



**Assembly Procedures  
Multiple Module Select Fire Guns  
Using Baffle Plate/Dart Box X Pin  
3 1/8" & 4" O.D. Ported  
Casing Guns**

6/16/2009

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## Warning!

- A. The prevention of accidents in the use of explosive materials is a result of careful planning and observance of the best known practices. The user must remember that he is dealing with a powerful force and that various devices and methods have been developed to assist him in directing this force. He should realize that this force, if misdirected, may either kill or injure both him and his fellow workers.
- B. All explosive materials are dangerous and must be handled and used with care either by or under the direction of competent, experienced persons. All commercial explosive materials are designed to detonate when supplied with a sufficient amount of initiating energy. Unfortunately, the explosive material cannot differentiate between initiating energy purposely supplied or that is accidentally supplied. It is the responsibility of all persons who handle explosive materials to know and follow all approved safety procedures.
- C. All of Titan's ballistic tools and systems are designed to meet or exceed the operational guidelines set forth in the API Recommended Practices for Oilfield Safety (RP-67). The user must become aware of and comply with all Federal, State and local laws and regulations governing explosive materials. Additionally, the user must have knowledge and thorough understanding of the specific and generally accepted safety practices adopted by the industry to protect the user and the general public from bodily harm while using these tools and systems.
- D. U. S. Federal law prohibits the transportation of loaded, armed perforating guns on public highways. Select fire guns must be armed at the wellsite. To be transported on public highways, select fire guns must be affixed with an approved Detonator

Interrupt Device and the user must be granted an exemption from the U. S. Department of Transportation.

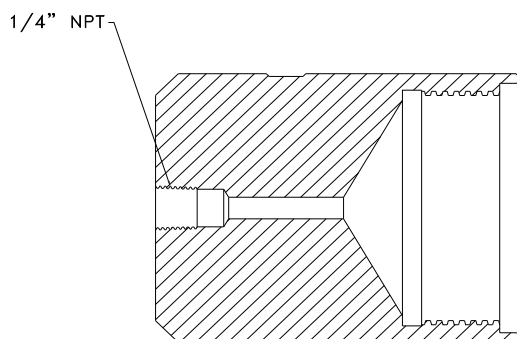
- E. Ported Casing Guns can be re-used many times but do have a limited service life. When detonated, the destructive force of the explosive components contained within the gun assembly will cause barrel expansion, port sealing area distortion and shrapnel damage to other reusable, internal components. The damage is cumulative and eventually cracks in the barrel or excessive port distortion will cause wellbore fluid to enter one or more of the gun segments. When a gun segment is fired, the Dart Assembly is driven into a seat in the Baffle Plate, effectively sealing off the pathway for wellbore fluid entry from the open port(s) of the lower gun into the upper gun assemblies. If a barrel leaks above a sealed barrier, the rest of the gun assembly will also fill with fluid. The most common method to detect if excessive damage has occurred is to visually check each component and to perform a pressure test by applying air pressure to the inside of each **UNLOADED**, sealed barrel while it is submerged in a water bath. Sealing is accomplished through the installation of a Pressure Test Cap on the "Pin" end of the barrel and a Gun Bottom in the "Box" end of the barrel (see parts list on **page 7** for details). **UNDER NO CIRCUMSTANCES SHOULD A LOADED BARREL, CONTAINING A DETONATOR BE SUBJECTED TO THE PRESSURE TEST PROCEDURE. AN ELECTRIC DETONATOR CAN BECOME "CHARGED" WITH THE PRESSURIZED AIR AND CAN DETONATE WHEN THE TRAPPED PRESSURE IS SUDDENLY VENTED FROM THE ASSEMBLY.**

