TITAN 4

TITAN 4

A Dexterous, Rugged, Seven-Function Remote Manipulator System

The TITAN 4 features in-arm slave electronics to increase reliability, enhance troubleshooting, decrease weight, and decrease spares requirements.

- *In-arm slave electronics*
- *Titanium construction*
- *Standard depth rating of 4,000 msw*
- *Optional extended depth rating to 7,000 msw*
- *Quick, easy diagnostics*
- *Miniature replica master arm*
- *Large operating envelope*
- *High lift-to-weight ratio*
- *Dexterous and accurate*
- *Rugged and reliable*

With slave electronics now located inside the slave arm, the TITAN 4 manipulator system sets new standards for reliability and performance.

The fourth-generation TITAN 4 replaces the TITAN 3 manipulator system. Kits are also available to upgrade TITAN 3 systems to the in-arm slave electronics configuration.

The TITAN 4 is widely regarded as the world's premier servo-hydraulic remote manipulator system. Since the introduction of the TITAN 7F in 1987, TITAN systems have been industry standards for dexterous manipulator systems used in underwater applications, and are extensively used on remotely operated vehicles (ROVs).

Slave arm electronics are located in the forearm, increasing system reliability and minimizing electrical connections.

Unequaled Performance

The seven-function TITAN 4 has the dexterity and accuracy necessary to perform the fine movements needed for complex tasks. When this ability is combined with the manipulator's reach (1,916 mm or 75.4 inches), payload capacity (122 kg or 270 lb at full extension), depth rating (available up to 7000 msw), and large operating envelope, the TITAN 4 offers unequaled performance in a wide range of subsea applications.

Reliable In-Arm Slave Electronics

In the TITAN 4, all downside slave arm electronics are located inside the manipulator forearm. This configuration greatly reduces the number of electrical connections, simplifying service operations and increasing the system's ability to withstand shock.

Robust Power/Signal Connection

A Schilling Robotics SeaNet cable connects the slave arm to electrical power and telemetry, providing a robust, reliable attachment. The small-diameter cable (8.9 mm, or 3/8 inch) is actively pressure balanced and oil filled. The connector head has spring-loaded contacts, and a positive locking feature eliminates accidental cable disconnection.

TITAN 4 Specifications

General Description

Mode of operation ..... Closed-loop position control
Input device ..... Replica master arm
Number of functions ..... Six plus grip
Materials of construction ..... Primarily titanium

Manipulator Arm Specifications

All specifications are based on the standard system configuration using Shell Tellus® Oil 32 hydraulic fluid, input pressure of 207 bar (3,000 psi), and available flow of 19 lpm (5 gpm).

Depth rating:
- Standard ..... 4000 msw (13,124 fsw)
- Extended ..... 7000 msw (22,967 fsw)

Maximum reach ..... 1,916 mm (75.4 in.)
(from azimuth pivot to standard gripper T-bar slot)
Weight in air ..... 97 kg (213 lb)
Weight in seawater ..... 76 kg (168 lb)
Lift at full extension, nominal ..... 122 kg (270 lb)
Maximum lift, nominal ..... 454 kg (1,000 lb)
Maximum gripper opening (standard gripper), nominal ..... 97 mm (3.8 in.)
Grip force, nominal ..... 4,448 N (1,000 lbf)
Wrist torque, nominal ..... 170 Nm (125 ft-lb)
Wrist rotate, continuous ..... 360 degrees, 6-35 rpm

Manipulator Arm Functions

Actuator Function	*Type*	*Nominal Mechanical Range*
Azimuth	Rotary	240 degrees
Shoulder pitch	Linear	120 degrees
Elbow pitch	Rotary	270 degrees
Wrist pitch	Rotary	180 degrees
Wrist yaw	Rotary	180 degrees
Wrist rotate	Gerotor	360 degrees continuous
Gripper (standard)	Linear	97 mm (3.8 in.)

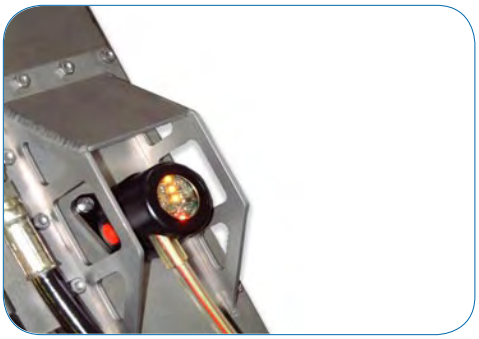
Master Controller Specifications

Length ..... 485 mm (19.1 in.)
Width ..... 153 mm (6.0 in.)
Height ..... 69 mm (2.7 in.)
Weight ..... 4.3 kg (9.5 lb)

AC Power Module Specifications

Module is needed only if DC power is unavailable.
Length ..... 15.2 cm (6 in.)
Width ..... 8.3 cm (3.3 in.)
Height ..... 8.9 cm (3.5 in.)

