FIRST TIME INSTALLATION GUIDELINES FOR DC BRUSHLESS MOTORS SUPPLIED IN TECNADYNE THRUSTERS, LINEAR & ROTARY ACTUATORS & HPU's

1. Introduction

First time installation of Tecnadyne DC brushless motors and controllers (supplied with Tecnadyne thrusters, linear and rotary actuators and HPU's) is simple and straightforward. However, to assure the success of the installation, certain guidelines must be followed. The guidelines presented in this document are in accordance with accepted good electrical engineering practice and common sense – please follow them to correctly configure your vehicle electrical interface for all first time installations of Tecnadyne equipment.

- It is essential that the electrical interface be configured in accordance with factory guidelines -- please refer to the manual supplied with your equipment and to Tecnadyne application note AN605 – *Electrical Interface to DC Brushless Motors Supplied in Tecnadyne Thrusters, Linear & Rotary Actuators & HPU's.* This application note describes the necessary interface requirements and options for the full range of Tecnadyne DC brushless motors using integral controllers that accept a +/-5v control signal.
- For a more general discussion of the issues related to the filtering of back EMF generated noise and to the elimination of ground loop generated noise, please refer to Tecnadyne application note AN601 – *Back EMF & Ground Loops*.
- For remotely installed controller options, please refer to Tecnadyne application note AN607 – *Available DC Brushless Drive Options*.

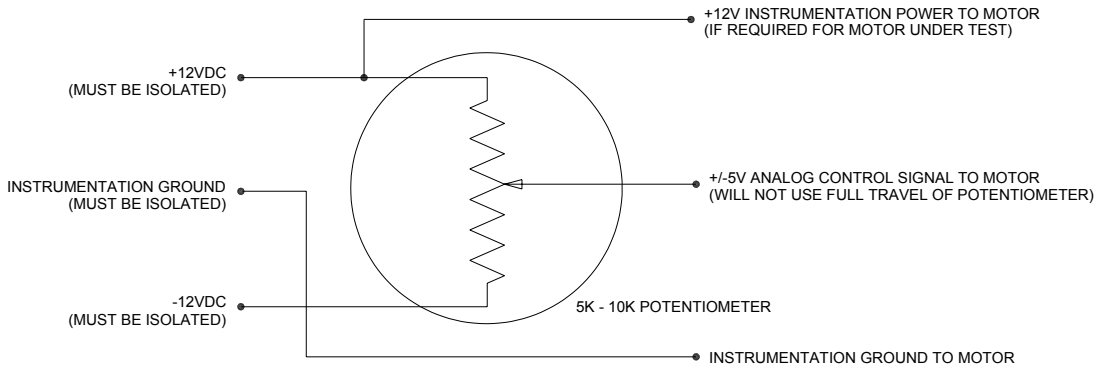
WARNING – EXTREME HAZARD
THE ELECTRICAL VOLTAGES USED TO POWER TECNADYNE MOTOS COULD SHOCK OR ELECTROCUTE PERSONNEL WHO COME IN CONTACT WITH THESE VOLTAGES.
ONLY TRAINED & EXPERIENCED PERSONNEL SHOULD WORK WITH THESE VOLTAGES.
ALL PERSONNEL MUST EXERCISE EXTREME CARE & CAUTION WHEN WORKING WITH THESE VOLTAGES.

2. Bench Testing

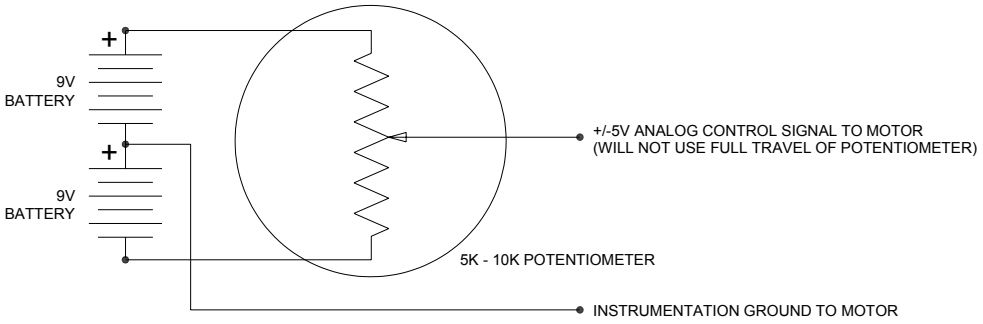
It is strongly recommended that Tecnadyne DC brushless motors (thrusters, linear and rotary actuators, HPU's) be operated on the bench (with regulated and isolated bench supplies) prior to installation and operation for the first time in a new or reconfigured ROV or AUV. Even though all Tecnadyne motors are rigorously tested at the factory and certified for correct operation and to meet or exceed the rated performance at the time of shipment to the

