D300 SERIES INSTALLATION MANUAL

D300 Multiplex Signaling Modules offer diverse functionality including adding alarm zones, monitoring points or controlling points by multiplexing signals all on existing wiring (twisted pair or telephone line).

Model	Manual Section
D312	12.3
D316	13.8
D318	14.3
D321	10.2
D322	11.3

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UL 609, Par. 59.11

The alarm housing for a mercantile alarm system without a remote alarm transmission connection shall be mounted on the outside of the building, visible from a public street or highway. It shall be accessible for examination and repair. It shall also be located not more than four stories above the street level unless:

a) A second alarm sounding device and housing, intended for outside service, is mounted adjacent to the premises or area of the building in which the alarm system is installed or
b) A second alarm sounding device, intended for inside service, is mounted within the premises.

In either case, the outside alarm sounding device and housing may be mounted as high as the seventh floor.

SECTION 1. BEFORE INSTALLING

1.1 Read this manual

This manual has been expanded to cover the common questions users have had over the years. Users familiar with the old 300 series analog modules will find many favorable changes in the new D300 series. Users new to the D300 series will find the units to be easy to use and quick to set up. Reading this manual will be a big help. There are details to using the D300 series that must be understood **BEFORE** attempting installation.

If you are new to the D300 series, we suggest that you familiarize yourself with the contents of this manual. We also suggest that you hook up and test a pair of modules on a workbench before installing them. Simulate the inputs and outputs as they will be set up in the field. An hour or two spent doing this WILL save several hours in the field.

DORADO Parking Systems technical support (303-944-7734) will be glad to answer any questions you may have, and additional copies of this manual are available, at no charge, upon request.

Units returned for repair with no problem found or a blown communications line fuse [F1] will be assessed a fee. These types of repairs are NOT covered under our warranty.

1.2 The D300 series is NOT a life-safety device

The D300 series is not listed for, nor should ever be used as, a personal safety device. For example: The D300 series should not be used as a distress call signaling device such as those installed in hospitals or nursing homes indicating a medical emergency.

1.3 Static electricity

Static electricity usually damages IC junctions in a way that will eventually cause the IC to fail. A damaged IC may work fine for a few hours to a few months before it fails. To prevent static electricity damage to the D300 series (and to save additional service calls) take the following precautions:

- **Do not unwrap the module from its anti-static packaging until ready for use.**
- **Touch a well-grounded surface before unwrapping/handling a module.**
- **Handle the module only by its edges.**
- **Retain the unit's anti-static packaging to use if necessary to return the product for service.**

1.4 Using the included surge arrestor

UL specifications require that an in-line fuse be placed in the communications line. This fuse is located on the printed circuit assembly, and is rated at 1/16 Amp.

To help prevent this fuse from blowing, you will find a 12-volt surge arrestor (SA12) pre-installed across the communication line terminal blocks. This device is bi-directional and will not load down the communication circuit in normal operation. A 12 Volt difference across the surge arrestor's leads will short the voltage spike away from the fused portion of the communication circuit.

If this voltage is present for more than a few milliseconds, the surge arrestor may have to be replaced, depending on the current that has flowed through the device. A damaged surge arrestor will develop a partial or total short, loading down the communications signal.

If the surge arrestor is suspect, remove at least one end from the module's terminal block and measure the resistance across the arrestor. A good arrestor will measure well over 1 Meg Ω resistance. If needed, replace the surge arrestor with a like product, or order our part number 0325-0005.

The included surge arrestor is designed only to protect against normal voltage surges. If the communication line will be exposed to lightning-induced surges, seek additional lightning surge protection. This will help prevent additional service calls and undue damage to the D300 modules.

SECTION 2. IMPORTANT CHANGES TO THE D300 SERIES

2.1 The new 'B' board

The D300 series has had major design changes to the 'B' board [bottom] half of the module. These new digitally tuned units are completely compatible with any existing 300/500 series units already installed. The new D300 series uses the exact same wiring and communications circuits and have UL 609 and NFPA listings.

You will notice the new 'B' board is exactly the same for both the transmitters and receivers. This is an intentional design. Once the 'B' board is connected to the 'A' board [top] half of the D300 module, it will automatically figure out what it is connected to and function as it should.

2.2 The DIP switches [SW1.1 through SW1.8]

One major change to the 'B' board is the addition of a DIP switch array. These switches are used to select the frequency, speed, and Options B and D. The following sections describe the switch positions and their operation. The DIP switches are located on the topside of the bottom board, underneath TS2. The DIP switches are accessible without taking the module apart.

2.3 The Process Check LED indicator

The other major change to the 'B' board is the addition of a 'Process Indicator' LED; this LED indicates whether the 'B' board is transmitting or receiving, or receiving a slightly out-of-tune signal. See SECTION 5 for details. The Process Check LED indicator is located next to the DIP switches.

2.4 Why would an old transmitter be out-of-tune

When replacing an old 300 series analog receiver, the transmitter may have to be returned for factory re-tuning. The reason for this is the fact the new D300 receivers [Model D321 and D322] are extremely selective in the frequency range they will accept. They are much more selective than our previous models.

This level of selectivity is a definite improvement over the old 300 series. However, if a new D300 series receiver is paired with an old analog transmitter, the tuning of the analog transmitter may be off too much for the receiver to understand or even see. Analog devices are affected by temperature, exact voltage and age much more readily than digital devices.

2.5 Important note on using the DIP switches

Whenever ANY DIP switch position is changed, the D300 series module MUST be power-reset for at least 3 seconds and then powered back up for any setting change to take effect.

SECTION 3. FREQUENCY SELECTION

3.1 Determining what frequency to use when mating with the older 300/500 series

When replacing an existing 300 series unit there are a few ways to determine the frequency:

- Check the Model number; if it ends with a letter, that is the frequency.
- Pull apart the unit and look for a replaceable module, if it has letters on it such as 'AT', this would mean the module is for a transmitter and is channel 'A'.
- Pull apart the unit and look for a replaceable module, if it has numbers on it then look at the last digit of the module such as '10'; 0 = channel 'A', 1 = 'B', 2 = 'C', 3 = 'D'.

3.2 Setting the frequency

Note: The D300 module must be power-reset before any DIP switch settings will take effect.

