

### *Tether Overview*

VideoRay tether is the lifeline of the ROV and is used to deliver power and control signals to the submersible and return video and sensor feedback to the operator. A typical spool of tether is shown in Figure 1. VideoRay tether comes in different buoyancy and performance ratings and is available in almost any length, however, the maximum length supported without appreciable loss of power or signal degradation is 1,100 feet (335 m). All VideoRay tethers include a Kevlar<sup>®</sup> reinforcing fiber and are strength rated to withstand 200 lbs (90 Kg)



*Figure 1 – VideoRay Tether*

of tension. Tether connectors are male and female, so they will only work in one orientation. They are also wet mate-able so you do not have to worry about making connections while the tether is wet.

VideoRay tether comes in the following performance ratings.

**Neutral** Neutral tether is the standard tether that is delivered with new VideoRay systems. It includes a foam core insert that makes it neutrally buoyant in fresh water. It has a diameter of approximately 0.5 inches (12 mm). Neutral tether has good all around performance characteristics, but its larger diameter makes it more susceptible to being pushed around in strong currents and wind.

**PPT** PPT Professional Performance Tether is similar to Neutral tether, but uses smaller conductors and has a smaller diameter of approximately 0.3 inches (8 mm). This makes it ideal for operating in currents or winds. PPT is also used in conjunction with the PPP (Professional Performance Package) that includes an ROV mounted battery for extra performance while using long tether lengths.

**Negative** Negative tether does not include any flotation within its core, and is sometimes called extension tether. It is most commonly used in conjunction with neutral tether or PPT. In this arrangement, the negative tether is connected to the control box and neutral tether or PPT is connected to the ROV. Negative tether has a diameter of approximately 0.3 inches (8 mm).

## Tether Components

In addition to the tether, VideoRay manufactures several complementary tether components.

**Tether Deployment System (TDS)** – The TDS is a self-contained reel that can be used to ease tether handling and transport. It includes space to store the ROV as well as the tether. See Figure 2.



Figure 2 – Tether Deployment System

**Tether to ROV Stress Relief** – The Tether to ROV stress relief is a cable that reduces the loads carried by the ROV tether whip. The tether whip does not include a Kevlar reinforcing fiber and should not be subjected to loads of more than 50 lbs (23 kg). The cable clips to tether just beyond the tether connector. VideoRay recommends using the Tether to ROV stress relief at all times, especially when the ROV will be used to retrieve heavy objects. See Figure 3.



Stress Relief Cable

Figure 3 – Tether to ROV Stress Relief

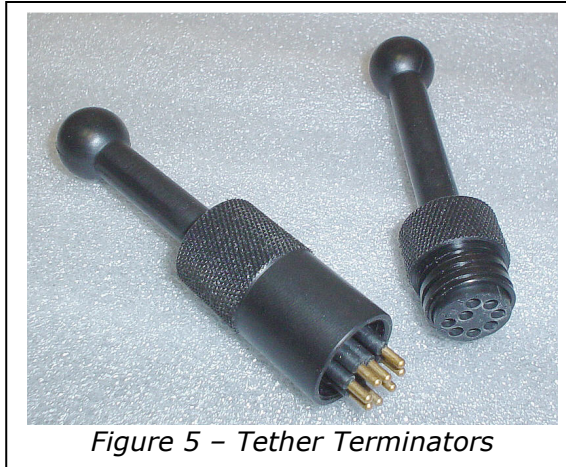
**Tether to Tether Bend Relief Connector** – When connecting multiple lengths of tether together, the tether to tether bend relief connector should be used. This reduces the bending stresses at the connection when the tether is spooled tightly such as when it is spooled on the Tether Deployment System. See Figure 4.



