ZTR

Control Systems

# NEXSYS INSTALLATION INSTRUCTIONS

# REV NONE

**Customer: Ferronor S.A.**
**Schematic Number: 400 A 420**
**Unit Type: GR12**

**Please call ZTR Locomotive Technical Support with any questions:**
**(519) 452-1233**

# *Introduction*

**PLEASE READ THESE INSTALLATION INSTRUCTIONS THROUGH FIRST TO FAMILIARIZE YOURSELF WITH THE INSTALLATION PROCEDURE. THIS WILL SAVE TIME AND PREPARE YOU FOR THE INSTALLATION.**

These installation instructions were designed and geared towards personnel with basic to advanced locomotive experience and training. ZTR will assume that when asked to weld, mount, drill, wire, etc. that personnel with the proper skills and conscientious methods will be used.

**The general flow of the NEXSYS installation should be as follows:**

1. Locomotive Pre-Qualification
2. Existing Hardware and Wiring Removal
3. NEXSYS Hardware Installation
4. Electrical Wiring
5. Testing (Included as a separate document)

# *Locomotive Pre-Qualification*

**This checklist should be performed before installation of a NEXSYS system. Although it is strongly recommended that all of these steps be performed, it should in no way impede the installation.**

| | | | |
|---|---|---|---|
| **Installer:** | | **NEXSYS Serial Number:** | |
| **Date:** | | **Locomotive Unit Number:** | |

| | | |
|---|---|---|
| **The following steps should be performed with the locomotive shut down.** | | |
| 1. | Open the battery switch. Using a multimeter set to measure resistance, check for grounds on the Control Breaker positive and negative. | Initial: _____ |
| 2. | Check the rack for freedom of movement by pushing on the lay shaft. The rack should be free and smooth with no evidence of binding or sticking. | Initial: _____ |
| 3. | Visually inspect wheel diameters and ensure that measurements are within standard operating tolerances. | Initial: _____ |
| 4. | Visually inspect the trucks and traction motors for integrity and proper operation. | Initial: _____ |
| 5. | Visually inspect traction motor cabling and bus bars for integrity and proper operation. | Initial: _____ |
| 6. | Visually inspect switchgear for integrity and ensure proper operation. | Initial: _____ |
| 7. | Visually inspect the Dynamic Braking grids for integrity and ensure airflow to grids is unobstructed. | Initial: _____ |
| At this time, the locomotive should be started. | | |
| 8. | Check the level of oil in the governor with the engine at idle speed. The oil level should be at the full mark in the sight glass. (DO NOT OVERFILL) | Initial: _____ |
| 9. | Check the voltage regulator adjustment. The voltage should be 74 +/- 0.5 Volts. If not, adjust accordingly. | Initial: _____ |
| 10. | Make sure that the unit loads in forward and reverse. | Initial: _____ |
| 11. | Operate the unit (No Load) in throttle 1 through 8. Ensure proper engine speed. | Initial: _____ |

**Customer Supplied Consumable Materials**

The parts needed during installations vary depending on the locomotive.
You will want to have on hand some or all of the following parts:

- Tapping pads – for general securing cables or sealtite.
- Sealtite conduit various sizes.
- Sealtite connectors various sizes.
- Nipples and bushings 3/4" and 1" – wires run through walls.
- Ring terminals 1/4" or 3/16" assorted sizes – various wiring.
- Fast-on terminals assorted sizes – various wiring.
- Butt splices assorted sizes – various wiring.
- Exane wire 18, 14, 12, 8 AWG – various wiring.
- Cable ties assorted – various to neaten bundles.
- Electrical tape.

# BEFORE BEGINNING THIS INSTALLATION

1. Pull the Battery Switch (and/or disconnect cables from the batteries). Once any wire modifications have begun, do not re-apply until installation is complete.
2. Ensure locomotive handbrakes are applied and/or wheels are chocked.
3. FOLLOW ALL RAILROAD SAFETY PROCEDURES.

*These instructions are intended for use on GR12 Class locomotives and specifically reference* **Ferronor S.A. Drawing # 400 A 420.**

# ***Existing Hardware and Wiring Removal***

These instructions specify the removal of wires necessary to isolate redundant circuits. The complete disassembly of those circuits is left to the discretion of the user. A list of redundant items is shown at the back of this instruction guide. It may be necessary to remove some components in order to allow space for the mounting of NEXSYS components.