The DIP switches **SW1.1** and **SW1.2** are used to set the frequency.

- 'Down' is defined as the DIP switch being positioned toward the closest edge of the board.
- 'Up' is defined as the DIP switch being positioned toward the center of the board.

3.3 Frequencies and selection table

Channel	Frequency	SW1.1 position	SW1.2 position
A	2800 Hz	Down	Down
B	1650 Hz	Up	Down
C	980Hz	Down	Up
D Not valid at 500 series high-speed mode.	580 Hz	Up	Up

SECTION 4. SPEED SELECTION

4.1 Determining what speed to use with the old 300/500 series

Note: The older multiplexing units were manufactured in two models, Series 300 and 500. The Series 300 was standard, and 500 was high speed for special applications. There was no provision to field select the speed of these models. The new D300 has an on-board DIP switch to allow setting at either speed. Both transmitter and receiver must operate at the same speed. Attempting to transmit or receive at mixed speeds between modules simply will not work.

For the vast majority of applications where an old 300/500 series is being replaced, the low-speed setting will be used. However, to be certain, check the Model number of the unit you are replacing. If the Model number begins with a 3, then use the low-speed setting. If the Model number begins with a 5, use the high-speed setting.

4.2 Setting the speed

Note: The D300 module must be power-reset before any DIP switch settings will take effect.

Note: Do not use the 500 series high-speed mode with the 'D' channel setting.

The DIP switch **SW1.6** is used to select the speed at which the D300 module operates.

- 'Down' is defined as the DIP switch being positioned toward the closest edge of the board.
- 'Up' is defined as the DIP switch being positioned toward the center of the board.

4.3 Speed descriptions

Low-speed, old 300 series compatible: It takes 800mSec for a change of input at a transmitter to be reflected by the matching receiver and can be used with all frequencies.

High-speed, old 500 series compatible: it takes approximately160mSec for a change of input to be reflected by the matching receiver and can be used with frequencies A, B and C (not D).

4.4 Speed selection table

Speed	SW1.6 position
Low-speed	Down
High-speed	Up

SECTION 5. THE PROCESS CHECK LED INDICATOR

5.1 Transmitter Process Check LED indications

The transmitter Process Check LED flashes at a rate of .45 second to indicate it is powered up and working. If the transmitter power indicator LED [Located on the top of the transmitter unit] is lit, but the transmitter Process Check LED is dark or flashing erratically then:

- Check the voltage to the D300 unit for proper level (see SECTION 7).
- Reseat the connection made from the top ['A'] board to the bottom ['B'] board.

5.2 Receiver Process Check LED indications

The receiver Process Check LED flashes at a rate of either .8 seconds or .1 seconds to indicate it is powered up and working. If the receiver power indicator LED [Located on the top of the receiver unit] is lit, but the transmitter Process Check LED is dark or flashing erratically then:

- Check the voltage to the D300 unit for proper level (see SECTION 7).
- Reseat the connection made from the top ['A'] board to the bottom ['B'] board.

If the transmitter Process Check LED indicator still remains dark or flashes erratically then the unit must be returned for service.

When the receiver's Process Check LED is flashing at a rate of .8 seconds, this means one of two things, depending on the state of the Signal Check LED [Located on the top of the receiver unit]

- If the Signal Check LED is flashing regularly, then the receiver is accepting and processing a signal that it has been set to receive.
- If the Signal Check LED is not flashing, then the receiver is not seeing a useable signal at the frequency it has been set to receive. When using a new D300 series receiver to replace an existing analog 300 series receiver, this may indicate the old transmitter is out of tune. In this case, the old transmitter will have to be returned to the factory for re-tuning.

When the receiver Process Check LED is flashing at a rate of .1 seconds, this means the transmitter that it is paired with will have to be returned for re-tuning. Refer to SECTION 2.4 for details

SECTION 6. USING THE COMMUNICATION END-OF-LINE RESISTOR

6.1 Why is an end-of-line resistor used?

Also called a load resistor and commonly used in telephone circuits, the 300 series is designed to utilize a 680Ω load on each end of the communication circuit. Basically, the purpose of the resistor is to prevent a signal from 'reflecting' back to its source and therefore causing interference and possibly canceling itself.

6.2 When to use the end-of-line resistor

Generally speaking, there should be one [but never more than one] end-of-line resistor at each end of the communication circuit. If the communication lines between the D300 transmitters and receivers are extraordinarily long or have a high signal loss factor, then it is certainly permissible to omit one or both end-of-line resistor[s].

If there is excessive loss through the communication lines, remove the end-of-line resistor from the transmitter end of the communication lines first, as the resistor at the receiver end will prevent the signal from reflecting back. If the signal is still too low, remove the end-of-line resistor from the transmitter end also, since the high impedance of the signal line will minimize the signal reflection.

In the situation where there is both a transmitter and a receivers at each end of the communication line and excessive signal loss occurring, then it is best to remove both end-of-line resistors from the communication circuit.

6.3 How to set the end-of-line resistor

Note: Having more than one 680Ω resistor selected on either end of the communication circuit will result in excessive signal loss and possible communication problems.

The jumper **TS4** selects whether the end-of-line resistor is being utilized or not. This jumper is located on the bottom side of the top, 'A' board of the module, underneath **TS1-1.** To utilize the end-of-line resistor [built into the board] set the jumper on **TS4** across pins 1-2. To *not* utilize the end-of-line resistor, move the jumper to pins 2-3.

SECTION 7. POWERING THE D300 SERIES

7.1 General notes for powering the D300 series

Note: All power connections are to be made using wire of a 22AWG minimum.

For the most reliable performance, it is HIGHLY recommended the D300 be powered using AC power for primary power and a rechargeable battery for back-up power. Using this arrangement for power provides a constant and clean power level.

7.2 AC Power requirements

Use a 16Vac, UL class 2, 10-80 VA transformer. These are available either in a surface mounting package or a package that will plug into a standard 115 Vac outlet. To adhere to U.L. standards, 120 Vac wires must be properly enclosed in a UL rated electrical enclosure.

7.3 AC Power connections

Connect the AC power to points **TS1-8** & **TS1-9** using at least 22AWG wires**.** To adhere to U.L. standards, the AC power leads should be twisted and tinned, and stripped only as far as needed to make the connections.