Figure 4 – Tether to Tether Bend Relief Connector

## Tether Primer

**Tether Terminator (Dummy Plug)** – The tether terminator can be used to seal tether connections when the tether is not in use. This will ensure that the tether contacts are not subject to abrasion or debris that can foul the connection. See Figure 5. Another alternative to seal the connectors is to simply connect the two ends of the tether together when not in use.



For models other than the Pro 4, VideoRay has also developed a Professional Performance Package (PPP) for extra performance and use with long tether lengths (Greater than 500 feet (150 m)). The voltage drop over long tether lengths can reduce the power available at the ROV. The PPP includes a battery that is mounted on the skid and provides extra power at the ROV. The tether is connected through the battery, and when the ROV is idle, the battery is recharged. The PPP also includes Professional Performance Tether (PPT), and for ROVs with 50 mm propellers, an upgrade to 60 mm propellers and thruster guards.



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System calibration is not required when changing, adding or removing, tether sections.

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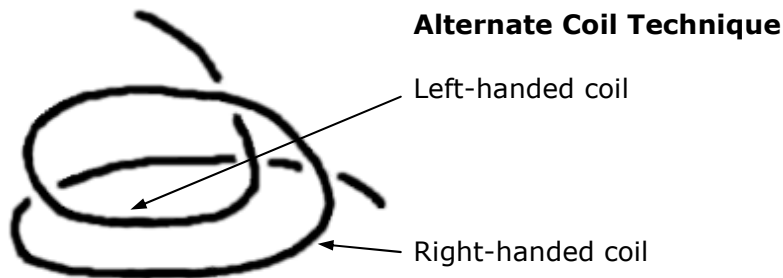
## ***Tether Handling***

Tether Handling Dos and Don'ts:

1. Make sure tether connections are secure before deploying the ROV.
2. Avoid deploying tether over rough or sharp edges.
3. Avoid crushing the tether – do not deploy across high traffic areas.
4. Avoid tight bends smaller than 3 inches (75 mm) in diameter (about the size of a soda can).
5. Clean the tether after use.

## Tether Primer

6. Keep the tether connectors clean.
7. Do not clean gold-coated contacts with abrasives.
8. Do not exceed the strength rating – 200 lbs (90 kg).
9. The maximum usable length for the Pro 4 is about 2,000 ft. (600 m). For all other models, it is about 1,200 ft. (365 m).
10. To spool the tether, use a TDS, alternate coil technique or a “stuff” bag.



## ***Tether Management***

The success of an ROV pilot is often attributable to the ability to manage the tether. The following tips can help users become more aware of the issues and how to handle certain situations.

- Use a multi-person ROV crew with one person acting as a tether handler, affectionately called the “Tether Monkey.” Communication is critical for the team to succeed.
- Select the right tether type for your conditions. See the next section on Tether Connections for the various options and recommended applications.
- Deploy only as much tether as needed. Too much tether in the water can act like a sail and catch the current or wind if the tether is floating on the surface.
- If the current or wind is strong, work with it instead of against it. Allow the ROV to navigate downstream under power, and use the tether to pull the ROV upstream.
- When making small adjustments of the ROV’s position, use the ROV to pull some slack to avoid “tether pull” (the tendency for the tether to recoil and pull the ROV back to the previous position).

## Tether Primer

- When diving deep or in strong current, weight the tether a short distance back from the ROV. This will help hold the ROV in the general vicinity and allow a working radius from a relatively fixed location. The distance from the ROV will depend upon the working range needed and the amount of current. A reasonable starting point is 20 - 30 feet (6 - 9 m). Weights can either be taped or tied to the tether, but the connection should be spread over several inches of tether to reduce the stress and to avoid kinking the tether. Also, avoid weights with sharp edges, or make sure to cushion the edge.
- To get maximum performance, use the shortest amount of tether possible to complete the job. This will minimize voltage drop through the tether and provide the most power to the ROV.
- Use waterproof rubber gloves to improve your grip on the tether and make retrieval easier.



