 5 Vdc precharge voltage.

See Woodward MicroNet TMR manual **26167** Volume 1, Chapter 4, Sections 4–6 for more details on the Kernel Power Supplies.

Central Processor Unit (CPU) Module (Kernel A/B/C: A2)

The MicroNet TMR 5200 CPU module contains an MPC5200 processor,
128 Mbyte DDR RAM, 64 MB of flash memory, a Real Time clock, and various communication peripherals. These peripherals include (2) general use Ethernet ports, (1) Real Time Network port, (1) serial port, (1) one service port, and (2) CAN ports. This module includes an FPGA to provide VMEbus master/slave capability as well as other functions necessary for redundant systems.

This module, following the instructions of the application program, controls the circuits of the 5009FT control so that they perform all the required control and sequencing functions. There are three CPU modules provided with each system. Each CPU utilizes a PowerPC Motorola 5200 microprocessor to perform its data processing. The VME bus arbitrator block controls the VME bus and determines what device may use the bus when there is a conflict.

See Woodward MicroNet TMR manual **26167** Volume 1, Chapter 5, Section 1 for more details on the TMR 5200 CPU Module.

Analog Combo Module (Kernel A/B/C: A3)

Each High Density Analog Combo module supplied with the 5009FT contains circuitry for three passive speed sensor inputs (magnetic pickups), one proximity probe (active probe, low speed detection only), eight analog inputs, four analog outputs, and two proportional actuator driver outputs.

Each analog input must be 4–20 mA, and each actuator driver may be configured as 4–20 mA or 20–160 mA.

See Woodward MicroNet TMR manual **26167** Volume 1 for more details on the TMR Analog Combo Module.

Analog Termination Modules (FTM103-1, FTM103-2)

The FTM for the TMR Analog Combo can connect to two speed sensor inputs, four analog inputs, two analog outputs, and one proportional actuator driver output. Three MicroNet Low Density Analog cables are used to connect the FTM with each of the three TMR Analog Combo Modules.

There are several connections for power on the FTM, each for a dedicated purpose. There are four +24 Vdc connections available for sourcing 4–20 mA inputs. Each connection is protected with a 0.1 A fuse (F1-F4). There is a +24/12 Vdc output connection available for powering one proximity sensor. Each of these connections is protected with a 0.1 A fuse (F5, F6).

Two FTMs are provided and used with each 5009FT control (FTM103-1 and FTM103-2). Refer to **Appendix A** for an overview of modules and FTMs used.

See Woodward MicroNet TMR manual **26167** Volume 2, Chapter 12, Section 2 for more details on the TMR Analog Combo FTM.

Discrete I/O Module (Kernel A/B/C: A4)

Each 24/12 TMR Discrete I/O module (TMR High Density Discrete module) contains circuitry for twenty-four (24) discrete inputs and twelve (12) TMR discrete outputs, and provides latent fault detection for each relay output. Each discrete input may be 24 V, or 125 Vdc. Each relay output provides the option of using a normally open contact, or a normally closed contact.

See Woodward MicroNet TMR manual **26167** Volume 1, Chapter 7, Section 2 for more details on the TMR 24/12 TMR Discrete I/O Module.

Discrete Termination Modules (F/T Relay Module)

(FTM104-1A, FTM104-1B, FTM104-2A, FTM104-2B)

The Fault Tolerant Relay modules are used to connect discrete field wiring to the 5009FT control. Four FT Relays (FTM104-1A, FTM104-1B, FTM104-2A, and FTM104-2B) are provided and used with each 5009FT control. Refer to **Appendix B** for an overview of FTMs. Each FTM connects to the control's three independent Discrete I/O modules through individual cables, and provides a common cage-clamp terminal connection for customer field wiring. Each FT Relay box contains circuitry for six contact inputs, three relay outputs and houses circuitry to:

- route each contact input signal to the system's three independent (rack mounted) discrete modules
- provide an open / closed contact output based on associated discrete module commands
- indicate the health of all relays (latent fault detection)

Discrete input power (contact wetting voltage) can be supplied by the 5009FT control or from an external source. The 5009FT control provides an isolated 24 Vdc power source for contact wetting. The external source may be 24 Vdc or 125 Vdc (North American installations only). Separate discrete input terminals are provided based on the level of contact wetting voltage used. See **Appendix B**.

> **NOTICE**
>
> **To comply with CE Marking under the European Low Voltage Directive (LVD) and CSA requirements, the maximum external circuit voltage for both the Discrete Inputs and Relay Output circuit are limited to 18–32 Vdc maximum.**

The discrete output relays are mounted on sockets, with 18 relays per FTM. Six relays are used to create each relay output (normally open and normally closed contacts) and allow latent fault detection. See **Appendix B**. This configuration allows independent testing of each relay output (latent fault detection) without concern of relay position. Customer power is connected to one side of the configuration and load to the other.

Discrete outputs can be configured to use latent fault detection to identify output relay failures without affecting operation. When the contacts are closed, they are periodically opened in pairs, to ensure that they are in the correct state, and that they change state. When they are open, they are periodically closed individually, to ensure that they close. Any failures are annunciated, and further testing is disabled.

NOTICE

It is highly recommended to design the field wiring such that the latent fault detection can be utilized on critical relays (Trips). Without this feature, a single component fault might not be annunciated – leading to a potential unwanted turbine trip.

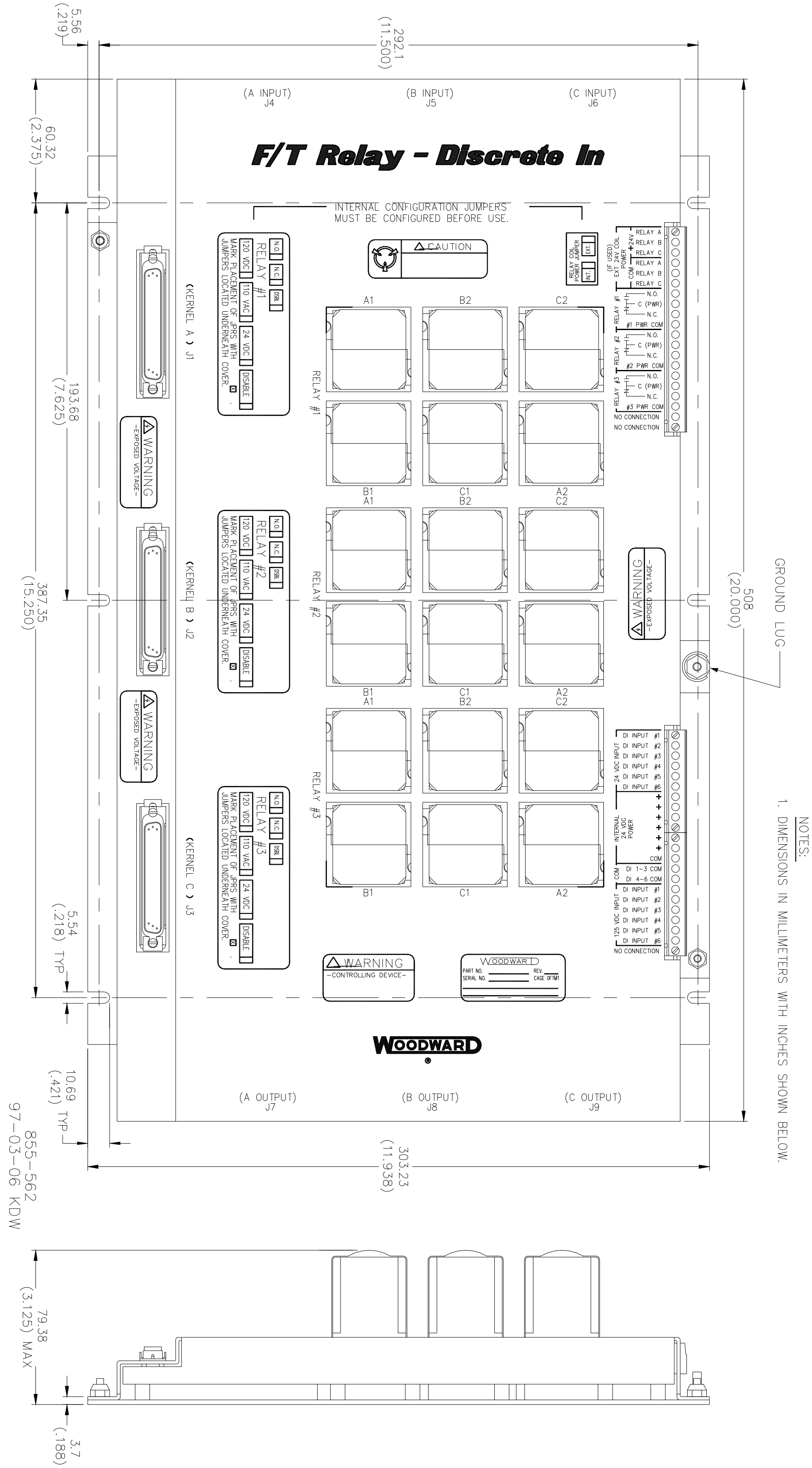

Figure 2-1. Fault Tolerant Relay Outline Drawing

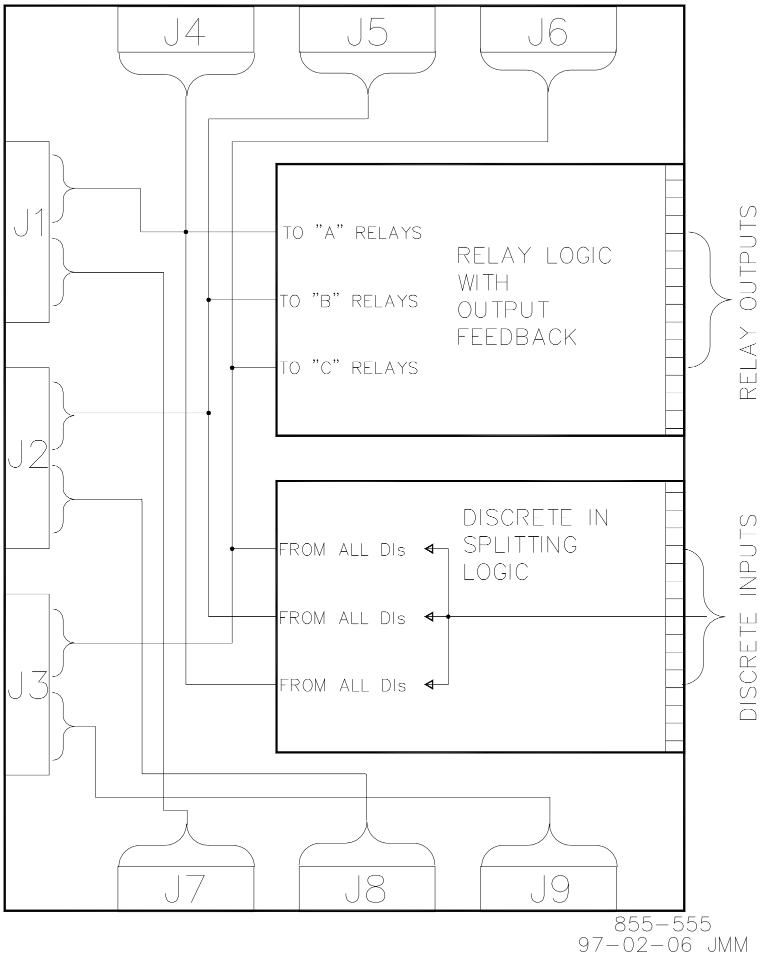

Figure 2-2. FT Relay Block Diagram

Field wiring constraints are detailed in the standard TMR manual—follow all shielding and wiring constraints listed. See Woodward MicroNet TMR manual **26167** Volume 1, Chapter 7, Section 2 for more details on the FT Relay Module.

Optional TMR 24/8 Analog Module (Kernel A/B/C: A5)

The 24/8 Analog module contains circuitry for twenty-four analog inputs and eight 4–20 mA outputs. These modules have no potentiometers and require no calibration. A module may be replaced with another module of the same part number without any adjustment.

The TMR 24/8 Analog module comes in the following configuration: 24 channels of 4–20 mA inputs with 8 channels of 4–20 mA outputs (2-pole 10 ms filter on all input channels, except channels 23 and 24, which have 2-pole 5 ms filter).

See Woodward MicroNet TMR manual **26167** Volume 1, Chapter 8, Section 1 for more details on the TMR 24/8 Analog Module.

Optional TMR 24/8 Field Termination Module (FTM105-1, FTM105-2)

The TMR 24/8 Analog FTM is used with the TMR 24/8 Analog Modules. Three MicroNet High Density Analog/Discrete cables are used to connect the FTM with the three TMR 24/8 Analog Modules. There are twelve +24 Vdc connections available for sourcing 4–20 mA inputs. Each connection is protected with a 0.1 A fuse.

See Woodward MicroNet TMR manual **26167** Volume 2, Chapter 12, Section 2 for more details on the TMR 24/8 Analog FTM.

Optional Two Channel Actuator Controller Module (Kernel A/B: A6)

Each channel controls an integrating or proportional, hydromechanical or pneumatic actuator. Each actuator may have up to two position feedback devices. There are several versions available, and the module part number indicates the module's maximum output current capability. A discrete (gray) cable must be used with this module. Do not use an analog (black) cable.

The 2 Channel Actuator Module's circuitry is divided into two channels. Each channel incorporates an output current driver and two position resolver feedbacks. Because the 5009FT is a redundant controller, two actuator drivers from separate modules provide control for each actuator / valve whether wired separately to dual actuator coils or wired in parallel to a single actuator coil. The redundancy is managed in the application program and Actuator Module microprocessors so that the two output drivers share load unless a problem is detected. If one of the drivers goes out of operation, the remaining driver will assume the required load. When redundant drivers are implemented, only one resolver feedback is available per channel for direct control. Even though only one position input can be used per channel, the availability of two channels allows for redundant feedback.

When pilot valves are used, the signal must be connected on the second LVDT input of the card. The Pilot signal can be redundant, if sent to card A106 and card B106. If physically, only one LVDT signal is available, the excitation can only be taken from one card, but the signal can be put in parallel.

See Woodward MicroNet TMR manual **26167** Volume 2, Chapter 9, Section 2 for more details on the Two Channel Actuator Controller Module.

Optional 2-Channel Actuator Field Termination Module (FTM106-1, FTM106-2)

The Two Channel Actuator Controller FTM is used with the 2Ch Actuator Modules. One MicroNet Low Density Analog cable is used to connect the FTM with the 2Ch Actuator module.

See Woodward MicroNet TMR manual **26167** Volume 2, Chapter 9, Section 2 for more details on the Two Channel Actuator Controller FTM.

CCT – TouchPanel PC

The 5009FT control system may include an engineering workstation as a Configuration and Commissioning Tool (CCT) for the control. The software on this device is covered in Volume 3 of this manual; the hardware used is listed here.

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Phoenix Contact - Valueline Industrial PC

Technical Data

Ambient temperature (operating)	5 to 55 °C
Ambient temperature (storage/transport)	–40 to +70 °C
Permissible humidity (relative)	5 to 95%
Display, 17 in. (dimensions/weight)	452 x 356.5 x 50 mm / 5.85 kg
Degree of protection	IP65 (front), IP20 (back)
Panel Mounting / LED indicators	Power, HDD, Run, Error

Electrical Data

Power supply	nominal 24 Vdc
Power supply	range 19.2—28.8 Vdc
Current draw, typical	1.0—1.5 A
Current draw, maximum	2.0—5.2 A
Power consumption, typical	36.0 W
Power consumption, maximum	124.8 W
RTC battery, typical life	5 years

NOTE: Protective earth ground and circuit ground (return) are connected.

Computer Data

Operating system	Windows XP
Processor	1.5 GHz Intel Core2 Duo, 667 FSB, 4 MB L2 Cache
RAM	2 GB
Data memory	2.5 in. SATA solid state drive 32 GB
Interfaces	USB 4x Type A, USB 1.1/2.0
Serial	RS-232 (configurable option) DB-9, male
Video (configurable option)	VGA (DB-15, female)
NVRAM size	128 kB
Number of Ethernet ports	Two RJ45 Ethernet ports (10/100/1000 Mbps)

Display (17 inch)

Screen size, diagonal	430 mm (16.93 in.)
Screen size, horizontal x vertical	337.92 x 270.34 mm
Resolution	1280 x 1024

Type	Resistive touch screen with serial/USB interface
Brightness	350 Cd/m²
Number of colors	16.7 million
Contrast ratio	1000:1

View angle, horizontal/vertical	(CR=10) 170°/160°
Installation cutout dimensions (width x height)	424.0 x 329.5 mm
Outside bezel dimensions (width x height x depth)	452.0 x 356.5 x 10 mm
Backlight life, minimum	50 000 hours
Interface (configurable option)	USB 1.1/2.0, Type A

Mechanical Tests

Shock test according to IEC 60068-2-27 15G, 11 ms impulse
Vibration resistance according to IEC 61131-2 Hard Drive: 0.5G

Conformance With EMC Directives

Developed according to IEC 61000-6-2
IEC 61000-4-2 (ESD) Criterion B
IEC 61000-4-3 (radiated-noise immunity) Criterion A
IEC 61000-4-4 (burst) Criterion B
IEC 61000-4-5 (surge) Criterion B
IEC 61000-4-6 (conducted noise immunity) Criterion A
IEC 61000-4-8 (noise immunity against magnetic fields) Criterion A
EN 55022 (noise emission) Class A

Approvals

CE
UL, cUL UL 508
UL, cUL Class I, Division 2, Groups A, B, C, D
UL 1604

Chapter 3. Mechanical Installation

Storage

Store 5009FT control and associated parts between –20 and +70 °C
(–4 and +158 °F) at a maximum relative humidity of 90% non-condensing. If power supplies are to be stored for a long time, apply operating power to them at least once every 18 months. For more detail, see MicroNet TMR manual **26167**.

Unpacking

Unpack each part of the system carefully. Check the units for signs of damage, such as bent or dented panels, scratches, or loose or broken parts. If any damage is found, notify the shipper immediately.

After a control system is received each item must be located and installed via this manual's instructions. The following items should be removed from the packing carton (s) and checked to make sure you have all the necessary components before attempting to assemble and install the system. Refer to MicroNet TMR manual **26167, Appendix A**.

Unit Location

Consider the following when selecting a location for mounting the 5009FT unit(s):

- Make sure the 5009FT unit(s) is mounted in a dry location, protected from water and condensation (Pollution Degree 2 environment).
- The 5009FT control must be used in a power installation environment rated at Overvoltage II.
- Make sure the ambient temperature of the system location is not lower than 0 °C (32 °F) or higher than 40 °C (104 °F) and that the relative humidity is not over 90%, non-condensing.
- Provide adequate ventilation for cooling the units. If the units must be mounted near heat-producing devices, shield them from the heat.
- Do not install the units or their connecting wires near high-voltage/high- current devices or inductive devices. If this is not possible, shield both the system connecting wires and the interfering devices or wires.
- If the selected location does not already have a conductor to a good earth ground, provide one.
- Unless otherwise stated, this equipment is suitable for non-hazardous locations only.

IMPORTANT	**Equipment is suitable for use in non-hazardous locations only.**

Use the following procedures to install a cabinet system in the selected location.

Chapter 4.
Electrical Installation

Introduction

⚠WARNING	**Before installation read all information and warnings on pages iv and v of this volume.**

Electrical ratings, wiring requirements, and options are provided to allow a customer to fully install the 5009FT control into a new or existing application. Field wiring must be rated at least 25 °C above ambient temperature.

Wiring for installations must be in accordance with Ordinary (non-hazardous) wiring methods and in accordance with the authority having jurisdiction.

After the system has been mechanically installed read this chapter thoroughly before proceeding. Perform system electrical installation by stepping through this chapter's instructions in sequence. Start with system cables instruction, then step to the next set of instructions, etc.

The installer should create a 5009FT I/O configuration wiring list to assist in electrical installation (see Volume 3). The wiring list will determine what inputs are hooked up to what terminal blocks and how the accessories are wired into the control.

Shields and Grounding

An individual shield termination is provided at the terminal block for each of the speed sensor inputs, actuator outputs, analog inputs, analog outputs, and communications ports. All of these inputs and outputs should be wired using shielded, twisted-pair wiring. See options below for correct shield terminations for your installation. The exposed wire length, beyond the shield, should be limited to one inch. Relay outputs, contact inputs, and power supply wiring do not normally require shielding, but can be shielded if desired.

For compliance with EMC standards, it is required that all analog and discrete input/output wiring be separated from all power wiring. It is also required to follow shielding and grounding practices as called out in the manual 26167 Volume 1 & Volume 2.

Signal Wiring—
OPTION 1 (Typical to most industrial sites)—Analog signal shields floating at device end and hard grounded at Control end. **Ensure the FTM Ground Terminals are grounded to Earth (terminal 52 on FTM103-1, -2 and terminal 37 on FTM106-1, -2).**

In this case, the device shield needs to be grounded at the Woodward FTMs. Grounding bars are installed in the FTMs to support this configuration since it is the most common. If the device shields are grounded (to Chassis ground) at the device end, then REMOVE these shorting bars and follow option two **OR** the individual tabs from the Grounding bar can be cut off.

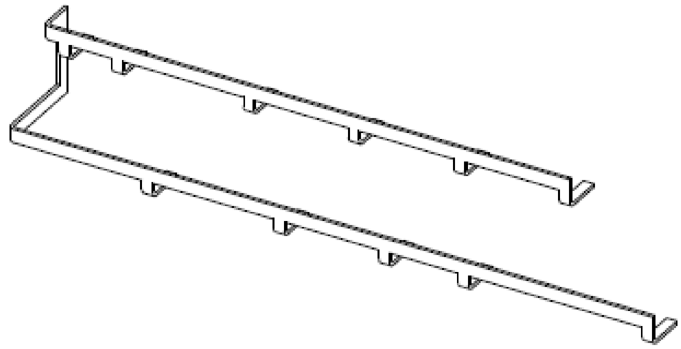


Figure 4-1. FTM103-1 and FTM103-2 Grounding Bars

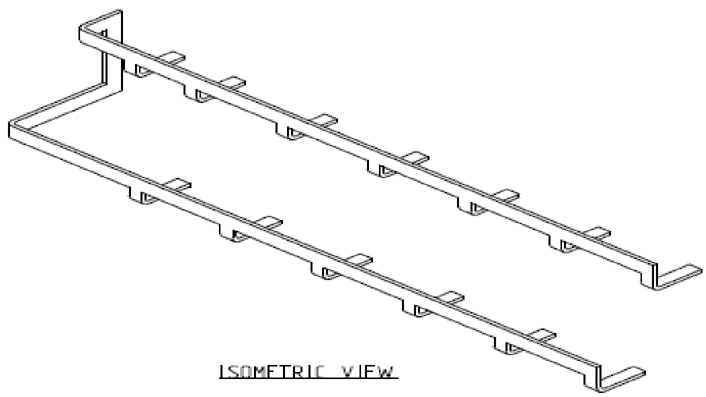


Figure 4-2. FTM106-1 and FTM106-2 Grounding Bars

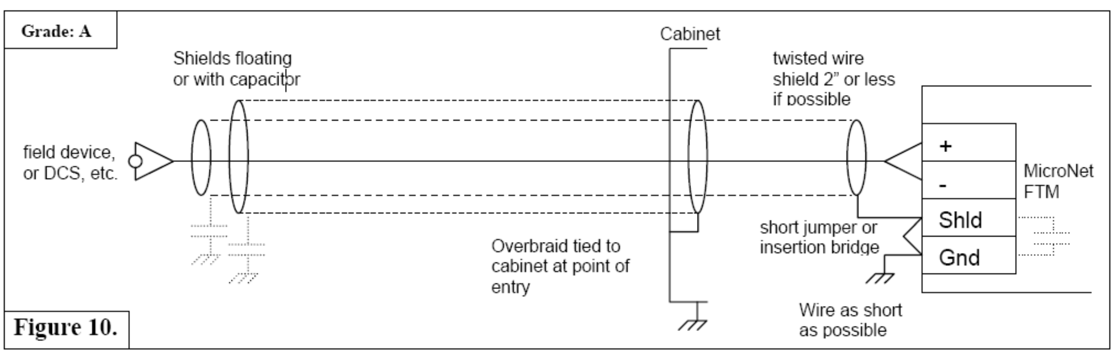


Figure 4-3. Shield Termination Diagram 1

Option 2—Analog signal shields grounded at device end.
The shields should be connected to earth ground at all intermediate terminal blocks, as well as terminated at the control terminal block (AC Coupled).

In this case the shorting bar is removed to provide a capacitive connection to ground (in addition to the 'hard' ground) at the device end.

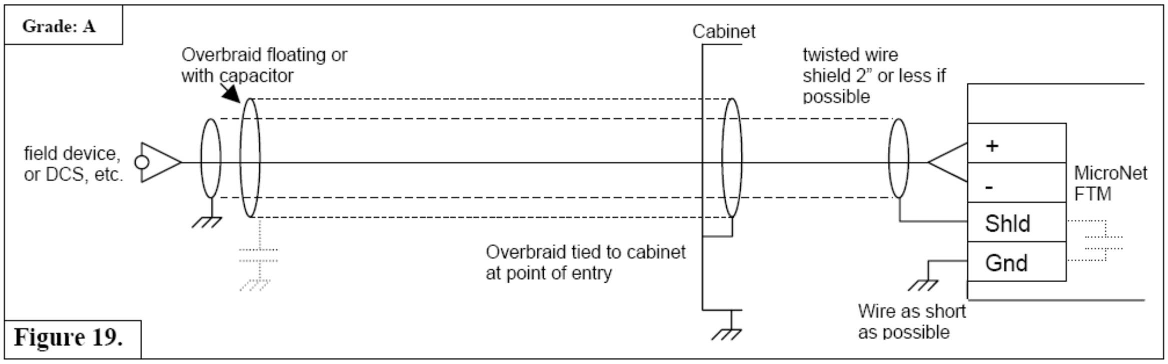


Figure 4-4. Shield Termination Diagram 2

Input Power

Branch circuit fuses, breakers, and wiring must have applicable safety approval and be selected according to applicable codes and area classifications. The system disconnect (not provided) MUST be in easy reach of the operator and marked as a disconnect device. Each main power supply must have its own branch circuit rated fuse, or circuit breaker with a rating no more than 250% of the maximum rated current of the power supply. See **Appendix A**. Do not connect more than one main power supply to any one fuse or circuit breaker. Use only the wire sizes specified, for the power required, which meet local code requirements.

Each 5009FT control requires a power source capable of a certain output voltage and current. For AC sources, this power rating is stated in volt-amps (VA). The maximum VA of a source can be calculated by taking the rated output voltage times the maximum output current at that voltage. This value should be greater than or equal to the 5009FT control VA requirement.

Note: the control's main power supplies are not equipped with input power switches.

Table 4-1 provides each power supply's holdup time specification, which is the time the supply will continue to operate within specification after its input power is interrupted. This information may be useful in specifying Uninterruptible Power Supply (UPS) systems.

Table 4-1. Fuse/Breaker Requirements

Input Voltage and Frequency Range	Rated Maximum Current	Maximum Fuse/C.B. Rating	Minimum Wire Size mm²/AWG	Wire Temp. Rating (°C)*	Hold Up Time (Minimum)
18–36 Vdc	33 A	50 A	5.5 / 10	90	5 ms @ 24 V
100–150 Vdc	6.0 A	20 A	4.0 / 12	90	7 ms @ 120 V
88–132 Vac 47–63 Hz	10.0 A	20 A	4.0 / 12	90	1 cycle @ 120 V
180–264 Vac 47–63 Hz	5.0 A	10 A	2.5 / 14	90	1 cycle @ 220 V
200–300 Vdc	3.0 A	10 A	2.5 / 14	90	7 ms @ 200 V

*Wire Temp ratings specified are for 55 °C cabinet ambient.
All fuses listed above are "slow blow".

Significant inrush currents are possible when current is applied to the main power supply. The magnitude of the inrush current depends on the power source impedance, so Woodward cannot specify the maximum inrush current. Time- delay fuses or circuit breakers must be used to avoid nuisance trips.

The 5009FT control includes a set of two main power supplies. Input power ratings are identified in Table 4-1 and on each power supply's front panel. Refer to MicroNet TMR manual **26167** for all power supply specifications.

IMPORTANT

Each main power supply provides three separate 24 Vdc outputs rated for 0–6 A each. To preserve system integrity, it is recommended that the control's three isolated 24 Vdc outputs be kept isolated from each other at all times. If the control's 24 V power is used to power external devices, the system's three 24 V outputs must not be tied together. If these outputs are tied together, and a short circuit occurs, it will shut down the entire 5009FT control. External devices requiring 24 Vdc power must be connected to only one of the power supplies.

Externally powered analog inputs or outputs and external relay coil power must be supplied by and IEC rated or NFPA 70 (NEC) Class 2 power supply as required by local authority having jurisdiction.

Speed Sensor Inputs—TMR Analog Combo Module

The 5009FT control uses speed sensing probes mounted off of a gear connected or coupled to the turbine's rotor to sense turbine rotor speed. The first three channels of the control accept passive magnetic pickup units (MPUs), 12 Vdc proximity probes or 24 Vdc proximity probes. Channel 4 only accepts 12 Vdc proximity probes or 24 Vdc proximity probes, as this channel is dedicated to be used for slow speed detection only.

It is not recommended that gears mounted on an auxiliary shaft coupled to the turbine rotor be used to sense turbine speed. Auxiliary shafts tend to turn more slowly than the turbine rotor (reducing speed sensing resolution) and have coupling gear back-lash, which results in less than optimum speed control. For safety purposes it is also not recommend that the speed sensing device sense speed from a gear coupled to a generator or mechanical drive side of a system's rotor coupling.

All speed sensing inputs use the same programmed gear ratio and number of teeth to calculate speed, thus the speed probes used should sense speed from the same gear. The 5009FT control can sense and control turbine speed from a single speed probe, however, it is recommended that all applications use multiple speed probes to increase system reliability.

A passive MPU provides a frequency output signal corresponding to turbine speed by sensing the movement of a gear's teeth past the MPU's pole piece. The closer the MPU's pole piece is to a gear's teeth and the faster the gear turns the higher a passive MPU's output amplitude will be. The 5009FT control must sense an MPU voltage of 1 to 25 Vrms for proper operation.

Depending on an MPU's limitations, each input channel can be jumper configured to allow an MPU to drive either two or three inputs (some MPUs cannot drive three inputs). Wire jumpers must be installed to allow an MPU to drive into all three inputs. When the jumpers are not installed, only two input modules are driven by a MPU. With proper MPU, gear size, and MPU-to-gear clearance, speed measurement should be capable down to 100 Hz. Standard MPU clearance is recommended to be 0.25 to 1.02 mm (0.010 to 0.040 inch) from tooth face to pole piece. For information on selecting the correct MPU or gear size, please refer to Woodward manual 82510. See Figure 4-4 for wiring schematic.

Speed channel 4 has to be configured to receive a proximity probe. A proximity probe may be used to sense very low speeds. With a proximity probe, speed can be sensed down to 0.5 Hz. The 5009FT control can be programmed to turn on or off a turbine turning gear using a relay output programmed as a slow speed switch. See Figure 4-5 for proximity probe wiring schematic.

Because of differences between the sensing circuits required to interface with passive (MPUs) and active (proximity) probes, separate terminals are provided for each type. This allows a simple method of field selecting the type of speed input based on the type of probe used. Short-circuit protected 12 Vdc and 24 Vdc sources, with isolation diodes on the power, common, and output source lines, are provided with each speed input to power system proximity probes.

Channel 4 prox return input accepts 5–28 Vdc. Alternatively with either 12 Vdc or 24 Vdc open collector probes. When interfacing to open collector type probes a pull-up resistor between the four-voltage terminal and the proximity return terminal is required.

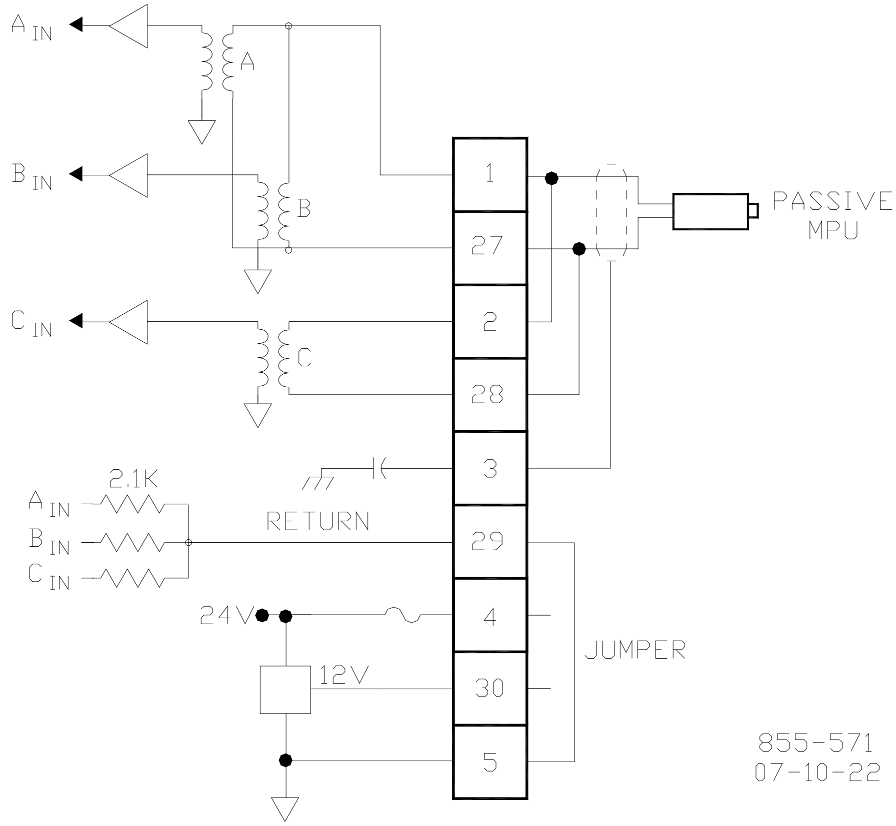


Figure 4-5. Example MPU Interface Wiring Diagram (Ch 1 shown)

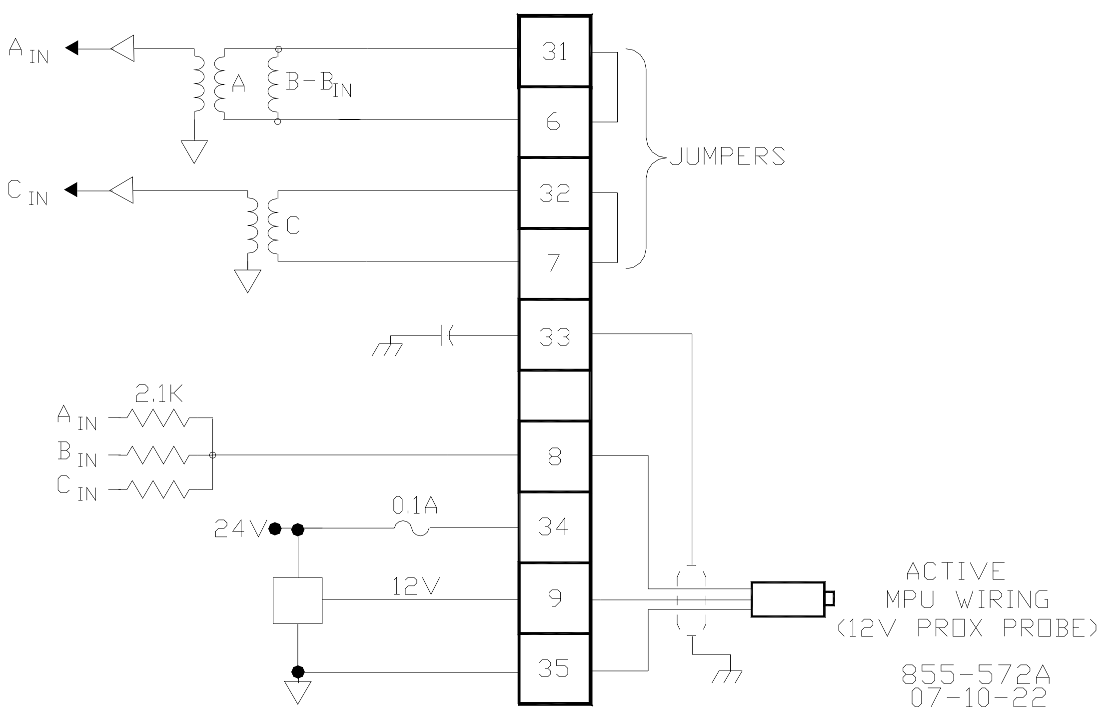


Figure 4-6. Example 24 V Proximity Probe Wiring Diagram

Each FTM connects to the control's MPU & Analog I/O modules through individual cables, and provides a common cage-clamp terminal connection for customer field wiring. Figures 4-4 and 4-5 illustrate the different input wiring configurations based on the type of speed sensing probes used.