7.4 DC Power requirements

Use a 12-24VDC, 8 Amp maximum output power supply.

7.5 DC Power connections

Connect the ground [-] to **TS1-7**, and positive [+] to **TS1-6**. To adhere to U.L. standards, the AC power leads should be twisted and tinned, and stripped only as far as need to make the connections.

7.6 Battery notes

- When using a battery for back-up power, the primary power must be ac, not dc, in order to charge the battery.
- Power connections must be made with minimum 22 AWG wires.
- Sufficient ventilation must be supplied to dissipate any gases that might be produced by the battery.
- Batteries should be checked periodically for proper operation.

7.7 Connecting a battery to the D300 series

Connect the ground [-] to **TS1-7**, and positive [+] to **TS1-6**. To adhere to U.L. standards, the AC power leads should be twisted and tinned, and stripped only as far as needed to make the connections.

7.8 Estimating battery recharge time

Note: The battery charging circuit found in the D300 series is NOT a high output pulse charger, it is a trickle charger; you may wish to pre-charge the battery before installation.

The battery charger output is designed to supply 13.25 Volts DC at 133 milliAmps. Depending on the condition and type of battery used, it can be approximated that it will take 1 hour for every 100 milliAmp-hours of charge. A fully discharged, 2.2 Amp-hour battery will be fully recharged in approximately 24 hours.

7.9 Estimating battery discharge time

Note: This section applies to batteries in good condition only; batteries should be checked periodically for the ability to hold a charge.

To estimate the length of time a battery will supply operating power to the D300 modules use the following steps:

- Add up the operating current of the D300 modules supplied by the battery. This can be estimated at 100 milliAmps per receiver and 50 milliAmps per transmitter.
- Add any additional current used by the receiver outputs, i.e., the amount of current used to light user-connected output indicator LEDs.
- Take the storage capacity of the battery (in Amp-hours) and divide by the amount of current being used (in Amps). This will give you the approximate time (in hours) that the battery could be expected to supply back-up power to the modules.

SECTION 8. COMMUNICATION PROPERTIES

8.1 Why this section.

The purpose of this section is to clear up any misconception about the type of communication lines that will have to be provided in order for the D300 transmitters and receivers to successfully and reliably communicate. When ordering a leased line, let your telephone company know your requirements.

8.2 One-way transmission.

Communication between transmitters and receivers is simplex. Transmitters only transmit a signal and receivers only receive a signal. Receivers do not acknowledge or request that data be sent, they only process the signal they are set to receive.

8.3 Analog signal.

The 300 series modules use an analog signal to communicate. Only analog means of communications will work with the 300 series unless analog-to-digital and digital-to-analog devices are employed.

8.4 Possible communication line sources

Just about any twisted pair line can be used to carry the signal[s] used by the D300 series.
Any spare [unused] pair of wires that may already be installed can be used, as long as the signal loss is 16dB or less over the range of frequencies the D300 series use. Examples of spare wires that might be found are:

- Unused/abandoned telephone circuits.
- Unused/abandoned networking circuits.
- Unused/abandoned coaxial cable.
- Unused/abandoned security device wiring.
- Unused/abandoned fire device wiring.

The signal can also be transmitted via radio, as long as it is analog radio.

8.5 Level of transmission:

Depending on the number of pairs used, the D300 series will transmit at a level from –6dB to –10dB. Perhaps counter-intuitive is the fact that as more frequencies are used on a transmission line, the lower the measured signal strength. This is due to the fact that multiple AC signals will 'combine' and produce an overall weaker signal.

The following table specifies the output level of a transmitter with no communication line connected to it.

Load	DB	V p-p
No Load; Communication lines unhooked & load resistor not in circuit	0dB	2.2
680 Ω; Communication lines unhooked & load resistor in circuit	-6dB	1.1

8.6 Level of reception

Under normal circumstances, a receiver will function properly when receiving a signal at a level as low as –30dB [.069Vp-p]**.** However, this does not take into consideration any externally induced signals from sources such as local radio towers or noisy telephone circuits, which may interfere with the D300 series transmission signal.

8.7 Twisted-pair communication line distance limit

The normal maximum twisted-pair (22-26 AWG) length between modules (not using a leased telephone line) is around 15 Miles. However this length is a product of line signal loss; the loss limit for the signal carrier is 16dB @ 1K Hertz, measured with a 680Ω load on each end of the communication circuit. Again, this is subject to externally induced signal interfering with the D300 series transmission signal.

8.8 Leased [telephone] line transmission length limits:

With a properly conditioned and amplified telephone leased line circuit, there is no limit to the distance between modules. The signal is filtered and re-amplified along its travel, effectively resulting in no line loss.

8.9 What to specify when ordering a leased line circuit.

When ordering a leased line circuit, most telephone companies understand the terms 'Voice grade data line' or '3002 type channel'. But if this isn't the case you can specify the following:

- One-way or two-way, depending on your application needs.
- Impedance of 600-680Ω resistive and balanced.
- Maximum signal of 0dB.
- Attenuation of 16dB or less, over a range of 300 to 3K Hz.
- Envelope delay distortion to be less than 1750 microseconds from 800 to 2600 Hz.
- DC or copper continuity is not required.
- A dedicated [not dial-up] line.

SECTION 9. SETTING AND USING RECEIVER FUNCTIONS

9.1.1 Determining the setting for Option B when replacing an old 300/500 series receiver

On the old 300/500 series receivers [Model X21X, X22X & X25X], Option B was a 3-pin jumper located on the topside of the bottom ['B'] board underneath TS2-1. If the jumper on the existing module was placed across pins 1-2 or the jumper is missing, then set Option B to OFF. If the jumper was found placed across pins 2-3, then Option B is set to ON.

9.1.2 Setting Option B

Note: The D300 module must be power-reset before any DIP switch settings will take effect.

The DIP switch **SW1.4** is used to invert the normal output state of outputs TS2-1 through TS2-6.
If Option B is set to OFF, the outputs TS2-1 through TS2-6 will normally be off until activated.
If Option B is set to ON, the outputs TS2-1 through TS2-6 will normally be on until activated.

- 'Down' is defined as the DIP switch being positioned toward the closest edge of the board.
- 'Up' is defined as the DIP switch being position toward the center of the board.