## Select Fire System Features

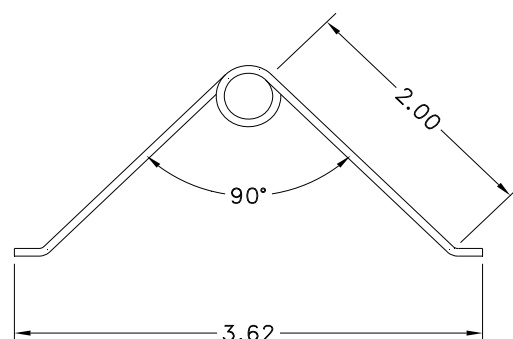
- Economical
  - Reliable
  - Simple loading procedure
  - Single wire between guns. All gun segments are diode protected to prevent them from being fired out of sequence.
  - Positive/Negative firing system
  - 350° F. operation
  - Up to 40 selections (depending on wireline resistance and shooting panel power)
  - Compatible with resistor type electric detonators up to 150 Ohms
  - Other Carrier, Hardware and Adapter Sub combinations are available upon request.
- The equipment represented here is used to familiarize the user with the basic components, assembly procedures and functional testing of the individual stages and the final assembly.

## Tools Required For Assembly

- Charge Loading Stick
- Approved Detonating Cord Cutting Device
- Approved Detonator Crimper
- Vise or Other Securing Instrument
- 22 GA Bare Stranded Wire
- Scotchloks (Optional, 300° F. max.) or Silicone rubber boot (TW-025-0210-001)
- Electric Detonator Test Chamber Part #9000-810-000
- 1/4" Hex Wrench
- Port Plug Spanner Wrench; 4 Hole
- Digital Blasters Multimeter # 9000-73645-MULTIMETER (**Figure 1**)
- Pressure test cap – shown below (0299-000-091 for 3-1/8", 0343-000-091 for PENG0 Style 3-1/8" and 0304-000-091 for 4" barrels)
- Detonator ground spring shown below (9000-860-001) or equivalent.



**Pressure Test Cap**



**Ground Spring**

## Special Notes and Assembly Hints

1. Clean and inspect all components prior to starting the assembly process.
2. The Diode Module determines the firing polarity of the Gun Assembly that it is mounted within. It is important to devise a polarity marking system for the outside of each individual barrel.
3. The polarity of the top and bottom barrel will be the same if the Gun Assembly contains an odd number (such as 25) and will be opposite if it contains an even number (such as 12). Both positive and negative polarity Diode Modules have a yellow wire protruding from one end. Additionally, the positive Diode Modules have red, blue, and red/white striped wires and the negative Modules have black, blue, and black/white striped wires protruding from the opposite end. Confirm the polarity of the first barrel, and alternate that polarity on down the barrels as the assembly process continues.
4. A crimp-on style detonator is used as a reference in this document. Any style of Fluid Sensitive or Disabled, resistorized detonator (51 Ohms minimum) can be used as long as the lead wires are electrically isolated from each other. **DO NOT USE FLUID RESISTIVE DETONATORS UNDER ANY CIRCUMSTANCE.**
5. Do not use black Nitrile rubber boots to isolate the electrical splices within the gun assembly. Because many of these types contain carbon, they will introduce electrical leakage into the circuit, causing erroneous meter readings or system failure. Titan offers a gray Silicone rubber boot (TW-025-0210-001) which is recommended for proper electrical isolation.
6. Use a Detonator Test Chamber and an approved Digital Blaster's Multimeter to perform a circuit test on all detonators before starting the loading process. Place the Detonator into the Test Chamber so that the lead wires are accessible when its lid is closed. Check for continuity and circuit resistance by placing the test leads of the Multimeter on the lead wires and compare the value observed to the Manufacturer's specifications. The Multimeter will also be used to test the gun circuit as additional stages are added to the assembly.
7. Always shunt the detonator legs together when the test is completed and before removing the Detonator from the Test Chamber.
8. Always keep the loading area clear of nonessential personnel.
9. Always keep the explosive components segregated and secure in the loading area until they are required for assembly.
10. An option to grounding one detonator lead by trapping it under the Shaped Charge is to use a Titan 9000-860-001 Grounding Spring (**Page 4**) attached to a lead wire and placed in contact with the inside of the barrel.