Wiring Notes:

- Refer to Figures 4-2, 4-3, and **Appendix A** for Speed Sensor wiring connections on the FTMs.
- Each Speed input channel can only accept one MPU or one Proximity probe at a time.
- If only 2 inputs are available they can be configured and connected as channel 1 and channel 3 (skip #2) which will place inputs on different FTM modules.
- MPUs only (ch1-3)—Jumper must be added to each channel as shown in Figure 4-4 to allow the "C" analog module to sense speed.
- MPUs only (ch1-3)—Jumper must be installed from 'PROXRTN' to 'COM PROX' as shown in Figure 4-4 to avoid noise issues.
- Proximity Probes only—Individual 12 Vdc and 24 Vdc sources, with isolation diodes on the power, common, and output source lines, are provided with each speed input to power system proximity probes (100 mA fuses are used on the 24 V output, the 12 V is current limited to 100 mA and located on the FTMs).
- Proximity Probes only—External pull-up resistors are required when interfacing with an open collector type of proximity probe.
- Proximity Probes only—Jumpers must be installed from 'A&B IN' and to 'C IN' as shown in Figure 4-5 to avoid noise issues.
- Proximity Probes only—If using external power for these inputs, the power supply should be isolated and must be located within 30 m of the Micronet+TMR chassis.
- It is required that twisted shielded wiring be used between each probe and FTM.
- Shields should be connected together at all intermediate terminal blocks and terminated to earth ground at the FTM terminal block through the Grounding Bar. The exposed wire length, beyond the shield, should be limited to 25 mm (1").
- FTM terminals accept wires from 0.08–2.5 mm² (27–12 AWG).

IMPORTANT	**The installation of jumpers on the unused terminals listed in the above wiring notes are extremely important to ensure that the control receives good clean speed frequency inputs.**

IMPORTANT	**If the speed signals are not within the following limits, the 5009FT control will respond with a speed sensor frequency error during the program checking procedure.**

(TxMxR)/60 must be < 25 000 Hz
T = Gear Teeth
M = (Overspeed Test Limit Setting x 1.02)
R = Gear Ratio

IMPORTANT	**If the MPU device is not providing a voltage greater than 1.5 Vrms, the MPU device should be moved closer to the gear where speed is being monitored. The following graph shows the minimum voltage necessary to detect speed at the various frequencies.**

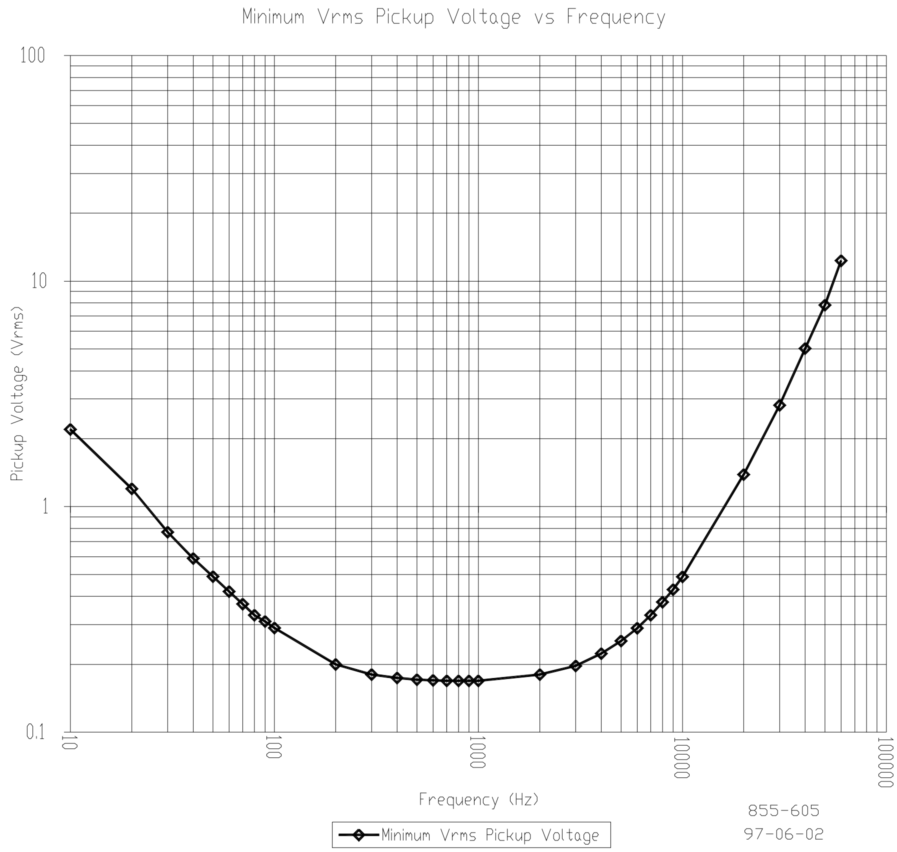


Figure 4-7. MPU Pickup Voltage vs Frequency

Analog Inputs—TMR Analog Combo Module

The base offering control accepts eight 4–20 mA current inputs, with each of the control's two FTMs accepting four inputs. All analog inputs may be used with two-wire ungrounded (loop powered) transducers or isolated (self-powered) transducers. Because inputs are not fully isolated, care must be taken in their application and maintenance to avoid "ground-loop" type problems. All analog inputs have 200 Vdc common mode rejection isolation. If interfacing to a non-isolated device which may have the potential of reaching over 200 Vdc with respect to the control's common, the use of a loop isolator is recommended to break any return current paths, which could result in erroneous readings.

All eight analog inputs are programmable. When an analog input is used, the chosen input must be wired to and configured within the control's program to function. Refer to Volume 3 of this manual for a complete list of programmable analog input options.

A 24 Vdc power supply is available from the 5009FT control to power external transducers or other auxiliary devices. Isolation is provided through diodes on the power and common lines. This 24 Vdc output is capable of providing 24 Vdc with +10% regulation. Power connections are be made through terminals located on system FTMs.

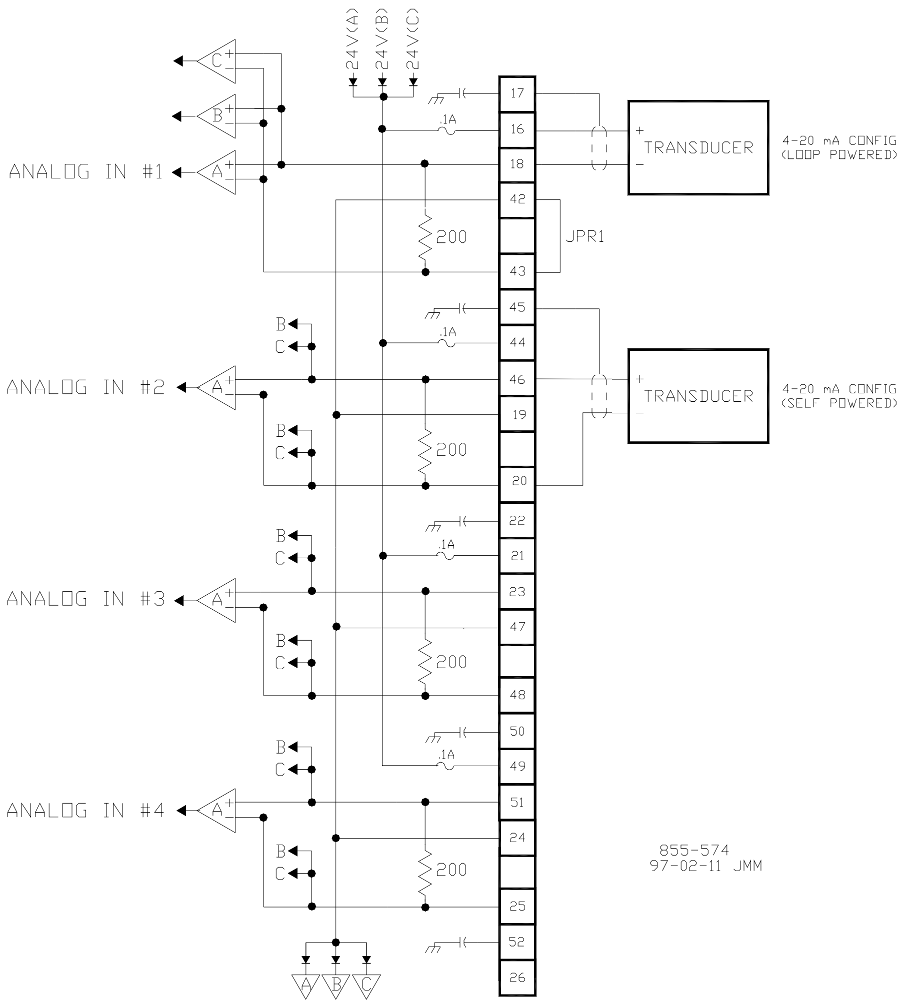


Figure 4-8. Example Analog Input Wiring Diagrams

Analog Inputs—TMR 24/8 Analog Module

For a 4–20 mA input signal, the 24/8 Analog Module uses a 200 ohm resistor across the input located on the 24/8 Analog Module. Each analog input channel may power its own 4–20 mA transducer. See Figure 4-8 for analog input connection. This power is protected with a 100 mA fuse on each channel to prevent an inadvertent short from damaging the module. The 24 Vdc outputs are capable of providing 24 Vdc with ±10% regulation. The maximum current is 0.8 A. Power connections can be made through terminals located on the 24/8 Analog FTMs. See Chapter 11 for complete field wiring information for the 24/8 Analog FTM.

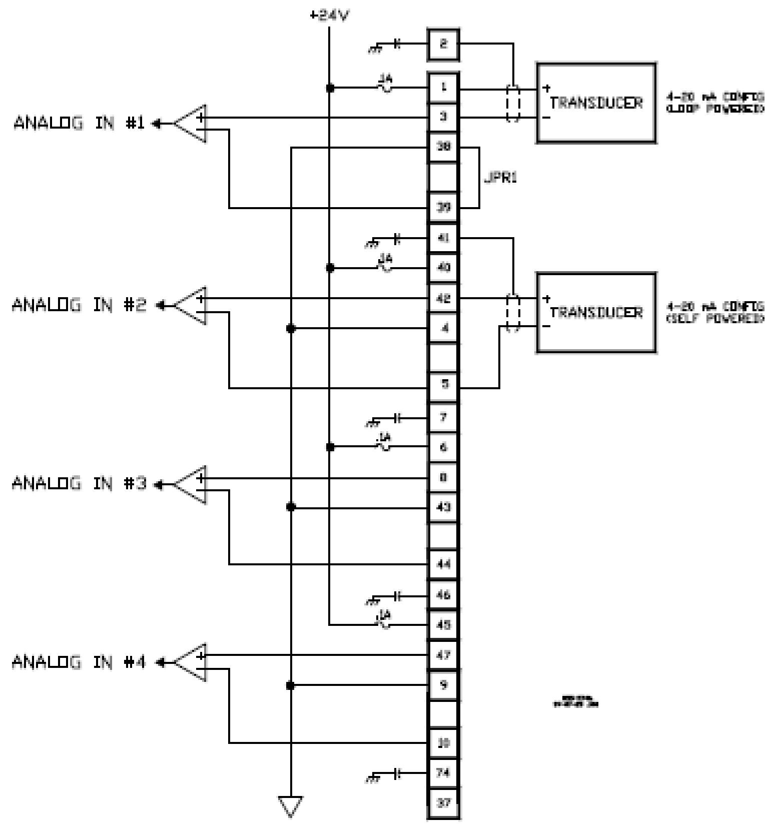


Figure 4-9. Analog Input Wiring for a 24/8 Analog FTM

Wiring Notes:

- Refer to Figures 4-7, 4-8, and **Appendix A** for Analog Input wiring connections on the FTMs.
- Only 4–20 mA signals are accepted.
- A jumper is required between a channel's circuit common terminal and "IN (–)" terminal when interfacing to a loop powered transducer.
- All analog inputs have an input impedance of 200 Ω.
- Each 24 Vdc source terminal has an internal 100 mA fuse in series with it (located on the FTM). To meet CENELEC ratings, power for sensors and contacts must be supplied either by the 5009FT power supplies, or the external power supply outputs must be rated for 30 Vdc or less and have its outputs fused with appropriate sized fuses (a maximum current rating of 100/V, where V is the supply's rated voltage or 5 A, whichever is less).
- It is recommended that 0.75 mm² (20 AWG) or larger twisted/ shielded wire be used between each transducer and FTM.
- Shields should be connected together at all intermediate terminal blocks and terminated to earth ground at the FTM terminal block through the Grounding Bar. The exposed wire length, beyond the shield, should be limited to 25 mm (1").
- Do not place shielded wires in the same cable conduit with high-voltage or large-current-carrying cables.
- Cable shields must be electrically continuous from the signal source to the point the signal wire enters the 5009FT Analog Termination Module.
- FTM terminals accept wires from 0.08–2.5 mm² (27–12 AWG).

Analog Outputs—TMR Analog Combo Module

The control has four 4–20 mA current output drivers, with two outputs per FTM. Applications using analog outputs must, within the control's program, have the desired analog value assigned or configured to a specific output. Refer to Volume 3 of this manual for a complete list of programmable analog output options.

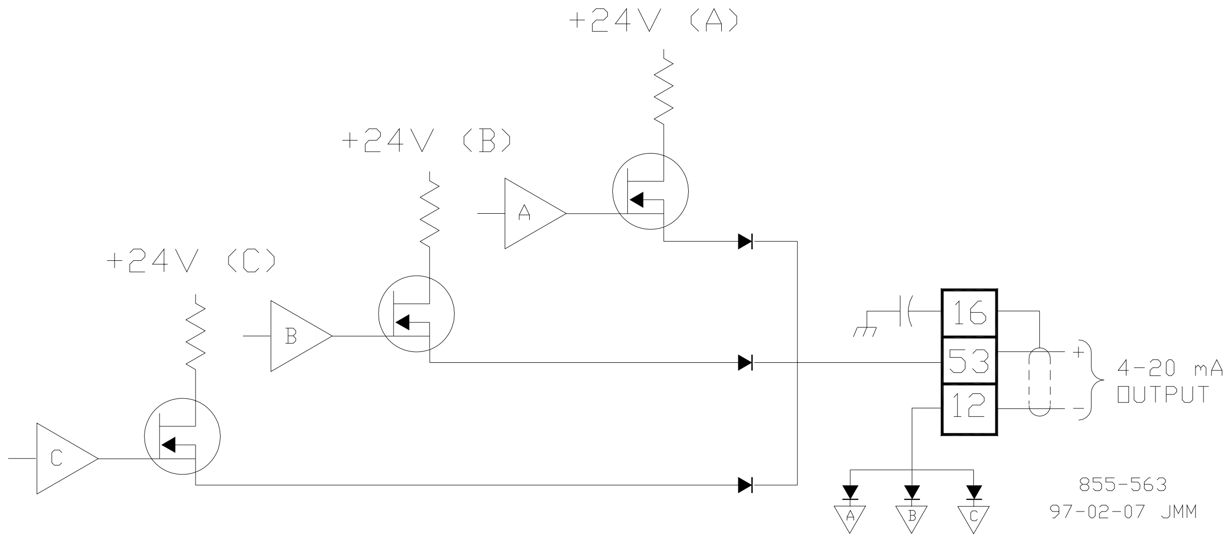


Figure 4-10. Example Analog Output Wiring Diagram

Analog Outputs—TMR 24/8 Analog Module

There are eight analog output channels of 4–20 mA with a full scale range of 0–25 mA. All Analog Outputs can drive a maximum load of 600 ohms (load + wire resistance). See Figure 4-10 and **Appendix A** for analog output connection. Each output monitors the output source current for fault detection. All of the analog outputs may be individually disabled. When a channel fault or a module fault is detected, the application program may annunciate the fault, disable the channel and stop using data in system calculations or control. Care should be taken to prevent ground loops and other faults when interfacing to non-isolated devices.

Wiring Notes:

- Refer to Figure 4-9 and **Appendix A** for Analog Output wiring connections on the FTMs.
- Only 4–20 mA signals are output.
- All analog outputs can drive into a maximum of 600 Ω.
- It is recommended that 0.75 mm² (20 AWG) or larger twisted/ shielded wire be used between each meter (or DCS input) and FTM.
- Shields should be connected together at all intermediate terminal blocks and terminated to earth ground at the FTM terminal block through the Grounding Bar. The exposed wire length, beyond the shield, should be limited to 25 mm (1").
- Cable shields must be electrically continuous from the signal source to the point the signal wire enters the 5009FT Field Terminal Module.
- FTM terminals accept wires from 0.08–2.5 mm² (27–12 AWG) wire.
- Analog outputs are not isolated; care should be taken when interfacing to other non-isolated devices to prevent wiring faults. The use of an isolator is recommended.

Actuator Outputs—TMR Analog Combo Module

The control has two proportional actuator output drivers (one output per FTM). The actuator output drive currents can be programmed to interface with Woodward Governor Company actuators (typically 20–160 mA drive currents) or non-Woodward actuators (4–20 mA drive currents). Each actuator output can be individually configured to interface with Woodward or non-Woodward type actuators.

Each actuator output can also be configured to drive single- or dual-coil actuators. When configuring an output to drive into either type of actuator, the output must be wired correctly (see Figures 4-8 and 4-9), and the control's program configured for the correct type of actuator. See Volume 3 for details on programming actuator outputs.

Dither is selectable through the system's engineering workstation, and is available for either output. Dither is a low frequency (25 Hz) signal consisting of a 5 millisecond pulse modulated onto the control's DC actuator-drive current to reduce stiction in linear type actuators. Woodward TM-type actuators typically require dither. See Volume 3 of this manual for details on adjusting dither.

Wiring Notes:

- Refer to Figures 4-8 and 4-9 and **Appendix A** for Actuator Output wiring connections to the FTMs.
- When configured to drive a single coil actuator, user-supplied jumpers are required between terminals 14 & 15 and terminals 44 & 45.
- Maximum impedance for a 4 to 20 mA actuator output driver is 360 Ω (actuator impedance + wire resistance).
- Maximum impedance for a 20 to 160 mA actuator output is 45 Ω (actuator impedance + wire resistance).
- Each actuator driver senses its drive current to allow over- and under- current alarms and shutdowns. Refer to Volume 1 of this manual for details on defaulted values and changing them.
- It is recommended that 0.75 mm² (20 AWG) or larger twisted/shielded wire be used between each actuator and FTM.
- Shields should be connected together at all intermediate terminal blocks and terminated to earth ground at the FTM terminal block through the Grounding Bar. The exposed wire length, beyond the shield, should be limited to
25 mm (1").
- Do not place shielded wires in the same cable conduit with high-voltage or large-current-carrying cables.
- Cable shields must be electrically continuous from the signal source to the point the signal wire enters the 5009FT Analog Terminal Module.
- FTM terminals accept wires from 0.08–2.5 mm² (27–12 AWG) wire.
- Actuator outputs are not isolated, so they should not be connected to non-isolated devices.

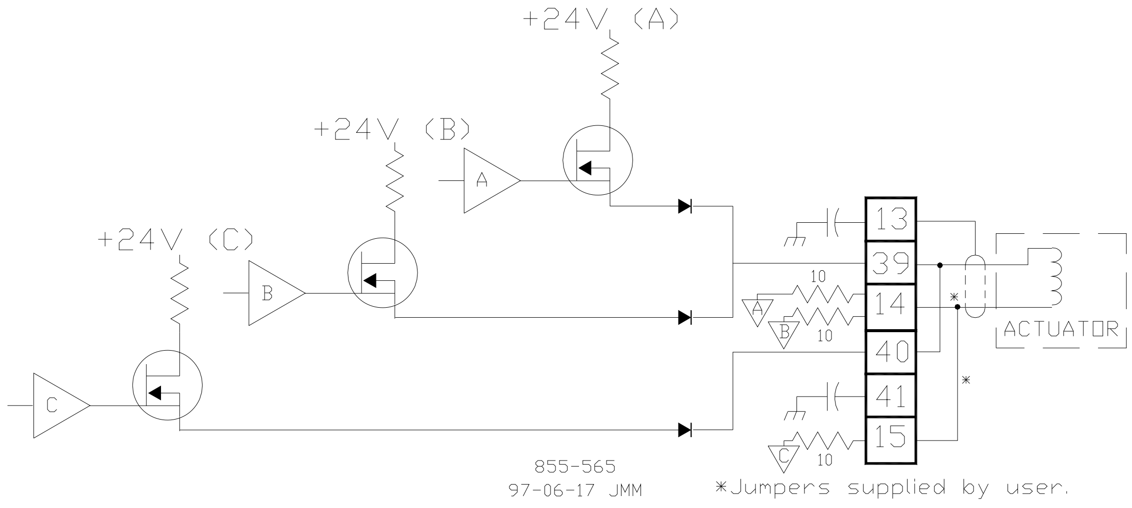


Figure 4-11. Example Single Coil Actuator Wiring Diagram

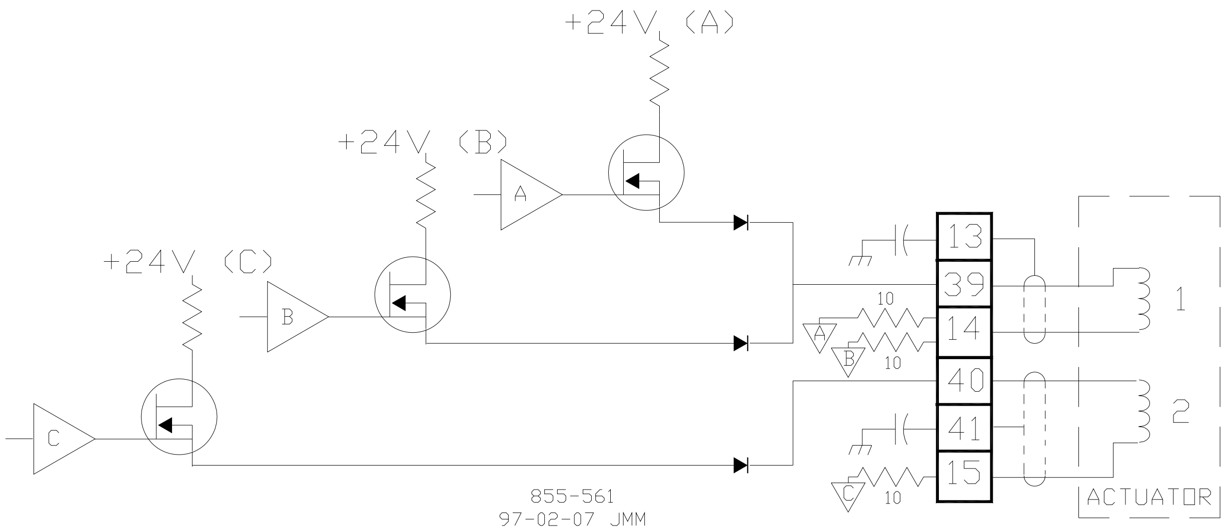


Figure 4-12. Example Dual Coil Actuator Wiring Diagram

Actuator Outputs—Actuator Controller Module

The 5009FT Control is designed to use redundant actuator outputs for each actuator or servo. Actuator output field wiring terminations are made at the terminal strips provided on the Actuator Field Termination Modules. Each Actuator FTM has termination points for two actuator output drivers and two RVDT or LVDT position feedback devices. Although each FTM may drive two actuator outputs, for reasons of redundancy the two actuators driving a single valve will originate from different FTMs. When redundant actuator outputs are used, redundant position resolver feedbacks are not supported. For a dual coil actuator, one driver should be wired to each coil. For a single coil actuator, wire the redundant drivers in parallel to the coil. Refer to Figure 4-11 for supported position resolver schematics.

Wiring Notes:

- Refer to Table 4-2 and Figures 4-12, 4-12a, 4-12b and **Appendix A** for Actuator Output FTM terminal assignments.
- Figure 4-11 gives feedback schematics.
- Maximum impedance for a 20 to 160 mA actuator output is 45 Ω (actuator impedance + wire resistance).
- Each actuator driver senses its drive current to allow over- and under- current alarms and shutdowns. Refer to Volume 3 of this manual for details on defaulted values and changing them.
- It is recommended that 0.75 mm² (20 AWG) or larger twisted/shielded wire be used between each actuator and Actuator FTM.
- Shields should be connected together at all intermediate terminal blocks and terminated to earth ground at the FTM terminal block through the Grounding Bar. The exposed wire length, beyond the shield, should be limited to
  25 mm (1”).
- Do not place shielded wires in the same cable conduit with high-voltage or large-current-carrying cables.
- Cable shields must be electrically continuous from the signal source to the point the signal wire enters the 5009FT Analog Terminal Module.
- Actuator FTM terminals accept wires from 0.08–2.5 mm² (27–12 AWG) wire.
- Actuator outputs are not isolated, so they should not be connected to non-isolated devices.

Some examples are shown below, refer to **Appendix A** for more information.

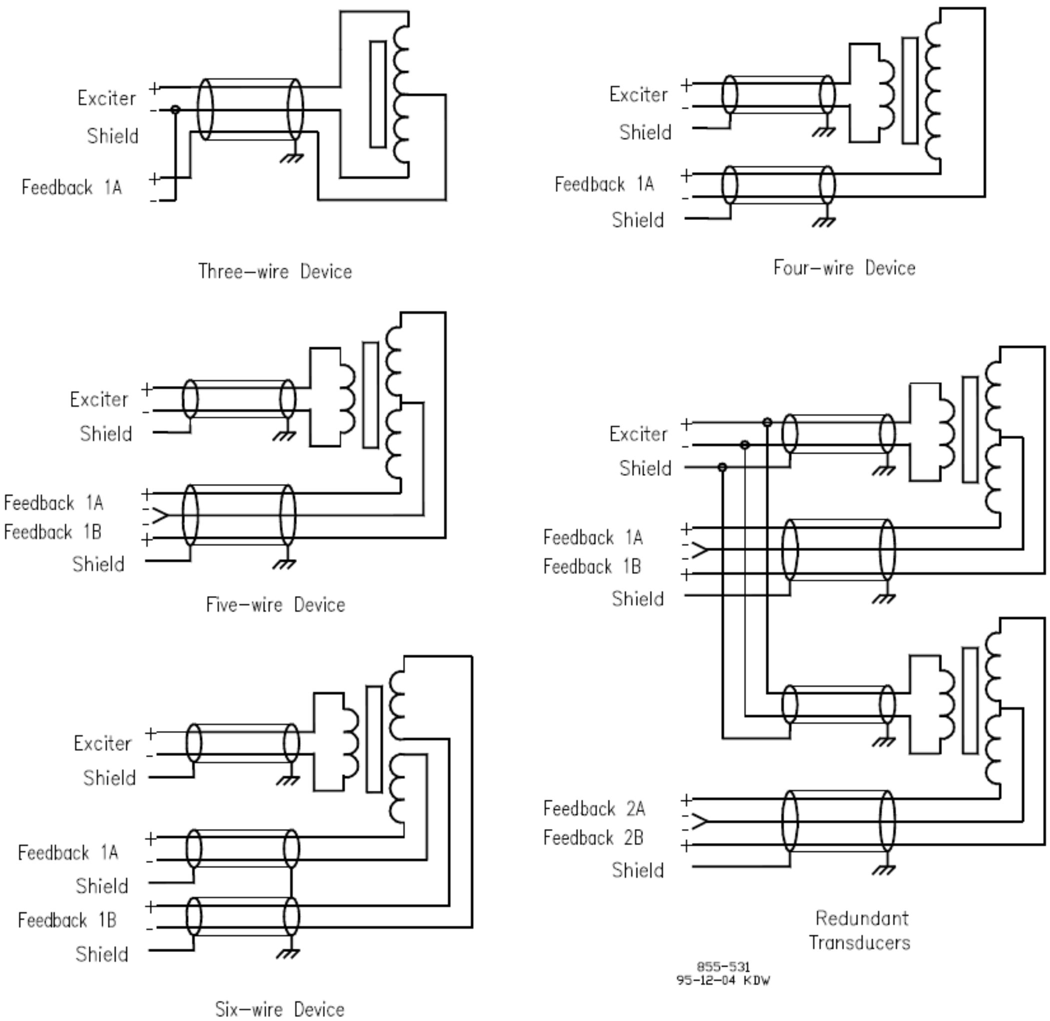


Figure 4-13. 5009FT Compatible Position Feedback Schematics

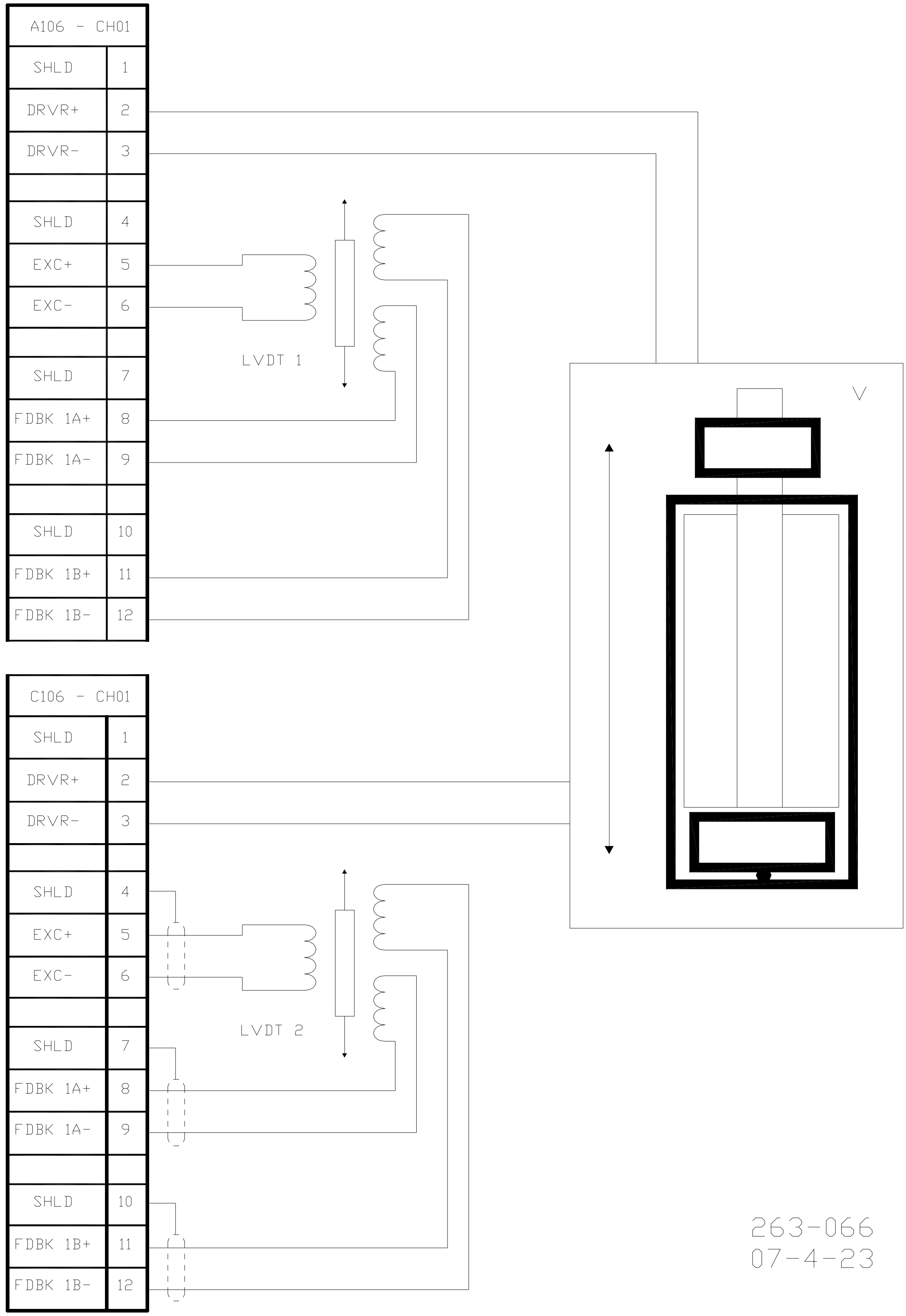


Figure 4-12a. Example of Single Loop with Dual Coil and Two LVDTs Type (A–B)/(A+B) on Cylinder Valve

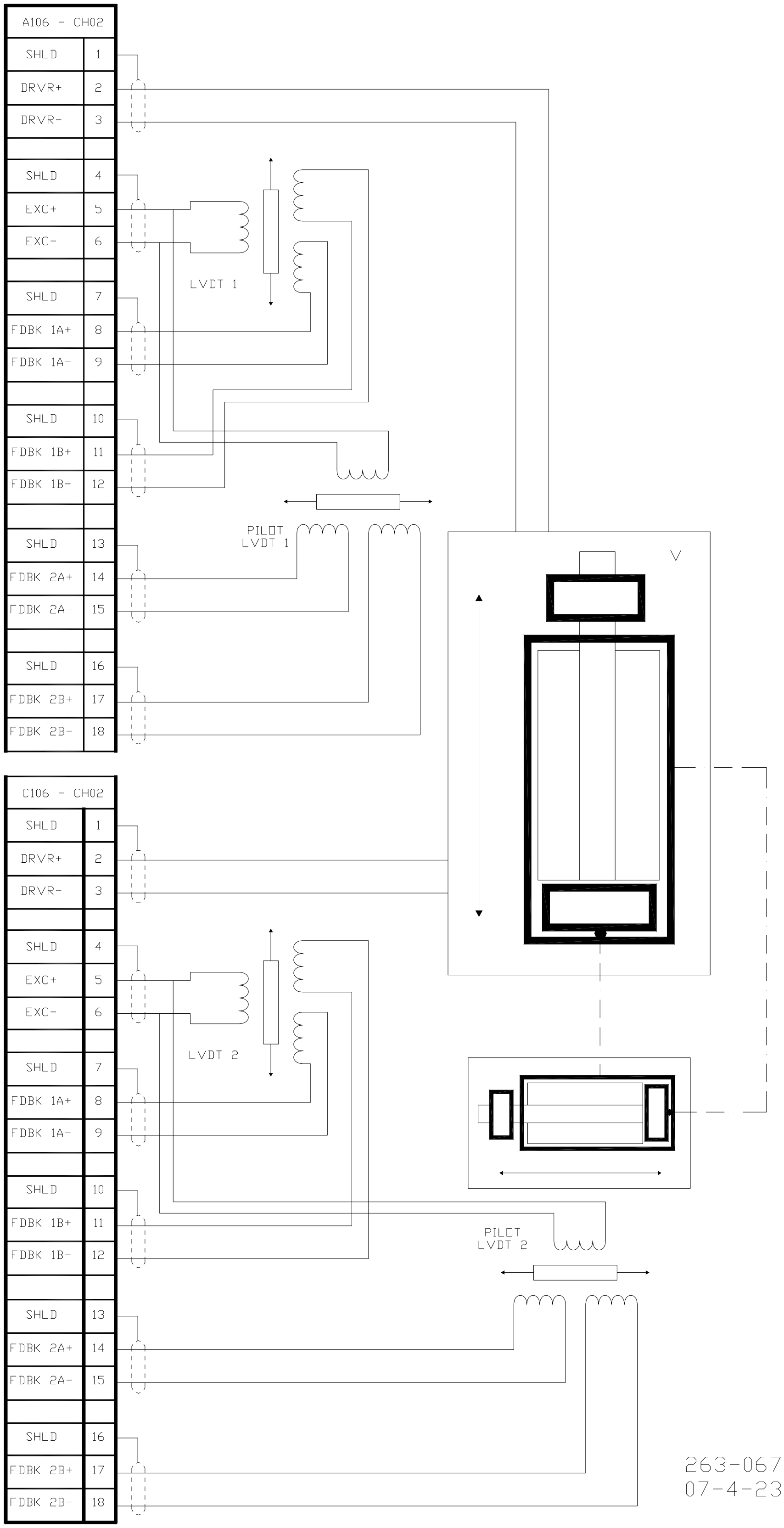


Figure 4-12b. Example of Dual Loop with Dual Coil and Two LVDTs Type (A–B)/(A+B) on Cylinder Valve and Two VDTs Type (A–B)/(A+B) on Pilot Valve

FTM Contact Inputs (F/T Relay–Discrete In)

The 5009FT control accepts 24 contact inputs. Each of the control's four Discrete Termination Modules accepts six contact inputs. All 24 contact inputs are configurable, but the first 6 have been defaulted to functions required by most all systems and should not be changed.
The Preset Contact Inputs are:

- External Emergency Shutdown #1 (fixed)
- External Reset
- Raise Speed Setpoint
- Lower Speed Setpoint
- Start Command
- Controlled Stop Sequence

The control will initiate an emergency shutdown any time the External Emergency Shutdown contact input is opened. This input is typically tied into the system's trip string. Before starting, the External Emergency Shutdown input must have an external contact or switch wired to it and it must be closed. The external reset contact can be used to remotely clear latched alarms and trip conditions. The raise and lower speed setpoint inputs can be used to remotely raise and lower speed or load.