9.1.3 Option B selection table

Option B	SW1.4 position
Do not invert outputs	Down
Invert outputs	Up

9.2.1 Determining the setting for Option D when replacing an old 300/500 series receiver

On the old 300/500 series receivers [Model X21X, X22X & X25X], Option D was a 3-pin jumper located on the topside of the bottom ['B'] board underneath TS2-9. If the jumper on the existing module was placed across pins 1-2 or the jumper is missing, then set Option D to OFF. If the jumper was found placed across pins 2-3, then Option D is set to ON.

9.2.2 Setting Option D

Note: The D300 module must be power-reset before any DIP switch settings will take effect.

The DIP switch **SW1.4** is used to invert the normal output state of outputs TS2-1 through TS2-6.
If Option B is set to OFF, the communication loss output TS2-7 will normally be off until active.
If Option B is set to ON, the communication loss output TS2-7 will normally be on until active.

- 'Down' is defined as the DIP switch being positioned toward the closest edge of the board.
- 'Up' is defined as the DIP switch being position toward the center of the board.

9.2.3 Option D selection table

Option D	SW1.5 position
Do not invert the communication loss output	Down
Invert the communication loss output	Up

9.3.1 Using the test output functions: Freeze, Reset, and Invert Outputs.

The functions FREEZE OUTPUTS, RESET OUTPUTS, and INVERT OUTPUTS have been designed to be used primarily for testing purposes. These inputs are activated by a ground applied to the respective input. The function FREEZE OUTPUTS will override RESET OUTPUTS, which in turn overrides INVERT outputs. For U.L. applications these functions are to be hooked up only through a momentary [spring-loaded] switch or button.

9.3.2 TS1-5, FREEZE OUTPUTS

This function will freeze the state of the outputs, regardless of any new signal inputs.

9.3.3 TS1-4, RESET OUTPUTS

This will de-activate all of the outputs, regardless of any new signal inputs.

9.3.4 TS1-5, INVERT OUTPUTS

This will invert the normal state of all the outputs.

SECTION 10. INSTALLING THE MODEL D321 TRANSISTOR OUTPUT RECEIVER

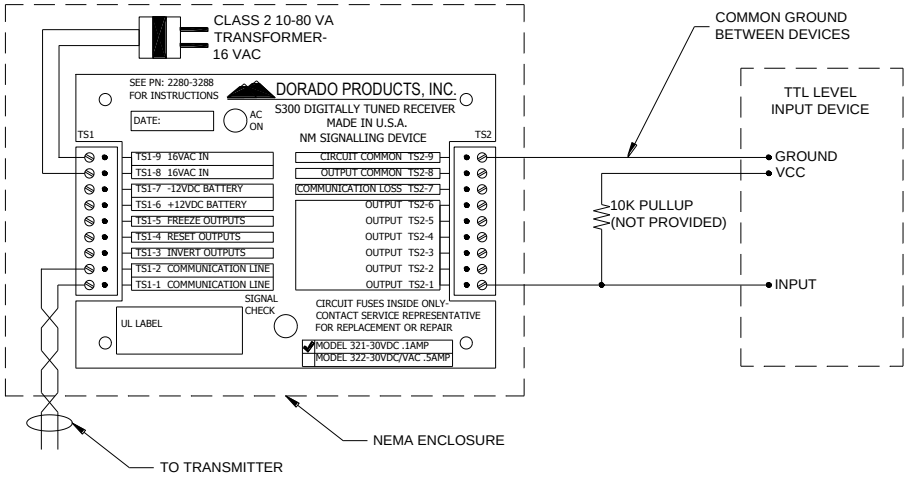
10.1 Model D321 receiver output ratings

The model D321 receiver employs transistor outputs. Each output [including the communication loss output] supplies a DC 100 milliAmp ground to any external device up to 30V. It is not recommended these outputs be used to supply a relay ground as the transients created by doing this will damage the output transistors. The outputs are designed to provide a TTL level output, light up indicator LEDs, or for any SMALL power purpose only.

10.2 Installing the Model D321

- Select the desired frequency and speed using the DIP switches. [Refer to SECTIONS 3 and 4.]
- Select the end-of-line resistor to be in or out of the communication circuit. [Refer to SECTION 6.]
- Select Option B and D setting. [Refer to SECTION 9.]
- Start with the ouput TS2-1.
- Install the required wire between the receiver outputs and the controlled devices. Refer to the wiring diagram below.
- Label each output point.
- Connect battery power. [Refer to SECTION 7.]
- Connect primary power. [Refer to SECTION 7.]
- Connect the communication circuit, making sure to use the included surge arrestor. [Refer to SECTION 1.2.]

10.3 Typical Model D321 receiver wiring diagram



SECTION 11. INSTALLING THE MODEL D322 RELAY CONTACT OUTPUT RECEIVER

11.1 Model D322 receiver output ratings

The Model D322 receiver employs reed relays. Each output [including the communication loss output] can provide an output of up to 30 Volts AC or DC, and 500 milliAmps. Output is determined by what is connected to terminal TS2-9.

11.2 TS5, connecting the outputs TS2-1 through TS2-7 to the D300 unit circuit ground

Note: All of the outputs TS2-1 through TS2-7 and the point TS2-8 [Labeled OUTPUT COMMON] are internally connected to the normally open side of the outputs.

TS5 is located on the bottom side of the top board, underneath TS2-1. It can be used to select a common output of circuit ground. In short, it acts the same as jumping TS2-8 to TS2-9.