# Assembly Diagram

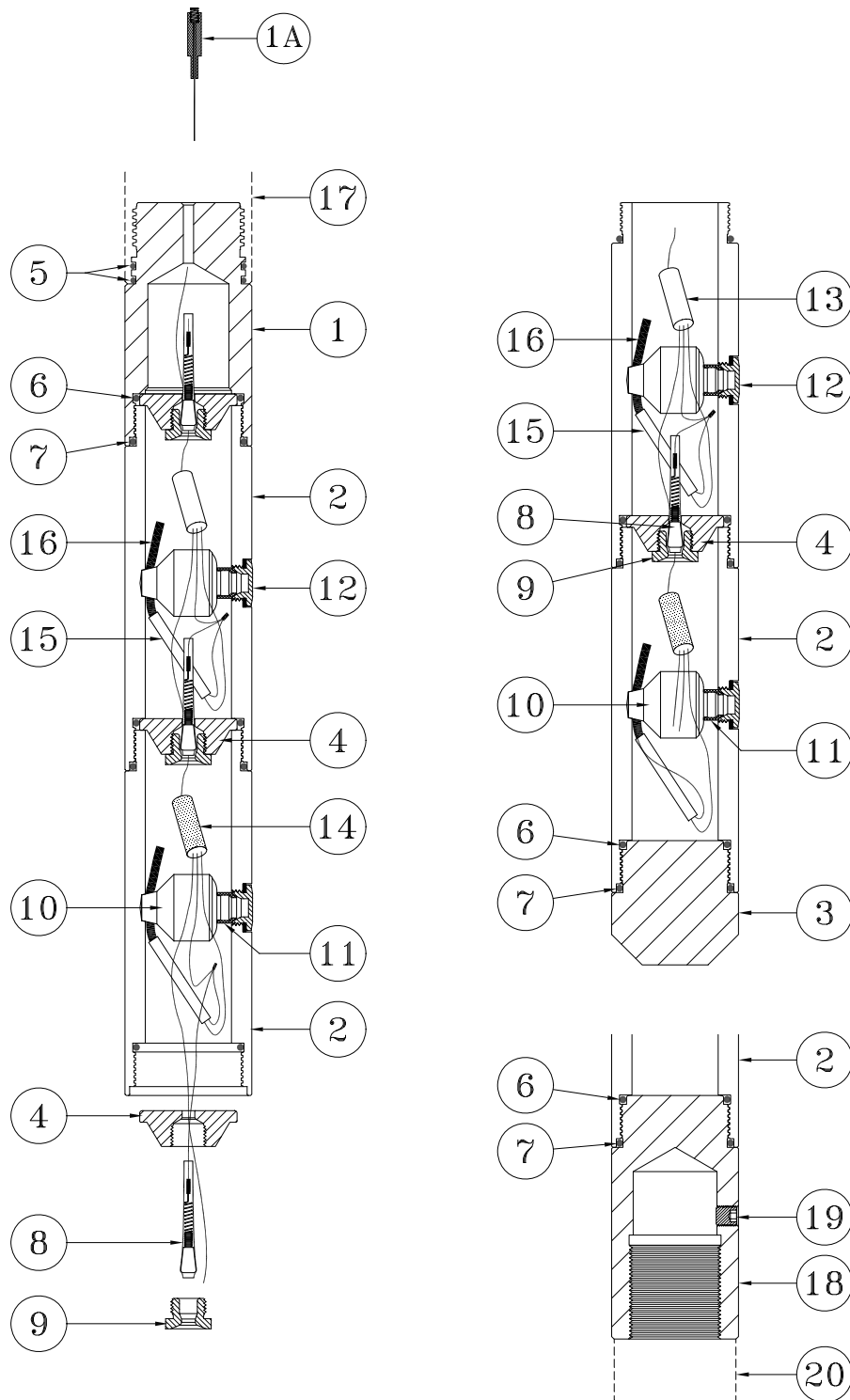


Figure 1

# Parts List

## (Refer to Assembly Diagram – Figure 1 on Page 6)

### MULTIPLE MODULE S. F. CASING GUN ASSEMBLIES 3 1/8" O.D. AND 4" O.D. GUNS

ITEM	PART NUMBER	DESCRIPTION
1	0299-000-081	3-1/8" Top Adapter Sub; "GO" Style
Not Shown	0299-000-091	3-1/8" Pressure Test Cap
1	0343-000-081	3-1/8" Top Adapter Sub - PENG0
Not Shown	0343-000-091	3-1/8" PENG0 Pressure Test Cap
1	0304-000-081	4" Top Adapter Sub; "GO" Style
Not Shown	0304-000-091	4" Pressure Test Cap
1A	0256-000-010	Pigtail Assembly (used with #1 Top Adapter Sub)
2	0299-007-011	3-1/8" One Port Carrier; 7" Long
	0304-009-011	4" One Port Carrier, 9" Long
	0299-012-021	3-1/8" Two Port Carrier, 12" Long, 0 degree phase (N1), (N2)
	0304-012-021	4" Two Port Carrier, 12" Long, 0 degree phase (N1), (N2)
	0299-012-022	3-1/8" Two Port Carrier, 12" Long, 180 degree phase (N1), (N2)
	0304-012-022	4" Two Port Carrier, 12" Long, 180 degree phase (N1), (N2)
	0343-008-021	3-1/8" PENG0 Carrier, 8" Long, 1 Shot, 2 Port (N1)
	0343-012-032	3-1/8" PENG0 Carrier, 12" Long, 2 Shot, 3 Port (N1)
	N1	Can be used for Detonator Interrupt Device* access * (Not provided by Titan)
	N2	Can be used for second Shaped Charge
3	0299-000-008	3-1/8" Gun Bottom
	0343-000-008	3-1/8" PENG0 Gun Bottom
	0304-000-008	4" Gun Bottom