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Pilots should not be afraid to allow the Tether Monkey to actively engage in controlling the ROV by pulling on the tether to maneuver the ROV. Often it is the most effective and efficient way to position the ROV, and there should be no shame in getting the job done.

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# Tether Connection Schematics

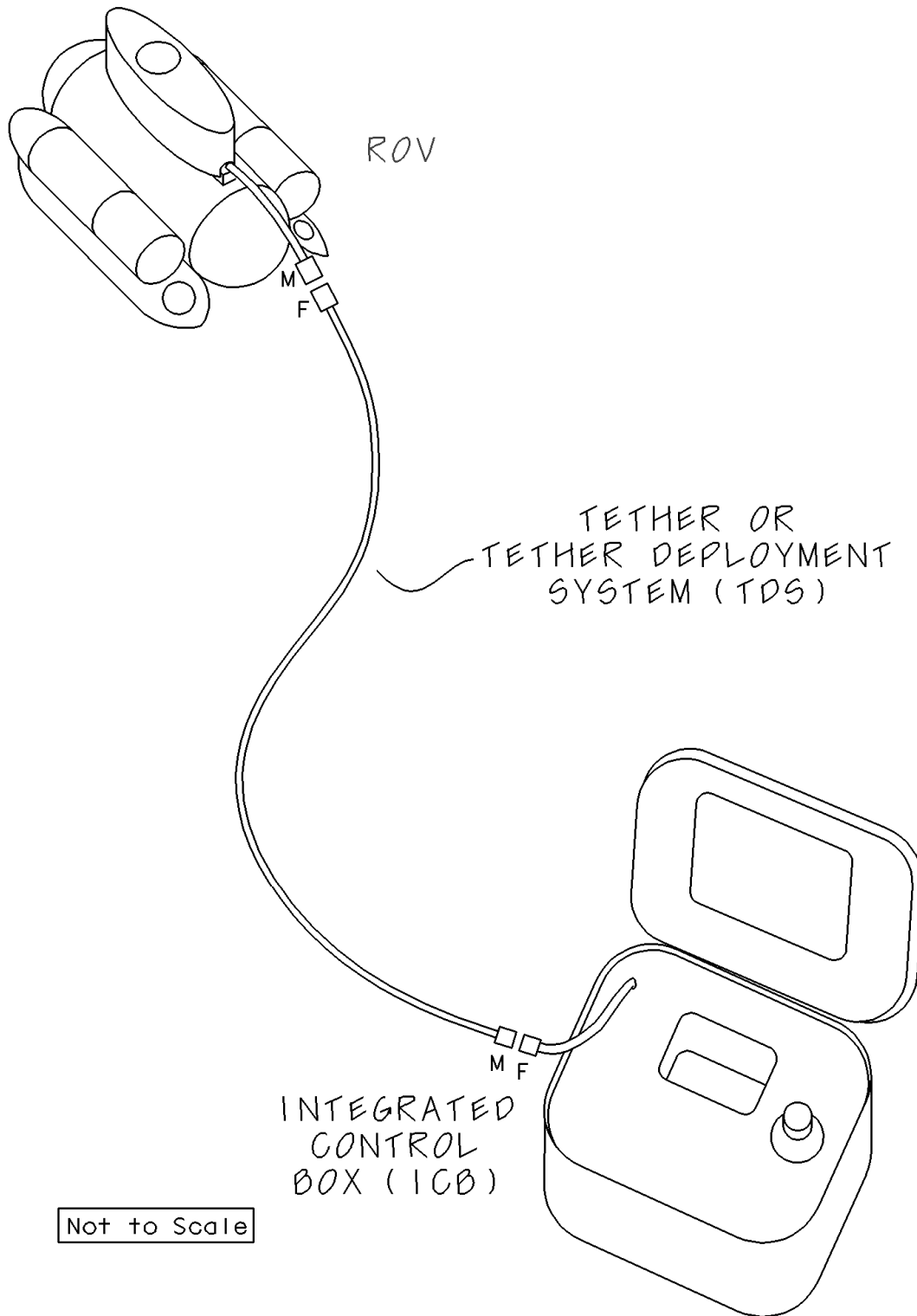


Figure 6 - Basic Tether Connection  
Used for typical dive conditions less than 250 feet and with minimal current.