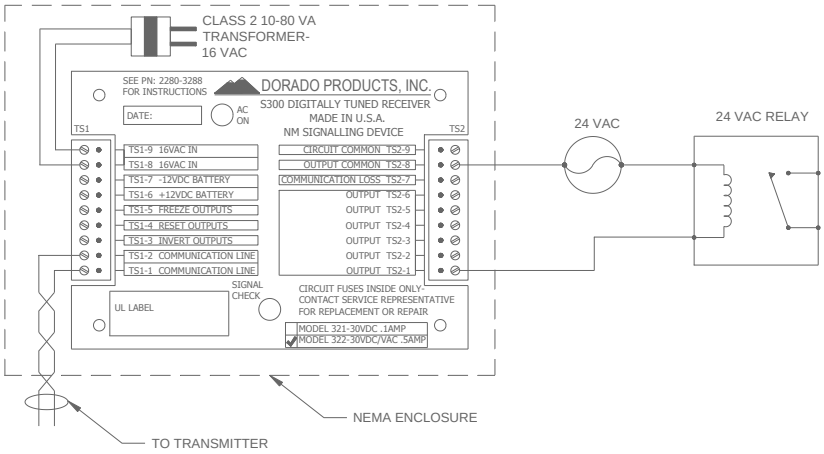
- To make this connection position the jumper found on TS5 across the pins 1-2.
- To keep the outputs isolated from circuit ground, position the jumper found on TS5 across the pins 2-3 and connect the desired output to TS2-8.

11.3 Installing the Model D321

- Select the desired frequency and speed using the DIP switches. [Refer to SECTIONS 3 and 4.]
- Select the end-of-line resistor to be in or out of the communication circuit. [Refer to SECTION 6.]
- Select Option B and D settings. [Refer to SECTION 9.]
- Start with the ouput TS2-1.
- Install the required wire between the receiver outputs and the controlled devices. Refer to the wiring diagram below.
- Label each output point.
- Connect battery power. [Refer to SECTION 7.]

- Connect primary power. [Refer to SECTION 7.]
- Connect the communication circuit, making sure to use the included surge arrestor. [Refer to SECTION 1.2.]

11.4 Typical Model D322 receiver wiring diagram



SECTION 12. USING THE MODEL D312 SECURITY TRANSMITTER

12.1 UL609 listing

‘These requirements cover construction, performance, and maintenance of local burglar-alarm units and systems for use in mercantile premises, mercantile safes and vaults, and bank safes and vaults.

As covered by these requirements, a local alarm system consists of protective circuits and devices, connected through control apparatus to an enclosed tamper-protected sounding device mounted on an outside wall of the building in which the protected property is situated. Intrusion into or disturbance of the units or wiring causes the sounding device to be actuated. The sounding device continues to operate until it is stopped by using the proper control key, by exhaustion of the power supply, or by action of an automatic timing element that is preset for a definite operating period. These systems usually operate within the limits of Class 2 remote control and signal circuits as defined by Article 725 of the National Electrical Code, NFPA 70.

The operation of a local alarm system is partially under the control and domination of the owners or others interested in the property. However, it is required that systems be maintained under the care and regular inspection service of the installing company. The installing company is expected to respond to troubles or calls for service promptly on report of the owner. See Maintenance, Sections 57 and 65. It is the responsibility of the owner to switch the system ON and OFF duty and to report malfunctioning of the system to the service company.

Local mercantile burglar-alarm systems are designated and are designated as to their acceptability for use either on mercantile premises or on mercantile safes and vaults.

Local bank burglar-alarm systems are designated and are for use on bank safes and vaults.

Regardless of the grade of equipment and service determined by this standard, devices installed on individual properties are further classified as to extent of protection at each location. Rules covering installation and classification (of extent) of alarm equipment at individual locations are published in the requirements for Installation and Classification of Burglar and Holdup Alarm Systems, UL 681, that should be consulted by burglar-alarm installers.

A product that contains features, characteristics, components, materials, or systems new or different from those in use when the Standard was developed, and that involves a risk of fire, electric shock, or injury to persons, shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the level of safety for the user of the product as originally anticipated by the intent of this Standard.'

12.2 Function description

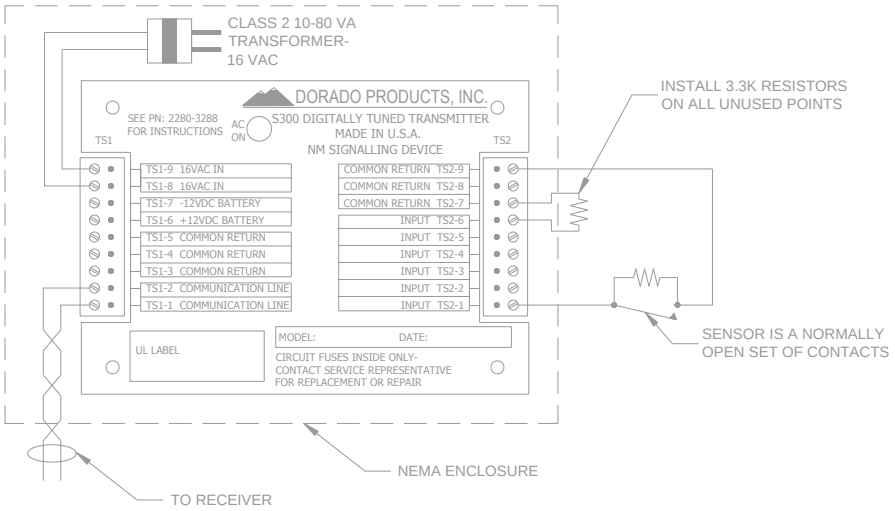
This transmitter is designed to monitor up to six input points per channel. It is assumed the input is a N.O. circuit as described in paragraph 15.4.1. The included supervisory resistors must be used with the input circuits. There are 2 ways an input will be activated.

- The opening of an input circuit. This is where the 3.3KΩ supervising resistor is no longer part of the input circuit; this indicates the input circuit has a broken/disconnected wire and must be attended to.
- The closing of a circuit. This is where the NO input circuit closes to ground. This condition is an actual alarm condition.

12.3 Installing the Model D312

- Select the desired frequency and speed using the DIP switches. [Refer to SECTIONS 3 and 4.]
- Select the end-of-line resistor to be in or out of the communication circuit. [Refer to SECTION 6.]
- Start with the input TS2-1
- Install the required wire between the transmitter inputs and the sensors. One side of the N.O. points should be connected to an input point, the other side of the N.O. points should be connected to a transmitter ground point. [Refer to paragraph 13.4.]
- Ground points are TS1-3, 4, 5 and TS2-7, 8, 9.
- Each of the sensors should have one of the included 3.3KΩ supervising resistor installed across the two points of the NO connections of the sensor.
- Unused input points should have one of the included 3.3KΩ supervising resistor installed from the unused input points to a module's ground point.
- Label each input point.
- Connect battery power. [Refer to SECTION 7.]
- Connect primary power. [Refer to SECTION 7.]
- Connect the communication circuit, making sure to use the included surge arrestor. [Refer to paragraph 1.2.]