4	0299-000-004	Baffle Plate, 3-1/8" Gun
	0343-000-004	Baffle Plate, PENG0 Gun
	0304-000-004	Baffle Plate, 4" Gun
5	0111-230-090	"O" Ring, 3-1/8" and 4" Gun
6	0111-332-090	"O" Ring, 3-1/8" Gun Baffle
	0111-338-090	"O" Ring, 4" Gun Baffle
	0111-228-090	"O" Ring, 3-1/8" PENG0 Gun Baffle
7	0111-333-090	"O" Ring, 3-1/8" and 3-1/8" PENG0 Gun
	0111-339-090	"O" Ring, 4" Gun
8	9000-900-120A	Aluminum Dart Assembly; Gray Silicone Rubber Insulation
	9000-900-120S	Steel Dart Assembly; Black Silicone Rubber Insulation
9	9000-900-229	Dart Retainer

10	Varied	Shaped Charge for Ported Carrier
11	860-AL-380 860-AL-480	3-1/8" Aluminum Alignment Sleeve 4" Aluminum Alignment Sleeve
12	0330-90S-071 0331-90S-078	3-1/8" Steel Port Plug; 4 Hole 4" Steel Port Plug Extra – THD; 4 Hole
13	9000-903-23P-350*	Diode Module; Positive Polarity (350° F.)
14	9000-903-23N-350*	Diode Module; Negative Polarity (350° F.) *Patented by Titan Specialties, Ltd.
15 Not Shown	Varied TW-025-0210-001	Resistorized Electric Detonator (crimp-on style shown) Silicone Splice Boot, 3/32" I.D.
16	Varied	Detonating Cord
17	0256-100-040	3-1/8" Quick-Change Assy.
18	0299-000-016 0304-000-016	3-1/8" Bottom Decentralizer Adapter 4" Bottom Decentralizer Adapter
19	5402-000-003	Set Screw; 1/2"-20 Thd. X 1/2" Long
20	5403-000-000	3" O.D. Bottom Decentralizer Assembly