# Tether Primer

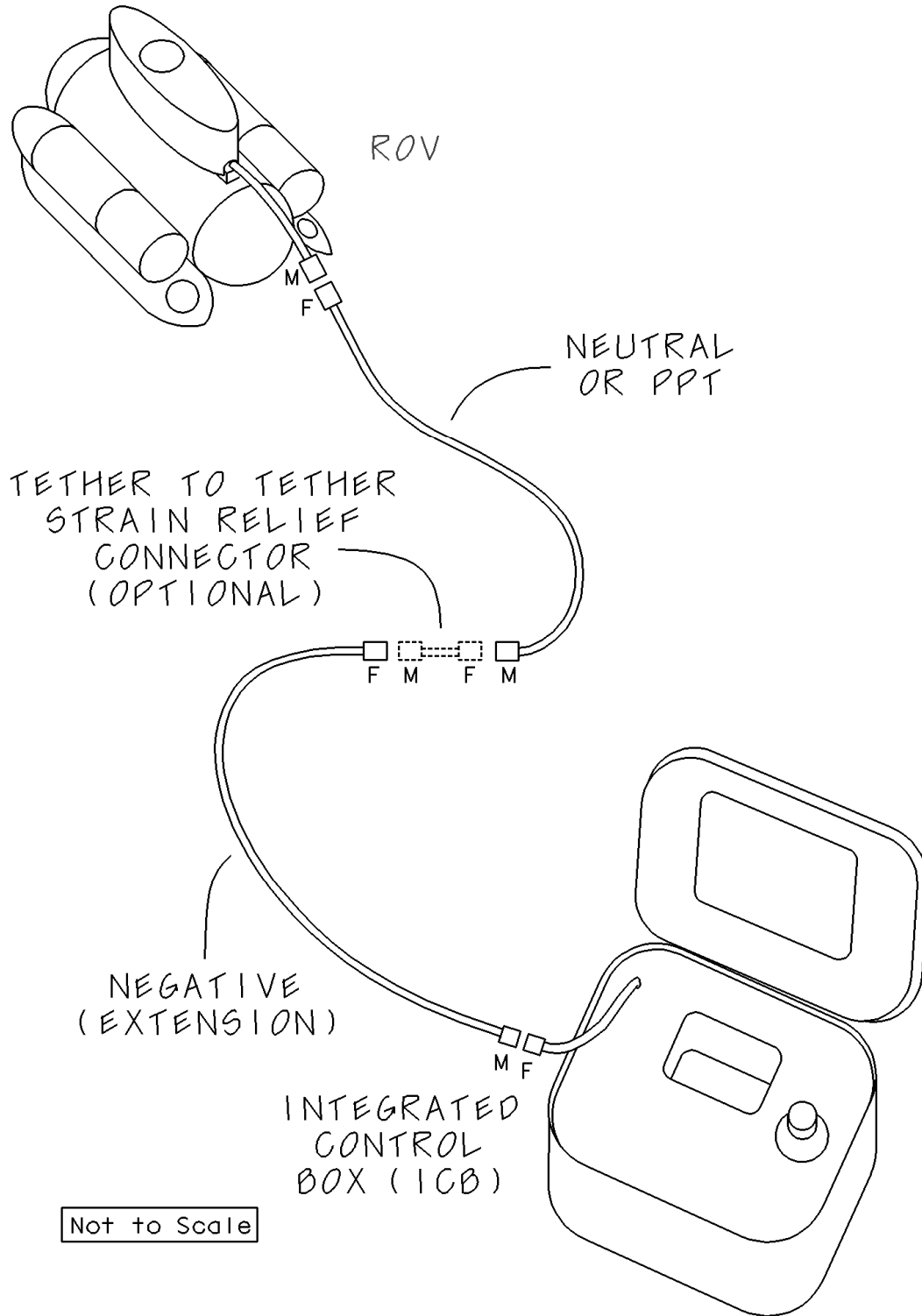


Figure 7 - Using an Extension Tether  
Use Neutral for medium tether lengths (250-500 feet (76 - 150 m)) or PPT for high current situations.