12.4 Typical Model D312 wiring diagram



SECTION 13. USING THE MODEL D316 FIRE TRANSMITTER AND APPLICATIONS.

13.2 NFPA 72 Listing

Installation, maintenance, and use of protective signaling systems

'A control unit as covered by these requirements consists of a unit assembly of electrical parts having provision for the connection of power supply circuits routed through the control unit equipment by a prescribed scheme of circuiting. The circuits are extended to separate devices by which the operating part of the control unit are actuated for signals, and to separate and/or integral devices by which the signals are indicated so as to form a coordinated system combination for definite signaling services. An installation wiring diagram attached to the control unit, or referenced in the control unit marking, indicates the devices and circuits which are acceptable for connection to the control unit in the field.

These requirements do not cover manual boxes, automatic fire detectors, automatic transmitters, or other initiating devices; nor do they cover bells, registers, or other indicating devices not provided as part of the control unit.

A product that contains features, characteristics, components, materials, or systems new or different from those in use when the Standard was developed, and that involves a risk of fire, electric shock, or injury to persons, shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the level of safety for the user of the product as originally anticipated by the intent of this Standard.'

13.3 Model D316 installation requirements for all applications

For all Model D316 applications, the following conditions must be adhered to:

- Consult your local fire authority to verify the acceptability of the D300 series, as regulations vary depending on location.
- Only the first five inputs are used to monitor N.O. points; the sixth point is used only as a trouble input.
- The trouble input is a set of N.C. contacts.
- A central display unit must audibly or visually indicate a trouble output from the receiver.
- A Model D322 receiver must be used.
- All installations must include a back-up power supply.
- Activated inputs will be reflected on the paired receiver accordingly.
- When any of the input circuits experience a break in the circuit, the sixth output of the receiver will become active. For obvious reasons, this output cannot be hooked up to alert the local fire company.

13.4 Supplementary Local Fire applications.

In this application, an existing fire alarm panel is monitored. A trouble output [N.C] must be monitored and up to 5 zone inputs can be monitored. The purpose of this application is to simply repeat the fire panel status to a new/additional remote site.

13.5 Initiating Circuit Signals applications and NFPA 72.

This application is for monitoring UL listed, 4-wire smoke detectors. It is HIGHLY recommended that a NC set of relay contact be utilized to indicate primary failure or/and any additional required trouble indication inputs.

13.6 Supplementary Proprietary Protective Signaling applications and NFPA 72.

In this application, a **listed** proprietary existing fire alarm panel is monitored. A trouble output [N.C.] must be monitored and up to 5 zone inputs can be monitored. The purpose of this application is to simply repeat the fire panel status to a new/additional remote site.

13.7 Function description

This transmitter is designed to monitor one trouble [N.C] input and up to five alarm [N.O.] input points per channel, the included supervisory resistors must be used with the input circuits. There are two ways an input will be activated:

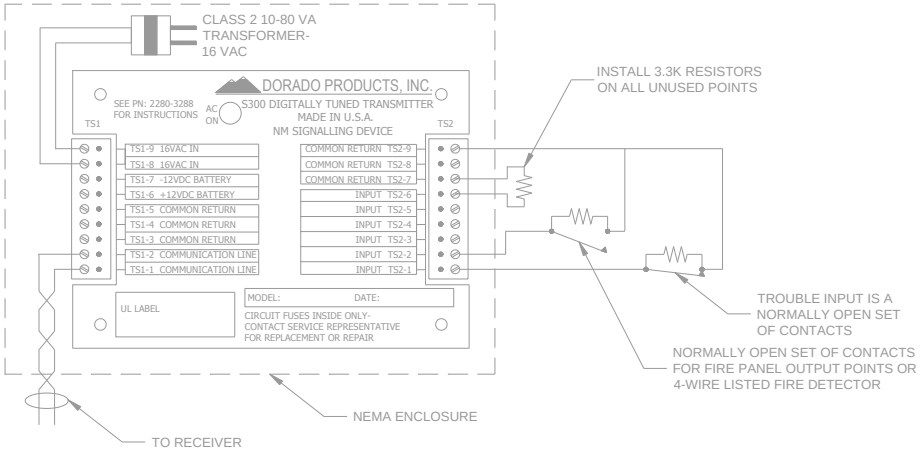
- The disconnection of an input circuit. This is where the 3.3KΩ supervising resistor is no longer part of the input circuit; this indicates the input circuit has a broken/disconnected wire and must be attended to. This type of input will be reflected on the receiver output TS2-6.
- The closing of a circuit. This is where the NO input circuit closes to ground. This condition is an actual alarm condition. This type of input will be reflected on the receiver output TS2-1 to TS2-5 accordingly.

13.8 Installing the Model D316

- Select desired frequency and speed using the DIP switches. [Refer to SECTIONS 3 and 4.]
- Select the end-of-line resistor to be in or out of the communication circuit. [Refer to SECTION 6.]
- Start with the trouble input point TS2-6.
- Install the required wire between the transmitter inputs and the trouble relay. One side of the N.C. points should be connected to an input point TS2-6, and the other side of the N.C. points should be connected to a transmitter ground point. Transmitter ground points are TS1-3,4,5 and TS2-7,8,9. [Refer to paragraph 14.9.]
- Continue with the input point TS2-1.
- Install the required wires between the transmitter inputs and the fire alarm zone points [or the sensors as applicable]. One side of the N.O. points should be connected to an input point, the other side of the N.O. points should be connected to a transmitter ground point. [Refer to paragraph 13.4.]
- Each of the sensors should have one of the included 3.3KΩ supervising resistors installed across the two points of the NO connections of the sensor.

- Unused input points should have one of the included 3.3KΩ supervising resistors installed from the unused input points to a module's ground point.
- Label each input point.
- Connect battery power. [Refer to SECTION 7.]
- Connect primary power. [Refer to SECTION 7.]
- Connect the communication circuit, making sure to use the included surge arrestor. [Refer to paragraph 1.2.]