Applications requiring external contact inputs must have the desired function assigned or configured to a specific input. Refer to Volume 3 of this manual for a complete list of programmable contact input options.

Normal Contacts must change state for a maximum of 160 milliseconds and a minimum of 80 milliseconds for the control to sense and register a change in state.

The ESD contact (#1) must change state for a maximum of 20 milliseconds and a minimum of 10 milliseconds for the control to sense and register a change in state.

Contact wetting voltage can be supplied by the control or from an external source. 24 Vdc contact wetting voltage is available on each FTM (with isolation diodes on the power and common lines). Optionally, an external 18–32 Vdc power source or an external 100–150 Vdc power source can be used to source the circuit wetting voltage. (The FTM's CE and CSA markings only apply to the 24 V option.) Because all discrete inputs are fully isolated, a common reference point must be established between the input opto-isolators and the contact wetting power source. If the 24 Vdc internal power source is used as for contact wetting, jumpers are required between FTM terminals 33 & 34, and terminals 33 & 35. If an external power source is used for contact wetting, the external source's common must be connected to the FTM's discrete input commons (terminals 34 & 35).

⚠WARNING	**HIGH VOLTAGE—If high voltage discrete inputs are used, and there is 125 Vdc on the FTM terminal blocks, there will be 125 Vdc on the FTM cables and cable connectors. All modules should be installed and cables connected before wiring the FTM.**

Wiring Notes:

- Refer to Figures 4-26 through 4-28 and **Appendix A** for Contact Input wiring connections to the FTMs.
- The wiring information on DI's in section 7.1 of 26167V1 must be followed.
- All contact inputs accept dry contacts.
- The internal 24 Vdc power source, an external 18–36 Vdc power source or an external 100–150 Vdc power source can be used for circuit wetting. (The FTM's European CE Compliance and CSA requirements only apply to the 24 V option.)
- If the 24 Vdc internal power source is used as for contact wetting, jumpers are required between FTM terminals 33 & 34 and terminals 33 & 35.

- If an external power source is used for contact wetting, the external source's common must be connected to the FTM's discrete input commons (terminals 34 & 35). To meet CE or CSA ratings, power for sensors and contacts must be supplied either by the 5009FT power supplies, or the external power supply outputs must be rated for 30 Vdc or less and have its outputs fused with appropriate sized fuses (a maximum current rating of 100/V, where V is the supply's rated voltage or 5 A, whichever is less).
- Each contact input pulls 13 mA @ 24 Vdc (13 mA @ 120 Vdc) when closed, and requires at least 4 mA @ 14 Vdc (4 mA @ 70 Vdc) to recognize a closure command.
- Verify that the correct input terminals are wired to with respect to the level of contact wetting voltage used.
- The combined current draw through terminals 27, 28, 29, 30, 31, and 32 cannot exceed 400 mA or the Discrete I/O module's on-board power converter will current limit.
- It is recommended that 0.75 mm² (20 AWG) or larger wire be used between each discrete input and the FTM.
- FTM terminals accept wires from 0.08–2.5 mm² (27–12 AWG) wire.
- If 125 Vdc Contact Power is used, the Power Supply must meet IEC 6164-1, Overvoltage Category II.
- With the use of 125 Vdc contact power, it is recommended that the contact power be removed before connecting or disconnecting any 5009-to-FTM cable.

FTM Relay Outputs (F/T Relay Outputs)

There are twelve relay outputs available from the 5009FT control, with three outputs per FTM. With the exception of Relay #1 – all of the relays are user-configurable. The defaulted outputs are:

- Shutdown relay #1 (fixed)
- Alarm relay
- Shutdown relay #2

The relay outputs can be programmed to energize upon a function change of state or an analog value level. Applications requiring programmable relay outputs must have the desired switch condition or specific analog value assigned to them within the control's program. Refer to Volume 3 of this manual for a complete list of programmable relay output options.

The 5009FT control system does not have the capability to provide circuit power to external circuits interfacing with a relay output. All external circuits interfacing with control relay outputs must have circuit power provided externally. All relays are dust-tight, magnetic blow-out type relays with Form-C type contacts.

Refer to MicroNet TMR manual **26167** for all relay ratings.

Latent Fault Detection

Because a fault tolerant system can tolerate a single fault, it is possible for this fault to go undetected. This is called a latent fault. If another fault occurs when a latent fault exists, it could cause a shutdown. This is why it is important to detect latent faults in a fault tolerant system.

Each relay output can be individually configured to use latent fault detection to identify relay failures without affecting a relay output's state. A fault tolerant relay configuration consists of 6 relays, driven by two discrete outputs from each kernel. The relays are configured in three legs of two relays each. See Figure
4-13. Customer circuit power is connected to one side of the resulting configuration, and customer load to the other side. Field selectable jumpers, located on system FTMs, are provided to allow each output's latent fault detection logic to be compatible with the circuit being interfaced to.

Six individual relays make up one relay output. When a relay output is closed, the contacts of all six relays are closed. Because of the series-parallel configuration that the relays are in, the failure of any two individual relays will not cause the output to be open. The relay output would continue to be closed. Once a relay output is closed, the output's individual relays are periodically opened and re-closed, to ensure that they were in the correct state, and that they change state.

When a relay output is open, the contacts of all six relays are open. Because of the series-parallel configuration that the relays are in, the failure of any one relay will not cause the output to be closed. The relay output would continue to be open. Once a relay output is open, the output's individual relays are periodically closed and re-opened one by one, to ensure that they were in the correct state, and that they change state. Position readback circuitry allows the state of each relay contact to be detected. Any failures are annunciated, and further testing is disabled without affecting the state of the relay output contact or control operation.

Latent fault detection (LFD) is not usable with all applications or circuits. The control's LFD logic can only work with circuits using voltages between 18–32 Vdc, 100–150 Vdc, or 88–132 Vac. For LFD to work, a small leakage current is passed through the circuit's load. See Figures 4-11, 4-12, and 4-13. Depending on the size of the load, the leakage current may be enough to cause a load to be on or active, when a relay contact is open. In this case, the individual relay's LFD logic may be disabled, eliminating the leakage current.

If LFD is desired, but the leakage current is too great for the load, an external resistor may be connected in parallel with the circuit's load to shunt some of the leakage current away from the load. To prevent failure of a load to de-energize, careful consideration should be given, to ensure that the voltage developed across the load due to leakage current is below the load's drop-out voltage.

With LFD, when a relay contact is closed, no difference in operation is experienced; the relay output appears as a closed contact. However, when a relay contact is open, it appears to the interfaced circuit as a large resistor instead of an open contact. Thus a small amount of current is leaked to the load, resulting in a developed voltage across the load. In most cases this has no bearing on the customer's circuitry, because such a small amount of voltage is developed across its load. However, when a relay output is used with a very high resistance load (low current load), enough voltage may be developed across the load to prevent it from de-energizing.

To verify if Latent Fault Detection can be used with a relay output:

1. Verify that circuit the relay output is used with has a voltage level of 18–32 Vdc, 100–150 Vdc, or 88–132 Vac. If circuit voltage is not within these ranges, disable the relay output's latent fault detection by placing the relay jumpers in their disable state. See Figure 4-17.

2. Use the graph below (Figures 4-12, 4-13, or 4-14) which corresponds to the circuit's voltage level to determine if the voltage developed across the load (due to the leakage current) is lower than the load's drop-out voltage level.
   - Acquire the resistance of the load (relay, motor, solenoid, etc.) to be driven by the relay.
   - Acquire the load's minimum drop-out voltage.
   - From the bottom of the graph, follow the line corresponding to the load's resistance, up until it intersects the circuit power line. At this point the corresponding voltage level (on the left of the graph) is the level of voltage that will be developed across the load due to leakage current.

3. If the developed load voltage (from the graph) is less than the load's drop-out voltage, latent fault detection can be used with the circuit.

4. If the developed load voltage is greater than the load's drop-out voltage, it is recommended that latent fault detection be disabled, or that a resistor be connected in parallel (shunt) with the load. A correctly sized resistor connected in parallel with the circuit load will decrease the developed load voltage below the load's drop-out voltage level. Using the corresponding LFD graph and the load's minimum drop-out voltage, perform the above procedure in reverse (See step #2) to determine an acceptable shunt resistance. When selecting a shunt resistor also verify that its voltage and wattage ratings meet that of the circuit.

LFD Verification Example:
Circuit Power = 110 Vac
Load Resistance = 200 Ω
Load drop-out voltage = 25 Vac

Using the graph in Figure 4-15, the intersection point between the 200 Ω load resistance line and the 110 Vac line was found. From this intersection point it was determined that the voltage developed across the load due to leakage current (when the relay is open) is approximately 7.5 Vac. This voltage level is lower than the load's 25 Vac drop-out voltage, thus Latent Fault detection can be used with this example circuit.

If, however, the load resistance was 1200 Ω, the intersection would be approximately 29.5 Vac too high for LFD. By following the graph along the 25 Vac line to the 110 V line, a total load resistance of 900 Ω is needed. By placing a properly rated 3600 Ω resistor in shunt with the load, (1200//3600⇨900) LFD can be used.

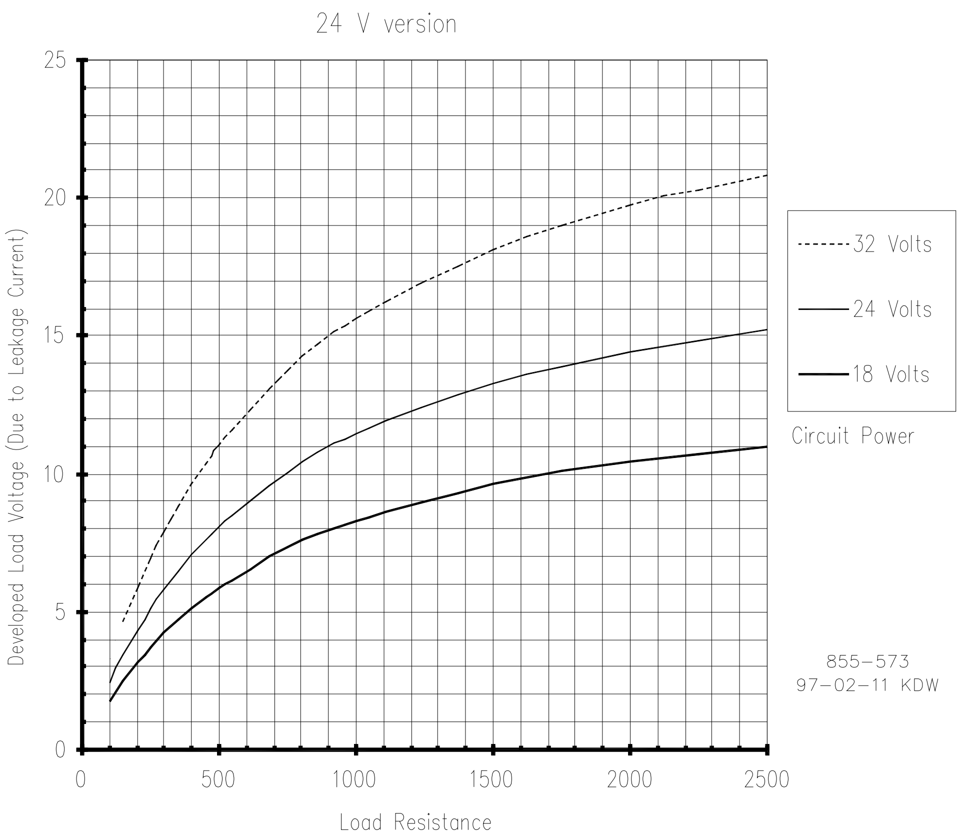


Figure 4-14. Latent Fault Detection Verification Graph—18–32 Vdc Circuitry

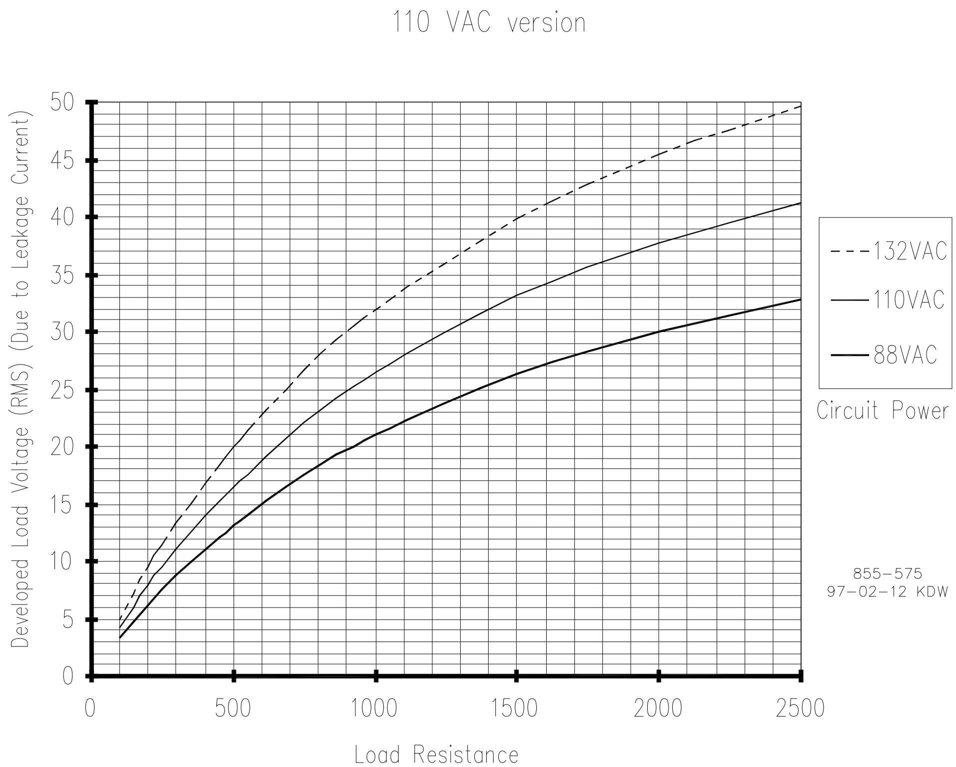


Figure 4-15. Latent Fault Detection Verification Graph—88–132 Vac Circuitry

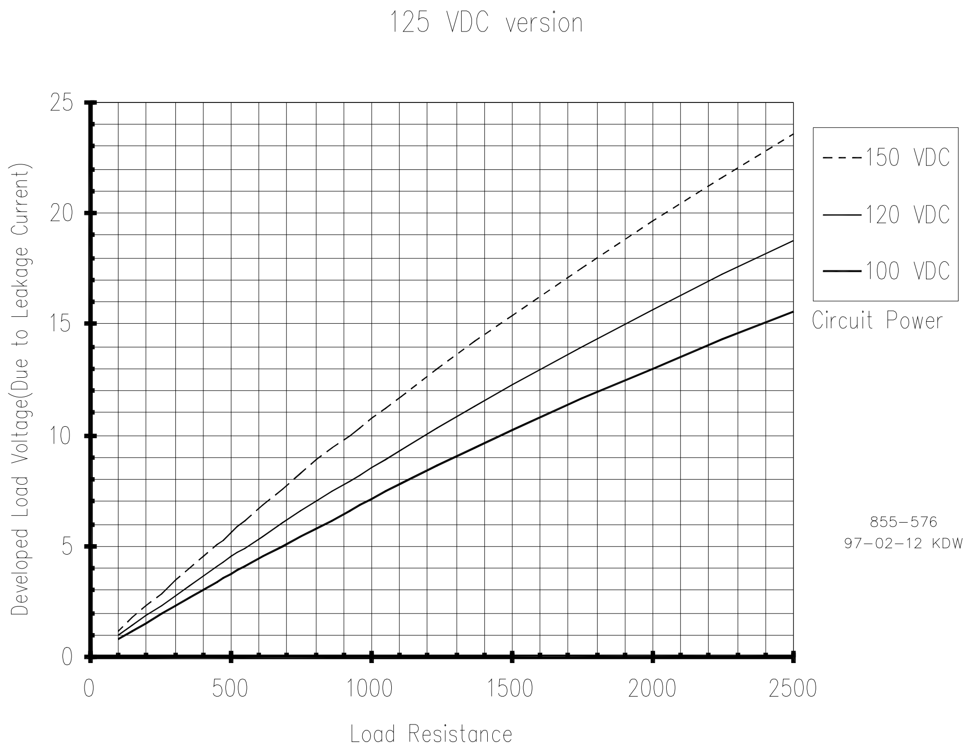


Figure 4-16. Latent Fault Detection Verification Graph—100–150 Vdc Circuitry

Relay Jumper Configurations

Relay coil power should be supplied by the control. Three independent isolated sources are diode selected (High Signal Selected) to power each FTM's relay coil. Jumper banks (four jumpers in one package) are provided on each FTM to allow field selection of internal or external relay coil power. See Figures 4-14 and 4-16. If external relay coil power is supplied, the relay coil power jumper bank must be moved from its defaulted INT. position to the EXT. position.

An FTM includes terminals and internal jumpers to allow its relay coils to be powered by an external power source. This relay coil power configuration was designed for systems which may not have the power sourcing capability to power all system modules and relays (custom designed systems). The 5009FT however, has sufficient power to supply all unit modules and relays.

IMPORTANT	**To retain circuit integrity if an external power supply is used for relay coil power, it must be an isolated 24 Vdc source, with ±5% regulation. When using an external power source for relay coil power, it is recommended that a start-up routine be utilized to remove the source during system power-up and power down. This routine will guarantee that no relay is inadvertently energized due to system power-up surges. (By using the FTM's internal relay coil power this start-up routine is automatically performed.)**

With this system's power configuration, recommend the control's internal power be used to supply the FTM's relay coils at all times.

Field configurable jumpers are used on FTMs to allow a relay's latent fault detection logic to be compatible with different levels of circuit power and to choose which set of relay contacts to test (normally open or normally closed). Each relay output has two banks of jumpers (multiple jumpers in one package).

One jumper-bank (a set of nine jumpers) is used to match the latent fault detection (LFD) circuit with the circuit voltage being interfaced with. The second jumper bank (a set of four jumpers) is used to select which set of relay contacts (N.O. of N.C.) is tested by the LFD logic. During operation, only one set of relay contacts (normally open or normally closed) can be tested. The set of relay contacts tested should be same set of relay contacts used by the circuit interfaced to. Refer to Figure 4-16. LFD can be jumper configured to be compatible with the following circuit voltages:

- 18–32 Vdc circuit power (meets CE & CSA ratings)
- 88–132 Vac circuit power (not listed)
- 100–150 Vdc circuit power (not listed)

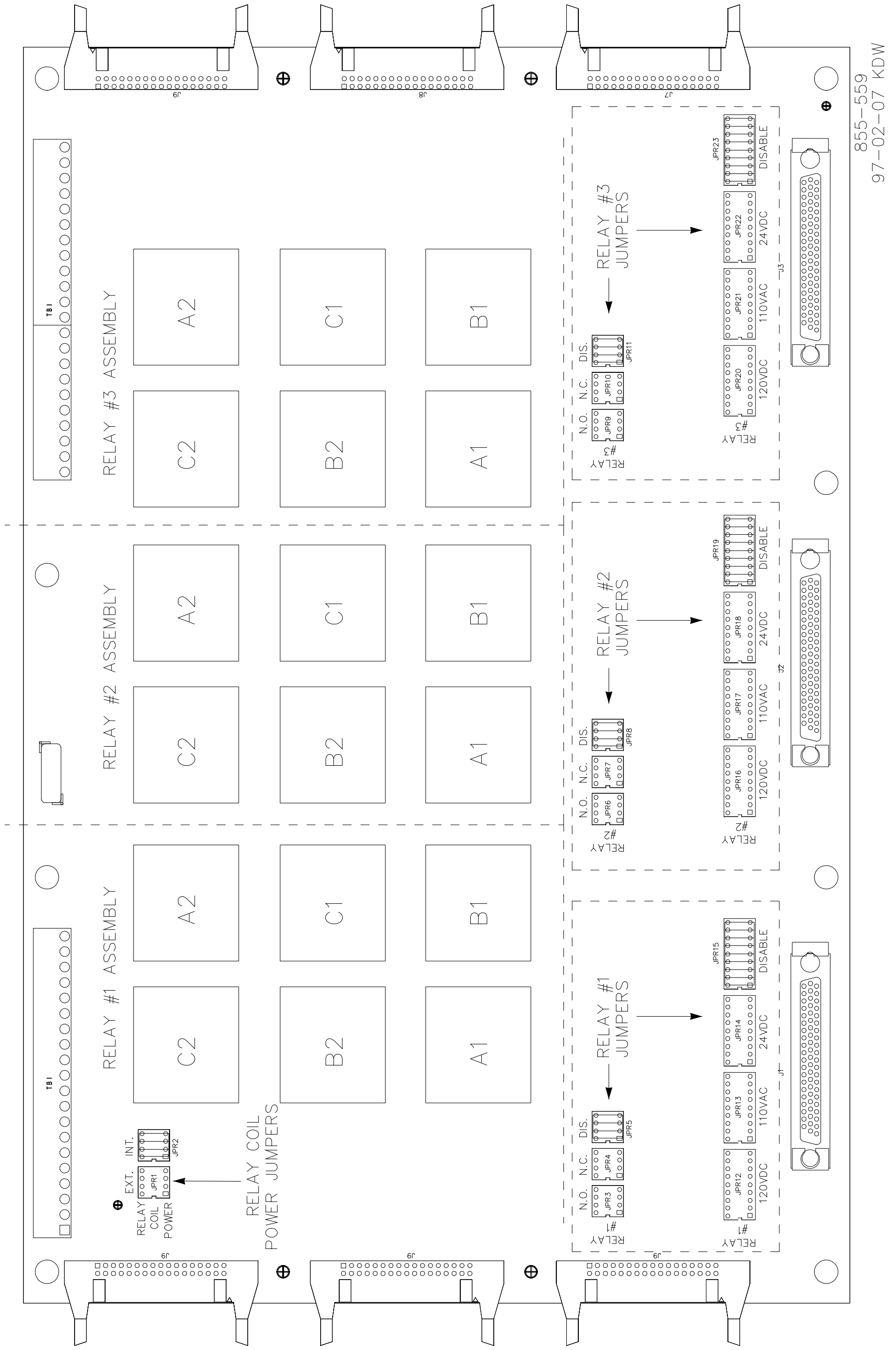


Figure 4-17. Jumper and Relay Location Diagram

After all jumper-banks have been correctly positioned, mark the placement of each jumper-bank on the FTM cover labels, located on each FTM's outer cover. See Figure 4-18.

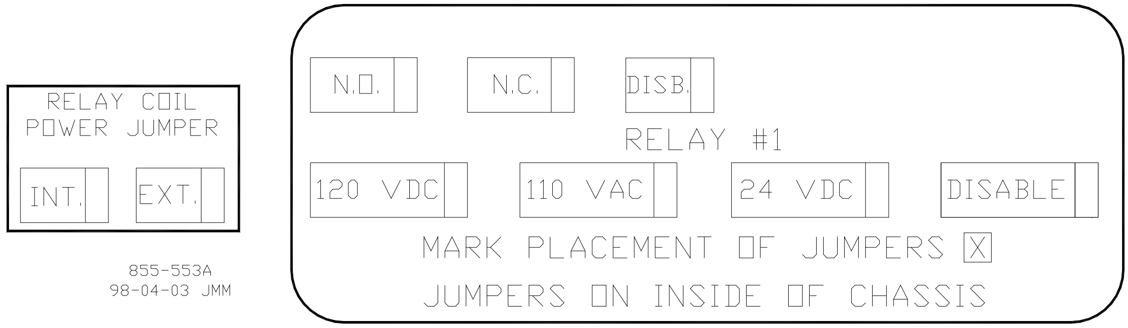


Figure 4-18. FTM Labels

Wiring Notes:

- Refer to Figure 4-19 and **Appendix A** for relay output wiring connections to the FTMs.
- The wiring information on DO's in section 7.1 of manual 26167V1 must be followed.
- Verify that each set of relay contacts meet the power requirements of the circuit which it is being used with. Interposing relays are required in cases where the interfaced circuit demands relay contacts with a higher power rating. If interposing relays are required, it is recommended that interposing relays with surge (inductive kick-back) protection be used. Improper connection could cause serious equipment damage.
- Verify system power is off before removing or installing any FTM jumper. All jumpers are fragile, use caution when removing and installing FTM jumper-banks.
- Select internal or external relay coil power. If the control's internal power is used verify that the FTM's "Relay Coil Power Jumper" bank is in the INT. position. If external relay coil power is supplied, move the FTM's "Relay Coil Power Jumper" bank to the EXT. position and verify that the external source is fully isolated. (Mark the FTM's label to indicate jumper position.)
- Verify if Latent Fault Detection (LFD) can be used with each relay output.
- If LFD cannot be used with the relay output, verify that the relay's LFD jumper-banks are in their Disable positions. (Mark the FTM's label to indicate jumper position.) Alternatively an external resistor can be wired in parallel with the load to allow LFD to be used with the relay output. In this case it is the customer's responsibility to calculate the required resistor ratings and install it.
- If LFD can be used with the relay output, move the relay's LFD jumper- bank to the correct circuit power position. Also select which set of relay contacts (NO or NC) are to be tested by the LFD logic. Mark the FTM labels to indicate jumper positions.

⚠WARNING	**HIGH VOLTAGE—Relay circuit power is also present on an FTM's relay and cable connectors. When using high voltage relay circuit power, it is recommended that care be taken not to touch exposed connectors when replacing relays or cables. If possible remove relay circuit power from all FTM relays before replacing any FTM relay or cable.**

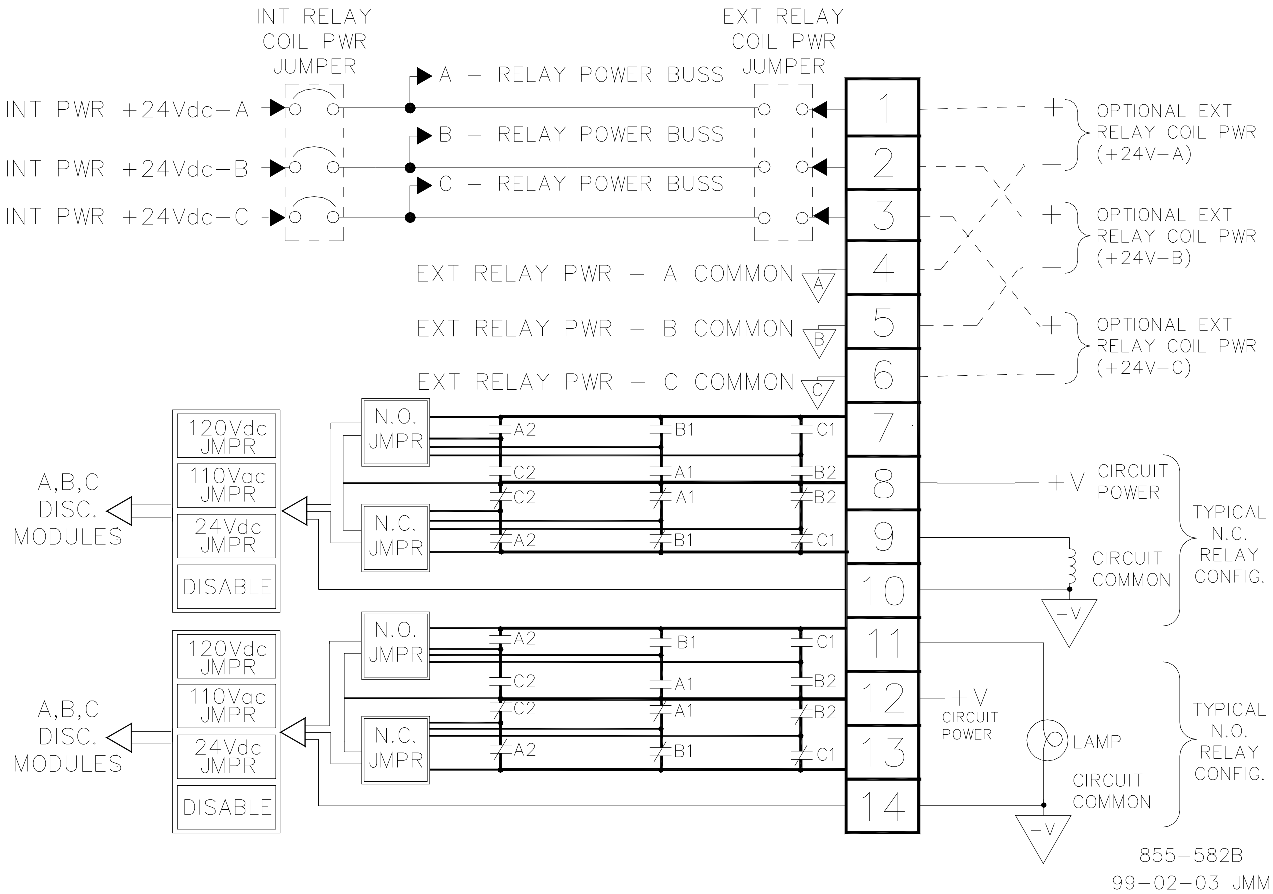


Figure 4-19. Example Relay Output Wiring Diagram

Communications

Each Kernel CPU has two User-available Ethernet ports and one serial communication port. Two network LAN switches (Hirschmann ETH1/ETH2) are provided with the system making it convenient for the user to connect to all three CPU's via one physical RJ45 cable connection. The primary communication interface to the control is using Ethernet on ETH1. The secondary communication interface is use ETH2 as a separate network to link to the control. If serial connections are desired, the port on each CPU is configurable to be used as a Modbus link. Modbus #1 has three available slave communication links and Modbus #2 has two.

IMPORTANT **If both Ethernet ports (1 & 2 on same CPU's) are to be used they must be configured with IP addresses that are on different domains. Refer to Volume 3 to see they default IP settings from Woodward as an example.**

Communication to the CCT –
The door mounted Configuration and Commissioning Tool (CCT) Touchscreen PC has two Ethernet ports that are connected to the two LAN switches. This device is factory set with default IP addresses that will automatically connect to the control system for all Woodward software tool interfacing. **If the user changes the IP addresses of the control on 1 or both of the Ethernet networks, then the IP address (s) of this computer need to be changed also to be on the same network.**

Port configurations:

- CPU-A (RS-232/422/485) can function as a port on Modbus #1 or #2
- CPU-B (RS-232/422/485) can function as a port on Modbus #1 or #2
- CPU-C (RS-232/422/485) can function as a port on Modbus #1 or #2

All communication ports can interface with other devices via RS-232 communication. RS-232 communication is limited to a distance of 15 m (50 ft). In cases where a device which is being interfaced to is located a distance of greater than 15 m (50 ft) from the control, it is recommended to use RS-422 or RS-485. RS-422 and RS-485 communication support multi-dropping (multiple slaves on a single communication line); RS-232 communication does not.

The 5009FT control can simultaneously communicate with up to five Modbus based devices using ASCII or RTU Modbus transmission protocols. The Ethernet Modbus links can be configured for TCP or UDP protocol. Refer to Volume 3 of this manual for a list of all the Modbus commands and parameters available.

Control Wiring Diagrams

When installing a system, follow all I/O specific wiring notes (covered earlier in this chapter) and general wiring notes below. For ease of identification system notes are displayed within a triangle on each wiring diagram. The number that appears in a triangle pertains to a wiring note. **Appendix A** provides all necessary information to wire to the system.

Wiring Notes

1 Refer to **Appendix A**.
2 Refer to MicroNet TMR manual **26167** for input power ratings.
3 Consult the Customer supplied wiring.
4 Optional Wiring (dependent upon system options).
5 Read and follow all Wiring notes, instructions, and recommendations within this chapter when electrically installing a system.
6 Confirm each connection before operating unit.
7 All analog inputs must be isolated from earth ground.
8 Follow authorized standards for conduit loading and sealing.
9 All wires to terminal blocks shall have wire markers, marked with associated terminal number.

System Power-Up

If at any time during this procedure the defined or expected result is not achieved, step to Chapter 5 of this volume and begin system troubleshooting.

1. Turn the power for one power supply on and verify that the power supply's green LED is the only power supply LED on.
2. Turn the power for second power supply on and verify that the power supply's green LED is the only power supply LED on.

At this point, the system will perform off-line diagnostics, this diagnostics testing will typically take about **2 minutes**. When all CPUs have synchronized and completed their diagnostic tests, no red LEDs should be on, and the control will begin running the application program.