## Assembly Instructions

1. Using a copy of the assembly drawing and the parts list, gather and lay out all necessary tools, equipment, and components to complete the task. Inspect all items for damage and cleanliness. Replace any questionable parts. Place new o-rings on all items requiring them. **DO NOT REUSE O-RINGS.** Lubricate the o-rings and mating surfaces with an appropriate lubricant compatible with the o-rings and anticipated downhole conditions.
2. For single shot barrels, use an approved Detonating Cord Cutter to cut 4" lengths of Detonating Cord (**item 16**) for each Shaped Charge (**item 10**). Multiple shot barrels will require longer lengths (increase length 3" for each Shaped Charge added).
3. **DO NOT UNSHUNT THE ELECTRIC DETONATOR LEADS AT THIS TIME. KEEP THE LEADS TOGETHER AS LONG AS POSSIBLE DURING THE ASSEMBLY PROCESS.** Complete item 6 under the "Special Notes and Assembly Hints" section on page 5 of this document before proceeding. Crimp Electric Detonators (**item 15**) to the cut lengths of Detonating Cord, and thread the other end of the Detonating Cord

through the base of each Shaped Charge. The open end of the Detonating Cord should be sealed with a Rubber Boot, crimp-on End Seal or tape to prevent powder loss.

4. Determine the correct polarity of first barrel and thread the Yellow wire from the Diode Module selected (**item 13 or 14**) through the Dart retainer, Baffle Plate and Top Adapter as shown. For the top barrel only, the Blue Wire that is normally attached to the Dart is not used and should be cut off. Install Dart into Baffle Plate and secure with a Dart Retainer. Lubricate the outer flange of the Baffle Plate so that it will seat properly within the o-ring (**item 6**), install it into the Top Adapter and then attach the Top Adapter (**item 1**) to the first barrel and tighten securely. Position the Diode Module so that it will be located above the Shaped Charge when it is installed. Extend the three wires from the bottom of the Diode Module through the first barrel. While holding the wires to either side of the Shaped Charge, place the Shaped Charge with Detonating Cord/Detonator attached into this barrel and secure with an Alignment Sleeve (**item 11**) and Port Plug (**item 12**). Utilize care to avoid damaging the insulation on the wires.
5. **TAKE NOTE OF THE TYPE OF MODULE YOU HAVE USED AND MARK IT'S POLARITY ON THE OUTSIDE OF THE GUN BODY.**
6. Perform the Circuit Test Procedure using an approved Digital Blasters Multimeter (the model available from Titan is shown in **Figure 2**):

**Digital Blasters Multimeter  
Titan Part #9000-73645-Multimeter**



**Figure 2**

## Circuit Test Procedure

- a) Make sure the black (NEG) lead is in the COM socket, and the red (POS) lead is in the V  $\Omega$  socket on the front of the meter.
- b) Strip about  $\frac{1}{2}$ " of insulation from the wire coming from the bottom of the barrel (Red/White positive or Black/White negative), and short the wire to the outer body.
- c) Strip about  $\frac{1}{2}$ " of insulation from the Yellow wire coming from the top of the Adapter. With the meter in the 2k scale, attach one lead to the Yellow wire and the other lead to the outer surface of the barrel. It should read approximately 221 Ohms (.221). The example shown is 219 Ohms (.219). The polarity of the meter does not matter in this test (**Figure 3**).



Figure 3

- d) Remove the bottom wire from contact with the barrel. With the meter in the 20M scale, measure from the Yellow wire to the barrel body. The meter must read open (on this meter, an open circuit is displayed as a 1, then a space and a period or 1 . as shown in **Figure 4**). **ANY READING OTHER THAN THIS IS UNACCEPTABLE, AND THE PROBLEM MUST BE CORRECTED.** Reverse the meter leads, and make the measurement again. The meter should still read open. (Note that you

cannot be touching the tips of both meter leads, or an erroneous reading will be observed).