customer, it is advisable to operate them in a bench test setting to prove correct operation before installation in an untested ROV or AUV vehicle system.

- For initial bench testing, it is preferable that a current limiting, variable voltage power supply be used to provide the motor power. Verify that this power supply is able to deliver the full rated amperage if the Tecnadyne motor is to be tested in fully loaded condition (refer to the supplied QS-08 Test Log for this amperage value). This bench power supply must have a capacitor bank – this is essential for filtering the back EMF generated by the Tecnadyne motors.
- The +12v instrumentation power supply, if required for the Tecnadyne motor under test, must provide isolated 12vdc power at 250mA or more.
- If a dual output power supply is used, above, for the +12v instrumentation power, this power supply can also be used for the +/-5v analog control signal – simply connect +12v to one end terminal of a 5k-10k potentiometer, connect -12v to the other end terminal, and take the control signal from the wiper of the potentiometer. It is OK that the control signal voltage exceed +/-5v – this will not damage the motor electronics (but do not exceed +/-12v). Attach a multimeter to the control signal line so that you know what voltage is being applied to the motor. Also, do not install a switch in the control signal line – it is important that the control signal be brought to 0v with some source impedance – it is not advisable to use a switch as this will leave the control signal line in an “open loop” state. A schematic of this is shown in the following illustration.



- Alternately, two 9v batteries can be wired in similar fashion to the potentiometer. Again, it is OK that the control signal voltage exceed +/-5v – this will not damage the motor electronics. Attach a multimeter to the control signal line so that you know what voltage is being applied to the motor. Also, do not install a switch in the control signal line – it is important that the control signal be brought to 0v with some source impedance – it is not advisable to use a switch as this will leave the control signal line in an “open loop” state. A schematic of this is shown in the following illustration.



- If a computer D/A card is to be used to supply the +/-5v control signal, it is essential that each individual analog channel be fully isolated. If there is any doubt, use an external isolation amplifier (such as the Tecnadyne ISO-4 card) on each channel. Many computer D/A cards are not correctly isolated and have poor internal transient and overload protection and are not suitable for controlling Tecnadyne motor products without external isolation amplifiers.
- Consult the manual supplied with the Tecnadyne motor under test for the correct connector pin assignments for the subsea connector on the Tecnadyne motor. It is advisable to use the correct mating connector (this can be supplied by Tecnadyne) to connect to the subsea connector on the Tecnadyne motor. It is not recommended that clip leads or other methods be used to connect to this connector. Please double check the connector pin assignments, as severe damage to the Tecnadyne motor can result if power is applied to the improper pins.

CAUTION
DO NOT OPERATE TECNADYNE MOTORS OUT OF WATER AT HIGH SPEEDS OR FOR EXTENDED PERIODS OF TIME. THE MOTOR & ELECTRONICS REQUIRE WATER FOR COOLING & MUST NOT BE ALLOWED TO GET HOT TO THE TOUCH WHEN OPERATED IN AIR

- First apply the +12v instrumentation power, if required for the Tecnadyne motor under test.
- Next, set the control signal to 0v and verify this with a multimeter.
- Before applying motor power, first make sure that the bench power supply had been set to the correct voltage for the motor under test and that the current limit has been set to a value roughly equal to the no-load current of the motor under test (refer to the supplied QS-08 Test Log for voltage and amperage values). If a current limiting power

supply is not available, install a fast-blow type fuse in the power line – initially, this fuse should have a current rating approximately 2x of the no-load current value.