IMPORTANT	**When the momentary RESET button is pressed the CPU's red Fault and Watchdog LEDs should go out and the green RUN LED should go on. At this time, the CPU is performing the self-diagnostics and boot-up processes. If only one CPU has been reset, (other CPUs still failed) the 5009FT will wait for another CPU to boot-up before both CPUs will go to a running state.**

⚠WARNING

Improperly calibrated devices can cause turbine damage and possible personnel injury or death. Before starting the turbine for the first time, and periodically thereafter, verify the calibration of all external input and output devices.

Chapter 5.
Troubleshooting and Module Replacement

Introduction

This chapter provides detailed information on system hardware, gives tips to assist in solving hardware related issues, and includes module replacement instructions. Once a system problem is annunciated, this chapter can be utilized as a troubleshooting guide to assist problem finding and if necessary module replacement.

Because testing all functions of an individual module is beyond the scope of this manual, when the results of the procedures indicate that a module may be faulty, replace the suspected module with a module known to be good. This will help verify that the cause of the problem actually is in the suspected module.

If after following this chapter's guidance the cause of a problem cannot be found, contact the Woodward technical assistance group.

NOTICE	**Only qualified service personnel should perform the following module replacement procedures.**

Main Power Supply (PSM1 and PSM2)

System diagnostic routines continuously monitor each main power supply for proper operation. If a fault condition is detected, the fault is annunciated, and the supply's output disabled. If necessary, use the power supply's front panel LEDs to assist in diagnosing a related problem. If all supply LEDs are turned off (not illuminated), it is probable that input power is not present and verification should be made.

Main Power Supply LED descriptions:

OK LED—This green LED turns on to indicate that the power supply is operating and no faults are present.

INPUT FAULT LED—This red LED turns on to indicate that the input voltage is either above or below the specified input range. If this LED is on, check the input voltage and correct the problem. Long-term operation with incorrect input voltages may permanently damage the power supply. Once the input voltage is within the supply's input specifications, this LED will turn off. Refer to Table 4-1 for power supply input specifications.

OVERTEMPERATURE LED—This red LED gives an early warning of a thermal shutdown. The LED turns on to indicate when the internal power supply temperature reaches approximately 80 °C. If the internal supply temperature rises further to approximately 90 °C the supply will shutdown. Because of the many variables involved (ambient temperature, load, thermal conductivity variations) there is no accurate way of predicting the time between the indication of Overtemperature (LED illuminated) and power supply shutdown. If this LED is turned on, verify that the fan in the power supply chassis is turning, and is free of dust or other obstructions and that the temperature around the power supply is less than 55 °C. If the power supply is cooled down without delay, it can recover from this situation without shutting down. This LED will turn off once the internal supply temperature decreases below approximately 75 °C.

POWER SUPPLY FAULT—This red LED turns on when one of the supply's three power converters has shut down. If this LED is on, check for a short circuit on external devices connected to the control's power supply. Once the short circuit is removed, the supply may resume normal operation. If no short circuit is found, try resetting the supply by removing input power for one minute. Once input power has been restored, if the power supply is still not functioning, verify that the supply is properly seated to the motherboard connector, if still not functioning, replace the supply.

Each main power supply must have its own branch circuit rated fuse or circuit breaker. A main power supply module has internal fuses; however these fuses do not protect the supply's input circuitry, and will only open in the event of a component failure internal to the power supply. If any of the supply's internal fuses are open, replace the supply.

To Replace a main power supply (PSM1, PSM2):

1. Read all warnings at the beginning of this volume before replacing any module.
2. Remove input power from the power supply being replaced (CB3 or CB4).
3. Unscrew front panel mounting screws, and release the module from the motherboard connectors by pressing the top handles up and the bottom handles down.
4. Remove module by pulling straight out.
5. Install a new power supply by aligning the circuit board edges in the card guides and push the unit into the slots until the connectors on the modules and the connectors on the motherboard make contact.
6. With even pressure exerted at the top and bottom of the supply's front panel, firmly push the unit into place.
7. Tighten the screws that secure the module in place (two at the top and two at the bottom).
8. Re-apply power to the input of the power supply.

Kernel Power Supply (Kernel A/B/C: A1)

Each kernel section of the MicroNet TMR control contains one kernel power supply module located in the first slot of the kernel. This module receives 24 Vdc from the main TMR supply and regulates it to 5 Vdc, 10 A for the rest of the kernel section. The kernel power supply also creates a 5 V pre-charge voltage. There are no switches on this module. A Fault LED is on the front panel of the power supply. It will illuminate if a problem occurs with the 5 V or 5 V precharge.

The kernel power supply module also assists in CPU to CPU communications. If the control reports a CPU to CPU communication fault, the affected kernel power supply module may need to be replaced.

⚠WARNING	**With this control the removal of any single kernel will not cause a shutdown. However, if other faults are present within other kernels, those faults combined with any faults created by the removal of this kernel power supply may cause a system shutdown.**

To Replace a Kernel power supply module:

1. If the control is running and on-line, use the CCT to verify the other CPUs are running without faults. Correct all other CPU faults within the other kernel sections before replacing a kernel's power supply.
2. Unscrew the **Kernel Power Supply** module's captive screw fasteners and release the module from the motherboard connectors.
3. Press the momentary reset button on the respective kernel's **CPU** to place the kernel in 'Reset' mode.
4. Remove the **Kernel Power Supply** by pressing the top handle up and the bottom handle down.

5. Remove the module by pulling straight out and place it into a conductive plastic bag (Woodward P/N 4951-041).

6. Install the replacement supply module by aligning the circuit board edge in the card guides and push the module into the slots until the connector on the module and the connector on the motherboard make contact.

7. With even pressure exerted at the top and bottom of the supply's front panel, firmly push the supply module into place. Tighten the two screws that secure the module in place (one at the top and one at the bottom).

8. At this point, the kernel **CPU** will automatically begin a reboot procedure and perform off-line diagnostic tests for approximately 60 seconds then re-synchronize with the other control CPUs.

9. At this point – return to the CCT (re-connect if Kernel A was the area affect by the above procedure), go to the Alarm Summary page, and enter a RESET.

10. All kernel and module alarms should clear, restoring complete fault tolerance to the system.

Replacing a 5009FT CPU while Unit is Running

The 5009FT system ships from Woodward with the following default IP Addresses

For **Kernel A CPU**
Ethernet 1 =
Enter the IP address **172.16.100.47**
Enter the Subnet mask 255.255.0.0
Ethernet 2 =
Enter the IP address **192.168.128.21**
Enter the Subnet mask 255.255.255.0

For **Kernel B CPU**
Ethernet 1 =
Enter the IP address **172.16.100.48**
Enter the Subnet mask 255.255.0.0
Ethernet 2 =
Enter the IP address **192.168.128.22**
Enter the Subnet mask 255.255.255.0

For **Kernel C CPU**
Ethernet 1 =
Enter the IP address **172.16.100.49**
Enter the Subnet mask 255.255.0.0
Ethernet 2 =
Enter the IP address **192.168.128.23**
Enter the Subnet mask 255.255.255.0

For **Woodward 'Spare' CPU default from factory**
Ethernet 1 =
Enter the IP address **172.16.100.1**
Enter the Subnet mask 255.255.0.0
Ethernet 2 =
Enter the IP address **192.168.128.20**
Enter the Subnet mask 255.255.255.0

CPU Module (Kernel A/B/C: A2)

System diagnostic routines continuously monitor each CPU for proper operation. If a fault condition is detected, the fault is annunciated and the CPU is locked out of all voting. If necessary, use the CPU module's front panel LEDs to assist in diagnosing a related problem. If all CPU LEDs are turned off (not illuminated), it is probable that input power is not present and verification should be made. If only one CPU module has all of its LEDs off, it is probable that the kernel power supply is not functioning.

The CPU module has the following indicators and switch:

RESET (Recessed)—This momentary push-button resets the CPU and I/O modules (Kernel) when pressed. The CPU performs a boot-up sequence, and then synchronizes to the other Kernels and functions normally.

RUN LED—This turns GREEN when the CPU is operating and no faults are present. If this is RED, the CPU is in Reset mode.

ETH G/Y (Link & TX/RX) LEDs—Link Active GREEN indicates a valid Ethernet connection to another device exists. Tx/Rx Active YELLOW when data is transmitted or received.

SYSCON LED—System Controller GREEN LED –on when the CPU is active and in control of the Kernel IO

LOW VCC LED—This red LED turns on when the Kernel power supply's +5 Vdc output is out of its specified limits. If this LED is on and remains on after a CPU reset, replace the Kernel power supply.

FAULT LED—This RED LED actively flashes CPU fault codes as necessary.

STANDBY LED—NOT USED FOR TMR SYSTEMS

I/OLOCK LED—This red LED turns on when a major CPU or I/O module hardware fault has been detected. When a major fault is detected, the fault is annunciated, all discrete outputs are locked in a de-energized state, and all analog output signals locked to zero current. The reason for a hardware fault can be viewed through the engineering workstation. After the problem has been corrected, perform a CPU reset to unlatch the I/O lock logic.

WDOG LED—This RED LED turns on if the CPU stops executing the application program. After the problem has been corrected, perform a CPU reset to unlatch the Watchdog LED logic.

CAN LEDs—CAN communication ports – NOT USED THIS SYSTEM

Table 5-1. Default IP Addresses

	KERNEL A	KERNEL B	KERNEL C
ENET1	IP = 172.16.100.47 Subnet = 255.255.0.0	IP = 172.16.100.48 Subnet = 255.255.0.0	IP = 172.16.100.49 Subnet = 255.255.0.0
ENET2	IP = 192.168.128.21 Sub = 255.255.255.0	IP = 192.168.128.22 Sub = 255.255.255.0	IP = 192.168.128.23 Sub = 255.255.255.0

To Replace a CPU module:

1. Read all warnings on pages v and vi of this Volume before replacing any module. **Replacing a CPU will disable all IO from this kernel.**

2. If the control is running and on-line, use the CCT to verify that the other CPUs are running without faults. Review the Alarm Annunciation page to ensure that no IO channels in the selected Kernel are needed to operate.

3. Unscrew the **Kernel Power Supply and the CPU** module's captive-screw fasteners

4. Press the **CPU's Reset button** to place CPU in reset mode.

5. Disengage the **Kernel Power Supply** by pressing the top handle up and the bottom handle down, slide it out about an inch, but leave it placed in the chassis.

6. Disconnect any communication cables from the **CPU**.

7. Remove the CPU module from the motherboard connectors by pressing the top handles up and the bottom handles down.

8. Remove the CPU module by pulling straight out and place it into a conductive plastic bag (Woodward P/N 4951-041).

9. Install the replacement CPU module by aligning the circuit board edge in the card guides and push the module into the slot until the connector on the module and the connector on the motherboard make contact.

10. *With even pressure exerted at the top and bottom of the CPU module's front* panel, firmly push the module into place.

11. Tighten the two screws that secure the CPU module in place (one at the top and one at the bottom).

12. Re-connect any communication cables to the CPU.

13. Re-engage the **Kernel Power Supply** module by pushing the module into the slot until the connector on the module and the connector on the motherboard make contact, use *even pressure exerted at the top and bottom of the Kernel Power Supply module's front panel*

14. Tighten the two screws that secure the Kernel Power Supply module in place (one at the top and one at the bottom).

15. Launch **AppManager** from CCT using ToolKit or from the Desktop (if desired the ToolKit program can be minimized).

16. Should see 2 good kernels as IP addressed above and a new CPU – The factory default settings of a Spare CPU will be:
    ENET1 - IP = 172.16.100.1 with Subnet Mask 255,255,0,0
    ENET2 - IP = 192.168.128.20 with Subnet Mask 255,255,255,0

17. Use **AppManager** (Control/Network Settings) to change the IP addresses on new one to the CPU that is being replaced:
    For example of changing Kernel C
    Ether 1 = 172.16.100.49 and Ether 2 = 192.168.128.23
    The username & password – ServiceUser & ServiceUser

18. The CPU will reboot to accept the new IP addresses. Once rebooted it should show up on AppManager w/ new IP's.

19. Use AppManager and go to one of the running CPU's and use the pull-down 'Retrieve Files' and retrieve the **5418-3416_x.OUT** file, to a folder on the CCT. (This is the version of the application running in your system – with **x** above being the revision NEW, A, B, C….).

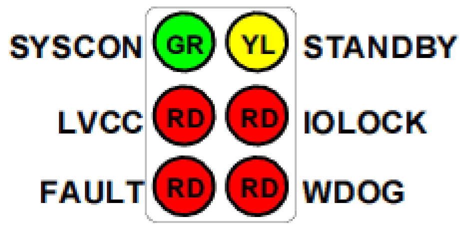
20. Use AppManager and go to the replaced CPU and use the pull-down 'Transfer Application Files' and place this file on the CPU.

21. Click on this application file and click on the 'Start Application' (pull-down or tool bar icon).

22. The CPU will Start the application and synchronize with the other kernels. It will obtain all current states and tunable values during synchronization with the other Kernels.

23. At this point – return to the CCT (re-connect if Kernel A was the area affect by the above procedure) and go to the **Alarm Summary** page and enter a RESET.

24. All kernel and module alarms should clear, restoring complete fault tolerance to the system.



For a CPU that already has the correct application loaded and set to Auto-Start, the following is the correct/normal sequence of CPU LED indications above through the boot-up initialization routine (times are approximate):

		TIME
1–	Fully inserting CPU into kernel rack with KPS on **LEDs ON—RUN, SYSCON, LVCC, IOLOCK, WDOG**	0:00
2–	**RUN LED** goes OFF	0:05
3–	**RUN LED** goes back ON	0:40
4–	**FAULT LED** goes ON for 2 sec pulse then back OFF	1:05
5–	**LVCC LED** goes OFF	1:20
6–	**WDOG LED** goes OFF	1:30
7–	**IOLOCK LED** goes OFF, hear relay click, sync complete	1:40

Note: If you just press the CPU Reset button on the CPU—sequence and time are the same—the only difference is that the LVCC LED will be OFF the whole time.

Analog and Discrete I/O Modules (Kernel A/B/C: A3-A5)

Each I/O Module has a red Fault LED, controlled by the CPU, that is turned on when the system is reset. During initialization of an I/O module, which occurs after every CPU reset, the CPU turns the Fault LEDs on. The CPU then tests each I/O module using diagnostic routines built into software. If the diagnostic test is not passed, the LED remains on. If the test is successful, the LED goes off. If the Fault LED on a module is illuminated after the diagnostics and initialization have been run, the module may be faulty or in the wrong slot.

If during normal control operation all Kernel I/O modules have their Fault LEDs on, check the Kernel CPU for a failure. If during normal control operation, only one module's Fault LED is turned on or flashing, replace this module. A flashing LED indicates that a certain module failure has occurred, and is used by factory technicians to locate module faults. When a module fault is detected, its outputs are disabled or de-energized.

Each Analog I/O Module has a fuse in it. This fuse is visible and can be changed through the bottom of the plastic cover of the module. If this fuse is blown, replace it with a fuse of the same type and size (24 Vdc/0.1 A).

To Replace an Analog or Discrete I/O module:

1. Read all warnings on pages iv and v of this volume before replacing any module.
2. If the control is running and on-line, use the system engineering workstation to verify that the other CPUs are running without faults.
3. Unscrew the **Analog or Discrete I/O** module's captive screw fasteners.
4. Disengage the **Analog or Discrete I/O** by pressing the top handle up and the bottom handle down, slide it out about halfway, but leave it placed in the chassis.

IMPORTANT	**To eliminate the possibility of causing a system trip when replacing a module always un-seat the module before disconnecting the I/O cables. (A system trip is possible if a number of the cable connector pins are shorted to chassis ground.)**

5. Disconnect the module I/O cable or cables. The I/O cables use a slide latch (to disengage slide the latch up).
6. Remove the module by pulling straight out and place it into conductive plastic bag (Woodward P/N 4951-041).
7. **Verify that the replacement module is the same Part number as the module that has been removed**. It may have a different Revision letter (A, B, C…..) but it must have the same 7 or 8 digit part number (for example the Discrete I/O module is 5466-256).

⚠WARNING	**Dependent on the field connections and options, connecting the wrong module part number to an FTM or FT Relay Module may cause a system shutdown.**

8. Install the replacement module by aligning the circuit board edge in the card guides and pushing the module into its slot. Slide it in approximately halfway, take care not to allow the module to become in contact with the motherboard connector.
9. **Re-connect both module I/O cables**. The I/O cables use a slide latch (to secure the cable, slide the latch down). To eliminate the possibility of causing a system trip when replacing a module always connect the I/O cables before seating the module to the motherboard. (A system trip is possible if a number of the cable connector pins are shorted to chassis ground.)
10. With even pressure exerted at the top and bottom of the module's front panel, push the module into place until the module connector is firmly within the motherboard's module receptacle.
11. Tighten the two screws that secure the module in place (one at the top and one at the bottom).
12. At this point the modules LED light should have gone out. If Latent Fault Detection of the FT Relays is used in the system you may hear the clicking of each relay as the system verifies all discrete output functions, this is normal.
13. At this point – return to the CCT and go to the **Alarm Summary** page and enter a RESET.
14. All module and channel alarms should clear, **restoring complete fault tolerance to the system.**

IMPORTANT **If the module's Fault LED does not turn off after the module has been installed for at least one minute, it may be necessary to re-seat the module more firmly. To re-seat a module follow step #3 of the above procedure to release the module from the motherboard, then re-install the module by following procedure steps #8 and #9.**

2 Channel Actuator Module (Kernel A/B: A6)

Analog Module and FTM troubleshooting instructions apply to the 2 Channel Actuator Module and FTM with the exception of the fuses. The Actuator FTM does not contain any fuses, however the Actuator Controller Module does have a fuse accessible at the rear bottom edge of the module. In case of module non-operation, this fuse may be checked before replacing the module. If it is faulty replace with a .2 A / 250 V fuse.

Attention to wiring details must be followed when installing and commissioning the valve/actuators used at a specific site to ensure that on-line replaceability of the actuator module can be done. Ensure that all redundant signals are connected to only one of the actuator FTMs.

Termination Modules

The replacement of termination modules can be performed on-line (while the unit is operational) or off-line (while the unit is shut down).

IMPORTANT **If on-line replacement of the FTMs is required/desired, the user must consider this in the assignment of redundant input signals. For example, use speed signals 1 & 3 (not 1 &2) and place redundant AI signals on channels 1 & 5 (not 1 & 2).**

Caution must be taken whenever replacing a termination module on-line, or a unit trip could result. The procedure used in the replacement of termination modules on-line varies based on the control's configuration and system wiring configuration. Contact a Woodward representative to establish the correct termination procedure to use based on your configuration.

To replace an Analog or Discrete Termination Module while the unit is off-line:

1. Read all warnings at the beginning of this Volume before replacing any module.
2. Shut down the control.
3. Remove all power from the system. Do not attempt to replace a termination module with the system powered.
4. Disconnect all FTM and field wiring.
5. Disconnect all FTM cables. The I/O cables use a slide latch (to disengage, slide the latch toward the cable end).
6. Remove the termination module from its panel and install its replacement.
7. Re-connect all cables. The I/O cables use a slide latch; to secure cable, slide the latch away from the cable end.
8. Re-connect all field wiring.
9. Re-apply all power to the system.

10. Reset all CPUs.

To replace FTM Fuses:

1. Read all warnings on pages v and vi of this volume before replacing any fuse. If the control is running and on-line, take care not to come in contact with any FTM circuitry.

2. Remove FTM cover.

3. Verify that the circuit problem has been corrected.

4. Locate and replace fuse (See Figure 5-1) with one of the same size and rating (24 Vdc/0.1 A).

5. Replace FTM Cover.

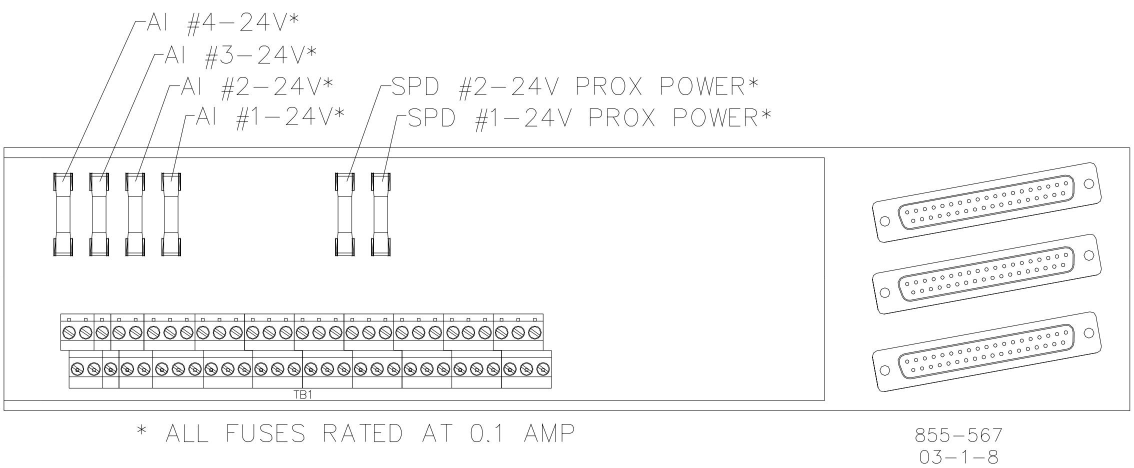


Figure 5-1. FTM Fuse Locations

To replace FT Relays:

> **WARNING**
>
> **HIGH VOLTAGE—Relay circuit power is also present on an FTM's relay and cable connectors. When using high voltage relay circuit power, it is recommended that care be taken not to touch exposed connectors when replacing relays or cables. If possible remove relay circuit power from all FTM relays before replacing any FTM relay or cable.**

1. Read all warnings at the beginning of this volume before replacing any Relay.

2. Locate and replace faulty relay (See Figure 4-18). See MicroNet TMR manual **26167** for recommended replacement relays.

3. Perform a system Reset to clear Alarm.

Diagnostics

The MicroNet CPU module runs off-line and on-line diagnostics that display troubleshooting messages through the debug Service Port and AppManager. Offline diagnostics run automatically on power-up and when the Reset switch is asserted. On-line diagnostics run during normal Control System operation when the GAP application is active. More information on diagnostics tests, subsequent LED flash codes, and serial port messages is contained in the VxWorks® * manual.

*—VxWorks is a trademark of Wind River Systems, Inc.

A table of the CPU fault LED flash codes is shown below:

Failure	Flash Code
RAM Test Failure	1, 4
Real Time Clock Test Failure	2, 2
Floating Point Unit Test Failure	2, 3
Flash Test Failure	2, 4
HD1 Flash Test Failure	2, 5
I2C Bus Test Failure	2, 6
Module Installed in wrong slot	2, 7
Main Chassis CPU switch must be set to 0	3,5
Remote RTN Rate Group 5 Slip	3, 7
Remote RTN Rate Group 10 Slip	3, 8
Remote RTN Rate Group 20 Slip	3, 9
Remote RTN Rate Group 40 Slip	3, 10
Remote RTN Rate Group 80 Slip	3, 11
Remote RTN Rate Group 160 Slip	3, 12
Remote RTN Chassis Switch Invalid	4, 5
Backup Remote RTN Chassis Switch different from Primary Remote RTN	4, 6
This module does not support the CAN port(s)	4, 7
This module needs a “footprint” update	4, 9

*A table of Message ID values as displayed in AppManager:

Description of ID	ID Number
Created by the Coder (Evaluate specific Application)	1-99
“sysinit” – Problem in system initialization	184,185,186
VerifyCpuMem -- Problem in verify CPU memory	103
VerifyNVLog -- Problem in verify NV_LOG functions	104,143,145
ExecuteTMRMessageTask -- Freerun task error	101,102
TMRDportDiagnostics -- Problem running DualPort test	105,106,112,113,114
WaitRTNBuffer -- Problem waiting for RTN messages	146,147
ioRead -- Problem in the ioRead function	142,183
Run_ll_int -- Problem in the Ladder Logic executive	180
SynCmdBuffer – Problem sending messages to RTN chassis	181
CheckSyncCmdBuffer - Problem sending message to RTN	182
Clk_xvstat -- TMR CPU missing in interrupt service routine	604,605
PresInt -- TMR CPU unable to reach previous target	660
CopyToPickup – Problem syncing lost CPU	130,131,132
Re-sync -- Problem syncing lost CPU	133,134,135,136,137,138
Re-sync -- Lost CPU failed to sync properly	139

Each CPU performs both off-Line and on-line diagnostics. Off-Line diagnostics are performed at power-up or when the CPU’s Reset button is pushed. On-Line diagnostics are performed when the CPU is in its normal operational mode, under application-program control.

System Troubleshooting Guide

The following is a troubleshooting guide for areas to check which may present potential difficulties. By making these checks prior to contacting Woodward for technical assistance your system problems can be more quickly and accurately assessed.

MECHANICAL SYSTEM

ACTUATORS

- Is the oil clean?
- Does the actuator have the correct hydraulic pressure (if required)?
- Does the actuator have the correct pneumatic pressure (if required)?
- Does the drive shaft rotate (if required)?
- Is the actuator wiring correct?
- Is the direction of the stroke correct?
- Has the compensation (if so equipped) been adjusted correctly?
- Is the hydraulic return line free and not clogged?
- Is there backpressure on the hydraulic return line?
- Is the feedback (if any) adjusted correctly and sending the correct signal?

LINKAGE

- Is there slop or lost motion?
- Is there misalignment, binding, or side loading?
- Is there visible wear or scarring?
- Does the linkage move smoothly?

VALVES

- Does the valve move through its proper stroke smoothly?
- Does the valve travel its full stroke?
- Can mid-stroke be obtained and held?
- Does the valve fully seat (close) before the governor reaches full minimum stroke?
- Does the valve fully open before the governor reaches maximum stroke?
- Is the bypass valve(s) (if any) in the proper position?
- Are there nicks or contamination which allow steam to pass when the valve is closed?

OIL/HYDRAULIC SYSTEM

- Is the oil at the proper operating pressure?
- Is the oil temperature too high for the type of oil being used?
- Is the oil contaminated?
- Does the actuator have sufficient flow of oil?
- Are the accumulators (if any) charged to the correct pressure?
- Are the filters plugged?
- Is the oil pump operating properly?

STEAM CONDITIONS

- Is the turbine inlet pressure at design specification?
- Is the steam pressure in the proper operating range?
- Are pressure transducers (if any) located close to the turbine?
- Are there any pressure regulating devices or valves which may interfere with governor operation or proper steam flow?

CONTROL, ALARM, AND FAULT INDICATIONS

- Does the governor indicate it is in the correct control mode?
- Is the governor issuing any alarms?
- Are any of the components of the governor indicating hardware faults?
- Does the actuator demand agree with the actual valve position?
- Are any shutdown conditions present?
- Have the control dynamics been tuned to match the system response?

COMMUNICATIONS
- Are the LAN switches powered and operable?
- Are the Ethernet (or Serial) cables all securely connected at both ends?
- Are the IP addresses on the same network domain (within subnet mask)?
- Are any IP addresses duplicated? (LAN will prevent second one from joining)
- Is the 5009FT configured correctly for desired port/protocol/slave #?
- Are there status LEDs that can be checked for activity (on Ethernet)?

INPUT SIGNALS
- Are all input signals properly scaled?
- Are the inputs free of electrical noise and properly shielded?
- Is the wiring correct?
- Have all field input signals to the control been verified?
- Is the polarity of the signals correct?

OUTPUT SIGNALS
- Are the outputs calibrated?
- Have the actuator drivers been calibrated to the stroke of the turbine valves?
- Are the output signals free of noise and properly shielded?
- Is the wiring correct?

TRANSDUCERS
- Is the transducer calibrated for the proper range?
- Has it been tested by simulating its input and measuring its output signal?
- Does the transducer have power?
- Are the sensing lines feeding the transducer clear of obstructions?

MAGNETIC PICKUPS AND OTHER SPEED SENSING DEVICES
- Is the wiring between the speed sensing pickup and the control correct?
- Are there any grounding problems or worn shields?
- Is the signal sufficient (at least 1.5 Vrms)?
- Is the signal a clean sine wave or square wave with no spikes or distortions?
- Is the MPU head clean and free of oil or metallic particles?
- Is the MPU head free of any nicks or chips?
- Is the MPU or proximity probe correctly aligned with the gear?
- Is the speed sensing probe adjusted to the correct gap?
- Is the speed sensing probe head the correct size for the toothed wheel it is being used with?
- Are the proper jumpers installed on the FTM?

INPUT VOLTAGE/POWER SUPPLIES
- Is the input power within the range of the control's power supply input?
- Is the input power free of switching noise or transient spikes?
- Is the power circuit dedicated to the governor only?
- Are the control's supplies indicating that they are OK?
- Are the control's supplies outputting the correct voltage?

ELECTRICAL CONNECTIONS
- Are all electrical connections tight and clean?
- Are all signal wires shielded?
- Are shields continuous from the device to the control?
- Are the shields terminated according to Woodward specifications?
- Are there low voltage signal wires running in the same wiring trays as high voltage wiring?
- Are the governor's signal common or grounds not tied to any other devices?
- Have the signals been checked for electrical noise?

VOLTAGE REGULATOR
- Is the voltage regulator working properly?

EXTERNAL DEVICES

- Are there external devices the control is dependent on for input signals?
- Are these devices providing the correct signal to the control?
- Is the external device configured or programmed to be compatible with the control?

Chapter 6.
Hardware Specifications

5009FT Control Package—Not Including Optional Hardware (except as noted)

Environmental

Humidity
0 to 90%, non-condensing

Shock
US MIL-STD-810C, Method 516.2-1 procedure 1b (15 g 11 ms Half Sine pulse)

Vibration
Lloyd's type ENV2 Vibration test #1
13–150 Hz @ 1.0 G Ten sweeps at one octave per minute
Unless otherwise reduced by options as shown in the Environmental Classifications for Options Table below, the following classifications apply.

Table 6-1. Environmental Classifications for Options

EN 50178 Humidity Class	EN 50178 Air Pressure Class
3K3 5% to 85%	3K3 86 to 106 kPa

Air Quality
Pollution Degree #2

Altitude (max)
2000 m

Storage Temperature
–20 to +70 °C (-4 to +158 °F)
Component life is adversely affected by high temperature, high humidity environments. Room temperature storage is recommended for long life.

Sound Level
Less than 70 dBA

MicroNet TMR/5009FT I/O Chassis Weight:
22 kg (48 lb)

MicroNet TMR/5009FT Main Power Supply Weight:
8 kg (17 lb)

Power Supply Specifications

Input Power Ratings (see Appendix A for P.S. Options)

DC (18–36 Vdc)

- Nominal Voltage Rating (24 Vdc), (as on Power Supply Label)
- Rated Maximum Current = 33 A
- Input Power Fuse/Breaker Rating = 50 A slow blow
- Wire Size = 5.5 mm² (10 AWG) or larger
- Holdup Time = 5 ms @ 24 Vdc

DC (100–150 Vdc)
- Nominal Voltage Rating (111–136 Vdc), (as on Power Supply Label)
- Rated Maximum Current = 6.0 A
- Input Power Fuse/Breaker Rating = 10 A slow blow
- Wire Size = 2.5 mm² (14 AWG) or larger
- Holdup Time = 7 ms @ 120 Vdc

AC (88–132 Vac, 47–63 Hz)
- Nominal Voltage Rating (98–120 Vac), (as on Power Supply Label)
- Rated Maximum Current = 10.0 A
- Input Power Fuse/Breaker Rating = 20 A slow blow
- Wire Size = 4.0 mm² (12 AWG) or larger
- Holdup Time = 1 cycle @ 120 Vac

High Voltage AC (180–264 Vac, 47–63 Hz)
- Nominal Voltage Rating (200–240 Vac), (as on Power Supply Label)
- Rated Maximum Current = 5.0 A
- Input Power Fuse/Breaker Rating = 10 A slow blow
- Wire Size = 2.5 mm² (14 AWG) or larger
- Holdup Time = 1 cycle @ 220 Vac

High Voltage DC (200–300 Vdc)
- Nominal Voltage Rating (223–272 Vdc), (as on Power Supply Label)
- Rated Maximum Current = 3.0 A
- Input Power Fuse/Breaker Rating = 10 A slow blow
- Wire Size = 2.5 mm² (14 AWG) or larger
- Holdup Time = 7 ms @ 200 Vdc

Installation Overvoltage Rating
Category II

Dielectric Withstand
AC/DC and HVAC version: 2200 Vdc from power input to chassis

Power Output Ratings
- 24 Vdc Analog power (prox and analog input power)
  Acceptable Output Range 20.4—25.2 Vdc (at FTM terminals)
  Fused to 100 mA on each terminal output
- 24 Vdc Discrete Input power (Contact Wetting Voltage)
  Acceptable Output Range 20.4—25.2 Vdc (at FTM terminals)
  Current Limited to 400 mA on each FTM output

CPU Batteries for Real Time Clock Back-Up
NiCd, Not User Replaceable; Charge Time: 72 hours @ 25 °C.
CPU Storage Temperature with battery operating specifications: –20 to +45 °C.

⚠WARNING	**ELECTROCUTION HAZARD—Ground leakage exceeds 3.5 mA. Protective earth grounding is required.**

General I/O Specifications

For details on all I/O specifications consult **MicroNet TMR manual 26167**.

Chapter 7.
System Maintenance

Cables and Connections

Periodically, check the cables to make sure they are still in good condition, and check the connectors to make sure they are plugged in all the way.

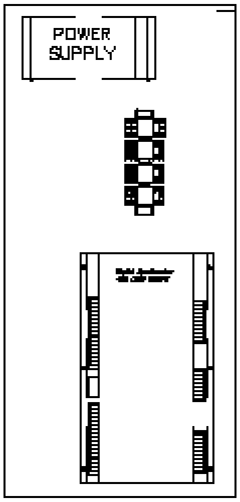
Fans

Power must be removed prior to replacing chassis fans. Only qualified personnel should replace chassis fans. As a preventive maintenance, it is recommended that the main chassis and power chassis cooling fans be replaced every 50 000 hours. For replacement, use fans of like design and specification, or purchase replacement fans from Woodward.