***Please refer to the supplied marked up locomotive schematics for the wiring removal in the affected circuits.***

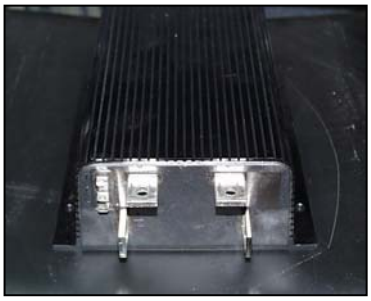
# ***Hardware Installation***

## ***Control Panel***


*Description* – The main control panel contains the CPU and I/O modules necessary to control the locomotive.

*Typical Mounting* – This component must be a solid mount in a location that is easily accessible for troubleshooting purposes yet out of the way during locomotive operation.

***Battery Field Supply***



*Description* – This component is used to control the Battery Field Current.

*Typical Mounting* – Mount the **Battery Field Supply** in the high voltage cabinet. Since there are high voltage and high current exposed terminals**,** the placement should consider personnel safety and accidental shorting of lugs by screwdrivers, etc.

***Current Limiting Annunciating LED***

*Description* – This component is used to alert the crew that the NEXSYS system is limiting traction motor current.

*Typical Mounting* – Mount the **Current Limiting Annunciating LED** in the Cab (or on the Control Stand) where it will be clearly visible by the engineer during the locomotive operation. Label the LED accordingly.

***Dynamic Braking Resistor RZ3***

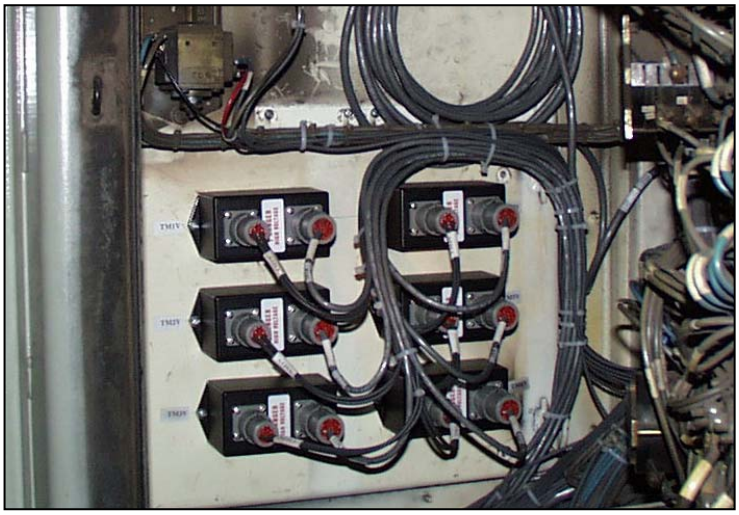
This 150Ω resistor will be connected to the SFT contacts. Locate resistor accordingly.

*Refer to page 3 of the marked up locomotive schematics.*

***Voltage Transducers***

*Description* – This component is used to measure the individual traction motor voltages.

*Typical Mounting* – Mount the six (6) **Voltage Transducers** in the high voltage cabinet. All voltage transducers are of the same type and fully interchangeable. Labelling is done only for cross-referencing purposes.



**Note: The transducers can be mounted vertically or horizontally.**

***Current Transducers***


*Description* – This component is used to measure the individual traction motor currents.

*Typical Mounting* – Remove the top from six (6) **Current Transducers** (item #12). These transducers should be labelled C1 through C6. All current transducers are of the same type and fully interchangeable. Labelling is done only for cross-referencing purposes.

CT1 (Traction Motor One). Apply transducer to cable A1. Arrow on transducer ***must*** point away from Traction Motor #1 towards S14-TOP.

CT2 (Traction Motor Two). Apply transducer to cable A2. Arrow on transducer ***must*** point away from Traction Motor #2 towards S25-TOP.

CT3 (Traction Motor Three). Apply transducer to cable GS3. Arrow on transducer ***must*** point away from GS BUS and towards RVF3.

CT4 (Traction Motor Four). Apply transducer to cable AA4. Arrow on transducer ***must*** point away from S14 Contactor towards Traction Motor #4.