(Continued on next page)



Diagnostic lights in the connector head indicate the status of electrical power delivery to the slave arm, master controller transmission to the slave arm, and slave arm responsiveness.

Quick, Easy Diagnostics

The SeaNet cable connector head contains bright LED status indicator lights that allow first-level diagnostics to be performed solely by visual inspection. The lights show not only whether electrical power is being delivered to the slave arm, but whether the master controller is transmitting to the slave arm and the slave arm is responding. This information lets the operator quickly determine where to begin troubleshooting, without removing connectors, applying a voltmeter, or opening sealed enclosures.

The system also detects missing or reduced slave arm position sensor signals, and diagnostic lights on the in-arm slave electronics module indicate processor health.

Titanium Construction

The TITAN 4 is constructed primarily of titanium for structural strength, light weight, and corrosion resistance. Titanium construction also makes the TITAN 4 extraordinarily resistant to damage from collisions.

The in-arm slave electronics module features diagnostic lights that indicate processor health.

(Specifications, continued from previous page)

Approved Hydraulic Fluids

Petroleum-based fluids..... Shell Tellus® 32, Mobil DTE 24, Chevron AW Hydraulic 32, Texaco Rando® 32, Castrol Hyspin AWS 32
Glycol-based fluid..... Houghto-Safe 620
Vegetable-based fluid..... Hydro-Safe ISO VG 32

Hydraulic Requirements

Viscosity ..... 10-200 cSt
Available flow..... 5.7-19.0 lpm (1.5-5.0 gpm)
Pressure..... 103 bar (1500 psi) minimum to 207 bar (3,000 psi) maximum
Slave arm performance is reduced at less than 3000 psi.
Hydraulic fluid temperature, maximum ..... 54 degrees C (130 degrees F)
Return pressure, maximum..... 34.5 bar (500 psi)
Filtration, hydraulic supply..... 3 microns (10 microns absolute)
Customer-supplied mating fittings required:
Supply hose fitting..... -4 JIC female, 1/4-inch
Return hose fitting..... -6 JIC female, 3/8-inch
Contact the factory about operation at other pressures and flow rates

Electrical and Telemetry Requirements

System supply at junction box..... 90-260 VAC, 50-60 Hz, single phase
Input power:
Master controller..... 90-260 VAC, 50-60 Hz, single phase
Slave arm..... 24 VDC
Power consumption:
Master controller..... 60 W start, 15 W run
Slave in-arm controller plus solenoid..... 6 W start, 12 W run
Slave arm current draw..... 500 mA at 24 VDC
AC power module (if needed):
Electrical input..... 90-260 VAC
Electrical output to slave arm ..... 24 VDC
Telemetry..... User selectable, RS-232 or RS-422/485 half-duplex 2-wire

Environmental Specifications

Operating temperature ..... -2 to +54 degrees C (+28 to +130 degrees F)
Storage temperature ..... -15 to +71 degrees C (+5 to +160 degrees F)
Humidity..... 0% to 100% condensing

Reliable

TITAN manipulators have a proven track record of reliability in the world's most demanding subsea environments. The TITAN 4 features:

- Slave electronics, electrical wiring, and sensors that are inside the arm and protected beneath titanium covers
- No exposed hoses or hydraulic fittings
- Roller bearings on all pivot points to withstand heavy loading and eliminate wear
- Titanium external fasteners
- Long-lasting, third-generation rotary actuators to minimize leakage and friction, and to reduce service requirements

Complete

The turnkey TITAN 4 system includes a manipulator arm with a 97-mm (3.8-inch) parallel-acting titanium gripper, a compact master controller with miniature replica master arm, and a compensator for slave arm electronics.

Easy to Operate

The TITAN master controller includes a six-degree-of-freedom miniature replica master arm that ensures comfortable, intuitive manipulator operation. The controller also contains function keys for selecting menu options and a display for viewing diagnostic and status information.