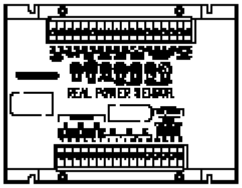
⚠WARNING	**Substitution of components may impair suitability of the equipment and is not recommended.**

Chapter 8.
MicroNet TMR® Compatible Products

The following is a list of compatible Woodward products that may be used with the MicroNet TMR 5009FT System:



DSLC Panel



Real Power Sensor

Figure 8-1. MicroNet™ Compatible Products

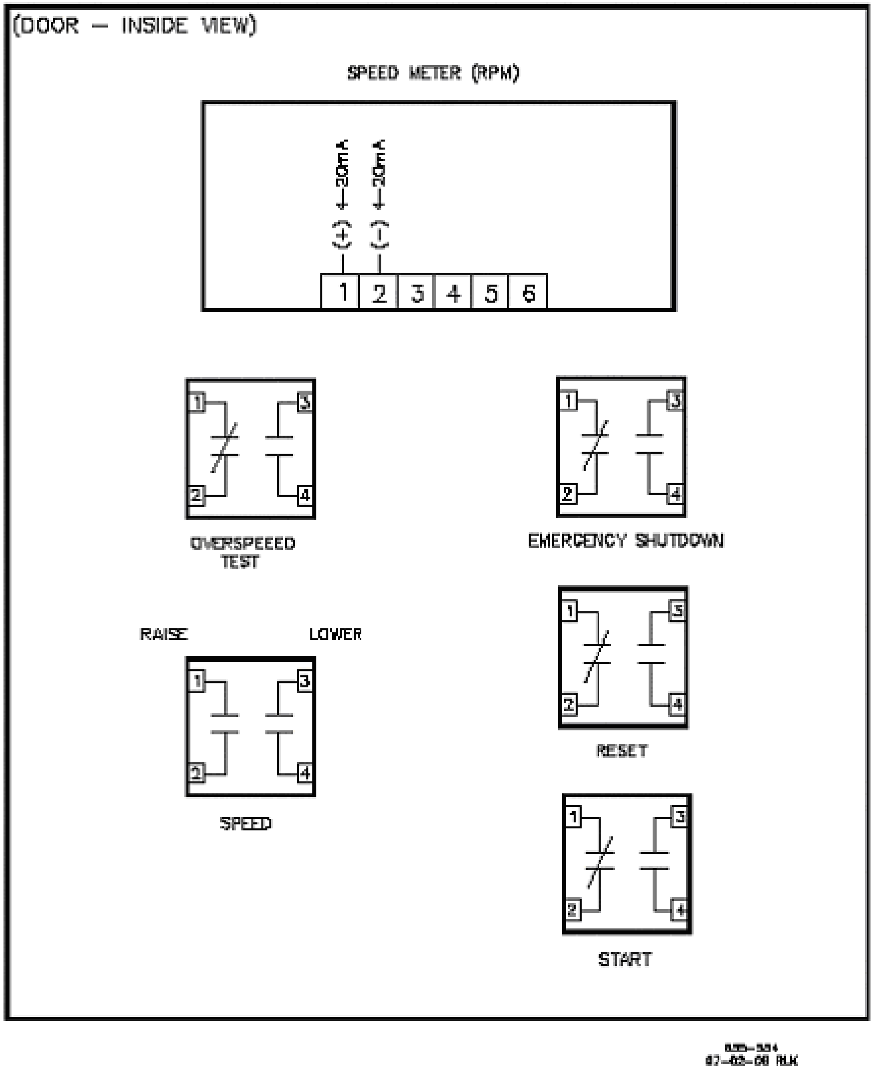


Figure 8-2. Inside View of Door

DSLC™ Digital Synchronizer & Load Control

This device is used with generator applications only. The DSLC is a microprocessor-based generator load sharing control designed for use on three phase ac generators with Woodward speed controls and automatic voltage regulators. The DSLC is a synchronizer, an isochronous load sharing control, a dead bus closing system, a VAR/PF control, and a process control, integrated into one package. The DSLC provides either phase match or slip frequency synchronizing, and ties into the unit automatic voltage regulator to match voltages before paralleling. It interfaces with the control via a speed bias signal to control generator frequency and phase (see Figure 8-4).

The DSLC, along with its auxiliary devices, will be mounted on a panel (see Figure 8-3). To simplify the DSLC interface, a 120 Vac-to-24 Vdc power supply and four interposing relays are included on the panel. This panel is designed to be mounted within a cabinet near the control or system switchgear.

To complete an interface with the 5009 control system, the panel must be hardwired to the control and the control's program configured to accept the interface (contact I/O and analog inputs programmed). The 5009 control can be programmed to use the DSLC as a synchronizer only, or as a synchronizer and load sharing control. Refer to the DSLC Manual (02007) for device-specific information.

DSLC Panel Installation

Mount panel near the control or unit switchgear within 300 m (1000 ft) of the control, leaving an adequate service loop.

1. Mark the panel location and mounting holes, taking care to leave sufficient space between the panel and walls, objects, etc. for easy access.

2. Drill and tap the mounting holes for appropriate size hardware (see Figure 8-4).

3. Place the panel in position, insert the mounting screws into the tapped holes, and tighten the hardware securely.

4. If the DSLC Panel is not at earth ground potential, connect it to earth ground via a 4.0 mm² (12 AWG) or larger green/yellow wire or braid.

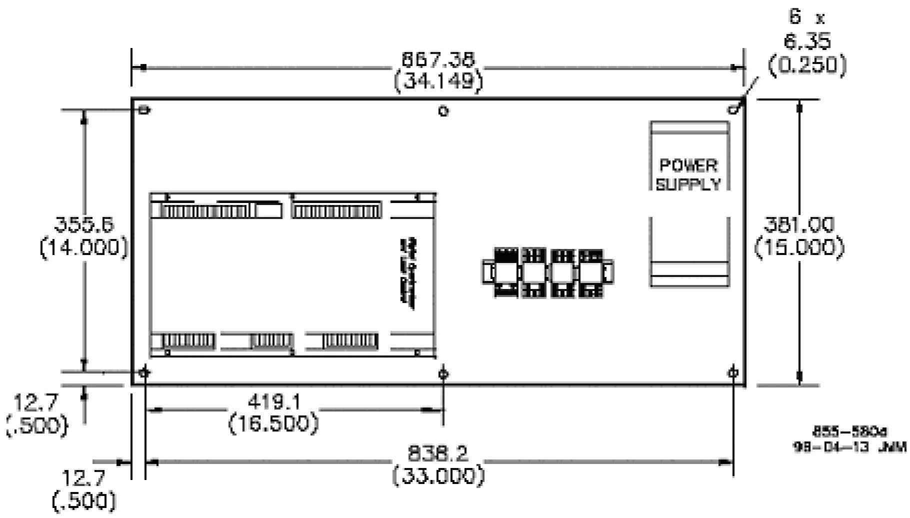


Figure 8-3. DSLC Mounting

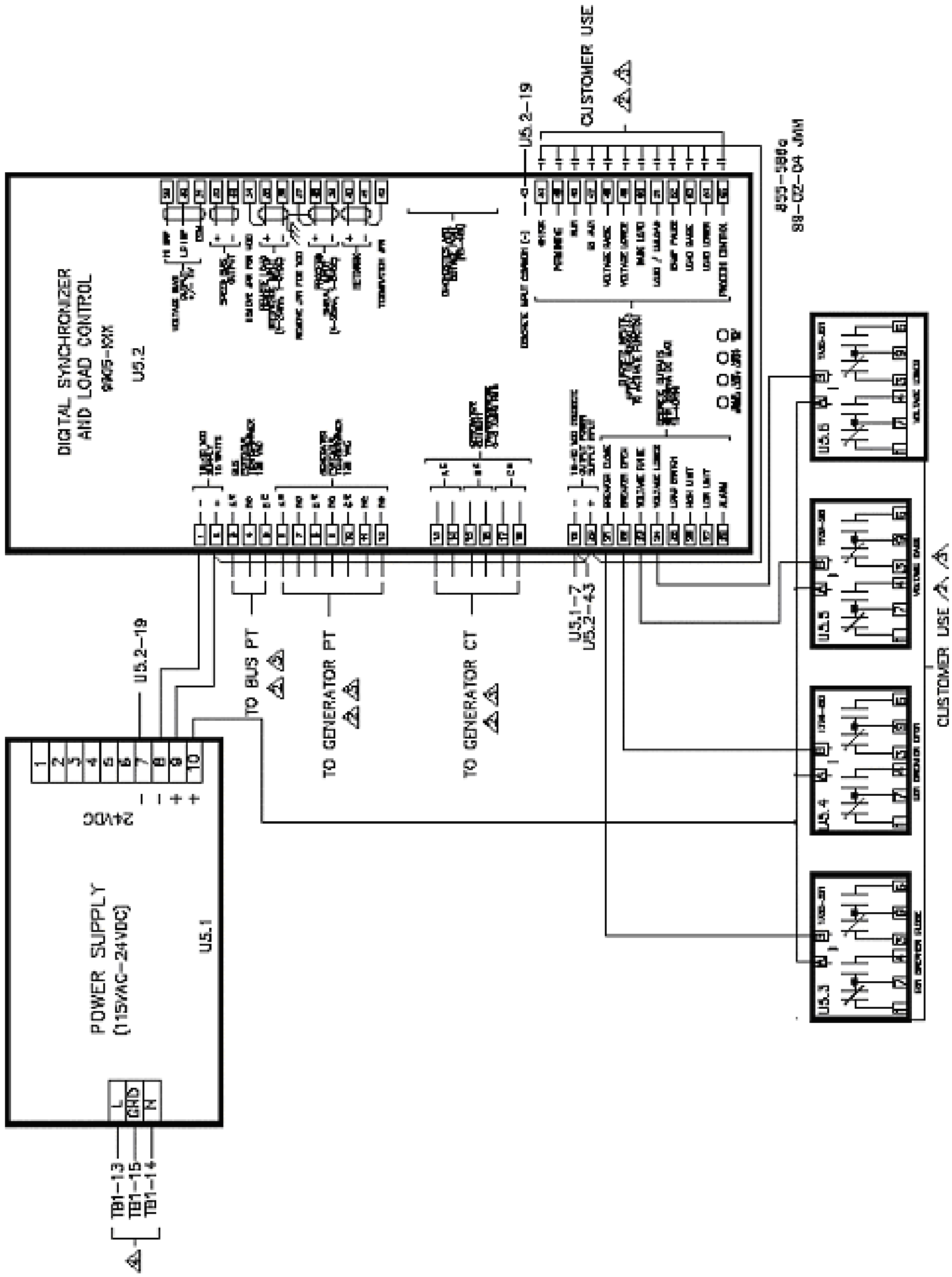


Figure 8-4. DSLC Control

Real Power Sensor (RPS)

The Real Power Sensor is used to sense the real power being produced by a generator, or flowing through a tie line. Woodward Real Power Sensors sense three phase voltages and three phase currents. The RPS compares each phase's voltage to current relationship and develops a 4–20 mA output proportional to real power.

The RPS provided with a standard 5009 system accepts only 0–5 A and has a kW and VAR readout. The "KW Readout" terminals provide a 4–20 mA signal proportional to real power, which is used by, and compatible with, the 5009 control.

Woodward-manufactured Real Power Sensors have a 2.5 Hz low pass filter (400 ms lag time) on the output to filter out the high frequency noise typically created in a switchgear-type environment. If another vendor's watt transducer is used, verify that it has similar filtering criteria before it is applied with the 5009. For more information on Woodward Real Power Sensors, refer to Woodward manual 82018.

Real Power Sensor Installation and Wiring

Mount the Real Power Sensor using the four mounting holes provided on the flanges of the enclosure (see Figure 8-5).

Connect external wiring to the Real Power Sensor as shown in Figure 8-6. When making wire connections, observe the following wiring recommendations:

- Use 0.5 mm² (20 AWG) or larger stranded, twisted shielded wire for all signal-carrying wires.
- Use 0.8 mm² (18 AWG) or larger stranded wire for all potential and current transformer connections.
- Ensure all wires shown in Figure 8-5 as shielded are actually shielded wires.
- Do not place shielded wires in cable conduits with high-voltage or high-current carrying cables.
- Do not connect the cable shields to any external grounds. The cable shield is grounded at the power sensor end only.
- Make sure that cable shields are connected through all intermediate terminal blocks from the signal source to the signal termination. (Do not leave any floating grounds.)

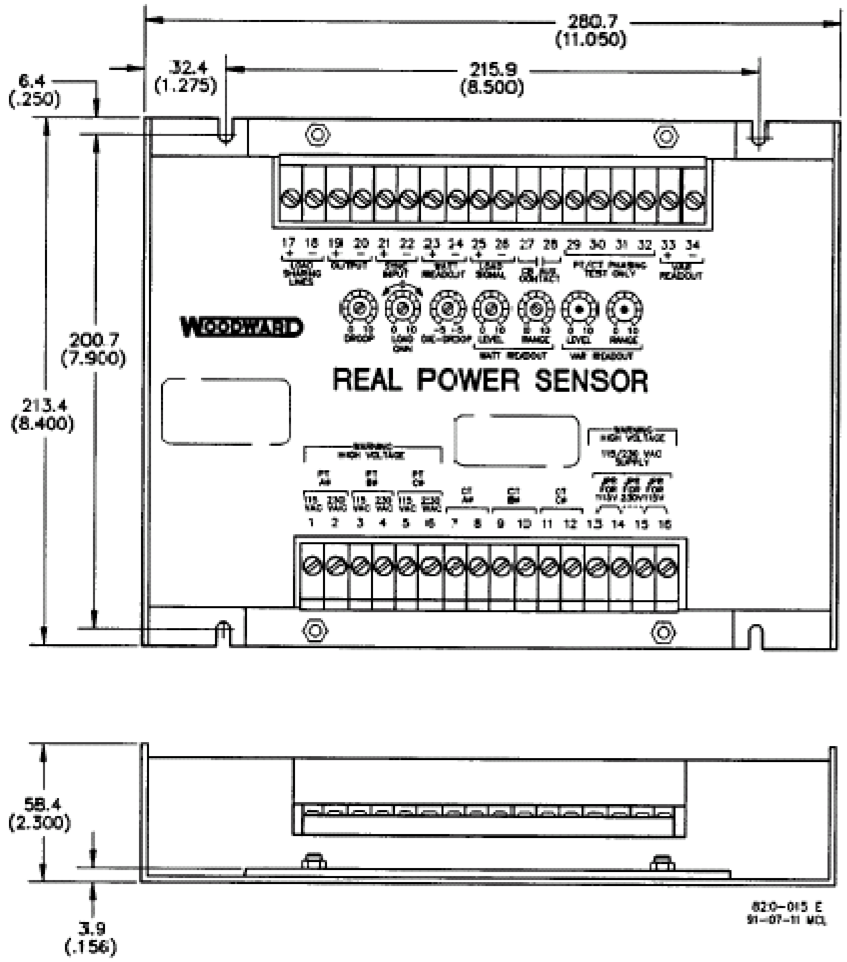


Figure 8-5. Real Power Sensor

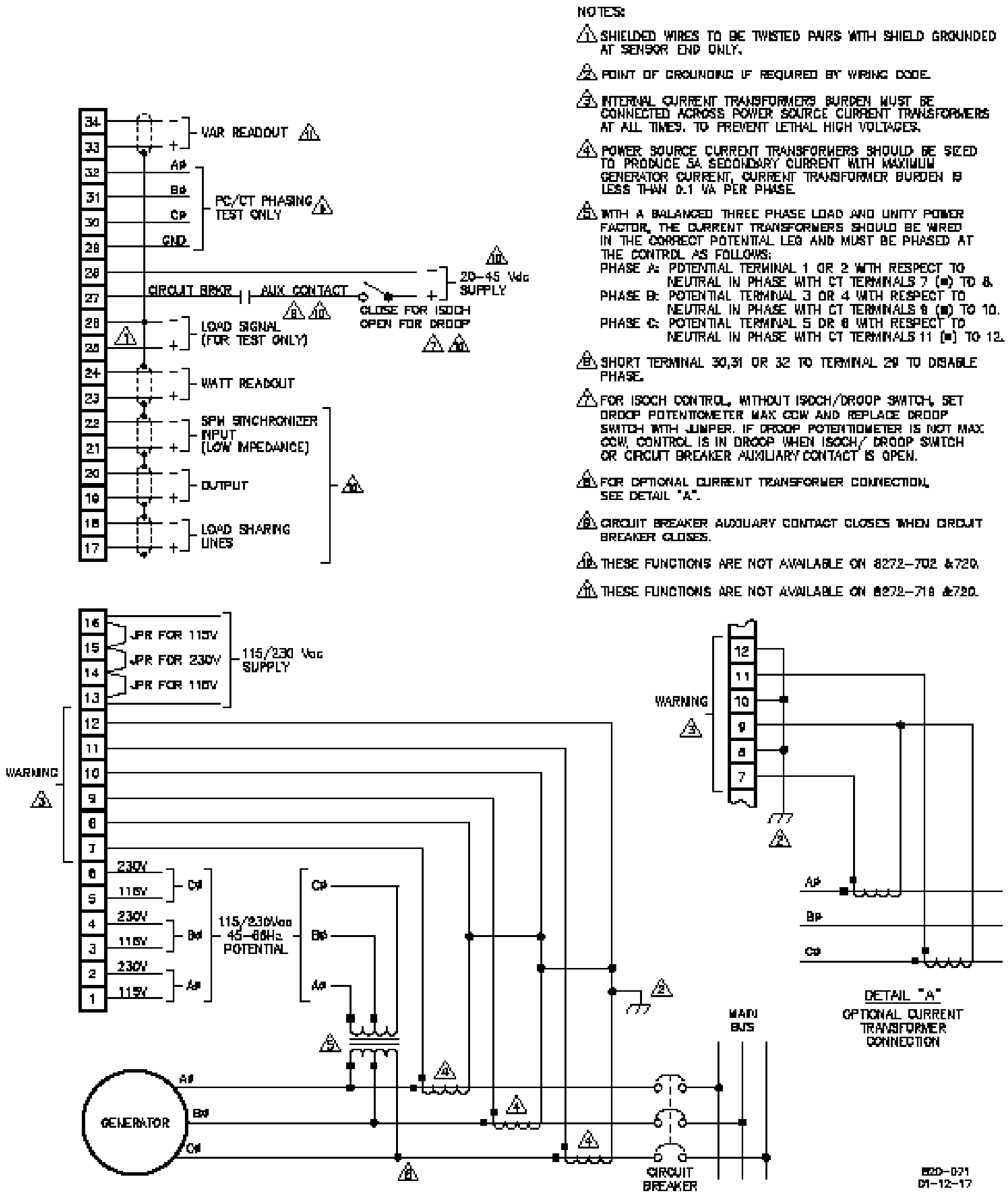


Figure 8-6. Plant Wiring Diagram for the Real Power Sensor

Appendix A.
Control Wiring Diagram

REV	DESCRIPTION		DATE	APPROVED
A	CN020982	DPENNI	FEB-2018	SOCEAN

Control Wiring Diagram

5009-FAULT-TOLERANT CONTROL

ITEM NUMBER	DESCRIPTION	CONTROL P/N	MICRONET+ TMR W/120VDC/AC PS	MICRONET+ TMR W/220VAC PS	INTEGER ACT OPTION	EXTRA AI/AO OPTION (A)	CCT: P/N 8269-1059 (A)
8262-1111	CONTROL - 5009FT MICRONET+W/2 120VAC/DC TMR PS		X				X
8262-1112	CONTROL - 5009FT MICRONET+W/2 120VAC/DC TMR PS+ ACT KIT		X		X		X
8262-1113	CONTROL - 5009FT MICRONET+W/2 120VAC/DC TMR PS + EXTRA AI/AO KIT		X			X	X
8262-1114	CONTROL - 5009FT MICRONET+W/2 120VAC/DC TMR PS + INTEG ACT & EXTRA AI/AO KIT		X		X	X	X
8262-1115	CONTROL - 5009FT MICRONET+W/2 220VAC TMR PS			X			X
8262-1116	CONTROL - 5009FT MICRONET+W/2 220VAC TMR PS + INTEG ACT KIT			X	X		X
8262-1117	CONTROL - 5009FT MICRONET+W/2 220VAC TMR PS + EXTRA AI/AO KIT			X		X	X
8262-1118	CONTROL - 5009FT MICRONET+W/2 220VAC TMR PS + INTEG ACT & EXTRA AI/AO KIT			X	X	X	X
8262-1119	CONTROL - 5009FT MICRONET+W/2 120VAC/DC TMR PS W/O CCT		X				
8262-1120	CONTROL - 5009FT MICRONET+W/2 120VAC/DC TMR PS + INTEG ACT KIT W/O CCT		X		X		
8262-1121	CONTROL - 5009FT MICRONET+W/2 220VAC TMR PS W/O CCT			X			
8262-1122	CONTROL - 5009FT MICRONET+W/2 220VAC TMR PS + INTEG ACT KIT W/O CCT			X	X		
8262-1123	CONTROL - 5009FT MICRONET+W/2 24VDC TMR PS						
8262-1124	CONTROL - 5009FT MICRONET+W/2 24VDC TMR PS + INTEG ACT KIT						
8262-1125	CONTROL - 5009FT MICRONET+W/2 24VDC TMR PS + EXTRA AI/AO KIT					X	
8262-1126	CONTROL - 5009FT MICRONET+W/2 24VDC TMR PS + INTEG ACT & EXTRA AI/AO KIT					X	
9907-1968	SYSTEM - 5009FT CABINET MICRONET+W/2 120VAC/DC TMR PS	8262-1111	X				X
9907-1969	SYSTEM - 5009FT CABINET MICRONET+W/2 120VAC/DC TMR PS + ACT KIT	8262-1112	X		X		X
9907-1970	SYSTEM - 5009FT CABINET MICRONET+W/2 120VAC/DC TMR PS + EXTRA AI/AO KIT	8262-1113	X			X	X
9907-1971	SYSTEM - 5009FT CABINET MICRONET+W/2 120VAC/DC TMR PS + EXTRA AI/AO KIT	8262-1114	X		X	X	X
9907-1972	SYSTEM - 5009FT CABINET MICRONET+W/2 220VAC TMR PS	8262-1115		X			X
9907-1973	SYSTEM - 5009FT CABINET MICRONET+W/2 220VAC TMR PS + INTEG ACT KIT	8262-1116		X	X		X
9907-1974	SYSTEM - 5009FT CABINET MICRONET+W/2 220VAC TMR PS + EXTRA AI/AO KIT	8262-1117		X		X	X
9907-1975	SYSTEM - 5009FT CABINET MICRONET+W/2 220VAC TMR PS + INTEG ACT & EXTRA AI/AO KIT	8262-1118		X	X	X	X

MATERIALS:

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.

THIRD ANGLE PROJECTION

APPROVED	DATE
TANAKA	MAR-2017
CHECKED W4536	MAR-2017
DRAWN W4536	MAR-2017

WOODWARD FT. COLLINS COLORADO USA

TITLE: CONTROL WIRING DIAGRAM 5009FT TMR

SIZE D | CAGE CODE 7LLB9 | DWG NO 9971-4265 | REV A

SCALE NTS | SHEET 1 OF 20

AUTOCAD

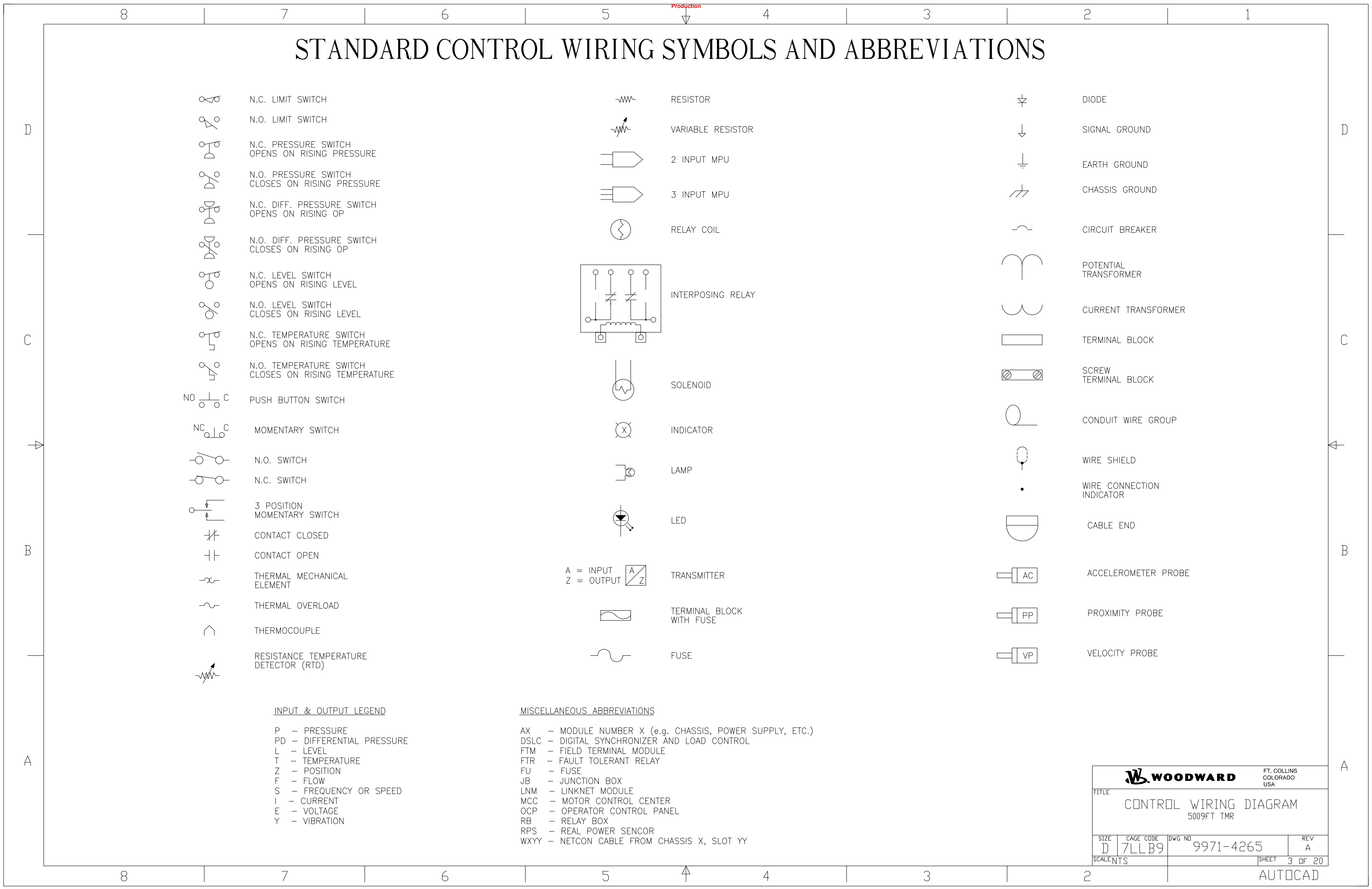
STANDARD CONTROL WIRING NOTES

1. SHIELDS MUST BE GROUNDED AS SHOWN.
2. ALL SHIELDS MUST BE CARRIED CONTINUOUSLY THROUGH ALL TERMINAL BLOCKS AND MUST NOT BE TIED TO OTHER SHIELDS. UNLESS OTHERWISE SHOWN.
3. INPUT SIGNAL FROM OTHER SYSTEMS MUST BE ISOLATED FROM EARTH EITHER BY DESIGN OR EMPLOYMENT OF ISOLATION AMPLIFIERS.
4. UNLESS OTHERWISE SPECIFIED:
   A. RELAYS SHOWN DE-ENERGIZED.
   B. RELAYS ENERGIZE FOR FUNCTION.
   C. RELAY CONTACT RATINGS:

   12/24 CHANNEL RELAY FTM:
   - RESISTIVE - 10A AT 28VDC
3A AT 150VDC
10A AT 115VAC 50/60HZ
   - INDUCTIVE - 3A AT 28VDC
1.2A AT 150VDC
6A AT 115VAC 50/60HZ
3A AT 240VAC 50/60HZ
5. CONFIRM EACH CONNECTION BEFORE OPERATING UNIT.
6. ALL ANALOG INPUTS MUST BE ISOLATED FROM EARTH GROUND.
7. CABLE WIRES ARE MARKED WITH COLORS DESIGNATED.
8. LETTERS IN PARENTHESES INDICATE LOWER CASE LETTERS 0N CONNECTORS.
9. UNLESS OTHERWISE SPECIFIED, ALL WIRE IS (WHT) 20GA. 600V CRC WIRE (9097-274) WITH THE EXCEPTION OF EARTH GROUND, WHICH IS GREEN. 16 GA, UNLESS OTHER WISE NOTED.
10. UNLESS OTHERWISE SPECIFIED, FOR SHIELDED WIRE USE:
    2008-053 20 GA 1 CONDUCTOR SHIELDED WIRE
    2008-055 20 GA 2 CONDUCTOR SHIELDED WIRE
    2008-057 20 GA 3 CONDUCTOR SHIELDED WIRE
    2008-089 20 GA 4 CONDUCTOR SHIELDED WIRE
11. MEASURE INDIVIDUAL WIRES TO LENGTH AND INSTALL ON CORRESPONDING TB POSITION PER THIS DOCUMENT.
12. SECURE CABLE ASSYS TO TIE POINTS AND SIDE MTG ANGLES USING 1609-569 TIE STRAPS.
13. USE CABLE INDEX OF THIS DOCUMENT FOR CABLE IDENTIFICATION.
14. ALL WIRES TO TERMINAL BLOCKS SHALL HAVE WIRE MARKERS; MARKED WITH IDENTIFYING TB NUMBER.
15. CUSTOMER SUPPLIED EQUIPMENT.
16. ALL UNUSED INDIVIDUAL WIRE ENDS (INCLUDING THOSE IN SHIELDED CABLES) TO BE FOLDED BACK AND COVERED WITH SHRINK TUBING.
17. DASHED WIRES ARE INSTALLED BY THE CUSTOMER — — —
18. UNUSED WIRES MAY BE PRESENT IN PREFABRICATED CABLE ASSEMBLIES AND SHOULD BE PROPERLY INSULATED IF NOT USED
19. ALL FIELD TERMINAL MODULES ARE TO BE GROUNDED USING WOODWARD ITEM NUMBER 1604-813 GROUND BLOCK AND GRN/YEL 16 AWG WIRE (2007-731).
20. FOR ALL WIRE CONNECTIONS, WIRE END TERMINALS (FERULES) ARE SUGGESTED.
    24 GA. WIRE, USE 0.25 MM2
    22 GA. WIRE, USE 0.34 MM2
    20 GA. WIRE, USE 0.50 MM2
    18 GA. WIRE, USE 0.75 MM2
    16 GA. WIRE, USE 1.50 MM2
21. SECURE ID LABELS TO MOUNTING PLATE, AND COMPONENTS.
22. DRILL AND TAP PANEL FOR A M6 SCREW. USE SHORT 2007-727 12AWG WIRE, 1602-249 (2X) LUG, 1023-200 FLAT WASHER, 1023-319 SPLITLOCK WASHER AND 1029-431 SCREW. USE EXISTING MOUNTING HARDWARE ON DEVICE END.
23. ATTACH GROUND BAR TO FTM TERMINALS:
    1751-4012 TO 5437-672 FTM
    1751-4014 TO 5501-372 FTM
24. TWIST WIRE TOGETHER (BLK/WHT) AND GND WIRE IF APPLICABLE FROM EACH CB TO DEVICE
25. REFER TO BOM FOR OPTIONAL COMPONENTS.
26. ITEM NOT INCLUDED WHEN ONLY A 8262-____ KIT IS PROVIDED.
27. 20A CIRCUIT BREAKER USED FOR 120VDC/VAC
    10A CIRCUIT BREAKER USED FOR 220VAC
    50A CIRCUIT BREAKER USED FOR 24VDC (USE ALL 8 GA WIRE)
28. (A) THE 5417-293 CABLE SHOULD BE ROUTED BEHIND THE CHASSIS PANEL WITH CONNECTORS ROUTING THROUGH THE PANEL HOLES TO CHASSIS POSTS.
29. (A) POWER AND ETHERNET WIRING TO CCT SHOULD ROUTE UP TO THE TOP OF BACK PANEL,ALONG TOP OF LEFT PANEL, DOWN FRONT OF LEFT PANEL APPROX. 24", THEN ACROSS DOOR TO CCT CONNECTIONS. SECURE WITH WIRE TIES AND TIE WRAP ANCORS AS NEEDED.