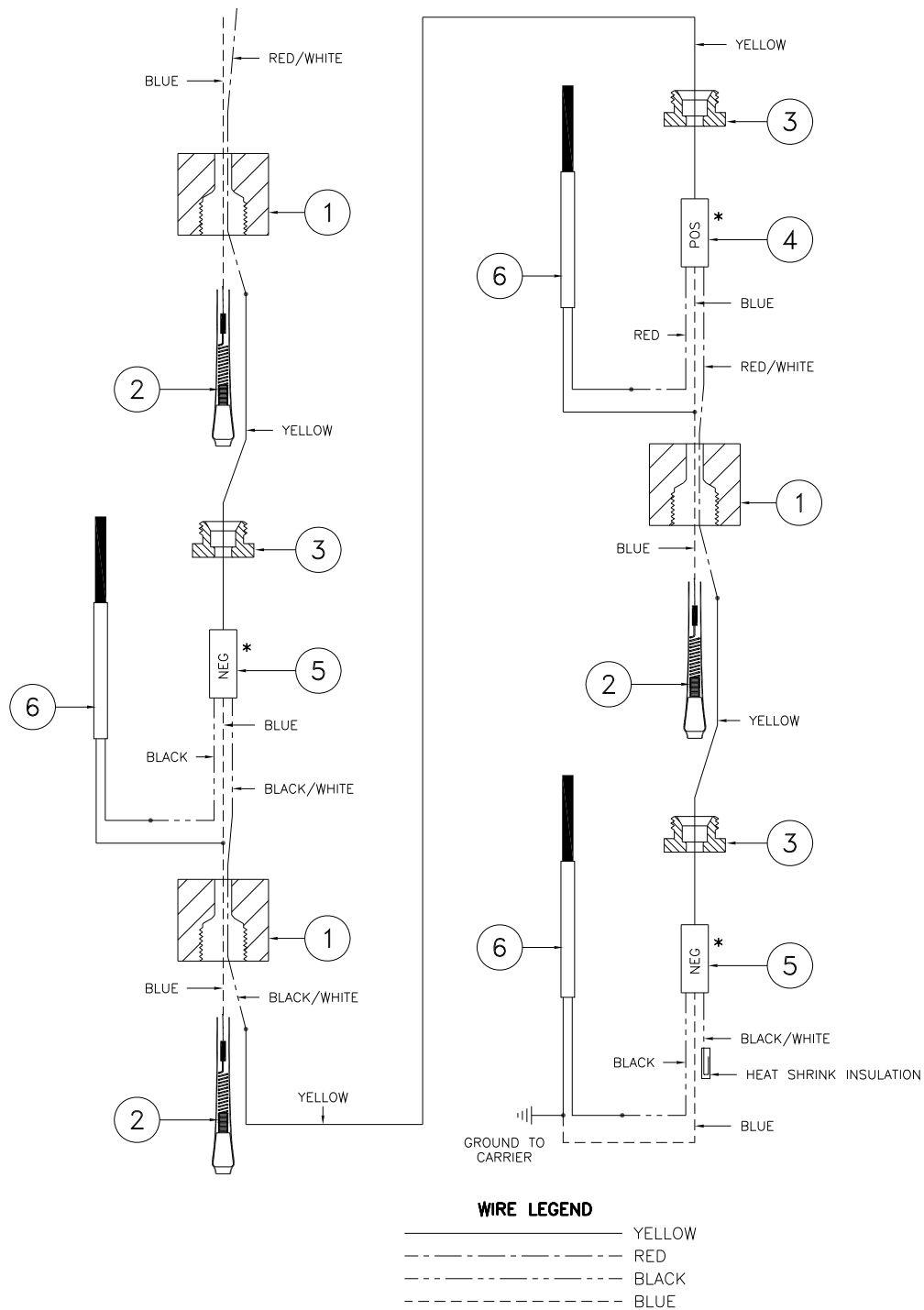
Figure 4

7. Continue loading and attaching barrels below the previous assembly in sequence and performing the Circuit Test Procedure. Thread the appropriate wire (Red/White positive or Black/White negative) through each Baffle Plate and alongside of the Dart assembly. The blue wire from the Dart Assembly must be spliced to one leg of the electric detonator and to the blue wire on the Diode Module. The other leg of the detonator should be spliced to the Black/White or Red/White striped wire from the diode module. This splice must be secure and electrically insulated. **DO NOT USE A SOLDERING IRON OR ELECTRICAL DEVICE TO MAKE THE SPLICED CONNECTION AS THEY COULD CAUSE PREMATURE DETONATION.** Scotchloks may be used up to 300° F. When performing the above test procedure, the gun should read “n” x 221 ohms with the bottom wire shorted. Example: With 9 guns, 9 x 221 = 1989 ohms (approx.). The gun should always read open in both directions with the bottom wire open and with the meter in the 20M scale. **ANY READING OTHER THAN THIS IS UNACCEPTABLE, AND THE PROBLEM MUST BE CORRECTED.**
8. After loading the last gun, **but before grounding the Detonator and the module blue wire**, perform the same test as above. Again, the meter will read “n” x 221 (.221) with the striped (bottom) wire shorted to the case. Example: With 9 guns, 9 x 221 = 1989

ohms (approx.). And again, with the meter in the 20M scale and the bottom wire open, the meter must read open in both directions.

9. Now, arm the bottom gun by grounding the Detonator and the blue wire from the select fire module to the gun case. This can be done by trapping one end of a 6" length of 22 Ga. bare stranded wire underneath the base of the Shaped Charge as the charge is seated in the gun (or through the use of a Grounding Spring referred to on **page 4**). This grounded wire can then be spliced to the leg of the detonator and the blue wire on the module. The striped wire remaining on the lower side of this first barrel diode module is not used and should be cut off. Be sure to insulate the stub end of the wire.