Advanced operational features are standard with the system, including individual joint freeze, position scaling (altering the ratio of master arm movement to manipulator arm movement), password security, programmable stow/deploy routines, individual joint movement limits, incremental gripper movement, individual joint diagnostics, and automatic error checking.

AC or DC power

The TITAN 4 in-arm slave electronics operate on 24 VDC power. A small, optional power module (90-260 VAC to 24 VDC) is available if the vehicle cannot supply 24 VDC to the slave arm.

TITAN 4/TITAN 3 COMPARISON

The TITAN 4, which replaces the TITAN 3, contains many new features:

- Slave controller, slave cable, and 79-pin wiring harness are replaced by in-arm slave electronics and a small-diameter SeaNet cable, increasing system reliability and reducing weight, installation space, and spares requirements.
- Diagnostic LEDs in the slave SeaNet cable allow first-level diagnostics to be performed solely by visual inspection.
- Increased standard depth rating of 4,000 msw (13,124 fsw), with optional extended depth rating to 7,000 msw (22,967 fsw).
- Faster control loop execution increases slave arm response time and accuracy.
- Total system weight is reduced by 18 kg (40 lb) in air and 9 kg (20 lb) in water.
- Slave arm electronics operate on 24 VDC power. An optional 90-260 VAC power converter is available.
- Pocketed slave arm for weight reduction.

Most TITAN 3 systems can be upgraded with these enhancements (except for the pocketed slave arm segments).

Contact the factory (wes.gerriets@schilling.com) for information on retrofit kits for your systems.

Options and Accessories

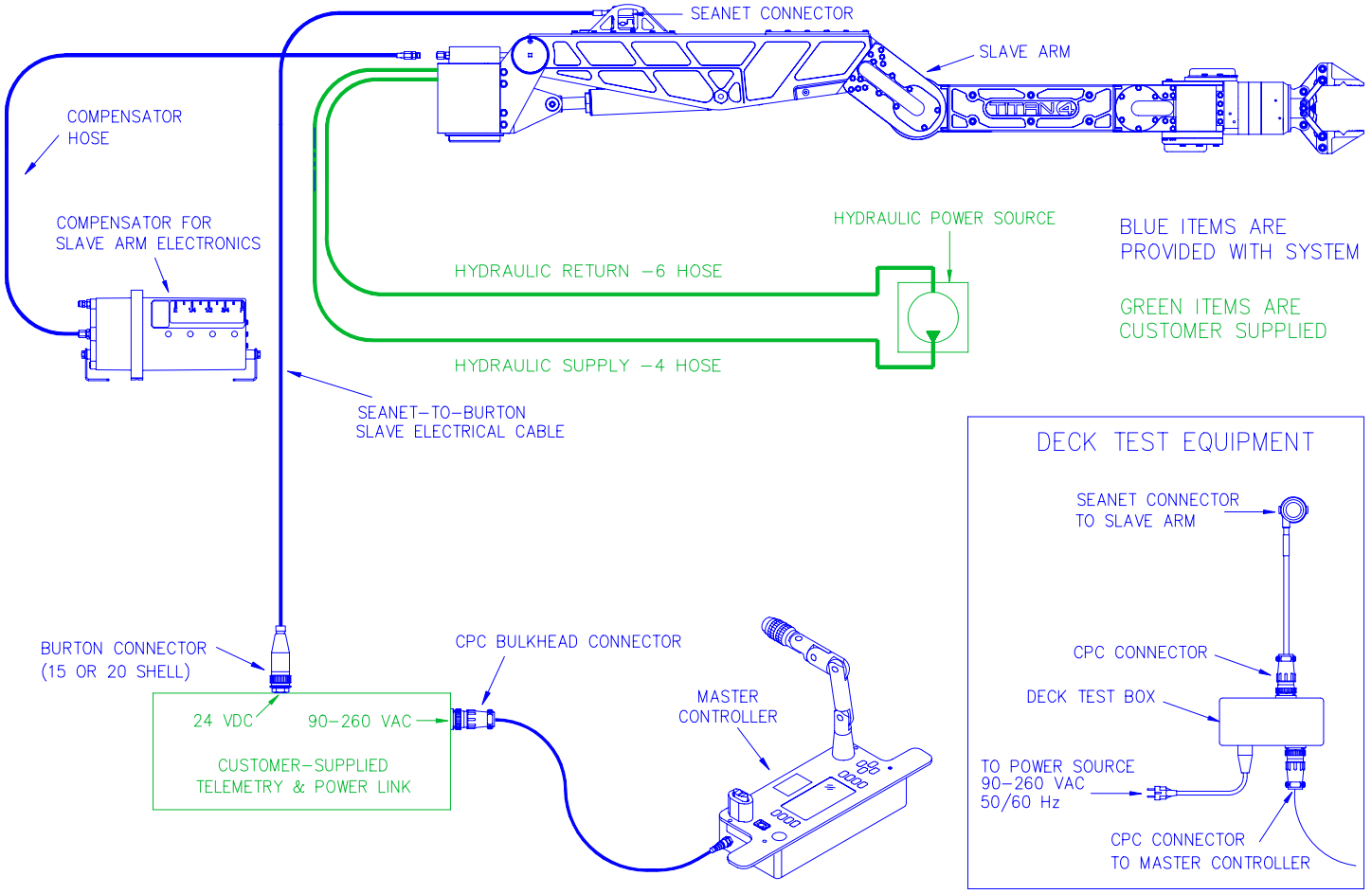
- Extended depth rating to 7,000 msw
- 152-mm (6-inch) parallel-acting titanium gripper
- 152-mm (6-inch), three-finger intermeshing titanium gripper
- 152-mm (6-inch), four-finger intermeshing titanium gripper
- AC-to-DC power conversion module
- Spares kit
- Seal installation tool kit
- Technician's tool kit
- Dual-manipulator configuration (two manipulator arms and a single master controller with two replica master arms)
- Radiation hardening (up to 1×10^7 rad gamma)
- Titanium wrist-mounted camera