WOODWARD	FT. COLLINS COLORADO USA		
TITLE: CONTROL WIRING DIAGRAM 5009FT TMR			
SIZE: D	CAGE CODE: 7LLB9	DWG NO: 9971-4265	REV: A
SCALE: NTS		SHEET: 2 OF 20	

AUTOCAD


STANDARD CONTROL WIRING SYMBOLS AND ABBREVIATIONS
N.C. LIMIT SWITCH
N.O. LIMIT SWITCH
N.C. PRESSURE SWITCH OPENS ON RISING PRESSURE
N.O. PRESSURE SWITCH CLOSES ON RISING PRESSURE
N.C. DIFF. PRESSURE SWITCH OPENS ON RISING OP
N.O. DIFF. PRESSURE SWITCH CLOSES ON RISING OP
N.C. LEVEL SWITCH OPENS ON RISING LEVEL
N.O. LEVEL SWITCH CLOSES ON RISING LEVEL
N.C. TEMPERATURE SWITCH OPENS ON RISING TEMPERATURE
N.O. TEMPERATURE SWITCH CLOSES ON RISING TEMPERATURE
NO C
PUSH BUTTON SWITCH
NC C
MOMENTARY SWITCH
N.O. SWITCH
N.C. SWITCH
3 POSITION MOMENTARY SWITCH
CONTACT CLOSED
CONTACT OPEN
THERMAL MECHANICAL ELEMENT
THERMAL OVERLOAD
THERMOCOUPLE
RESISTANCE TEMPERATURE DETECTOR (RTD)
RESISTOR
VARIABLE RESISTOR
2 INPUT MPU
3 INPUT MPU
RELAY COIL
INTERPOSING RELAY
SOLENOID
INDICATOR
LAMP
LED
A = INPUT
Z = OUTPUT
TRANSMITTER
TERMINAL BLOCK WITH FUSE
FUSE
DIODE
SIGNAL GROUND
EARTH GROUND
CHASSIS GROUND
CIRCUIT BREAKER
POTENTIAL TRANSFORMER
CURRENT TRANSFORMER
TERMINAL BLOCK
SCREW TERMINAL BLOCK
CONDUIT WIRE GROUP
WIRE SHIELD
WIRE CONNECTION INDICATOR
CABLE END
AC
ACCELEROMETER PROBE
PP
PROXIMITY PROBE
VP
VELOCITY PROBE
INPUT & OUTPUT LEGEND
P – PRESSURE
PD – DIFFERENTIAL PRESSURE
L – LEVEL
T – TEMPERATURE
Z – POSITION
F – FLOW
S – FREQUENCY OR SPEED
I – CURRENT
E – VOLTAGE
Y – VIBRATION
MISCELLANEOUS ABBREVIATIONS
AX – MODULE NUMBER X (e.g. CHASSIS, POWER SUPPLY, ETC.)
DSLC – DIGITAL SYNCHRONIZER AND LOAD CONTROL
FTM – FIELD TERMINAL MODULE
FTR – FAULT TOLERANT RELAY
FU – FUSE
JB – JUNCTION BOX
LNM – LINKNET MODULE
MCC – MOTOR CONTROL CENTER
OCP – OPERATOR CONTROL PANEL
RB – RELAY BOX
RPS – REAL POWER SENCOR
WXYY – NETCON CABLE FROM CHASSIS X, SLOT YY
WOODWARD
FT. COLLINS COLORADO USA
TITLE
CONTROL WIRING DIAGRAM
5009FT TMR
SIZE D
CAGE CODE 7LLB9
DWG NO 9971-4265
REV A
SCALE NTS
SHEET 3 OF 20
AUTOCAD
Production

SHEET NUMBER	DESIGNATION	DESCRIPTION	
SHEET 1		COVER SHEET	JAN–2017
SHEET 2		NOTES SHEET	JAN–2017
SHEET 3		SYMBOL LEGEND SHEET	JAN–2017
SHEET 4		SHEET INDEX SHEET	JAN–2017
SHEET 5		CABLE / FTM SHEET	JAN–2017
SHEET 6		POWER DISTRIBUTION SHEET	JAN–2017
SHEET 7		POWER DISTRIBUTION SHEET CONT	JAN–2017
SHEET 8		5009FT CHASSIS LAYOUT	JAN–2017
SHEET 9	FTM103–1	SPEED AIO COMBO SPEED INPUTS	JAN–2017
SHEET 10	FTM103–2	SPEED AIO COMBO INPUTS	JAN–2017
SHEET 11	FTM103–2	SPEED AIO COMBO OUTPUTS	JAN–2017
SHEET 12	FTM104–1A	FT RELAY MODULE DISCRETE INPUTS / OUTPUTS	JAN–2017
SHEET 13	FTM104–1B	FT RELAY MODULE DISCRETE INPUTS / OUTPUTS	JAN–2017
SHEET 14	FTM104–2A	FT RELAY MODULE DISCRETE INPUTS / OUTPUTS	JAN–2017
SHEET 15	FTM104–2B	FT RELAY MODULE DISCRETE INPUTS / OUTPUTS	JAN–2017
SHEET 16	FTM105–1	ANALOG HD TMR ANALOG INPUTS	JAN–2017
SHEET 17	FTM105–2	ANALOG HD TMR ANALOG INPUTS	JAN–2017
SHEET 18	FTM105–1/–2	ANALOG HD TMR ANALOG OUTPUTS	JAN–2017
SHEET 19	FTM106–1	2 CHANNEL ACTUATOR DRIVER	JAN–2017
SHEET 20	FTM106–2	2 CHANNEL ACTUATOR DRIVER	JAN–2017
SHEET 21			
SHEET 22			
SHEET 23			
SHEET 24			
SHEET 25			
SHEET 26			
SHEET 27			
SHEET 28			
SHEET 29			
SHEET 30			
SHEET 31			
SHEET 32			
SHEET 33			
SHEET 34			
SHEET 35			
SHEET 36			
SHEET 37			
SHEET 38			
SHEET 39			

SHEET NUMBER	DESIGNATION	DESCRIPTION	
SHEET 40			
SHEET 41			
SHEET 42			

WOODWARD FT. COLLINS COLORADO USA

TITLE CONTROL WIRING DIAGRAM 5009FT TMR

SIZE	CAGE CODE	DWG NO	REV
D	7LLB9	9971-4265	A

SCALE NTS SHEET 4 OF 20

AUTOCAD

		FROM	TO	FIELD
CABLE P/N	CABLE DESIGNATION	MODULE/CONNECTOR	FIELD TERMINATION/CONNECTOR	TERMINATION P/N
5416-977	W101-1	PS1-PS CHASSIS	A1 - TMR CHASSIS	
5417-293	W101-2	PS1- POSTS ON BACK	A1 TMR CHASSIS - POSTS ON BACK	
5417-393	W102-A1	A-A2 ENET 1	ETH1-PORT 1	
5417-393	W102-A2	A-A2 ENET 2	ETH2-PORT 1	
5417-026	W103-A1	KERNEL A-A3/J1	FTM103-1/J1	5501-502
5417-172	W103-A2	KERNEL A-A3/J2	FTM103-2/J1	5501-372
5417-172	W104-A1	KERNEL A-A4/J1	FTM104-1A/J1	5453-276
5417-172	W104-A2	KERNEL A-A4/J2	FTM104-2A/J1	5453-276
5417-172	W105-A1	KERNEL A-A5/J1	FTM105-1/J1	5501-372
5417-173	W105-A2	KERNEL A-A5/J2	FTM105-2/J1	5501-372
5417-041	W106-A	KERNEL A-A6/J1	FTM106-1/J1	5437-672
5417-393	W102-B1	B-A2 ENET 1	ETH1-PORT 2	
5417-393	W102-B2	B-A2-ENET 2	ETH2-PORT 2	
5417-026	W103-B1	KERNEL B-A3/J1	FTM103-1/J2	
5417-172	W103-B2	KERNEL B-A3/J2	FTM103-2/J2	
5417-172	W104-B1	KERNEL B-A4/J1	FTM104-1A/J2	
5417-172	W104-B2	KERNEL B-A4/J2	FTM104-2A/J2	
5417-172	W105-B1	KERNEL B-A5/J1	FTM105-1/J2	
5417-173	W105-B2	KERNEL B-A5/J2	FTM105-2/J2	
5417-041	W106-B	KERNEL B-A6/J1	FTM106-2/J1	5437-672
5417-393	W102-C1	C-A2 ENET 1	ETH1-PORT 3	
5417-393	W102-C2	C-A2 ENET 2	ETH2-PORT 3	
5417-026	W103-C1	KERNEL C-A3/J1	FTM103-1/J3	
5417-172	W103-C2	KERNEL C-A3/J2	FTM103-2/J3	
5417-172	W104-C1	KERNEL C-A4/J1	FTM104-1A/J3	
5417-172	W104-C2	KERNEL C-A4/J2	FTM104-2A/J3	
5417-172	W105-C1	KERNEL C-A5/J1	FTM105-1/J3	
5417-173	W105-C2	KERNEL C-A5/J2	FTM105-2/J3	
5417-019	W104-1AB-7	FTM104-1A/J7	FTM104-1B/J4	
5417-019	W104-1AB-8	FTM104-1A/J8	FTM104-1B/J5	
5417-019	W104-1AB-9	FTM104-1A/J9	FTM104-1B/J6	
5417-019	W104-2AB-7	FTM104-2A/J7	FTM104-2B/J4	
5417-019	W104-2AB-8	FTM104-2A/J8	FTM104-2B/J5	
5417-019	W104-2AB-9	FTM104-2A/J9	FTM104-2B/J6	
5417-394	W107-1	ETH1-4	CCT-1	
5417-394	W107-2	ETH2-4	CCT-2	

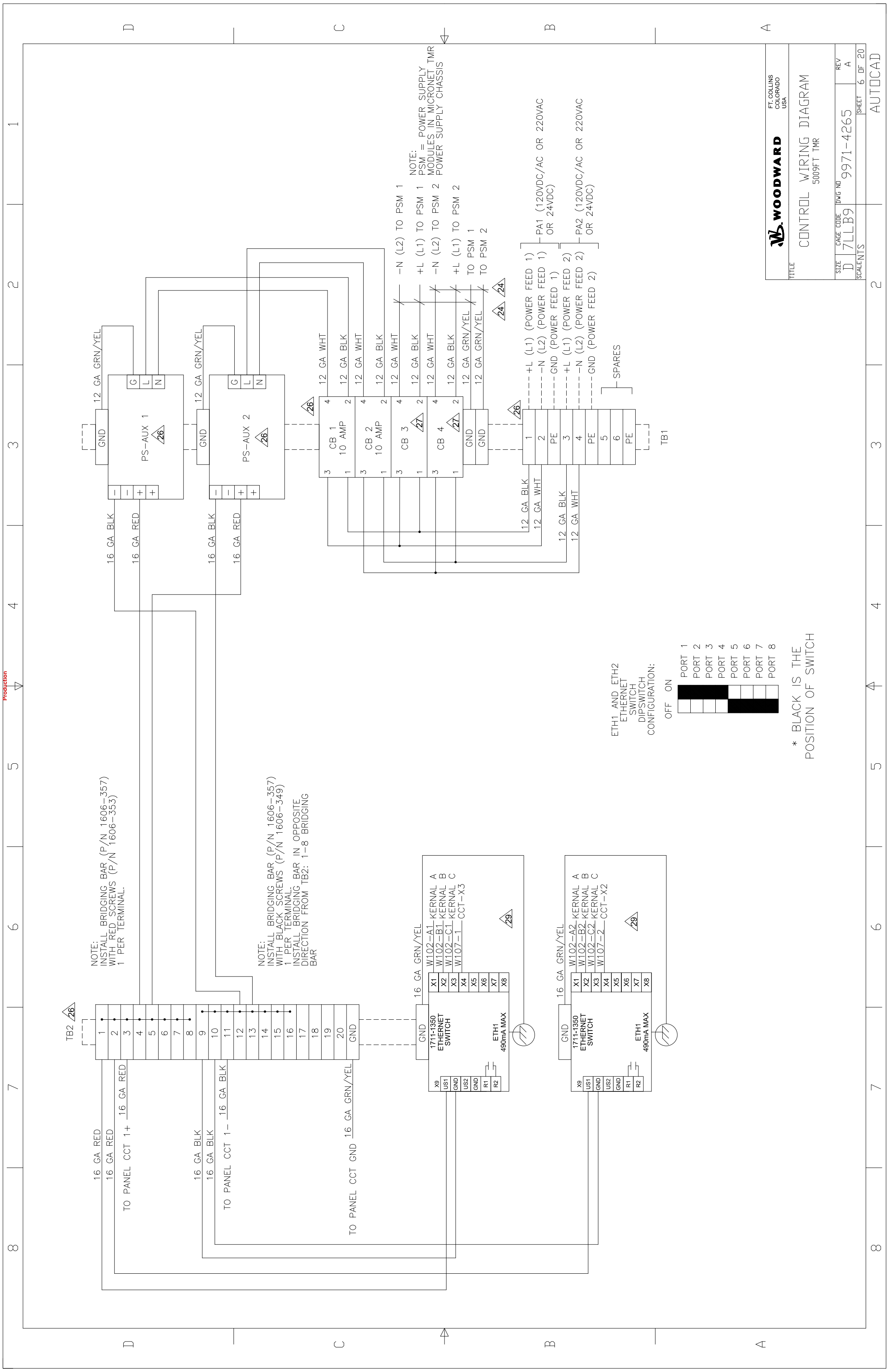
WOODWARD FT. COLLINS COLORADO USA

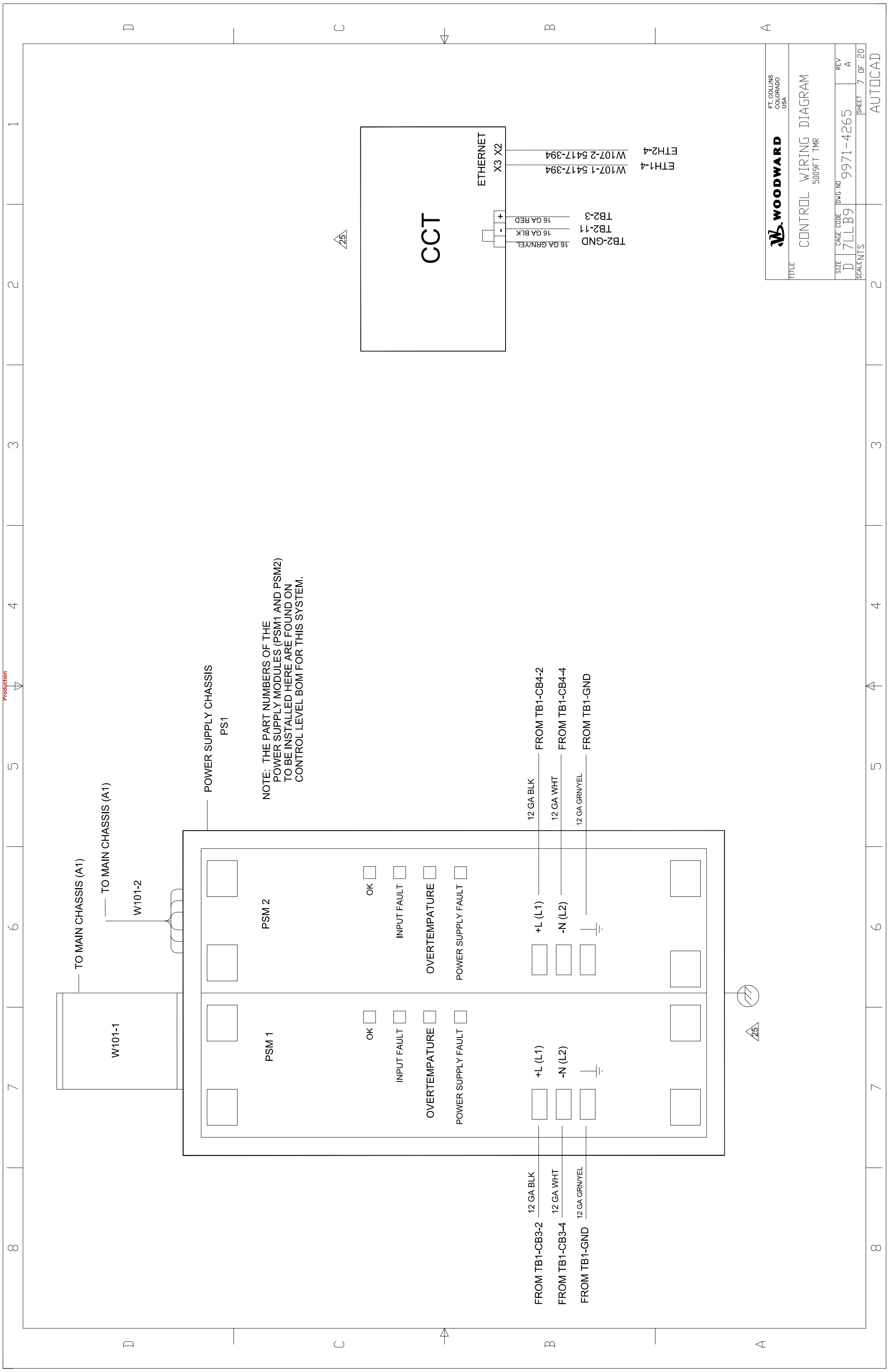
TITLE CONTROL WIRING DIAGRAM 5009FT TMR

SIZE D | CAGE CODE 7LLB9 | DWG NO 9971-4265 | REV A

SCALE NTS | SHEET 5 OF 20

AUTOCAD


CONTROL WIRING DIAGRAM
5009FT TMR
WOODWARD
FT. COLLINS COLORADO USA
9971-4265
7LLB9
D
A
SHEET 6 OF 20
AUTOCAD
NOTE:
PSM = POWER SUPPLY MODULES IN MICRONET TMR POWER SUPPLY CHASSIS
PA1 (120VDC/AC OR 220VAC OR 24VDC)
PA2 (120VDC/AC OR 220VAC OR 24VDC)
TB1
TB2
PS-AUX 1
PS-AUX 2
CB 1 10 AMP
CB 2 10 AMP
CB 3
CB 4
SPARES
NOTE: INSTALL BRIDGING BAR (P/N 1606-357) WITH RED SCREWS (P/N 1606-353) 1 PER TERMINAL.
NOTE: INSTALL BRIDGING BAR (P/N 1606-357) WITH BLACK SCREWS (P/N 1606-349) 1 PER TERMINAL. INSTALL BRIDGING BAR IN OPPOSITE DIRECTION FROM TB2: 1-8 BRIDGING BAR
TO PANEL CCT 1+
TO PANEL CCT 1−
TO PANEL CCT GND
1711-1350 ETHERNET SWITCH
ETH1 490mA MAX
ETH1 AND ETH2 ETHERNET SWITCH DIPSWITCH CONFIGURATION:
* BLACK IS THE POSITION OF SWITCH


CCT
ETHERNET
X3 X2
W107-2 5417-394
W107-1 5417-394
ETH2-4
ETH1-4
16 GA RED
16 GA BLK
16 GA GRN/YEL
TB2-3
TB2-11
TB2-GND
POWER SUPPLY CHASSIS
PS1
NOTE: THE PART NUMBERS OF THE POWER SUPPLY MODULES (PSM1 AND PSM2) TO BE INSTALLED HERE ARE FOUND ON CONTROL LEVEL BOM FOR THIS SYSTEM.
TO MAIN CHASSIS (A1)
TO MAIN CHASSIS (A1)
W101-2
W101-1
PSM 2
PSM 1
OK
INPUT FAULT
OVERTEMPATURE
POWER SUPPLY FAULT
+L (L1)
-N (L2)
12 GA BLK
12 GA WHT
12 GA GRN/YEL
FROM TB1-CB4-2
FROM TB1-CB4-4
FROM TB1-GND
FROM TB1-CB3-2
FROM TB1-CB3-4
FROM TB1-GND
WOODWARD
FT. COLLINS COLORADO USA
TITLE
CONTROL WIRING DIAGRAM
5009FT TMR
SIZE D
CAGE CODE 7LLB9
DWG NO 9971-4265
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SCALE NTS
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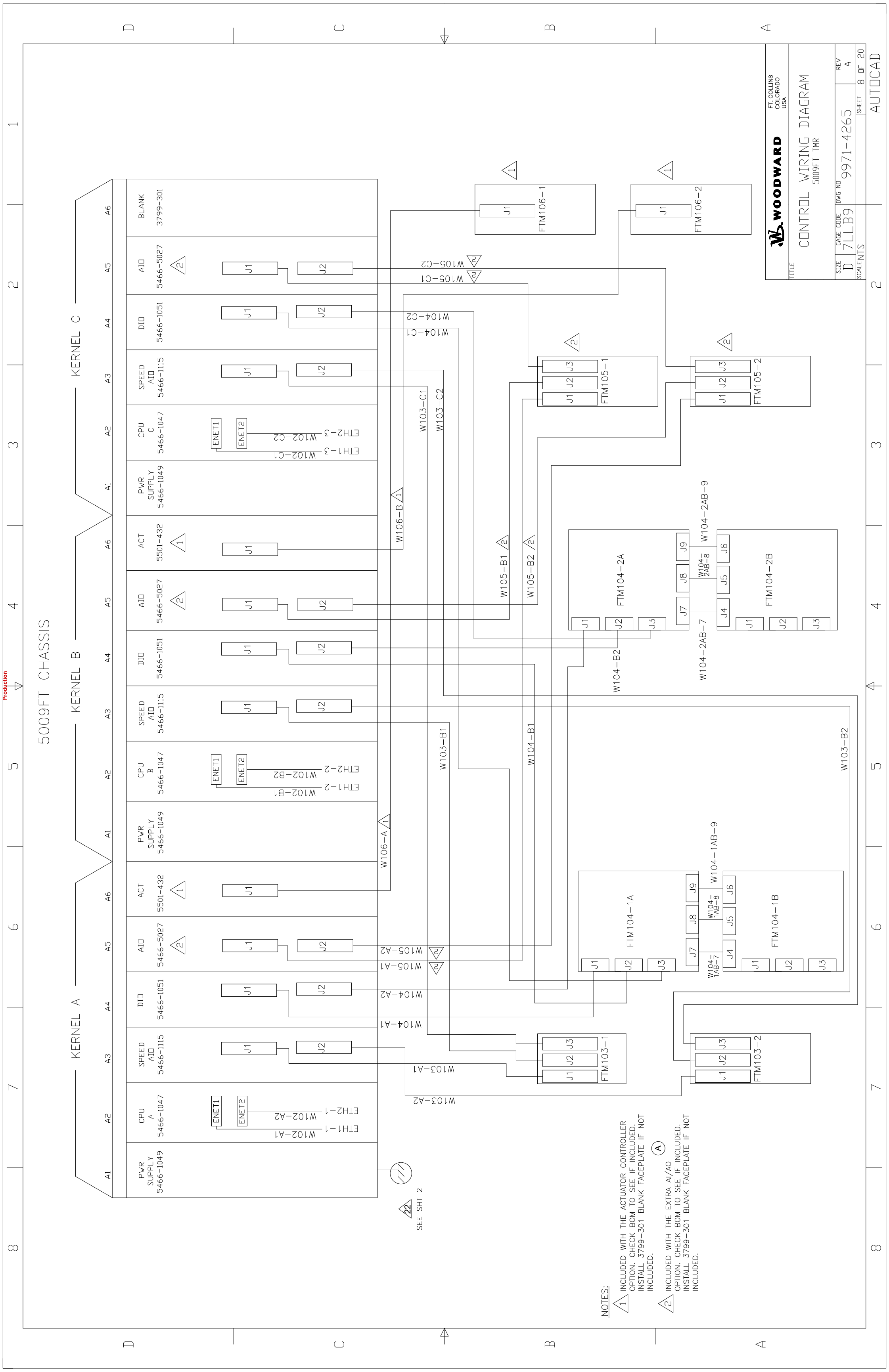
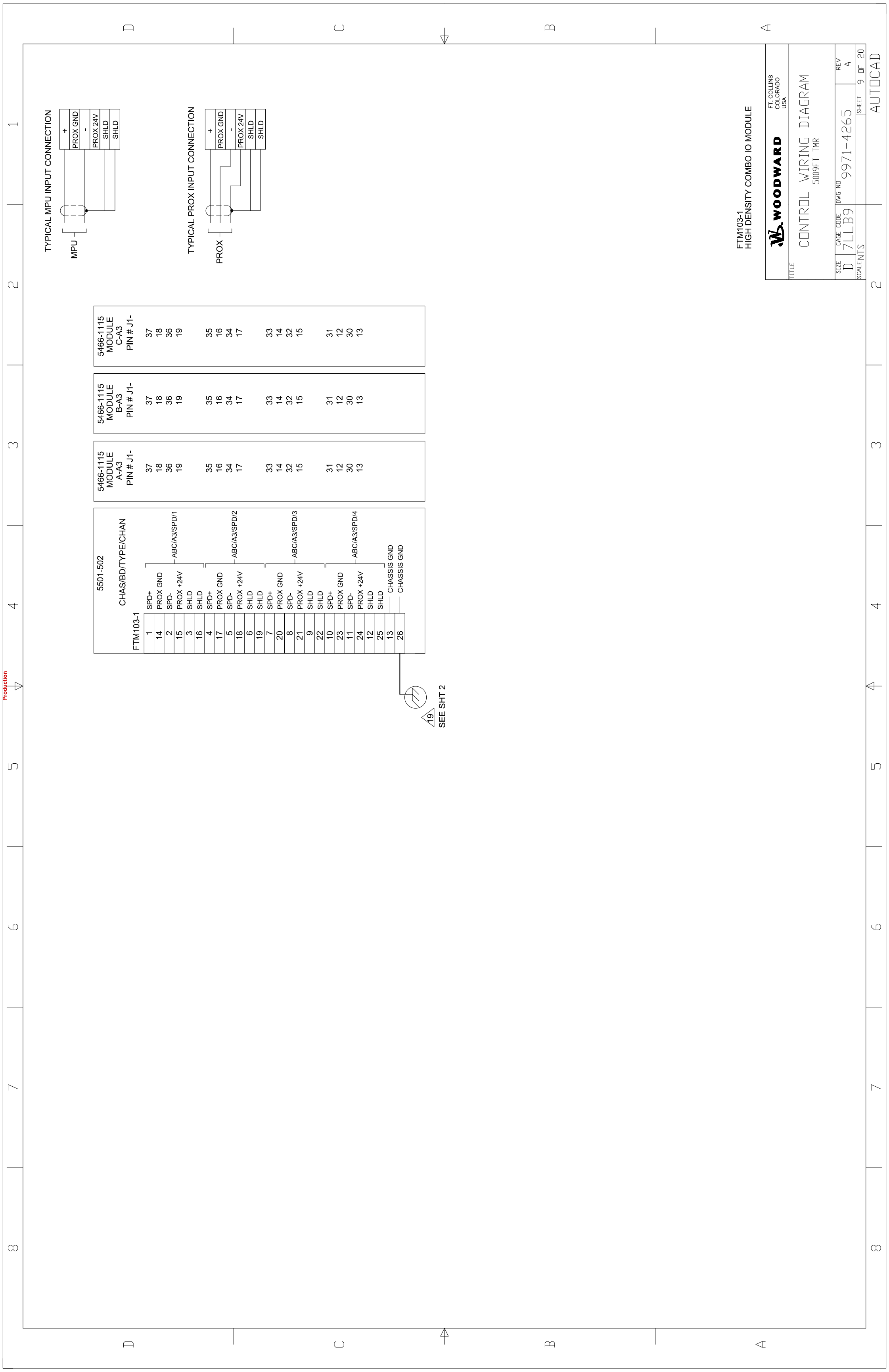
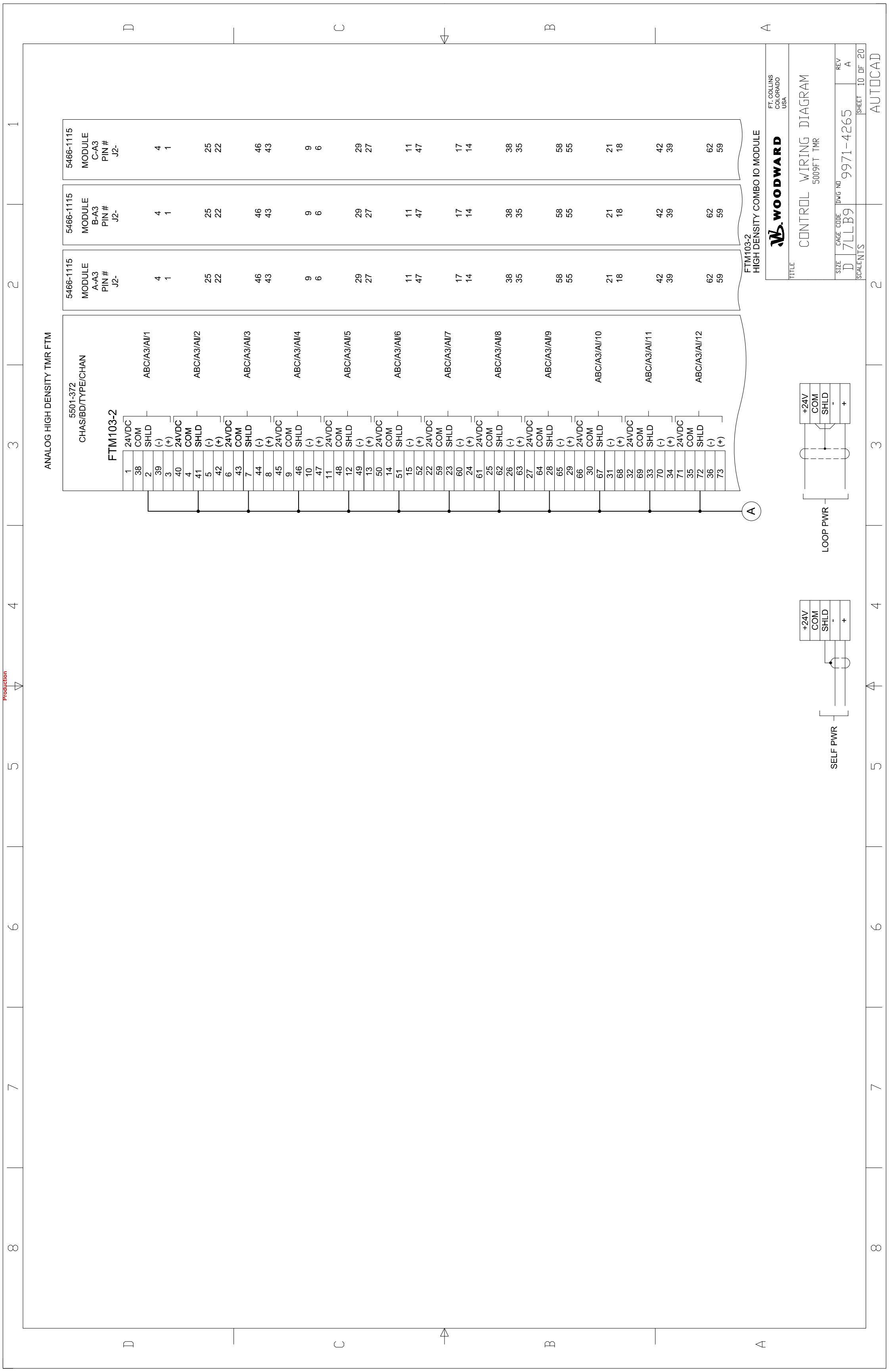
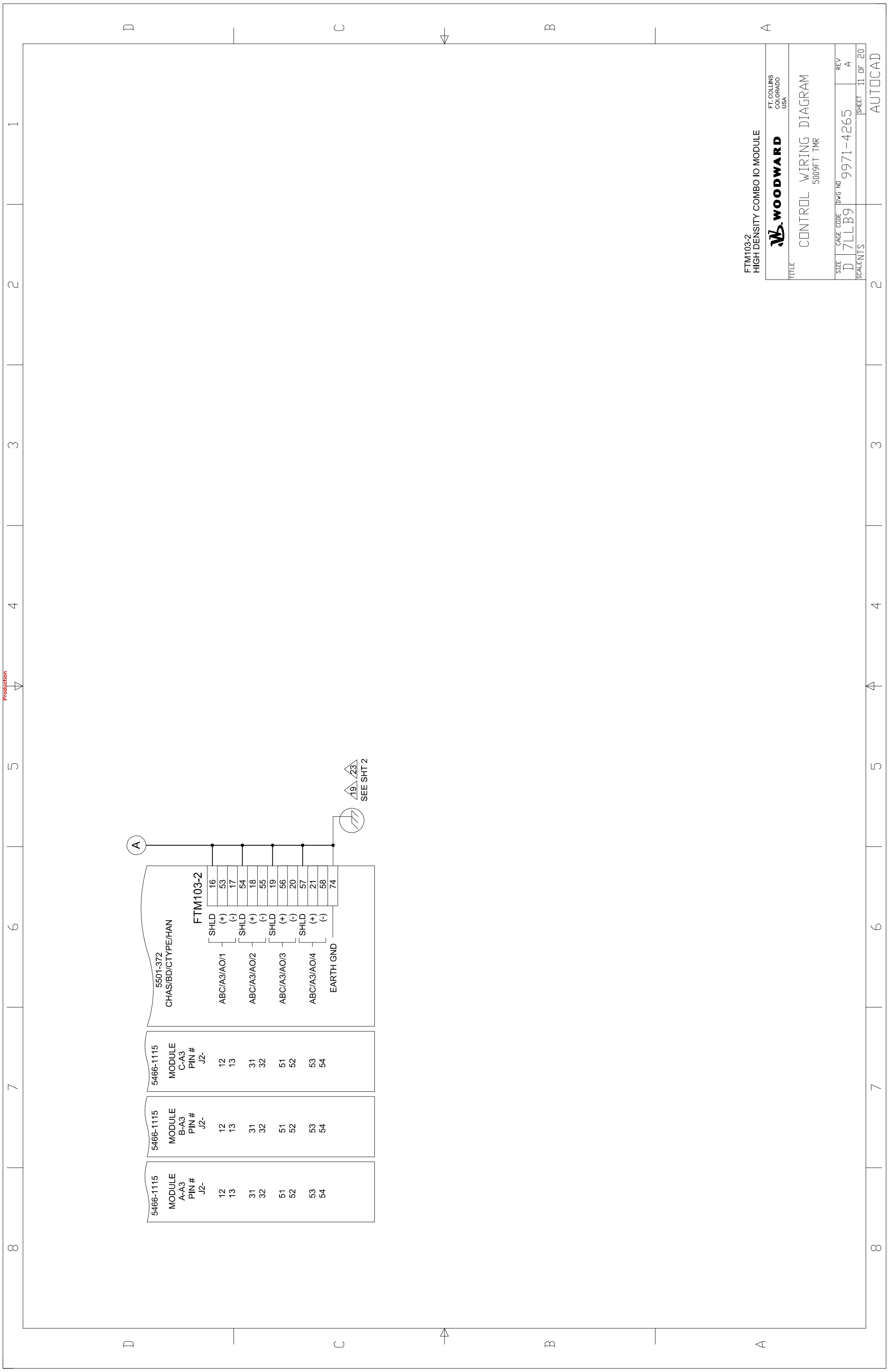
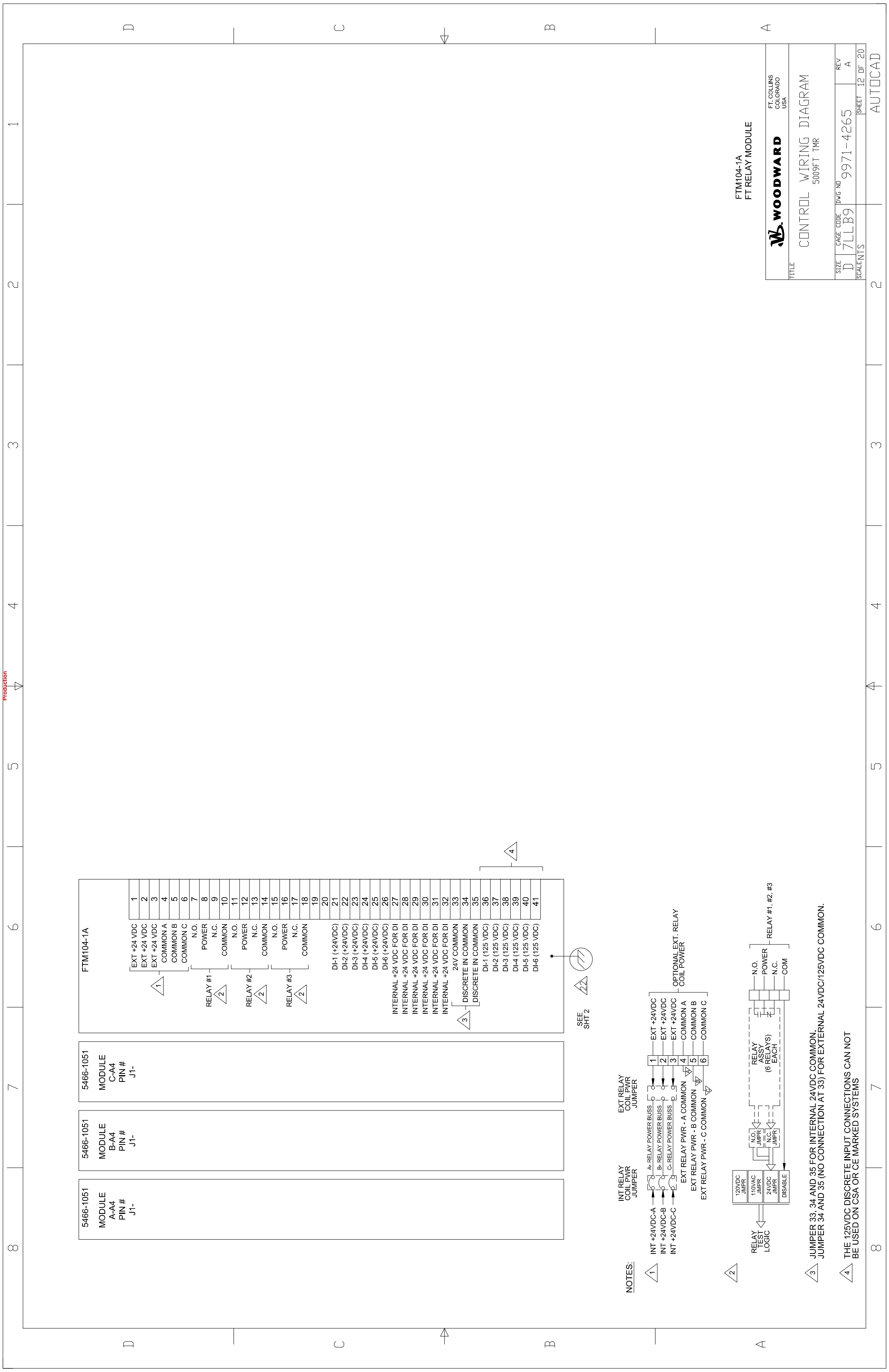
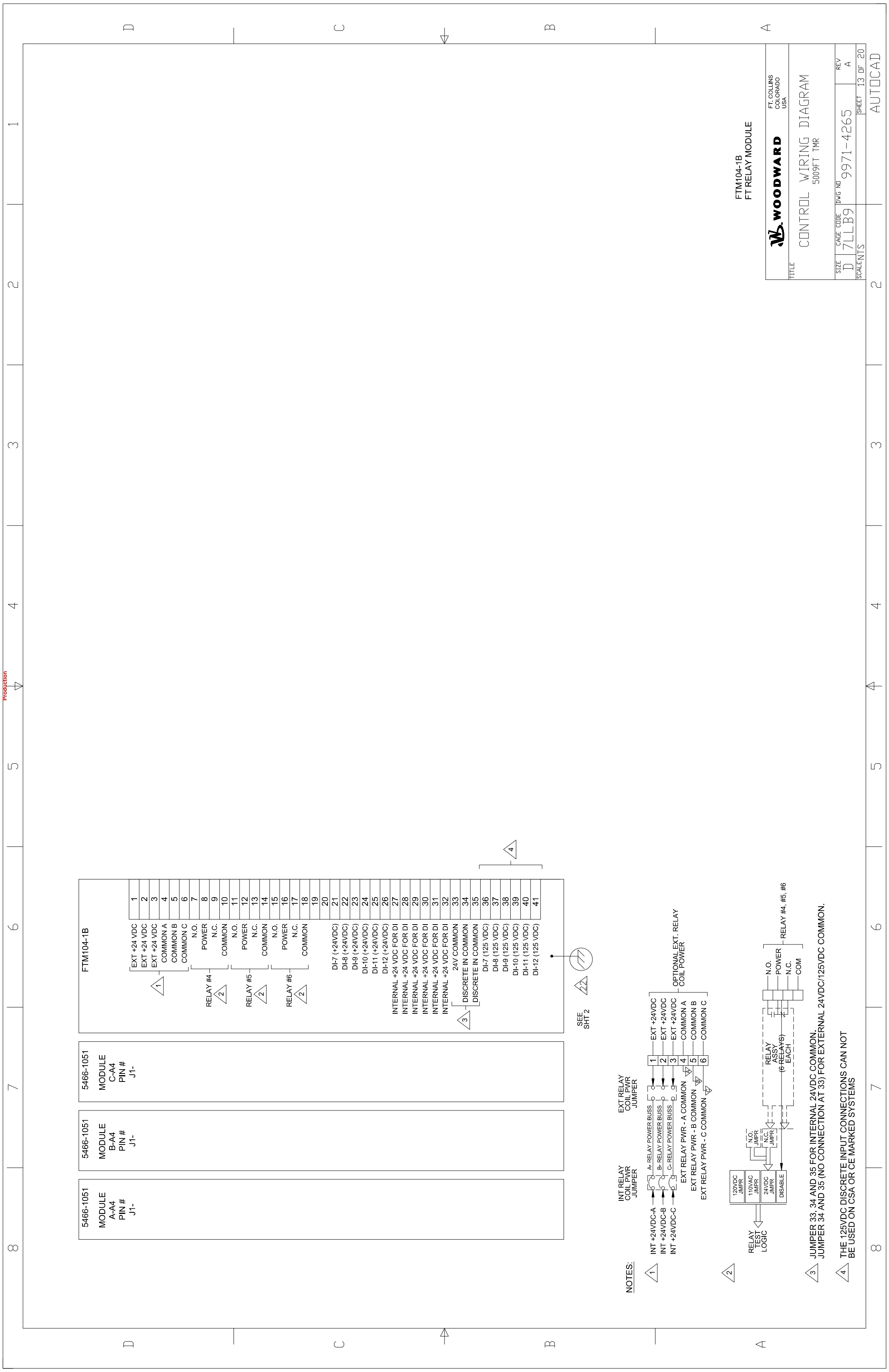

5009FT CHASSIS
KERNEL A
KERNEL B
KERNEL C
PWR SUPPLY 5466-1049
CPU A 5466-1047
SPEED AID 5466-1115
DIO 5466-1051
AIO 5466-5027
ACT 5501-432
BLANK 3799-301
FTM103-1
FTM103-2
FTM104-1A
FTM104-1B
FTM104-2A
FTM104-2B
FTM105-1
FTM105-2
FTM106-1
FTM106-2
WOODWARD
FT. COLLINS COLORADO USA
CONTROL WIRING DIAGRAM
5009FT TMR
9971-4265
AUTOCAD
NOTES:
1 INCLUDED WITH THE ACTUATOR CONTROLLER OPTION. CHECK BOM TO SEE IF INCLUDED. INSTALL 3799-301 BLANK FACEPLATE IF NOT INCLUDED.
2 INCLUDED WITH THE EXTRA AI/AO OPTION. CHECK BOM TO SEE IF INCLUDED. INSTALL 3799-301 BLANK FACEPLATE IF NOT INCLUDED.