CT5 (Traction Motor Five). Apply transducer to cable AA5. Arrow on transducer ***must*** point away from S25 Contactor towards Traction Motor #5.

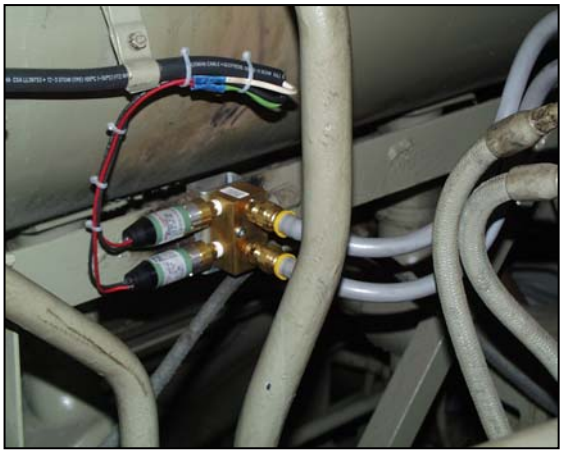
CT6 (Traction Motor Six). Apply transducer to cable AA6. Arrow on transducer ***must*** point away from S36 Contactor towards Traction Motor #6.

***Governor Pressure Switch Manifold Assembly***

*Description* – This component is used to measure the Governor "Increase Load" and "Decrease Load" port pressures.

*Typical Mounting* –ZTR has supplied the mounting bracket for the pressure switch manifold assembly. Use by the customer is optional. When using the mounting bracket, weld the bracket to the water tank mounting frame across from the governor.

**Note: Remove pressure switch manifold assembly from the bracket prior to welding. Failure to do so may severely damage pressure switches!**



It is advisable to mount the pressure switch manifold assembly so that the 1/8" NPT plugs opposite the switches are accessible. These plugs provide access for pressure gauges to measure governor UP/DOWN signal strength and could be used to determine if a feedback problem lies with the governor or with a pressure switch.

After the bracket has been welded, mount the pressure switch manifold assembly using the supplied bolts and lock washers.

Remove the increase and decrease lines between the load regulator and the governor. Using supplied 3/8" hose and fittings, connect the pressure switch manifold to the Governor making sure that one line is routed from the top manifold port to the governor port identified as "Decrease Load" and that the other line is routed from the bottom manifold port to the governor port identified as "Increase Load".

**Note: Ensure that there are no sharp bends, kinks or rubbing against sharp objects.**

***Other Components Required for Installation***

1 - Relay containing at least 1 normally open contact – labeled **BFA**. – This relay is to be connected in parallel with the BF contactor coil.

1 - 1.0 ohm resistor to be connected in parallel with the BKP23-J,K contacts in the battery field circuit. (refer to page 5)

1 - Relay containing at least 2 normally open contacts – labeled **CDR**. (refer to page 8)

1 - 10 ohm Resistor across CDR relay coil. (refer to page 8)

1 - 500 mfd Capacitor across CDR relay coil (refer to page 8)

# *Electrical Wiring*

There are basic rules that need to be adhered to during the electrical wiring:

Use wire gauges as specified. Substitutions must be approved by ZTR.

If necessary, splices will be permitted only on 14 gauge control wiring unless specifically noted below. All connections must be well insulated prior to testing.

Use the proper lugs and crimping tools to terminate cables and wires. A poor connection *will* have an undesirable influence.

### *New Wiring*

Refer to the supplied marked up locomotive schematics for new wiring to be added.

## *C2 Main Harness Wiring*

Apply **C2 Harness** to the C2 socket on the Main Control Panel (the socket on the left labelled C2).

Tie-back the following wires, as they are not used in this application:

**COR**

### *Current Limit Annunciating LED Wiring*

Run wire **CL** to the Current Limiting Annunciating LED and splice to the red wire.
Run wire **2NK2** to the Current Limiting Annunciating LED and splice to the white wire

### *Screen Communication Wiring*

Route and connect the MB2 cable to the communication port of the display screen.