- Apply motor power while monitoring the voltage and the current. If the Tecnadyne motor under test has an internal capacitor bank, there will be a very short (fraction of a second) current surge, but then the current should settle down to less than 0.5A. If the current is in excess of this value, or if the power supply goes into current limit, or if the fuse blows, immediately remove the power – this means that there is an improper connection to the subsea cable that must be corrected.
- If the motor power current is less than 0.5A, it is OK to slowly increase the analog control signal value from 0v. Please note that all Tecnadyne motors have a control signal dead-band in which the motor is stopped – this dead-band is generally in the range of +/-0.5v to +/-0.75v so that the motor can be stopped with certainty (it is not so easy to apply a signal of exactly 0v – but it is very easy to apply a signal between -0.5v and +0.5v). Please consult the QS-08 Test Log for the exact value of the dead band. At any rate, advance the control voltage past the dead-band point – the motor should start to turn. If the motor does not start to turn, immediately turn it off and check the connections to the subsea cable.
- It is generally OK to increase the speed of the motor and operate it at full speed for very short periods (several seconds) without it being immersed in cool water. However, if it is necessary to operate the motor on the bench for longer periods of time (maybe to check out operation of the computer control program), then it will be necessary to immerse the motor in cool water.
- Also, if the motor is to be operated under load, it will be necessary to increase the value of the fast-blow fuse to a value roughly equal to 1.5x the full power amperage for the Tecnadyne motor under test (consult the supplied QS-08 Test Log).
- Once correct operation of the Tecnadyne motor has been verified on the bench, it is OK to install it into the ROV or AUV system.

3. Installation and Initial Operation on the ROV or AUV

Once the bench testing has successfully been completed, it is OK to install the Tecnadyne motor or motors (thrusters, linear and rotary actuators, HPU's) into the new or newly configured ROV or AUV. Please follow these steps.

- On any ROV or AUV, it is essential to have a single point ground for all power busses and to verify that there are no ground loops. Please refer to Tecnadyne application note AN601 – *Back EMF & Ground Loops* for further explanation. Verify that the system has a single point ground and that there are not any ground loops before installation and operation of the Tecnadyne motors.
- Verify that the ROV or AUV power system has been installed and configured in accordance with Tecnadyne application note AN605 – *Electrical Interface to DC Brushless Motors Supplied in Tecnadyne Thrusters, Linear & Rotary Actuators & HPU's.* And make sure that the motor power supplied by the host system is at the correct voltage for the supplied Tecnadyne motor or motors (refer to the QS08 Test

Log for this voltage value). Remember that a capacitor bank is essential to filter the back EMF generated by the motor.

- Verify that the subsea cables to the Tecnadyne motors are routed and fastened to the host vehicle in such a manner that they will not be drawn into the Tecnadyne motor (if it is a thruster). Take care that the neoprene molded cable penetrator fitting(if supplied with this motor) is not deformed, as this could cause premature failure of the internal connections.
- Verify that the Tecnadyne motor or motors are structurally mounted to the host vehicle. For thruster motors and other Tecnadyne motors, please refer to AN603 – *Installation and Mounting of Tecnadyne DC Brushless Thrusters.*
- As was the case with the bench testing, above, apply the +12v instrumentation power and set the +/-5v analog control signal to 0v before applying the motor power.
- If at all possible, install fuses of a lower amperage value (fast-blow fuses, 2x the no-load amperage) for the initial test check out of the system. Once correct operation has been verified, then it is OK to reinstall the correct rated fast-blow fuses for the system.
- And as was the case with the bench testing, above, start the Tecnadyne motor or motors slowly, gradually bringing them to full speed. And make sure that they are immersed in water if operated at or near full power or if operated for more than several seconds.
- If the Tecnadyne motor or motors do not operate or if they do not operate correctly in the system, immediately turn off all power (motor power, instrumentation power, control voltage), disconnect the Tecnadyne motor from the system and verify that the motor power, instrumentation power and control signals are connected correctly to the mating subsea connector on the host vehicle system. If possible, use a multimeter to check that the motor power, instrumentation power and control signal are at the correct values. Use the multimeter to verify that the control signal / instrumentation power ground is isolated from the motor power.
- If the Tecnadyne motor or motors have been electrically connected correctly and continue to not operate or to not operate correctly, please send a detailed description of the problems encountered, a schematic of the host vehicle power systems and any other pertinent information to support@tecnadyne.com.