The replica master arm ensures comfortable, intuitive operation.

Exceptional Customer Service and Training

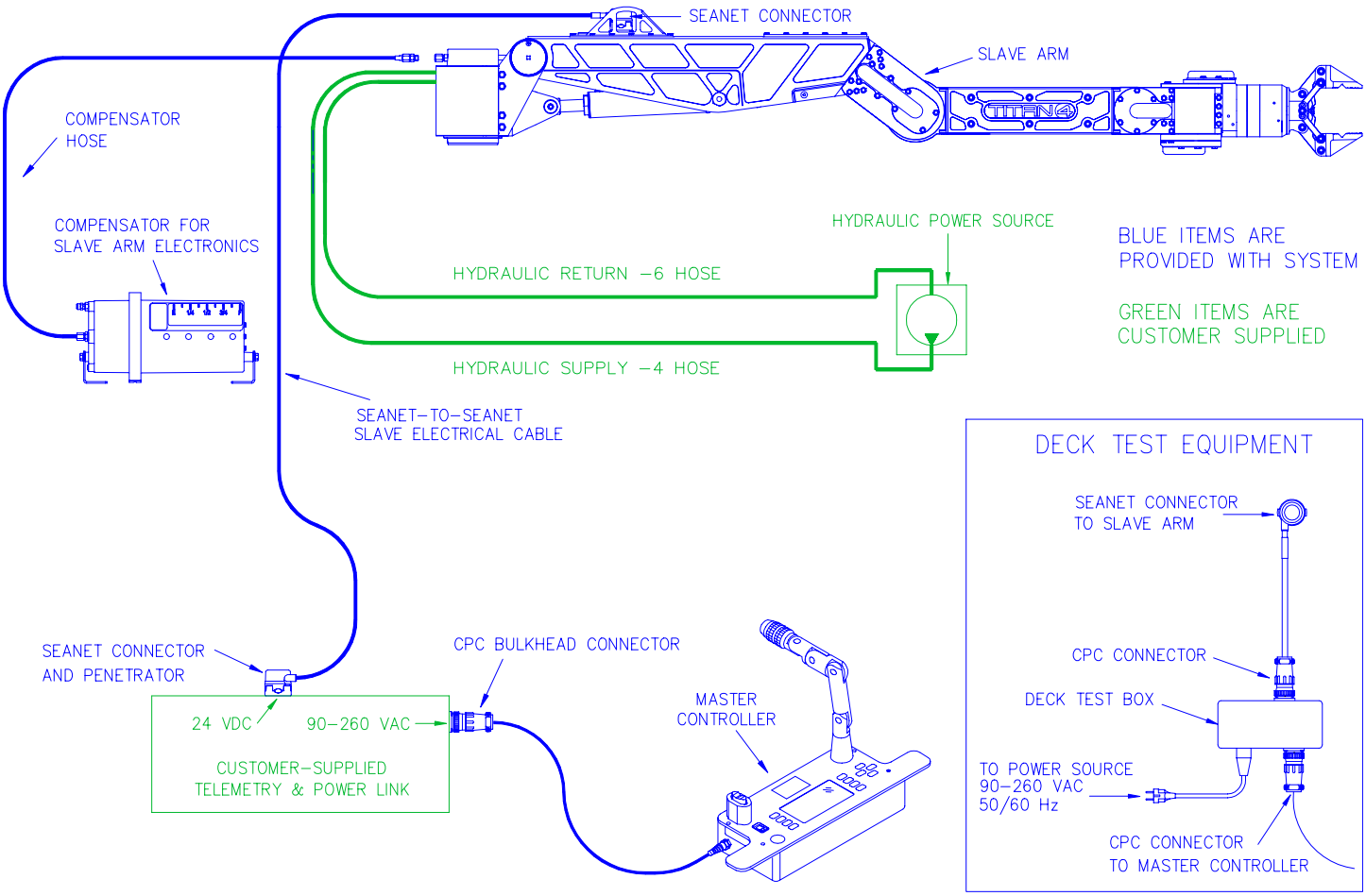
Schilling Robotics offers:

- A worldwide customer support network with factory-trained technicians
- Strategically located spares and factory service facilities
- 24-hour telephone access to qualified technical staff
- On-site and offshore installation and mobilization support
- Instant access to technical manuals, service instructions, and assembly drawings from our web site
- A web-based customer feedback system
- Operation and maintenance training courses at our factory, at customer facilities, or at our service centers worldwide



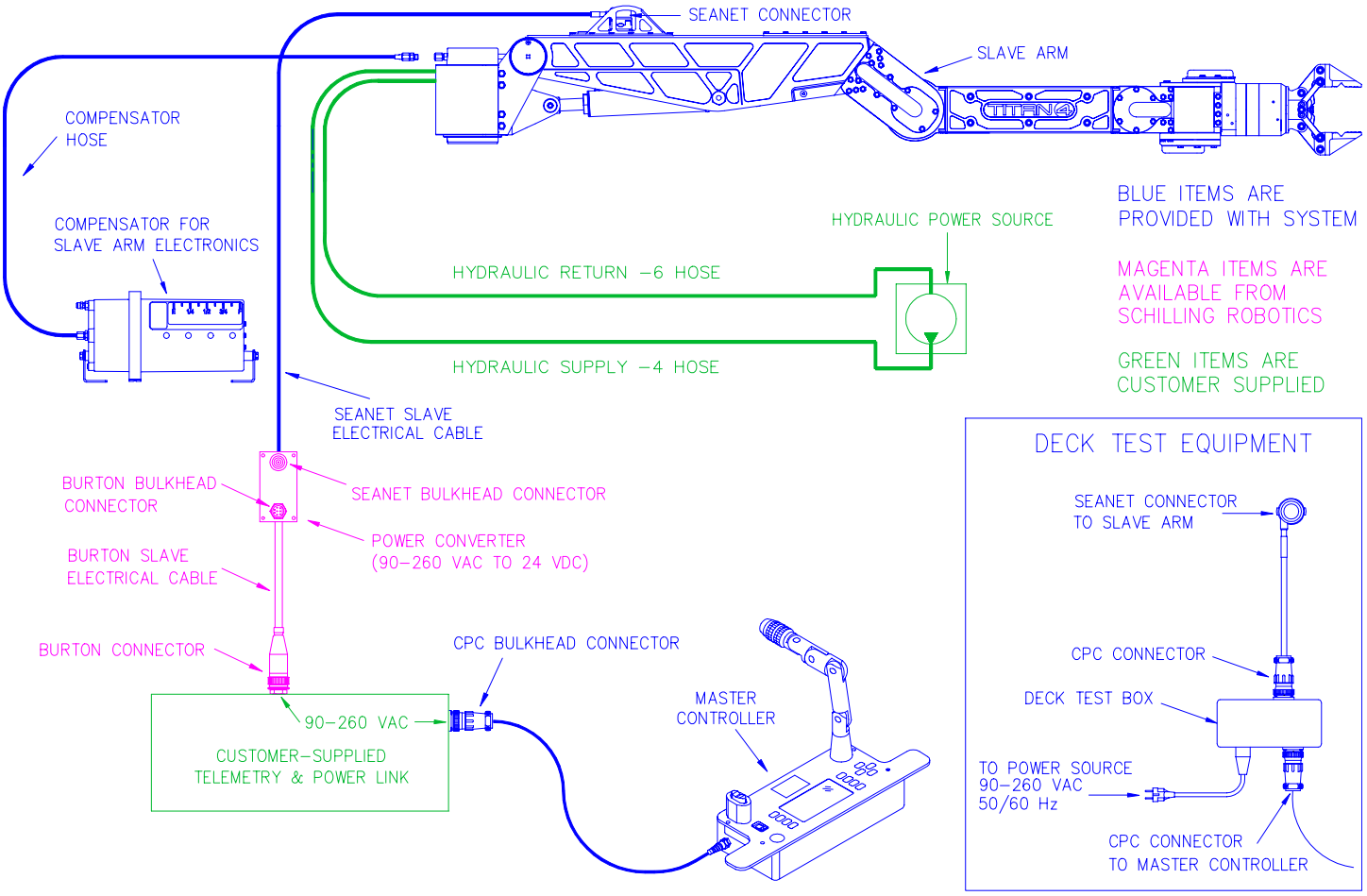
System Overview #1
SeaNet-to-Burton Configuration