***Current Transducer Wiring***

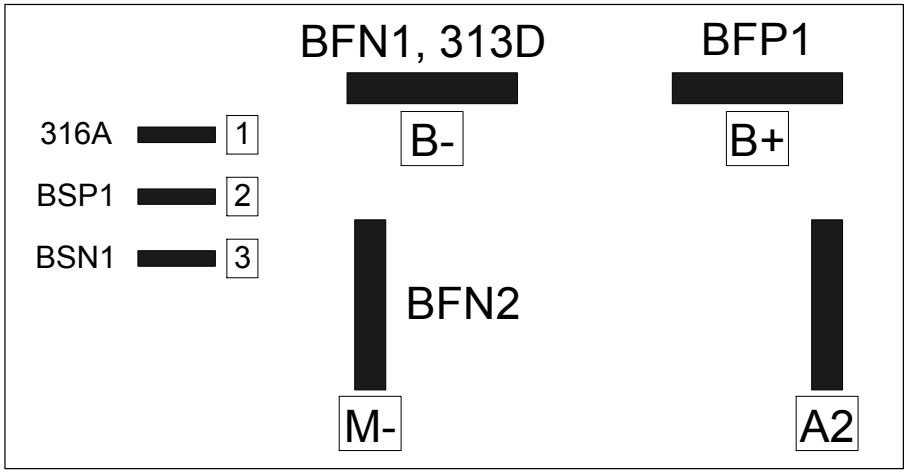
Route the six (6) cables labelled TM1C, TM2C, TM3C, TM4C, TM5C and TM6C to their corresponding current transducers. Plug TM1C connector into CT1 transducer, TM2C to CT2, TM3C to CT3, TM4C to CT4, TM5C to CT5 and TM6C to CT6. **With each application and routing, ensure that the control cable is not tie-wrapped to or does not come into contact with exposed traction terminals or bus bars.**

***Voltage Transducer Wiring (Low Voltage Side)***

Route six (6) cables labelled TM1V, TM2V, TM3V, TM4V, TM5V and TM6V to the voltage transducers. Plug TM1V connector into VT1 transducer, TM2V to VT2, TM3V to VT3, TM4V to VT4, TM5V to VT5 and TM6V to VT6. **It is helpful to have enough slack on each voltage transducer's harness so that they can be quickly interchanged with the transducer beside it. This will help in troubleshooting if necessary.**

***Battery Field Supply Control Wiring***

Run wire **316A** to the Battery Field Supply and connect to the Top faston terminal as shown below.
Run wire **BSN1** to the Battery Field Supply and connect to the Bottom faston terminal as shown below.
Run wire **BSP1** to the Battery Field Supply and connect to the Middle faston terminal as shown below.
Run wire 313D to the Battery Field Supply and connect to the B – terminal.
**Please note that wires 316A and 313D are found in harness C3, but for consistency have been shown here instead.**




**Battery Field Supply Connection Diagram**

***Voltage Transducer and High Voltage Harness Wiring***

Apply high voltage connectors (3-pin) to the voltage transducers. V1 connector to VT1 transducer, V2 to VT2, V3 to VT3, V4 to VT4, V5to VT5 and V6 to VT6. Form a harness remembering to leave enough slack that the connectors can be interchanged with the one beside it. Note that polarity is not important while installing the wires to the traction circuit. However, consistency and ability to troubleshoot is important and therefore the harnesses have been labelled and assigned to specific points. Please note that the following termination points are suggested locations for landing wires. If a specific location is difficult to wire to, an alternate position can be chosen if the new location is electrically identical to the location originally specified.
**Note that 2,000 volt wire is used for the wiring in the high voltage circuit and splices are not permitted here.**

**(Schematic Location 120-190)**

**Harness V1**
Connect wire **V1A** to BKP1 with TM cable AA1.
Connect wire **V1B** to connection with TM cable A1.

**Harness V2**
Connect wire **V2A** to connection with cable A2R.
Connect wire **V2B** to connection with cable A2.

**Harness V3**
Connect wire **V3A** to BKP23 with TM cable AA3.
Connect wire **V3B** to connection with TM cable A3.

**Harness V4**
Connect wire **V4A** to connection with TM cable AA4.
Connect wire **V4B** to BKB4 with TM cable A4.

**Harness V5**
Connect wire **V5A** to connection with TM cable AA5.
Connect wire **V5B** to BKP56 with TM cable A5.

**Harness V6**
Connect wire **V6A** to connection with TM cable AA6.
Connect wire **V6B** to BKP56 with TM cable A6.

***C3 Main Harness Wiring***

Apply **C3 Harness** to the C3 socket on the Main Control Panel (the socket on the right labelled C3). Unless otherwise noted, all new wires to be run are to be **#14 AWG** exane wires.