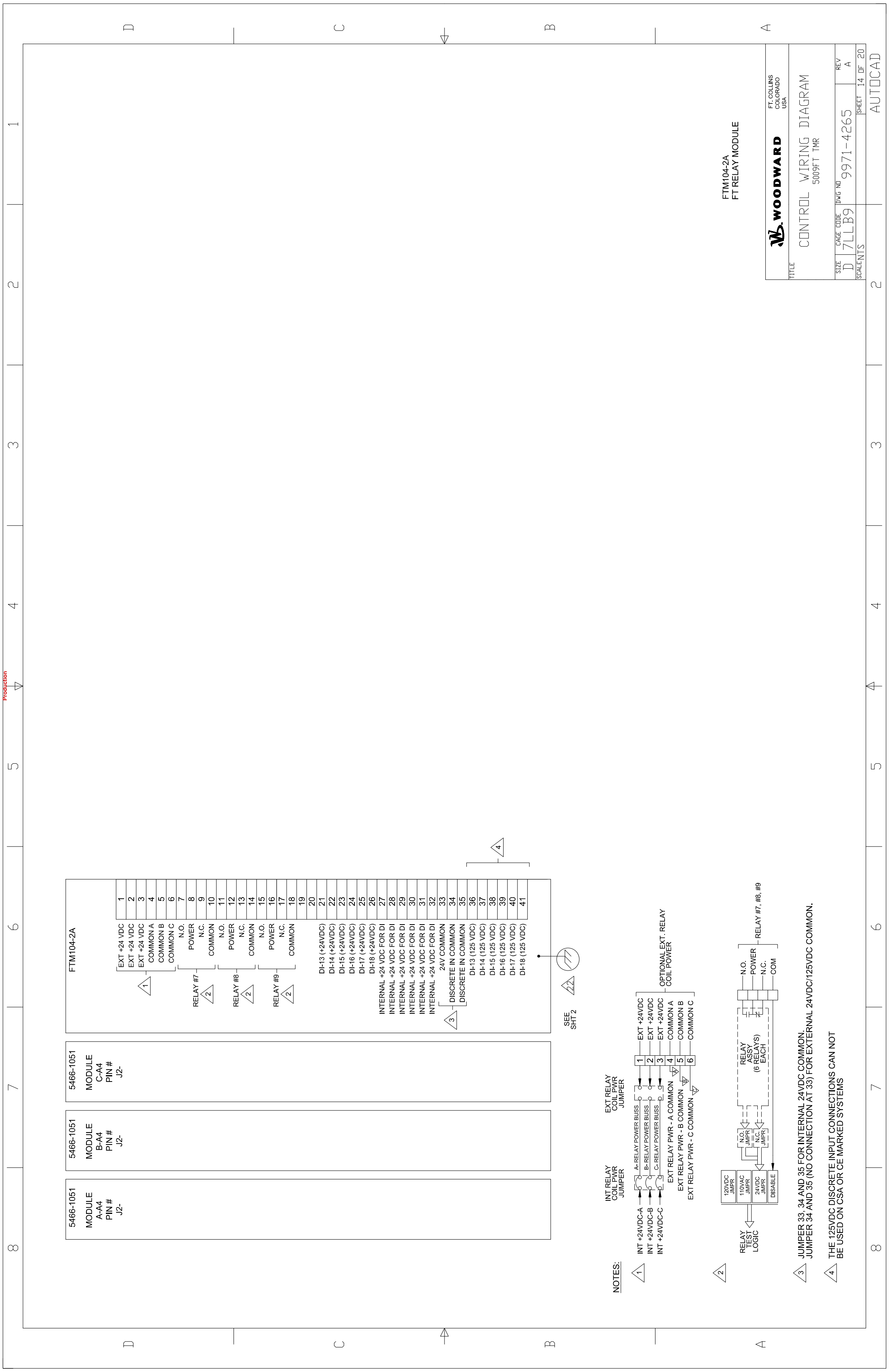

TYPICAL MPU INPUT CONNECTION
MPU
+
PROX GND
-
PROX 24V
SHLD
SHLD
TYPICAL PROX INPUT CONNECTION
PROX
5466-1115 MODULE C-A3 PIN # J1-
5466-1115 MODULE B-A3 PIN # J1-
5466-1115 MODULE A-A3 PIN # J1-
5501-502
CHAS/BD/TYPE/CHAN
FTM103-1
ABC/A3/SPD/1
ABC/A3/SPD/2
ABC/A3/SPD/3
ABC/A3/SPD/4
SPD+
SPD-
PROX +24V
CHASSIS GND
SEE SHT 2
FTM103-1
HIGH DENSITY COMBO IO MODULE
WOODWARD
FT. COLLINS COLORADO USA
CONTROL WIRING DIAGRAM
5009FT TMR
SIZE D
CAGE CODE 7LLB9
DWG NO 9971-4265
REV A
SHEET 9 OF 20
SCALE NTS
AUTOCAD

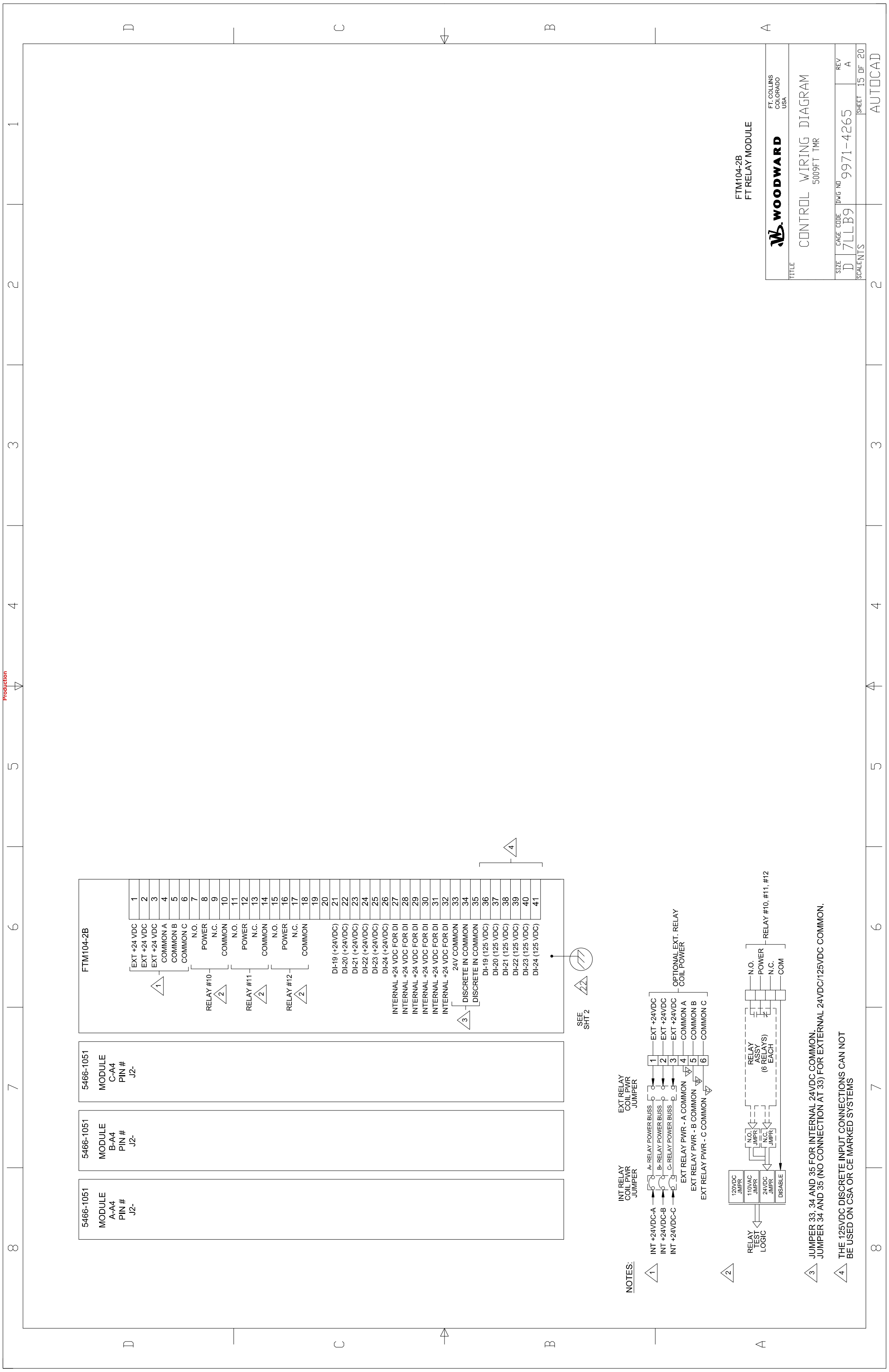

ANALOG HIGH DENSITY TMR FTM
5501-372
CHAS/BD/TYPE/CHAN
FTM103-2
5466-1115
MODULE
A-A3
PIN #
J2-
5466-1115
MODULE
B-A3
PIN #
J2-
5466-1115
MODULE
C-A3
PIN #
J2-
FTM103-2
HIGH DENSITY COMBO IO MODULE
LOOP PWR
SELF PWR
WOODWARD
FT. COLLINS COLORADO USA
CONTROL WIRING DIAGRAM
5009FT TMR
7LLB9
9971-4265
SHEET 10 OF 20
AUTOCAD

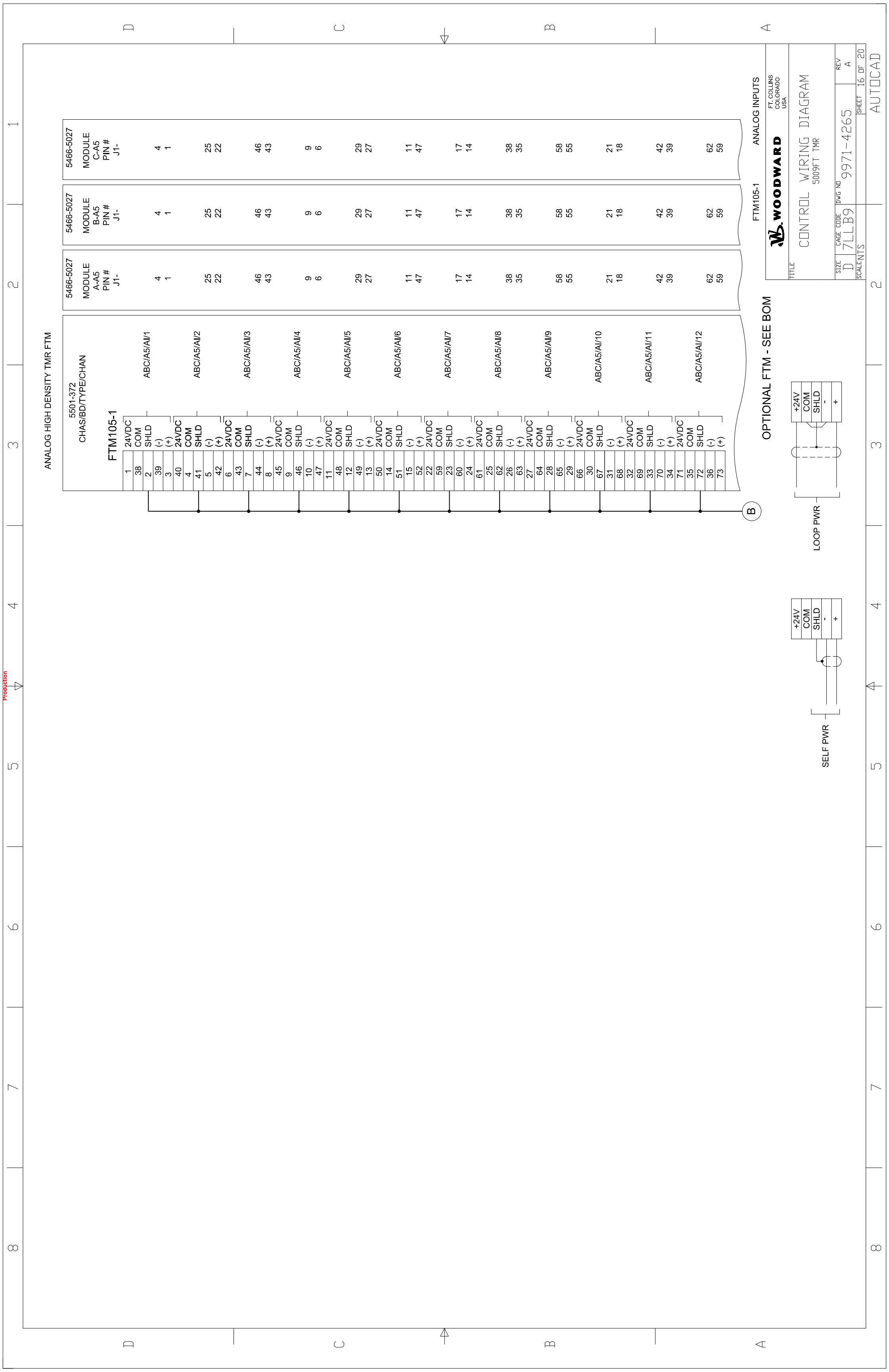

5466-1115
MODULE
A-A3
PIN #
J2-
12
13
31
32
51
52
53
54
5466-1115
MODULE
B-A3
PIN #
J2-
12
13
31
32
51
52
53
54
5466-1115
MODULE
C-A3
PIN #
J2-
12
13
31
32
51
52
53
54
5501-372
CHAS/BD/CTYPE/HAN
FTM103-2
ABC/A3/AO/1
SHLD
(+)
(-)
16
53
17
ABC/A3/AO/2
SHLD
(+)
(-)
54
18
55
ABC/A3/AO/3
SHLD
(+)
(-)
19
56
20
ABC/A3/AO/4
SHLD
(+)
(-)
57
21
58
EARTH GND
74
A
19
23
SEE SHT 2
FTM103-2
HIGH DENSITY COMBO IO MODULE
WOODWARD
FT. COLLINS
COLORADO
USA
TITLE
CONTROL WIRING DIAGRAM
5009FT TMR
SIZE
D
CAGE CODE
7LLB9
DWG NO
9971-4265
REV
A
SCALE NTS
SHEET 11 OF 20
AUTOCAD
Production

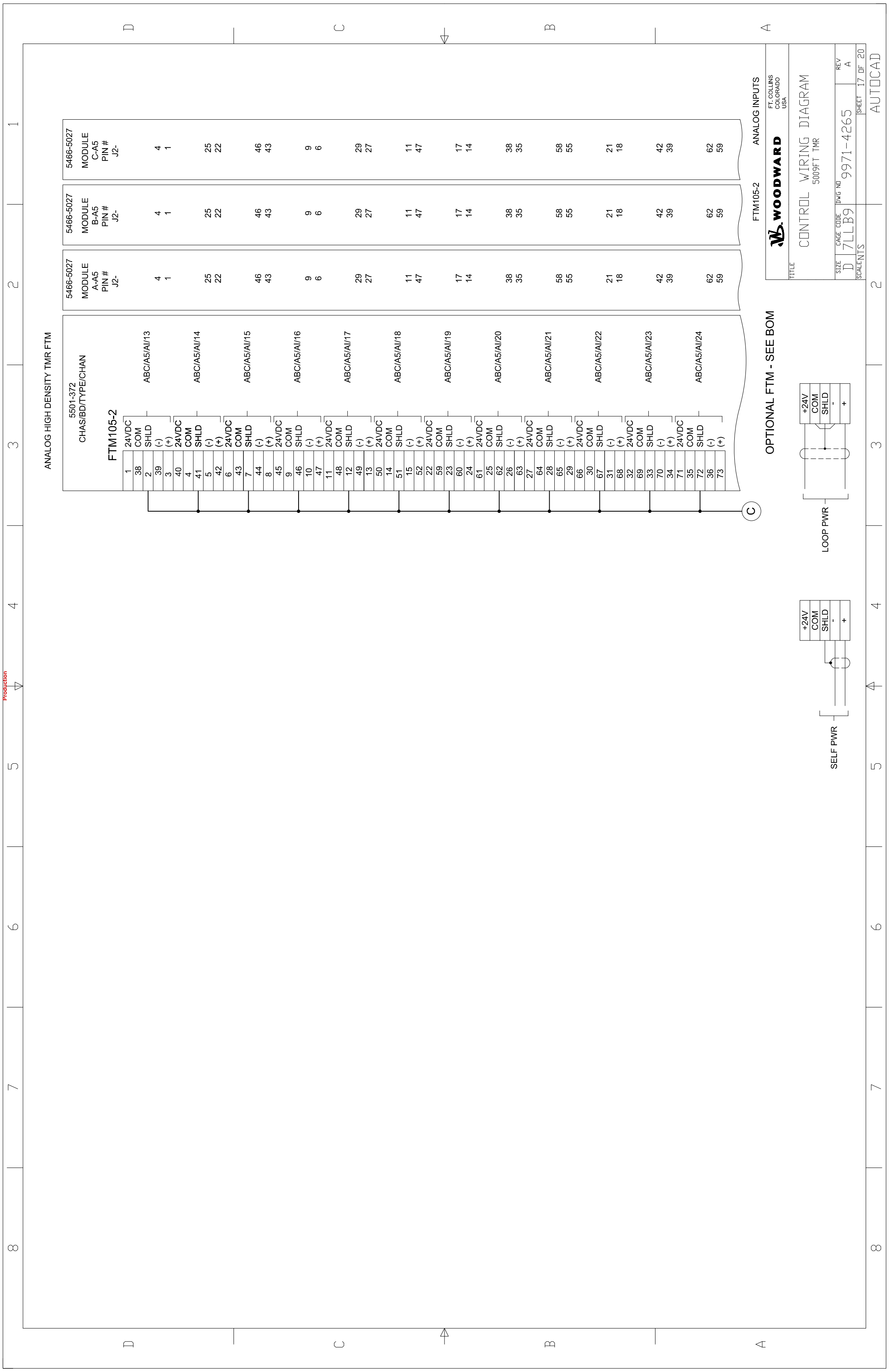

5466-1051
MODULE A-A4 PIN # J1-
5466-1051
MODULE B-A4 PIN # J1-
5466-1051
MODULE C-A4 PIN # J1-
FTM104-1A
EXT +24 VDC 1
EXT +24 VDC 2
EXT +24 VDC 3
COMMON A 4
COMMON B 5
COMMON C 6
RELAY #1
N.O. 7
POWER 8
N.C. 9
COMMON 10
RELAY #2
N.O. 11
POWER 12
N.C. 13
COMMON 14
RELAY #3
N.O. 15
POWER 16
N.C. 17
COMMON 18
19
20
DI-1 (+24VDC) 21
DI-2 (+24VDC) 22
DI-3 (+24VDC) 23
DI-4 (+24VDC) 24
DI-5 (+24VDC) 25
DI-6 (+24VDC) 26
INTERNAL +24 VDC FOR DI 27
INTERNAL +24 VDC FOR DI 28
INTERNAL +24 VDC FOR DI 29
INTERNAL +24 VDC FOR DI 30
INTERNAL +24 VDC FOR DI 31
INTERNAL +24 VDC FOR DI 32
24V COMMON 33
DISCRETE IN COMMON 34
DISCRETE IN COMMON 35
DI-1 (125 VDC) 36
DI-2 (125 VDC) 37
DI-3 (125 VDC) 38
DI-4 (125 VDC) 39
DI-5 (125 VDC) 40
DI-6 (125 VDC) 41
SEE SHT 2
NOTES:
INT RELAY COIL PWR JUMPER
EXT RELAY COIL PWR JUMPER
INT +24VDC-A
INT +24VDC-B
INT +24VDC-C
A- RELAY POWER BUSS
B- RELAY POWER BUSS
C- RELAY POWER BUSS
EXT RELAY PWR - A COMMON
EXT RELAY PWR - B COMMON
EXT RELAY PWR - C COMMON
1 EXT +24VDC
2 EXT +24VDC
3 EXT +24VDC
4 COMMON A
5 COMMON B
6 COMMON C
OPTIONAL EXT. RELAY COIL POWER
RELAY TEST LOGIC
120VDC JMPR
110VAC JMPR
24VDC JMPR
DISABLE
N.O. JMPR
N.C. JMPR
RELAY ASSY (6 RELAYS) EACH
N.O.
POWER
N.C.
COM
RELAY #1, #2, #3
3 JUMPER 33, 34 AND 35 FOR INTERNAL 24VDC COMMON.
JUMPER 34 AND 35 (NO CONNECTION AT 33) FOR EXTERNAL 24VDC/125VDC COMMON.
4 THE 125VDC DISCRETE INPUT CONNECTIONS CAN NOT BE USED ON CSA OR CE MARKED SYSTEMS
FTM104-1A
FT RELAY MODULE
WOODWARD
FT. COLLINS COLORADO USA
TITLE
CONTROL WIRING DIAGRAM
5009FT TMR
SIZE D
CAGE CODE 7LLB9
DWG NO 9971-4265
REV A
SCALE NTS
SHEET 12 OF 20
AUTOCAD

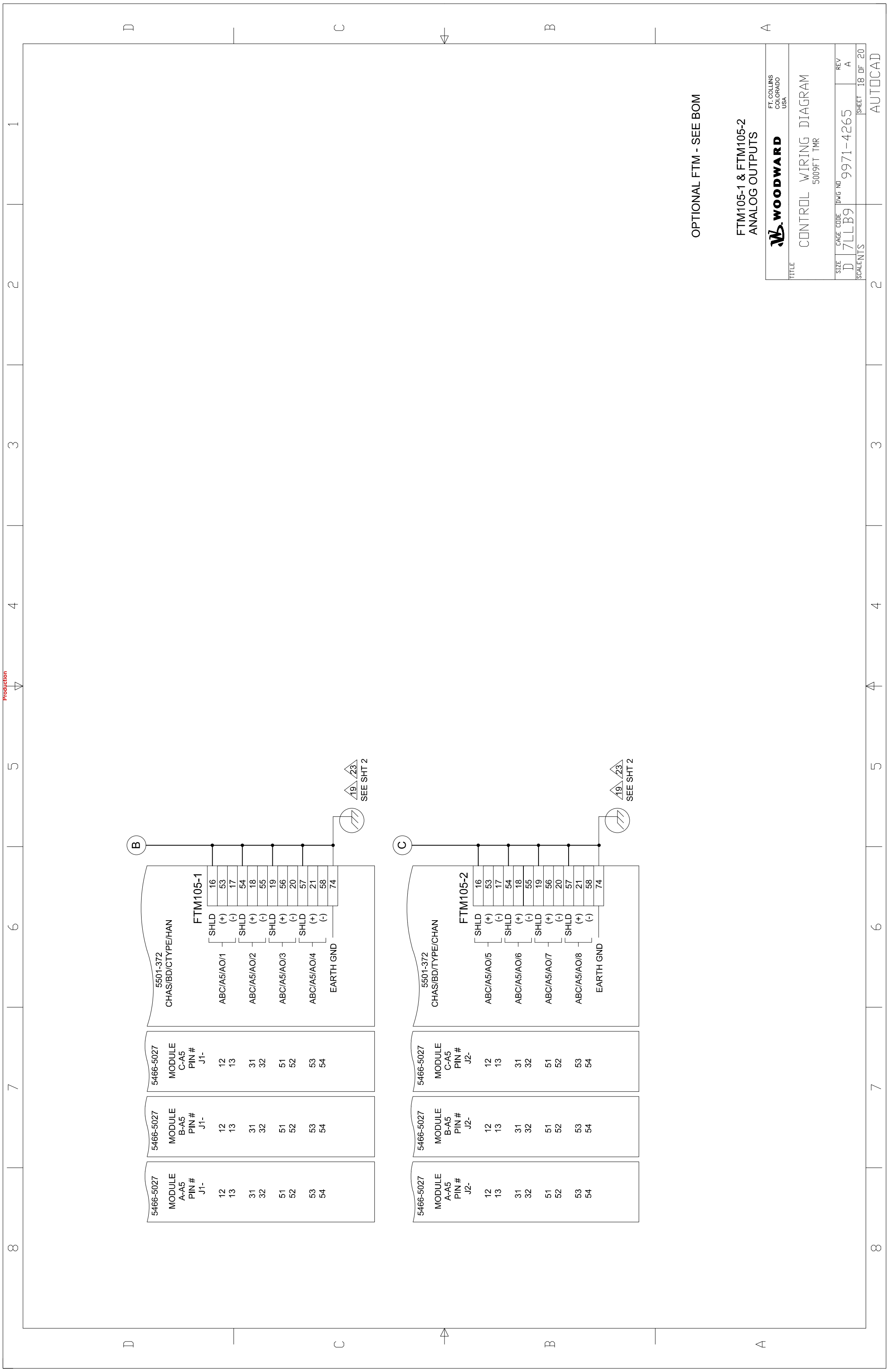

FTM104-1B
FT RELAY MODULE
WOODWARD
FT. COLLINS COLORADO USA
TITLE
CONTROL WIRING DIAGRAM
5009FT TMR
SIZE D
CAGE CODE 7LLB9
DWG NO 9971-4265
REV A
SCALE NTS
SHEET 13 OF 20
AUTOCAD
FTM104-1B
EXT +24 VDC
EXT +24 VDC
EXT +24 VDC
COMMON A
COMMON B
COMMON C
N.O.
POWER
N.C.
COMMON
RELAY #4
RELAY #5
RELAY #6
DI-7 (+24VDC)
DI-8 (+24VDC)
DI-9 (+24VDC)
DI-10 (+24VDC)
DI-11 (+24VDC)
DI-12 (+24VDC)
INTERNAL +24 VDC FOR DI
24V COMMON
DISCRETE IN COMMON
DI-7 (125 VDC)
DI-8 (125 VDC)
DI-9 (125 VDC)
DI-10 (125 VDC)
DI-11 (125 VDC)
DI-12 (125 VDC)
SEE SHT 2
5466-1051
MODULE
C-A4
B-A4
A-A4
PIN #
J1-
NOTES:
INT RELAY COIL PWR JUMPER
EXT RELAY COIL PWR JUMPER
INT +24VDC-A
INT +24VDC-B
INT +24VDC-C
A- RELAY POWER BUSS
B- RELAY POWER BUSS
C- RELAY POWER BUSS
EXT RELAY PWR - A COMMON
EXT RELAY PWR - B COMMON
EXT RELAY PWR - C COMMON
OPTIONAL EXT. RELAY COIL POWER
RELAY TEST LOGIC
120VDC JMPR
110VAC JMPR
24VDC JMPR
DISABLE
RELAY ASSY (6 RELAYS) EACH
COM
RELAY #4, #5, #6
JUMPER 33, 34 AND 35 FOR INTERNAL 24VDC COMMON.
JUMPER 34 AND 35 (NO CONNECTION AT 33) FOR EXTERNAL 24VDC/125VDC COMMON.
THE 125VDC DISCRETE INPUT CONNECTIONS CAN NOT BE USED ON CSA OR CE MARKED SYSTEMS

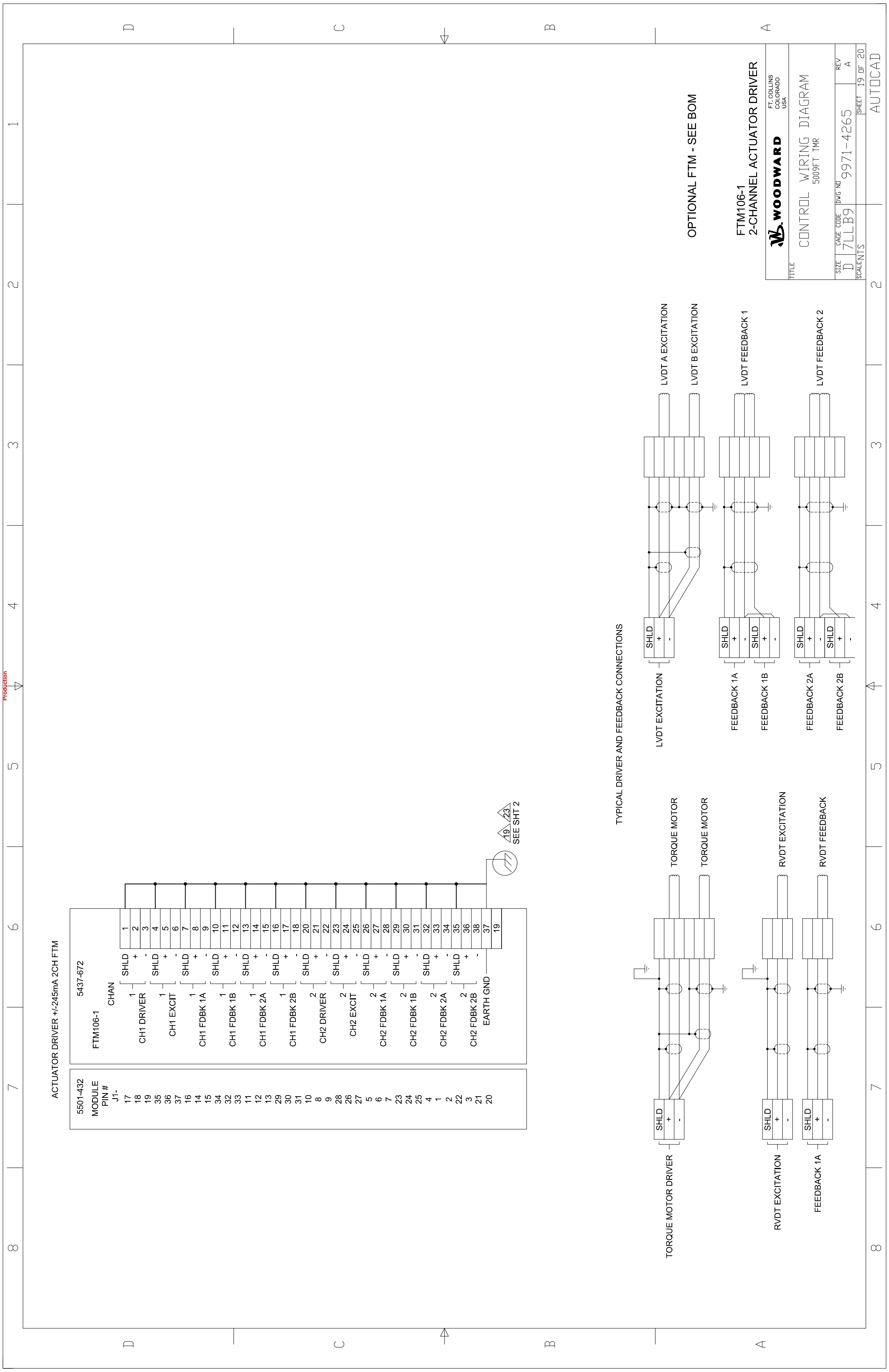

FTM104-2A
FT RELAY MODULE
WOODWARD
FT. COLLINS COLORADO USA
CONTROL WIRING DIAGRAM
5009FT TMR
D 7LLB9 9971-4265 A
SCALE NTS
SHEET 14 OF 20
AUTOCAD
5466-1051 MODULE A-A4 PIN # J2-
5466-1051 MODULE B-A4 PIN # J2-
5466-1051 MODULE C-A4 PIN # J2-
FTM104-2A
EXT +24 VDC
COMMON A
COMMON B
COMMON C
N.O.
POWER
N.C.
COMMON
RELAY #7
RELAY #8
RELAY #9
DI-13 (+24VDC)
DI-14 (+24VDC)
DI-15 (+24VDC)
DI-16 (+24VDC)
DI-17 (+24VDC)
DI-18 (+24VDC)
INTERNAL +24 VDC FOR DI
24V COMMON
DISCRETE IN COMMON
DI-13 (125 VDC)
DI-14 (125 VDC)
DI-15 (125 VDC)
DI-16 (125 VDC)
DI-17 (125 VDC)
DI-18 (125 VDC)
SEE SHT 2
NOTES:
INT +24VDC-A
INT +24VDC-B
INT +24VDC-C
INT RELAY COIL PWR JUMPER
EXT RELAY COIL PWR JUMPER
A- RELAY POWER BUSS
B- RELAY POWER BUSS
C- RELAY POWER BUSS
EXT RELAY PWR - A COMMON
EXT RELAY PWR - B COMMON
EXT RELAY PWR - C COMMON
OPTIONAL EXT. RELAY COIL POWER
RELAY TEST LOGIC
120VDC JMPR
110VAC JMPR
24VDC JMPR
DISABLE
N.O. JMPR
N.C. JMPR
RELAY ASSY (6 RELAYS) EACH
COM
RELAY #7, #8, #9
JUMPER 33, 34 AND 35 FOR INTERNAL 24VDC COMMON.
JUMPER 34 AND 35 (NO CONNECTION AT 33) FOR EXTERNAL 24VDC/125VDC COMMON.
THE 125VDC DISCRETE INPUT CONNECTIONS CAN NOT BE USED ON CSA OR CE MARKED SYSTEMS