10. With the meter in the 20M scale, it should read as follows: If the bottom gun is a negative fire, the meter will read open (**Figure 4**) with the red lead attached to the yellow wire at the top of the gun and the black lead grounded to the gun body. With the leads reversed, the meter will read between 1 and 20 megohms. If the bottom gun is a positive fire, it will read open (**Figure 4**) with the black lead attached to the yellow lead and the red lead grounded to the gun body and 1 to 20 megohms with the leads reversed.
11. The bottom sub (**item 3**) can now be installed.
12. With the assembly complete, the top adapter will have a yellow wire protruding from it. This wire should remain grounded to the gun body until the Pigtail assembly is installed and the CCL assembly is attached. The top adapter design will affect how this ground is made. The most common method of grounding the lead wire at the top of the gun assembly is to strip about 1" of the insulation from the yellow wire and trapping it under one of the o-rings (**item 5**) at the Top Adapter Sub.

# Positive/Negative Select-Fire Wiring Diagram



**Figure 5**

## Wiring Diagram Parts List (Refer to Wiring Diagram – Figure 5 on Page 13)

ITEM	PART NUMBER	DESCRIPTION
1	N/A	Dart Gland (profile machined into surface of Baffle Plate)
2	9000-900-120A 9000-900-120S	Aluminum Dart Assembly; Gray Silicone Rubber Insulation Steel Dart Assembly; Black Silicone Rubber Insulation
3	9000-900-229	Dart Retainer
4	9000-903-23P-350*	Diode Module; Positive (350° F.)
5	9000-903-23N-350*	Diode Module; Negative (350° F.) * Patented by Titan Specialties, Ltd.
6	Varied	Electric Detonator