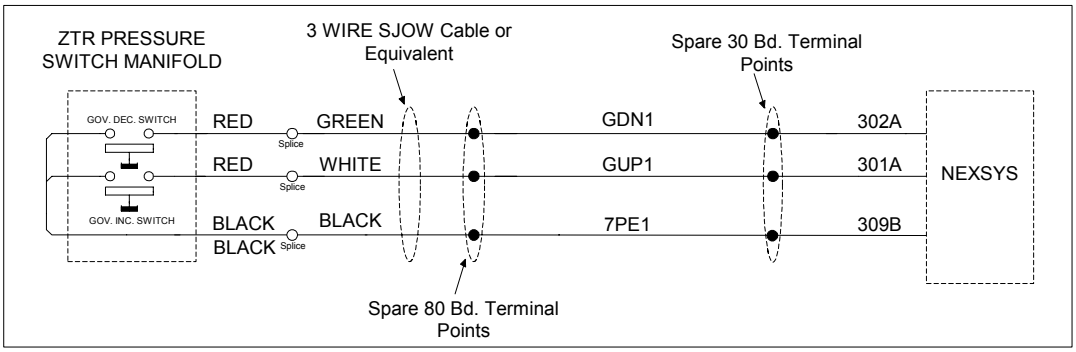
| Marker | Connection | Input/Output | Description |
|---|---|---|---|
| | | | |
| 301A | With wire GUP1 | I00033 | Gov UP |
| 302A | With wire GDN1 | I00034 | Gov DN |
| 303A | BFA-NO1 | I00035 | Battery Field UP |
| 304A | P2-F | I00036 | P2 UP |
| 305A | P3-F | I00037 | P3 UP |
| 306A | 'B' (Braking) Terminal Pt. | I00038 | Unit in DB |
| 307A | GR-B | I00039 | Ground Relay Input |
| 308A | GR Reset Button (B) | I00040 | Reset Ground Relay |
| 309A | TDS-Coil (+) | 000033 | Sand |
| 310A | GR Reset Coil (+) | 000034 | Ground Relay Input |
| 311A | CR8-BLACK | 000035 | Wheelslip Light |
| 312A | CRBW-BLACK | 000036 | Brake Warning |
| 313A | SF-Coil (+) | 000037 | Shunt Field Control |
| 314A | BF-Coil (+) | 000038 | Battery Field Control |
| 315A | BR-Coil (+) | 000039 | Braking Control |
| 316A | BFS – Top Pin | 000040 | BFS Enable |
| | | | |
| 301B | P4-F | I00041 | P4 UP |
| 302B | P5-H | I00042 | P5 UP |
| 303B | GR-H | I00043 | Request for BF |
| 304B | CDR-NO2 | I00044 | Request for Power |
| 305B | ER-B | I00045 | A Valve |
| 306B | ER-D | I00046 | B Valve |
| 307B | FPC-H | I00047 | C Valve |
| 308B | 3B Terminal Point | I00048 | D Valve |
| 309B | With wire 7PE1 | | +74V Supply for Gov. Press. Sw. |
| 310B | 'BC' Terminal Point | | DB Input Voltage |
| 311B | S14-Coil (+) | 000043 | S14 Pickup |
| 312B | S25-Coil (+) | 000044 | S25 Pickup |
| 313B | FS1-Y | 000045 | FS1 Pickup |
| 314B | FS3-Y | 000046 | FS2 Pickup |
| 74P | POA String | | +74V Supply for Nexsys |
| 74N | NA String | | -74V Supply for Nexsys |
| | | | |