# Tether Primer

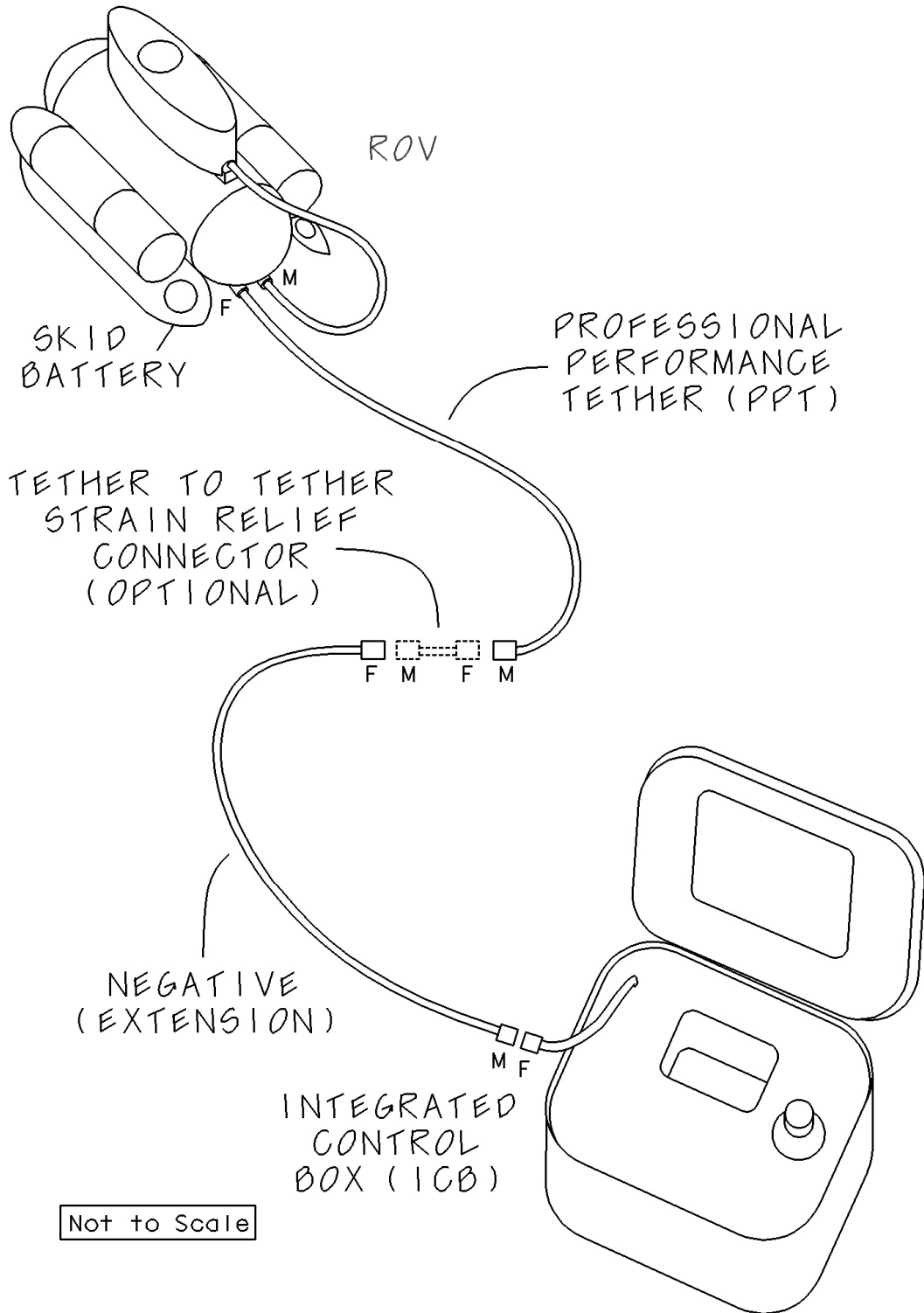
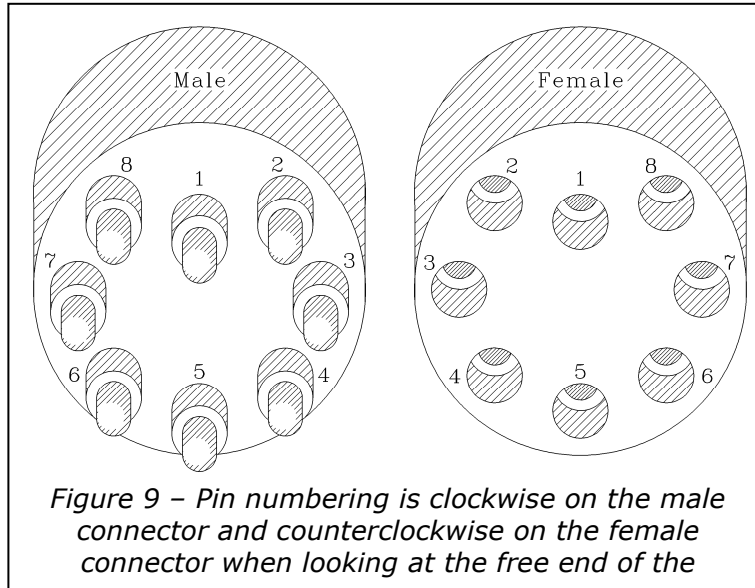