13.9 Typical Model D316 wiring diagram



SECTION 14. USING THE MODEL D318 PROCESS MANAGEMENT TRANSMITTER

14.2 Function description

Note: The voltages described in this section are approximate, +/- 5%; these are not high-precision voltage references.

The Model D318 does not use supervised inputs. Instead, a ground is applied to inputs to activate the respective output on the receiver. **TS3** is used to set the low voltage point where the input becomes activated; this jumper is located on the bottom side of the top board 'A', underneath **TS2-1**. The jumper settings create a low point at which the inputs become active:

TS3 Jumper Setting	Low voltage trigger point
1-2	6 V; use for 12V / Ground input
2-3	2.3 V; use for TTL level input

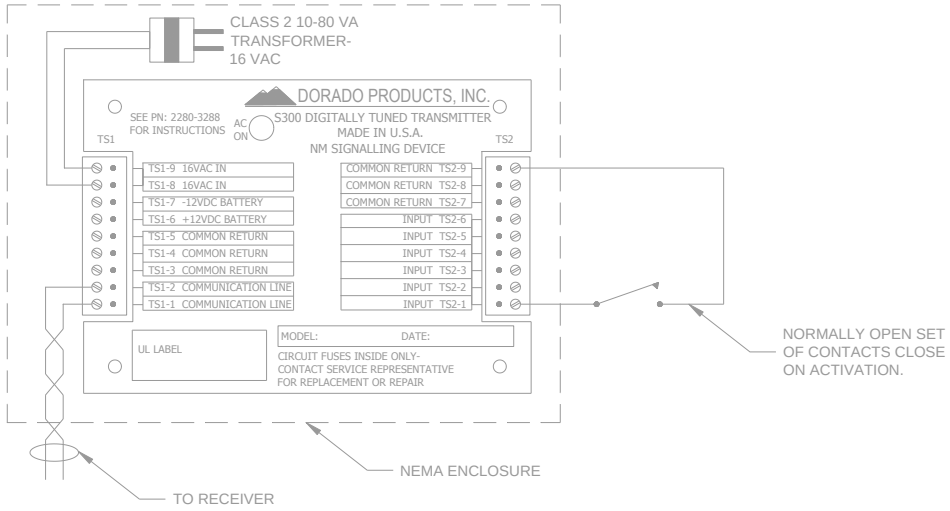
- When using N.O. to ground relay points to active in input, make sure to use a ground point found on the transmitter ground points on TS1-3,4,5 and TS2-7,8,9

- When using TTL level inputs, make sure ground a ground point from the transmitter has been tied to the TTL ground.

14.3 Installing the Model D318

- Select the desired frequency and speed using the DIP switches. [Refer to SECTIONS 3 and 4.]
- Select the end-of-line resistor to be in or out of the communication circuit. [Refer to SECTION 6.]
- Start with the input TS2-1.
- Install the required wire between the transmitter inputs and the sensors. One side of the N.O. points should be connected to an input point, the other side of the N.O. points should be connected to a transmitter ground point or TTL output. [Refer to paragraph 15.4.]
- Label each input point.
- Connect battery power. [Refer to SECTION 7.]
- Connect primary power. [Refer to SECTION 7.]
- Connect the communication circuit, making sure to use the included surge arrestor. [Refer to paragraph 1.2.]

14.4 Typical Model D318 installation wiring diagram



SECTION 15. TROUBLESHOOTING AND COMMON INSTALLATION MISTAKES

15.1 No Signal Check LED, or erratically flashing Signal check LED on the receiver.

In the case there is no Signal Check LED function on the receiver there are several possibilities for failure.

To identify the problem most efficiently, first unhook the communication lines from the transmitter and measure the output level. At the minimal level, the output should measure 1.0 V P-P. If there is no voltage or a low voltage then suspect a blown fuse or damaged surge arrestor.

If there is a signal of a sufficient level, then check the receiver for a blown fuse or damaged surge arrestor.

If all of the fuses and surge arrestors check good, then hook the pair up in close proximity to identify other possible problems:

15.1.1 Blown communication fuse [F1]

NOTE: This fuse is the size of a ¼ Watt resistor and is located on the underside of the top board, behind TS1-1.

This is, by far, the MOST common cause of communication failure. As previously mentioned in section 1.2, this UL-required fuse is rated 1/16 Amp, and is subject to blow quite readily. To check this fuse, disconnect the terminal strip TS1 and measure the resistance across TS1-1 and TS2-2. Compare the measurement to the following table:

Ω Measured	End-of-line resistor selected	Condition of F1
50	Yes	Good
50	No	Good
680	Yes	Blown
Open	No	Blown

15.1.2 Determining if a surge arrestor is damaged

The surge arrestors may be removed temporarily from the communication circuit to be checked. A good surge arrestor will have a resistance of at least 1MΩ across the leads; if the surge arrestor measures less than 1MΩ resistance, then the surge arrestor should be replaced.

15.1.3 Incorrect use of the end-of-line resistors

At each end of communication lines, there should be only one D300 unit with the end-of-line resistor enabled, Using more than one may result in excessive signal loss. Refer to SECTION 6

15.1.4 Low voltage level

Measure the AC [or DC] voltage being supplied to the module[s]. AC voltage should measure at least 16 Vac [or 12 Vdc] at the inputs. A battery in poor condition, or too many accessories connected to the D300 power supply can draw the voltage down. Refer to SECTION 7

15.1.5 Non-matching pairs with incorrect frequency and/or speed settings

Check that the transmitter and receiver are set to the same speed. Keep in mind:

- When replacing an old 300/500 signaling module that only a few of the units were high-speed units.
- You can only use ONE transmitter set at a particular frequency, regardless of the speed setting. For example: You cannot use frequency A at low speed and frequency A at high-speed on the same communication line.
- You can use as many receivers as you wish on a particular communication circuit as long as the frequency and speed is set the same as the transmitter. For example: You can have a transmitter

set for the B frequency at high speed at point A, and have a receiver set the same at point B and another point C.
- Frequency D does not work at the high-speed setting. It is permissible to use frequency A, B and C at high-speed and frequency D at low-speed on the same communication circuit. Refer to SECTIONS 3 and 4.