| Marker | Connection | Input/Output | Description |
|---|---|---|---|
| | | | |
| 301C | Spare – Ty-back | I00049 | MCO16 |
| 302C | Spare – Ty-back | I00050 | MCO25 |
| 303C | Spare – Ty-back | I00051 | MCO34 |
| 304C | S36-H | I00052 | S36 UP |
| 305C | P1-F | I00053 | P1 UP |
| 306C | P6-H | I00054 | P6 UP |
| 307C | S14-H | I00055 | S14 UP |
| 308C | S25-H | I00056 | S25 UP |
| 309C | P1-Coil (+) | 000049 | P1 Pickup |
| 310C | P6-Coil (+) | 000050 | P6 Pickup |
| 311C | P2-Coil (+) | 000051 | P2 Pickup |
| 312C | P3-Coil (+) | 000052 | P3 Pickup |
| 313C | P4-Coil (+) | 000054 | P4 Pickup |
| 314C | P5-Coil (+) | 000055 | P5 Pickup |
| 315C | S36-Coil (+) | 000056 | S36 Pickup |
| 316C | Spare – Ty-back | | Spare wire |
| | | | |
| 307D | SFT-F | | DB Shunt Positive |
| 308D | SFT-A | | DB Shunt Negative |
| 309D | Spare – Ty-back | | Spare Wire |
| 310D | Spare – Ty-back | | Spare Wire |
| 311D | Spare – Ty-back | | Spare Wire |
| 312D | Spare – Ty-back | | Spare Wire |
| 313D | BFS-B(-) Terminal | | BFS Negative Reference |
| 2PSC2 | Screen 24P Terminal | | +24V Screen Power |
| 2NSC2 | Screen 24N Terminal | | -24V Screen Power |
| 316D | Spare – Ty-back | | Hump Voltage In |

***NEXSYS Power Supply Input Wiring***

Run wire **74P** to POA Terminal Point (Local Control Positive String)
Run wire **74N** to NA Terminal Point (NA String)

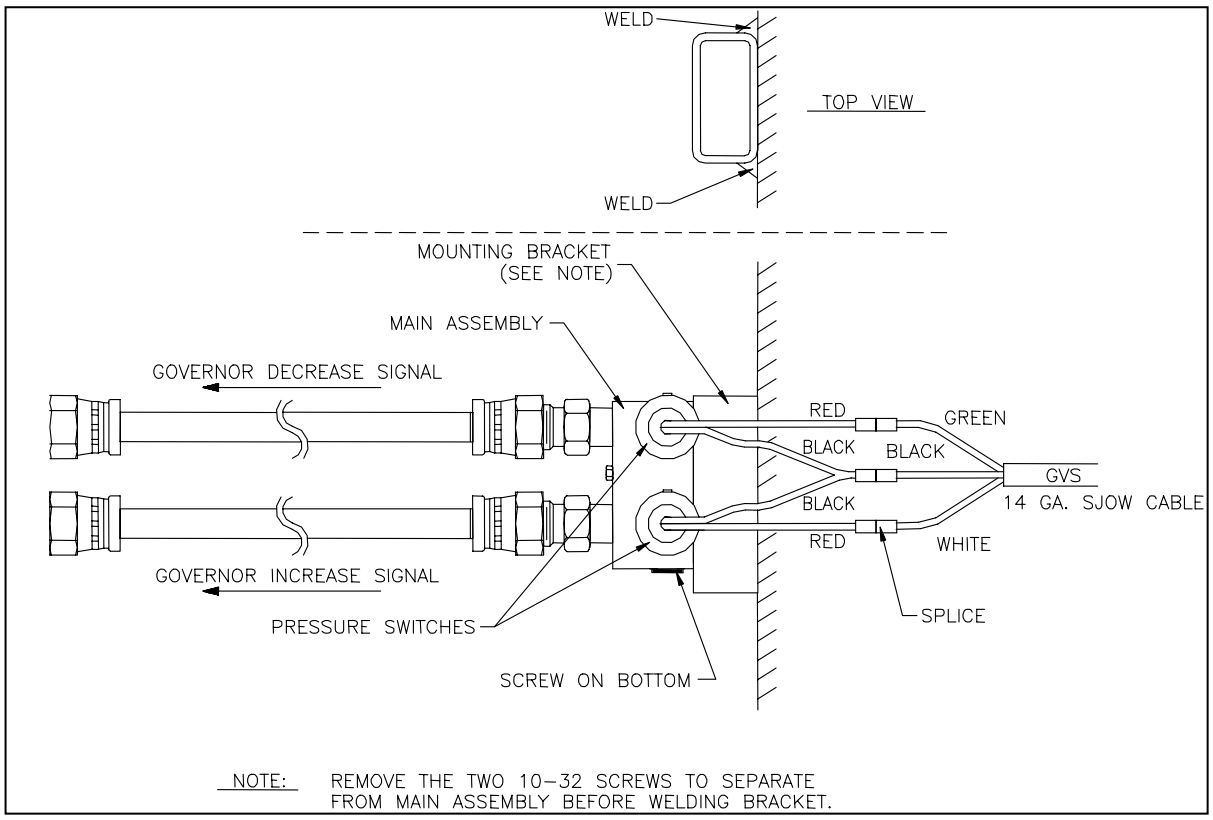
## ***Governor Pressure Switch Wiring***