Figure 8 - Using the Professional Performance Package (PPP)  
Use for long tether lengths (Greater than 500 feet (150 m)) or in high current situations.

# Tether Wiring



## Pin Assignments by Pin Number

Pin	Function	Subcon	Birns (Old)	Birns (Current)	Connector
1	Video -	Black	Black	Black	M2
2	Video +	White	White	Green	M1
3*	48 VDC +	Red	Red	Brown	FM1
4	Aux +	Green	Green	Blue	M1
5	Ground	Orange	Orange	Yellow	FM2
6	Aux -	Blue	Blue	Green/Black	M2
7*	Comms	White/Black	Yellow	Yellow/Black	M1
8*	Comms	Red/Black	Slate	Blue/Black	M2

## Pin Assignments by Pin Function

Pin	Function	Subcon	Birns (Old)	Birns (Current)	Connector
3*	48 VDC +	Red	Red	Brown	FM1
6	Aux -	Blue	Blue	Green/Black	M2
4	Aux +	Green	Green	Blue	M1
8*	Comms	Red/Black	Slate	Blue/Black	M2
7*	Comms	White/Black	Yellow	Yellow/Black	M1
5	Ground	Orange	Orange	Yellow	FM2
1	Video -	Black	Black	Black	M2
2	Video +	White	White	Green	M1

\* The VideoRay Pro 4 uses 74 VDC and RS-485 communications. All earlier models use CAN bus communications. Tether can be used interchangeably on any model.

## Tether Primer



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The tether contains ten conductors. Two conductor pairs are used for power in order to provide more flexibility. Some very early versions with VideoRay 2000 or 2002 models did not include an auxiliary spare pair and therefore only have eight conductors, connected to six pins. Tethers with eight conductors cannot be used with accessories such as sonar or ship hull inspection systems.

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