15.1.6 Possible tuning problems when replacing an old 300/500 series receiver

When replacing an old analog 300/500 series module receiver the matching transmitter may have to be returned for re-tuning. Observing the Signal Check LED on the receiver can help to determine this. If the LED is flashing at a rapid rate, then the receiver is set correctly but the transmitter will have to be re-tuned. Refer to paragraphs 2.3 & 2.4

There is also the possibility the replacement D300 is not set to the correct transmitter/receiver. Check the unit that is being replaced for the frequency and speed. Refer to SECTION 3 and 4.

15.2 Identifying local [non-leased] communication line faults

Obviously, it is best to test twisted pair lines before installing the D300 series modules. But, if the line hasn't been tested for the amount of loss you can determine the usability of a communication line by simply hooking a pair of D300s up a few feet from each other to verify the channel and speed settings match.

Once you have a working pair, measure and note the signal strength with the transmitter lines unhooked.

Perform a voltage reading on the proposed communication lines. It is perfectly normal and acceptable to have up to 15 milliVolts induced on the line from radio signals, ac mains, etc. If a higher voltage is observed on the communication lines, they are unusable.

Hook up the proposed communication line and check the signal strength again; the signal level should not significantly change. If the signal level drops dramatically, there is a good chance there is a short in the communication lines and this will have to be remedied before using.

15.3 Identifying leased line communication line faults

If the D300 pair[s] have been successfully tested when hooked up locally, then the cause of the failure is the communication circuit. Generally, leased lines aren't a problem, but when there is a fault, the most common problems are: noisy lines, induced radio signals, and excessive frequency filtering resulting in excessive signal loss, especially for frequencies D and A

15.4 Identifying input and output faults

Note: To most easily identify possible faults, it is best to work with one pair of the D300 modules at a time.

If at least one receiver is displaying a good Signal Check LED, then it can be assumed the communication line is good. But if the inputs/outputs do not seem to be working correctly re-check the frequency and speed settings.

15.4.1 Checking the Model D312 transmitter inputs

Internally, the inputs TS2-1 to TS2-6 are pulled up to 12 Volts through a 3.3KΩ resistor, when the external 3.3KΩ supervisory resistors are installed [with one side to the input and the other to ground], a voltage divider circuit is created.

Different voltages measured at the input points are then processed through a dual comparison circuit. One of these comparison circuits check for an input voltage that is greater than 7.5 volts; this indicates there is a break in the supervised circuit input. The other one of these comparison circuits check for an input voltage that is less than 2.5 volts; this indicates the N.O. input contact has closed and there is an active alarm.

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Input Voltage	Input condition for the Model D312
0 Volts	In alarm because of closed relay contact, reflected on the corresponding receiver output
6 Volts	Normal condition
12 Volts	In alarm because of a break in the input circuit, reflected on the corresponding receiver output

15.4.2 Checking the Model D316 transmitter inputs

The Model D316 inputs are almost identical to the Model D312 inputs, the difference is the comparison circuit that checks for a break in any of the supervised input circuit. Any break in the supervised inputs will activate the last input, which is TS2-6 on the receiver.

The input points TS2-1 through TS2-5 are still activated upon the input voltage that is less than 2.5 volts; this indicates a the N.O. input contact has closed and there is an active alarm. The corresponding output on the receiver will be activated.

Input Voltage	Input condition for the Model D316
0 Volts	In alarm because of closed input contact, reflected on the corresponding receiver output
6 Volts	Normal condition
12 Volts	In alarm because of a break in the input circuit, reflected on the receiver output TS2-6

15.4.3 Checking the Model D318 transmitter inputs

The Model D318 inputs are almost identical to the Model D312 inputs; the difference there is only one comparison circuit that checks for a low voltage on the input points TS2-1 through TS2-6. The voltage on the input point is compared to either 6 Volts or 2.3 Volts [Refer to section 15.2]. When the input voltage is below the selected reference voltage, the input is activated and will be reflected at the corresponding receiver output.

Input Voltage	Input condition for the Model D318
> Selected reference voltage	Activated because of low voltage input, reflected at the corresponding receiver output.
< or = Selected reference voltage 6 Volts	Normal condition, input is not activated.

15.4.4 Checking the Model D321 receiver outputs.

This test will identify transistor failures and the possibility of user connected equipment interfering with normal output operation. To test the outputs TS2-1 through TS2-6 and TS2–7 first unhook the terminal strip TS2; this will rule out the possibility of any user-connected devices interfering with the normal output operation.

Next, if the outputs are set to normally active, de-activate the outputs by activating the ‘INVERT OUTPUTS’ input [refer to paragraphs 10.3.1 and 10.3.4]. If the signal loss output [TS2-7] is set to be a

normally active output [refer to paragraphs 10.2.1 through 10.2.3], disconnect one of the communication lines to this output to become de-activated.

At this point all the outputs should be deactivated. Using an Ohm-meter, measure the continuity between TS2-9 and each of the output points. No output point should show continuity.

Next, activate all the outputs by using the activating or deactivating the 'INVERT OUPUTS' and hooking up or unhooking the communication lines as needed.

At this point all the outputs should be activated. Using a meter measure the continuity between TS2-9 and each of the output points. All output points should show continuity.

If all of the outputs measure correctly, then the cause is external.

15.4.5 Checking the Model D322 receiver outputs.

This test will identify transistor failures and the possibility of user connected equipment interfering with normal output operation. To test the outputs TS2-1 through TS2-6 and TS2–7, first unhook the terminal strip TS2; this will rule out the possibility of any user-connected devices interfering with the normal output operation.

Next, if the outputs are set to normally active, de-activate the outputs by activating the 'INVERT OUTPUTS' input [refer to section 10.3.1 & 10.3.4]. If the signal loss output [TS2-7] is set to be a normally active output [refer to sections 10.2.1 through 10.2.3], disconnect one of the communication lines to this output to de-activate it.

At this point all the outputs should be deactivated. Using an Ohm-meter measure the continuity between TS2-8 and each of the output points. No output point should show continuity.

Next, activate all the outputs by using the activating or deactivating the 'INVERT OUPUTS' and hooking up or unhooking the communication lines as needed.

At this point all the outputs should be activated. Using a meter measure the continuity between TS2-8 and each of the output points. All output points should show continuity.

If all of the outputs measure correctly, then the cause is external.