Run 3 wire SJOW from the NEXSYS Control Panel to the pressure switches mounted by the governor.

At the Pressure Switch end:
Splice SJOW Black to both pressure switch Black wires.
Splice SJOW White to the Governor Up switch Red wire.
Splice SJOW Green to the Governor Down switch Red wire.

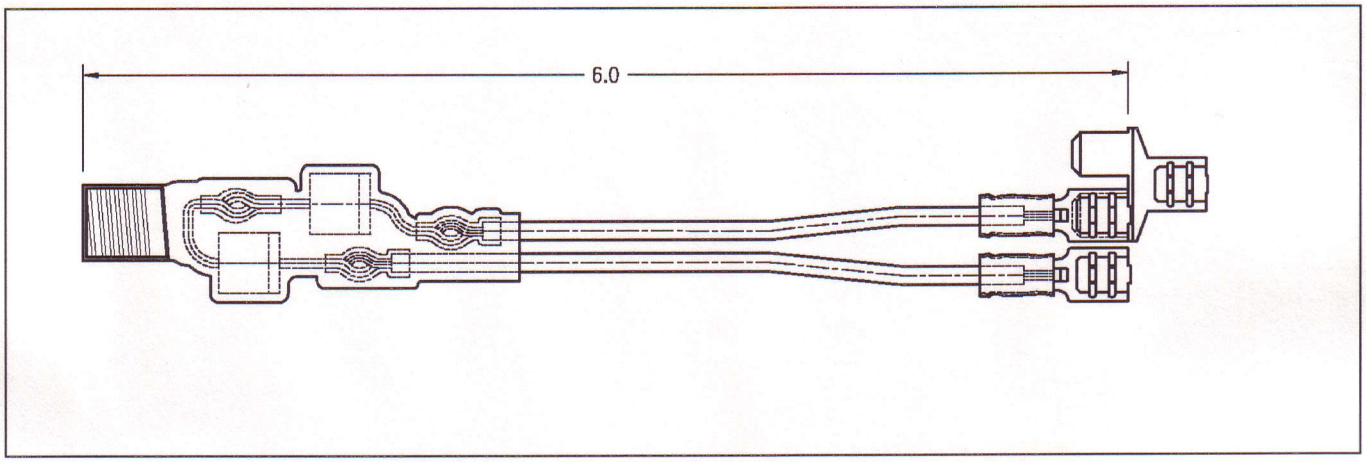
At the Control Panel End:
Run wire **301A** to SJOW White
Run wire **302A** to SJOW Green
Run wire **309B** to SJOW Black


WELD
TOP VIEW
WELD
MOUNTING BRACKET
(SEE NOTE)
MAIN ASSEMBLY
GOVERNOR DECREASE SIGNAL
RED
GREEN
BLACK
BLACK
GVS
14 GA. SJOW CABLE
BLACK
RED
WHITE
GOVERNOR INCREASE SIGNAL
PRESSURE SWITCHES
SPLICE
SCREW ON BOTTOM
NOTE: REMOVE THE TWO 10-32 SCREWS TO SEPARATE FROM MAIN ASSEMBLY BEFORE WELDING BRACKET.

***Installing Transorb Suppression***

Install transorb suppression on the following contactor coils (**BLUE** to positive, **BLACK** to negative):

FS1, FS3, P1, P2, P3, P4, P5, P6, S14, S25, S36, BR, BF, SF, SFT




***Installing Diode Suppression***

Install diode suppression on the following relay coils (**RED** to positive, **BLACK** to negative):

TDS, GR