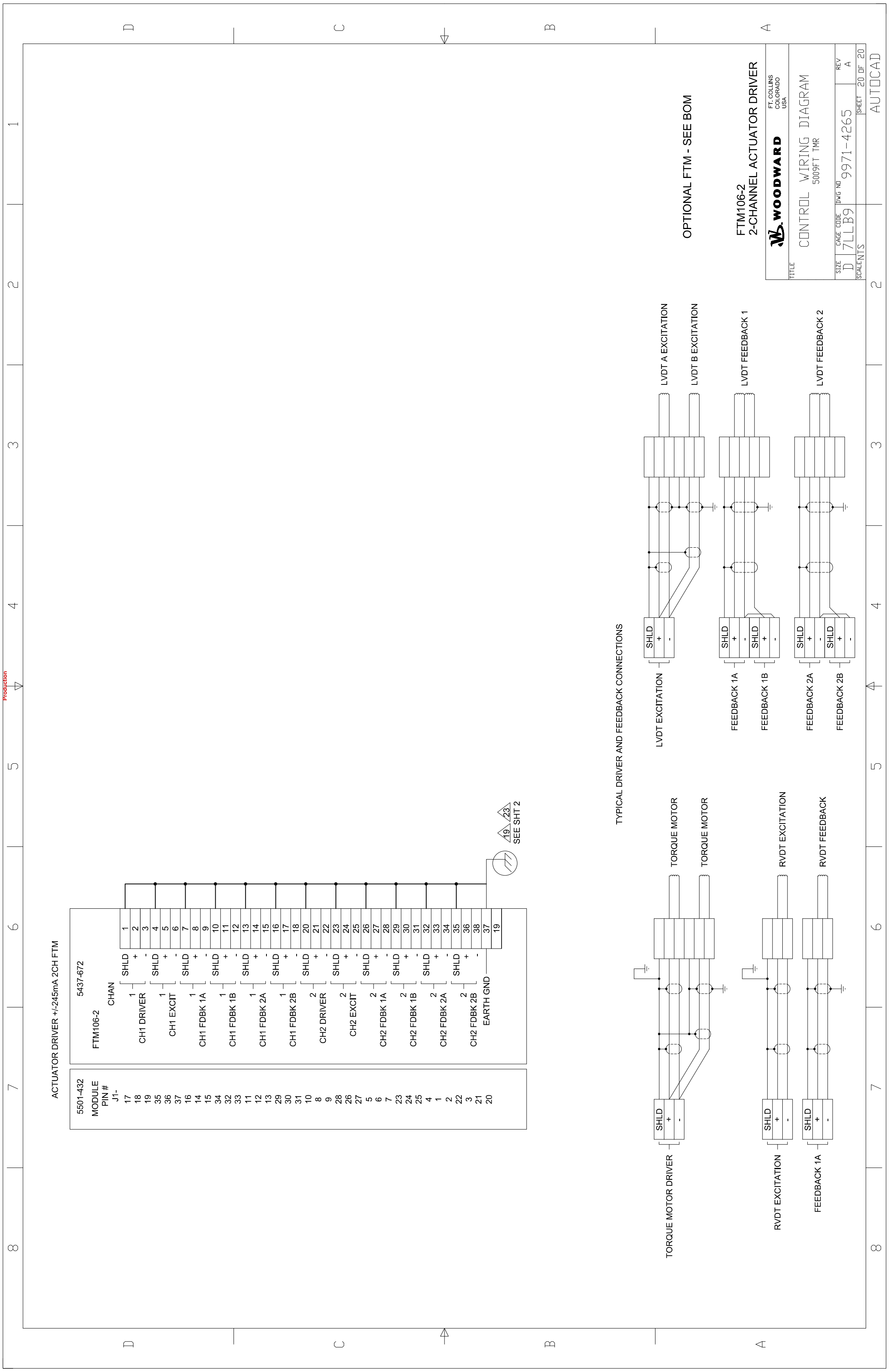

FTM104-2B
FT RELAY MODULE
WOODWARD
FT. COLLINS COLORADO USA
CONTROL WIRING DIAGRAM
5009FT TMR
SIZE D
CAGE CODE 7LLB9
DWG NO 9971-4265
REV A
SCALE NTS
SHEET 15 OF 20
AUTOCAD
5466-1051 MODULE A-A4 PIN # J2-
5466-1051 MODULE B-A4 PIN # J2-
5466-1051 MODULE C-A4 PIN # J2-
NOTES:
JUMPER 33, 34 AND 35 FOR INTERNAL 24VDC COMMON.
JUMPER 34 AND 35 (NO CONNECTION AT 33) FOR EXTERNAL 24VDC/125VDC COMMON.
THE 125VDC DISCRETE INPUT CONNECTIONS CAN NOT BE USED ON CSA OR CE MARKED SYSTEMS


ANALOG HIGH DENSITY TMR FTM
5501-372
CHAS/BD/TYPE/CHAN
FTM105-1
5466-5027
MODULE
A-A5
B-A5
C-A5
PIN #
J1-
OPTIONAL FTM - SEE BOM
LOOP PWR
SELF PWR
+24V
COM
SHLD
ANALOG INPUTS
FTM105-1
WOODWARD
FT. COLLINS
COLORADO
USA
CONTROL WIRING DIAGRAM
5009FT TMR
7LLB9
9971-4265
SCALE NTS
SHEET 16 OF 20
AUTOCAD

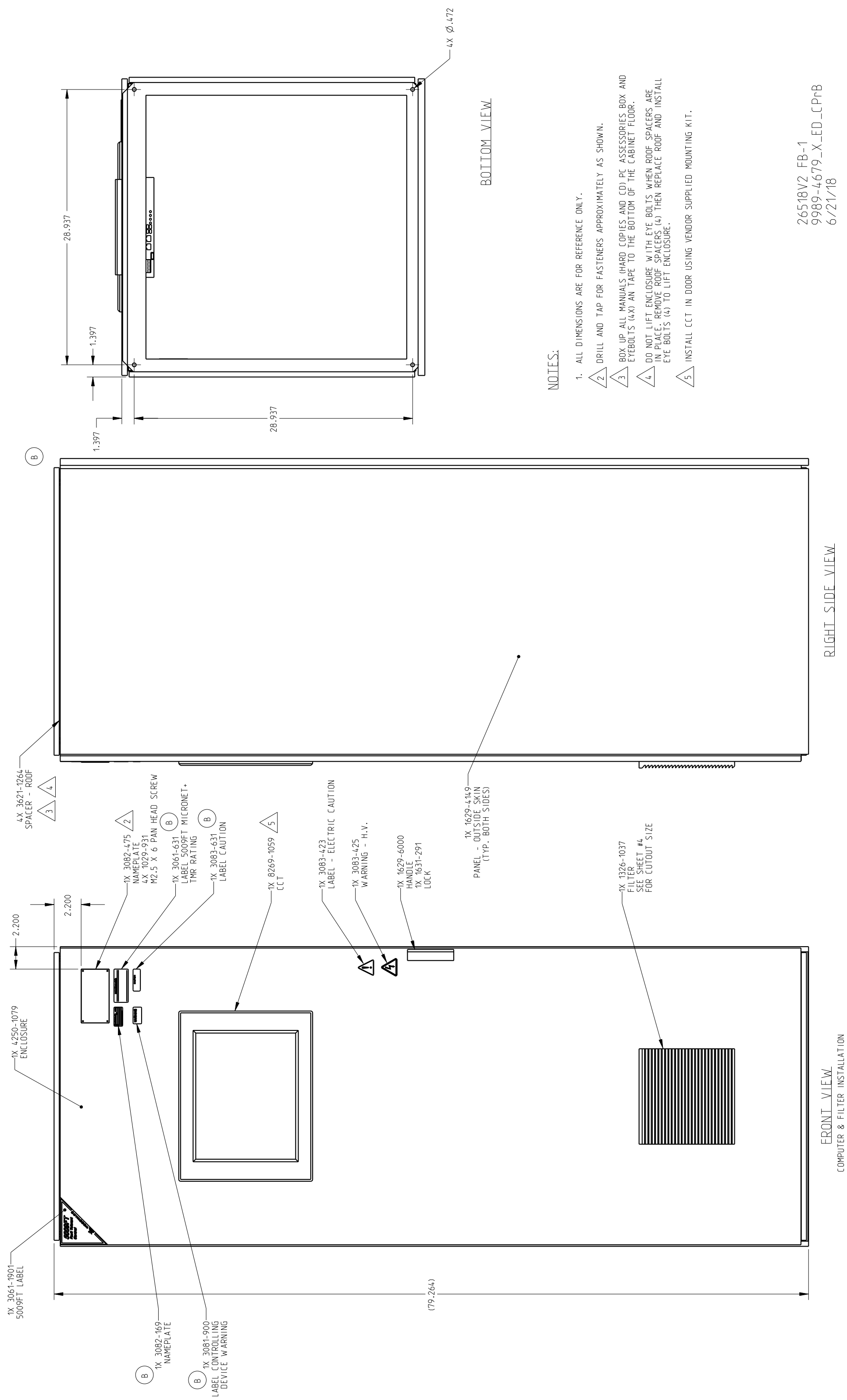

ANALOG HIGH DENSITY TMR FTM
5501-372
CHAS/BD/TYPE/CHAN
FTM105-2
5466-5027 MODULE A-A5 PIN # J2-
5466-5027 MODULE B-A5 PIN # J2-
5466-5027 MODULE C-A5 PIN # J2-
ABC/A5/AI/13
ABC/A5/AI/14
ABC/A5/AI/15
ABC/A5/AI/16
ABC/A5/AI/17
ABC/A5/AI/18
ABC/A5/AI/19
ABC/A5/AI/20
ABC/A5/AI/21
ABC/A5/AI/22
ABC/A5/AI/23
ABC/A5/AI/24
24VDC
COM
SHLD
(-)
(+)
OPTIONAL FTM - SEE BOM
+24V
COM
SHLD
LOOP PWR
SELF PWR
ANALOG INPUTS
FTM105-2
WOODWARD
FT. COLLINS COLORADO USA
CONTROL WIRING DIAGRAM
5009FT TMR
SIZE D
CAGE CODE 7LLB9
DWG NO 9971-4265
REV A
SCALE NTS
SHEET 17 OF 20
AUTOCAD

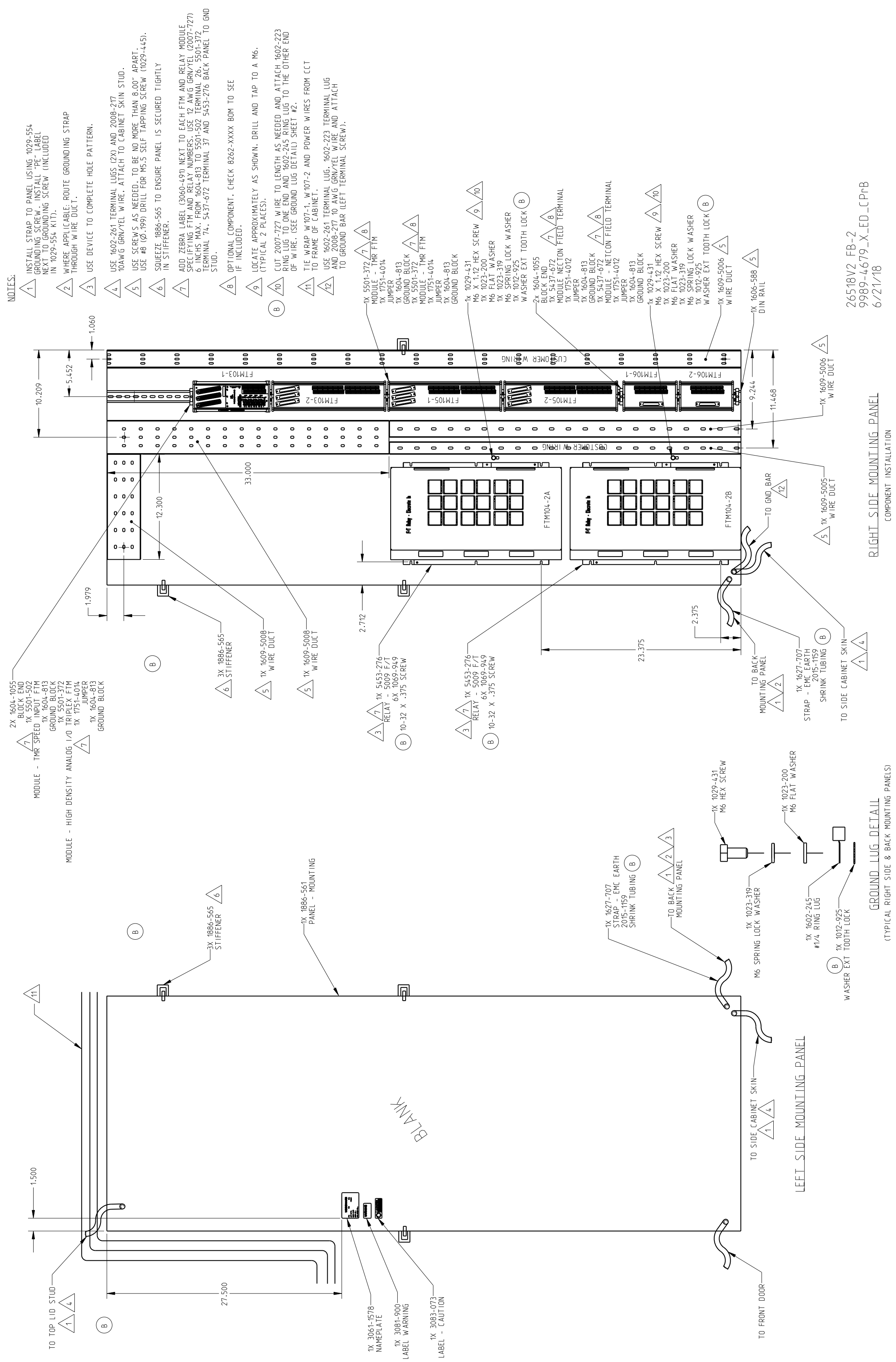

OPTIONAL FTM - SEE BOM
FTM105-1 & FTM105-2
ANALOG OUTPUTS
WOODWARD
FT. COLLINS COLORADO USA
CONTROL WIRING DIAGRAM
5009FT TMR
SIZE D
CAGE CODE 7LLB9
DWG NO 9971-4265
REV A
SCALE NTS
SHEET 18 OF 20
AUTOCAD
5466-5027
MODULE
A-A5
B-A5
C-A5
PIN #
J1-
J2-
12
13
31
32
51
52
53
54
5501-372
CHAS/BD/CTYPE/HAN
CHAS/BD/TYPE/CHAN
ABC/A5/AO/1
ABC/A5/AO/2
ABC/A5/AO/3
ABC/A5/AO/4
ABC/A5/AO/5
ABC/A5/AO/6
ABC/A5/AO/7
ABC/A5/AO/8
EARTH GND
FTM105-1
FTM105-2
SHLD
(+)
(-)
16
53
17
54
18
55
19
56
20
57
21
58
74
B
C
19
23
SEE SHT 2
Production


ACTUATOR DRIVER +/-245mA 2CH FTM
5501-432
5437-672
FTM106-1
MODULE PIN # J1-
CHAN
CH1 DRIVER
CH1 EXCIT
CH1 FDBK 1A
CH1 FDBK 1B
CH1 FDBK 2A
CH1 FDBK 2B
CH2 DRIVER
CH2 EXCIT
CH2 FDBK 1A
CH2 FDBK 1B
CH2 FDBK 2A
CH2 FDBK 2B
EARTH GND
SEE SHT 2
TYPICAL DRIVER AND FEEDBACK CONNECTIONS
TORQUE MOTOR DRIVER
TORQUE MOTOR
RVDT EXCITATION
RVDT FEEDBACK
FEEDBACK 1A
LVDT EXCITATION
LVDT A EXCITATION
LVDT B EXCITATION
FEEDBACK 1A
FEEDBACK 1B
LVDT FEEDBACK 1
FEEDBACK 2A
FEEDBACK 2B
LVDT FEEDBACK 2
SHLD
OPTIONAL FTM - SEE BOM
FTM106-1
2-CHANNEL ACTUATOR DRIVER
WOODWARD
FT. COLLINS COLORADO USA
CONTROL WIRING DIAGRAM
5009FT TMR
9971-4265
SHEET 19 OF 20
REV A
SIZE D
CAGE CODE 7LLB9
SCALE NTS
AUTOCAD

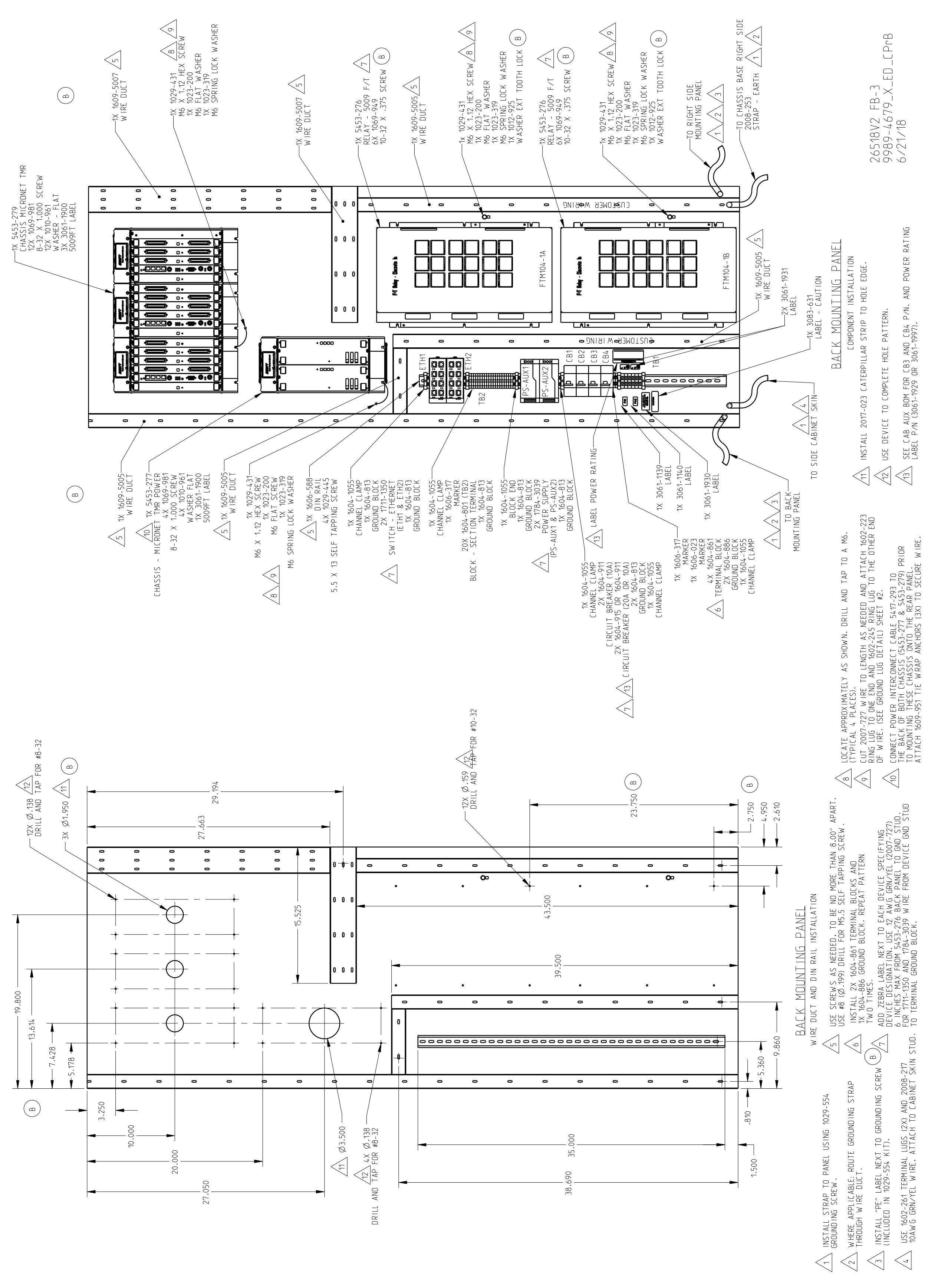

ACTUATOR DRIVER +/-245mA 2CH FTM
5501-432
5437-672
FTM106-2
MODULE PIN # J1-
CHAN
CH1 DRIVER
CH1 EXCIT
CH1 FDBK 1A
CH1 FDBK 1B
CH1 FDBK 2A
CH1 FDBK 2B
CH2 DRIVER
CH2 EXCIT
CH2 FDBK 1A
CH2 FDBK 1B
CH2 FDBK 2A
CH2 FDBK 2B
EARTH GND
SEE SHT 2
TYPICAL DRIVER AND FEEDBACK CONNECTIONS
TORQUE MOTOR DRIVER
TORQUE MOTOR
RVDT EXCITATION
RVDT FEEDBACK
FEEDBACK 1A
LVDT EXCITATION
LVDT A EXCITATION
LVDT B EXCITATION
FEEDBACK 1A
FEEDBACK 1B
LVDT FEEDBACK 1
FEEDBACK 2A
FEEDBACK 2B
LVDT FEEDBACK 2
OPTIONAL FTM - SEE BOM
FTM106-2
2-CHANNEL ACTUATOR DRIVER
WOODWARD
FT. COLLINS COLORADO USA
CONTROL WIRING DIAGRAM
5009FT TMR
9971-4265
7LLB9
SHEET 20 OF 20
REV A
SCALE NTS
AUTOCAD

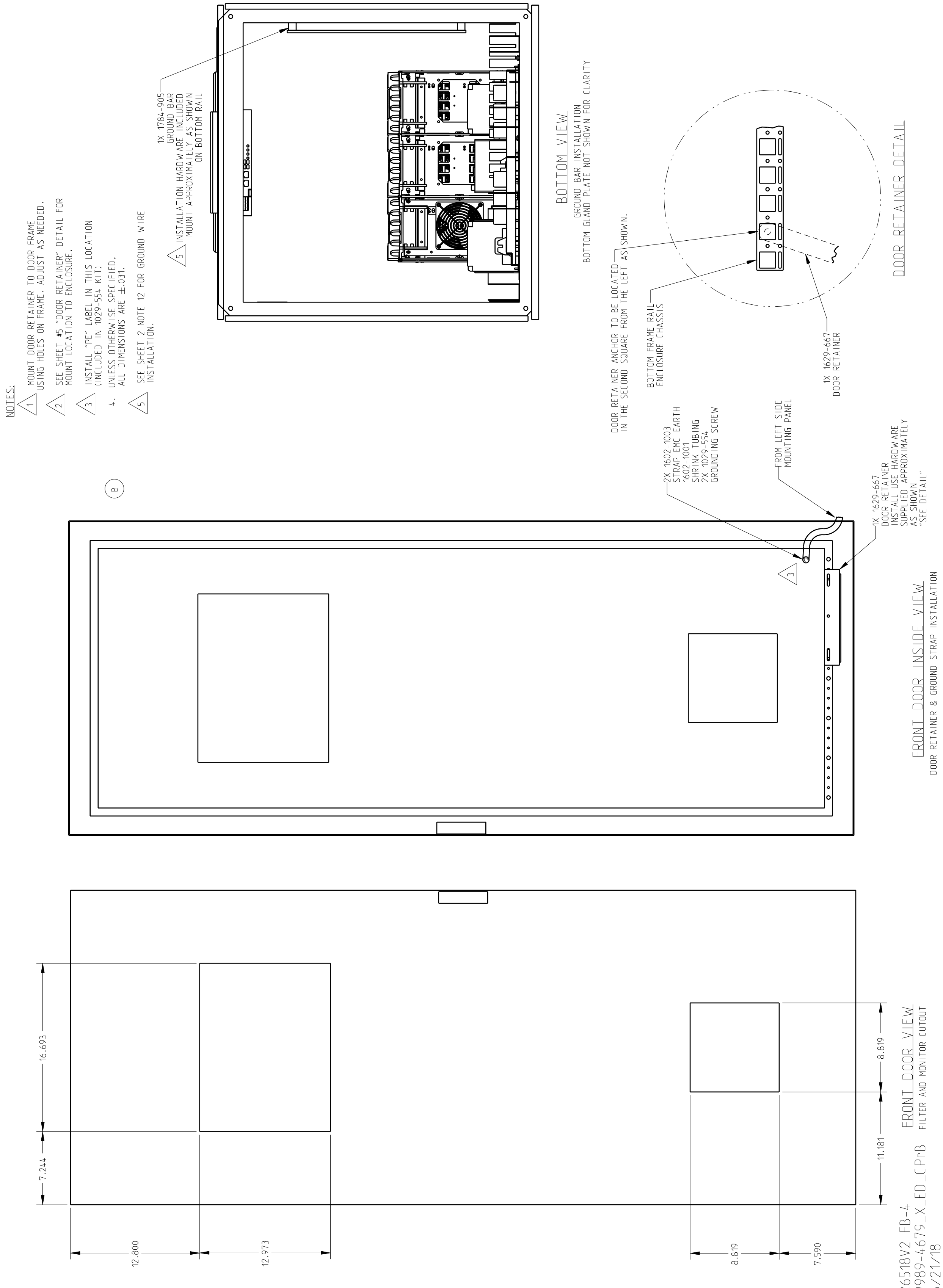
Appendix B.
Standard Cabinet Layout Diagram




NOTES:
1 INSTALL STRAP TO PANEL USING 1029-554 GROUNDING SCREW. INSTALL "PE" LABEL NEXT TO GROUNDING SCREW (INCLUDED IN 1029-554 KIT).
2 WHERE APPLICABLE: ROUTE GROUNDING STRAP THROUGH WIRE DUCT.
3 USE DEVICE TO COMPLETE HOLE PATTERN.
4 USE 1602-261 TERMINAL LUGS (2X) AND 2008-217 10AWG GRN/YEL WIRE. ATTACH TO CABINET SKIN STUD.
5 USE SCREWS AS NEEDED. TO BE NO MORE THAN 8.00" APART. USE #8 (Ø.199) DRILL FOR M5.5 SELF TAPPING SCREW (1029-445).
6 SQUEEZE 1886-565 TO ENSURE PANEL IS SECURED TIGHTLY IN STIFFENER.
7 ADD ZEBRA LABEL (3060-491) NEXT TO EACH FTM AND RELAY MODULE SPECIFYING FTM AND RELAY NUMBERS. USE 12 AWG GRN/YEL (2007-727) 6 INCHS MAX. FROM 1604-813 TO 5501-502 TERMINAL 26, 5501-372 TERMINAL 74, 5437-672 TERMINAL 37 AND 5453-276 BACK PANEL TO GND STUD.
8 OPTIONAL COMPONENT. CHECK 8262-XXXX BOM TO SEE IF INCLUDED.
9 LOCATE APPROXIMATELY AS SHOWN. DRILL AND TAP TO A M6. (TYPICAL 2 PLACES).
B 10 CUT 2007-727 WIRE TO LENGTH AS NEEDED AND ATTACH 1602-223 RING LUG TO ONE END AND 1602-245 RING LUG TO THE OTHER END OF WIRE. (SEE GROUND LUG DETAIL) SHEET #2.
11 TIE WRAP W107-1, W107-2 AND POWER WIRES FROM CCT TO FRAME OF CABINET.
12 USE 1602-261 TERMINAL LUG, 1602-223 TERMINAL LUG AND 2008-217 10 AWG GRN/YEL WIRE AND ATTACH TO GROUND BAR (LEFT TERMINAL SCREW).
TO TOP LID STUD 1 4
1.500
11
27.500
3X 1886-565 STIFFENER 6
1X 1886-561 PANEL - MOUNTING
1X 3061-1578 NAMEPLATE
1X 3081-900 LABEL WARNING
1X 3083-073 LABEL - CAUTION
BLANK
1X 1627-707 STRAP - EMC EARTH 2015-1159 SHRINK TUBING B
TO BACK MOUNTING PANEL 1 2 3
TO FRONT DOOR
TO SIDE CABINET SKIN 1 4
LEFT SIDE MOUNTING PANEL
1X 1029-431 M6 HEX SCREW
1X 1023-319 M6 SPRING LOCK WASHER
1X 1023-200 M6 FLAT WASHER
1X 1602-245 #1/4 RING LUG
B 1X 1012-925 WASHER EXT TOOTH LOCK
GROUND LUG DETAIL
(TYPICAL RIGHT SIDE & BACK MOUNTING PANELS)
2X 1604-1055 BLOCK END
7 1X 5501-502 MODULE - TMR SPEED INPUT FTM
1X 1604-813 GROUND BLOCK
1X 5501-372 MODULE - HIGH DENSITY ANALOG I/O TRIPLEX FTM
7 1X 1751-4014 JUMPER
1X 1604-813 GROUND BLOCK
1.979
10.209
5.452
1.060
12.300
33.000
3X 1886-565 STIFFENER 6
5 1X 1609-5008 WIRE DUCT
5 1X 1609-5008 WIRE DUCT
2.712
3 7 1X 5453-276 RELAY - 5009 F/T 6X 1069-949 B 10-32 X .375 SCREW
3 7 1X 5453-276 RELAY - 5009 F/T 6X 1069-949 B 10-32 X .375 SCREW
FTM103-1
FTM103-2
FTM105-1
FTM105-2
FTM106-1
FTM106-2
FTM104-2A
FTM104-2B
CUSTOMER WIRING
CUSTOMER WIRING
23.375
2.375
9.244
11.468
1X 5501-372 7 8 MODULE - TMR FTM 1X 1751-4014 JUMPER 1X 1604-813 GROUND BLOCK
1X 5501-372 7 8 MODULE - TMR FTM 1X 1751-4014 JUMPER 1X 1604-813 GROUND BLOCK
1x 1029-431 M6 X 1.12 HEX SCREW 9 10 1X 1023-200 M6 FLAT WASHER 1X 1023-319 M6 SPRING LOCK WASHER 1X 1012-925 WASHER EXT TOOTH LOCK B
2x 1604-1055 BLOCK END 1X 5437-672 7 8 MODULE NECTON FIELD TERMINAL 1X 1751-4012 JUMPER 1X 1604-813 GROUND BLOCK 1X 5437-672 7 8 MODULE - NETCON FIELD TERMINAL 1X 1751-4012 JUMPER 1X 1604-813 GROUND BLOCK
1x 1029-431 M6 X 1.12 HEX SCREW 9 10 1X 1023-200 M6 FLAT WASHER 1X 1023-319 M6 SPRING LOCK WASHER 1X 1012-925 WASHER EXT TOOTH LOCK B
1X 1609-5006 WIRE DUCT 5
1X 1606-588 DIN RAIL 5
TO BACK MOUNTING PANEL 1 2
TO GND BAR 12
1X 1627-707 STRAP - EMC EARTH 2015-1159 SHRINK TUBING B
TO SIDE CABINET SKIN 1 4
5 1X 1609-5005 WIRE DUCT
1X 1609-5006 WIRE DUCT 5
RIGHT SIDE MOUNTING PANEL
COMPONENT INSTALLATION
26518V2 FB-2
9989-4679_X_ED_CPrB
6/21/18

Released




NOTES:
1 MOUNT DOOR RETAINER TO DOOR FRAME USING HOLES ON FRAME. ADJUST AS NEEDED.
2 SEE SHEET #5 "DOOR RETAINER" DETAIL FOR MOUNT LOCATION TO ENCLOSURE.
3 INSTALL "PE" LABEL IN THIS LOCATION (INCLUDED IN 1029-554 KIT)
4. UNLESS OTHERWISE SPECIFIED. ALL DIMENSIONS ARE ±.031.
5 SEE SHEET 2 NOTE 12 FOR GROUND WIRE INSTALLATION.
1X 1784-905 GROUND BAR
5 INSTALLATION HARDWARE INCLUDED MOUNT APPROXIMATELY AS SHOWN ON BOTTOM RAIL
BOTTOM VIEW
GROUND BAR INSTALLATION
BOTTOM GLAND PLATE NOT SHOWN FOR CLARITY
DOOR RETAINER ANCHOR TO BE LOCATED IN THE SECOND SQUARE FROM THE LEFT AS SHOWN.
BOTTOM FRAME RAIL ENCLOSURE CHASSIS
1X 1629-667 DOOR RETAINER
DOOR RETAINER DETAIL
B
2X 1602-1003 STRAP EMC EARTH
1602-1001 SHRINK TUBING
2X 1029-554 GROUNDING SCREW
FROM LEFT SIDE MOUNTING PANEL
1X 1629-667 DOOR RETAINER INSTALL USE HARDWARE SUPPLIED APPROXIMATELY AS SHOWN "SEE DETAIL"
FRONT DOOR INSIDE VIEW
DOOR RETAINER & GROUND STRAP INSTALLATION
16.693
7.244
12.800
12.973
8.819
11.181
8.819
7.590
FRONT DOOR VIEW
FILTER AND MONITOR CUTOUT
26518V2 FB-4
9989-4679_X_ED_CPrB
6/21/18

Revision History

Changes in Revision E—
- Updated Regulatory Compliance Section to reference latest Directives
- Update Appendix A to remove the 9971-1416 drawing and insert 9971-4265 Rev. A
- Create Appendix B and insert the Standard Cabinet Layout Drawing Diagram 9989-4679 Rev. B

Changes in Revision D—
- Removed all references to Cabinet
- Removed Appendix A and renamed Appendix B to Appendix A
- Added new outline drawing to Appendix A
- Updated Declaration of Conformity

Changes in Revision C—
- Updated Table 2-1 and text to identify CCT as an optional component
- Updated Appendix B with new revision of wiring diagram
- Added Declaration of Conformity

Changes in Revision B—
- Added new fuse/breaker entry for 24 V to Table 4-1
- Added 24 Vdc information to Power Supply Specifications (page 58)

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	00421-04-EU-02-01
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Name(s)/Number(s):	5009FT
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC) Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits
Applicable Standards:	EN 61000-6-4, 2007 A1, 2011: EMC Part 6-4: Generic Standards Emissions for Industrial Environments EN 61000-6-2, 2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments EN61010-1, 2010: Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1:General Requirements

This declaration of conformity is issued under the sole responsibility of the manufacturer
We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER

Signature

Joe Driscoll

Full Name

Engineering Manager

Position

Woodward, Fort Collins, CO, USA

Place

02-Mar-2018

Date

5-09-1183 Rev 26

Released

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26518V2.

B26518V2 : E

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Email and Website—www.woodward.com

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