The slave electrical cable has a SeaNet connector on one end (for attachment to the slave arm) and a Burton 15 or 20 shell connector on the other end.



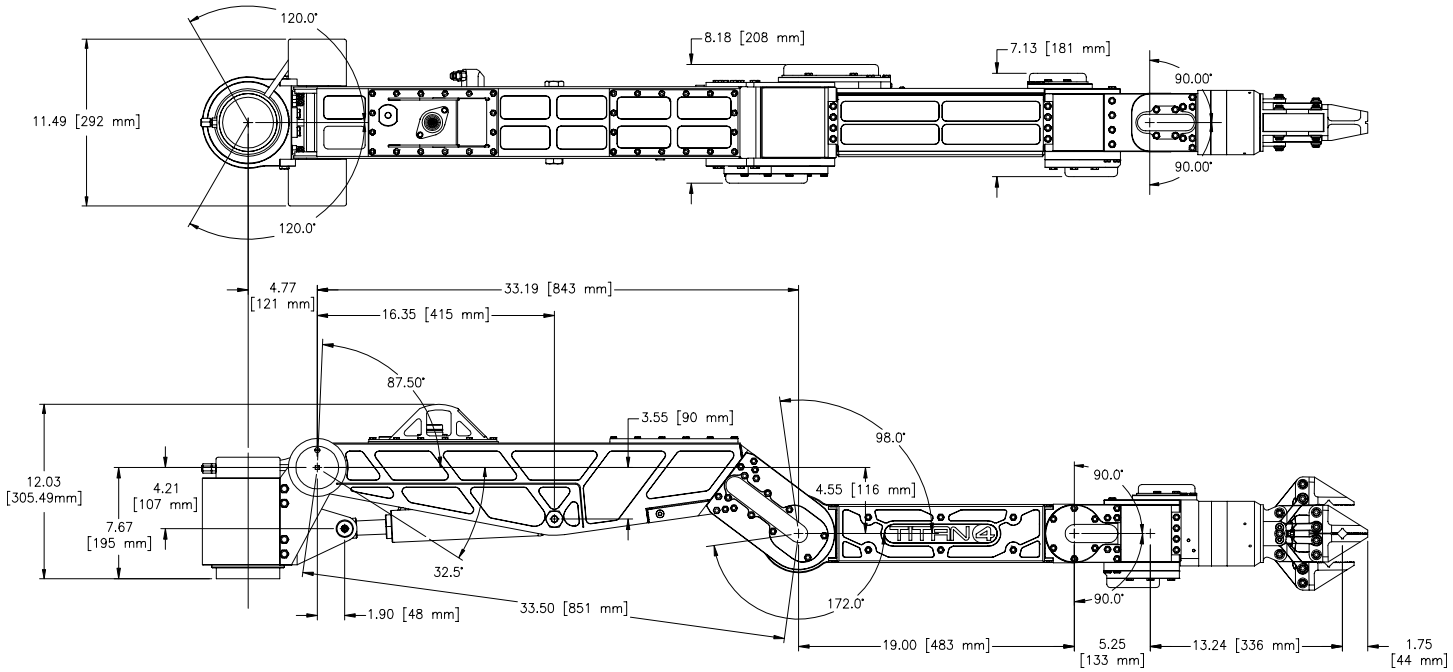
System Overview #2
SeaNet-to-SeaNet Configuration

The slave electrical cable has SeaNet connectors on both ends. A SeaNet penetrator is provided for installation into the customer's equipment.

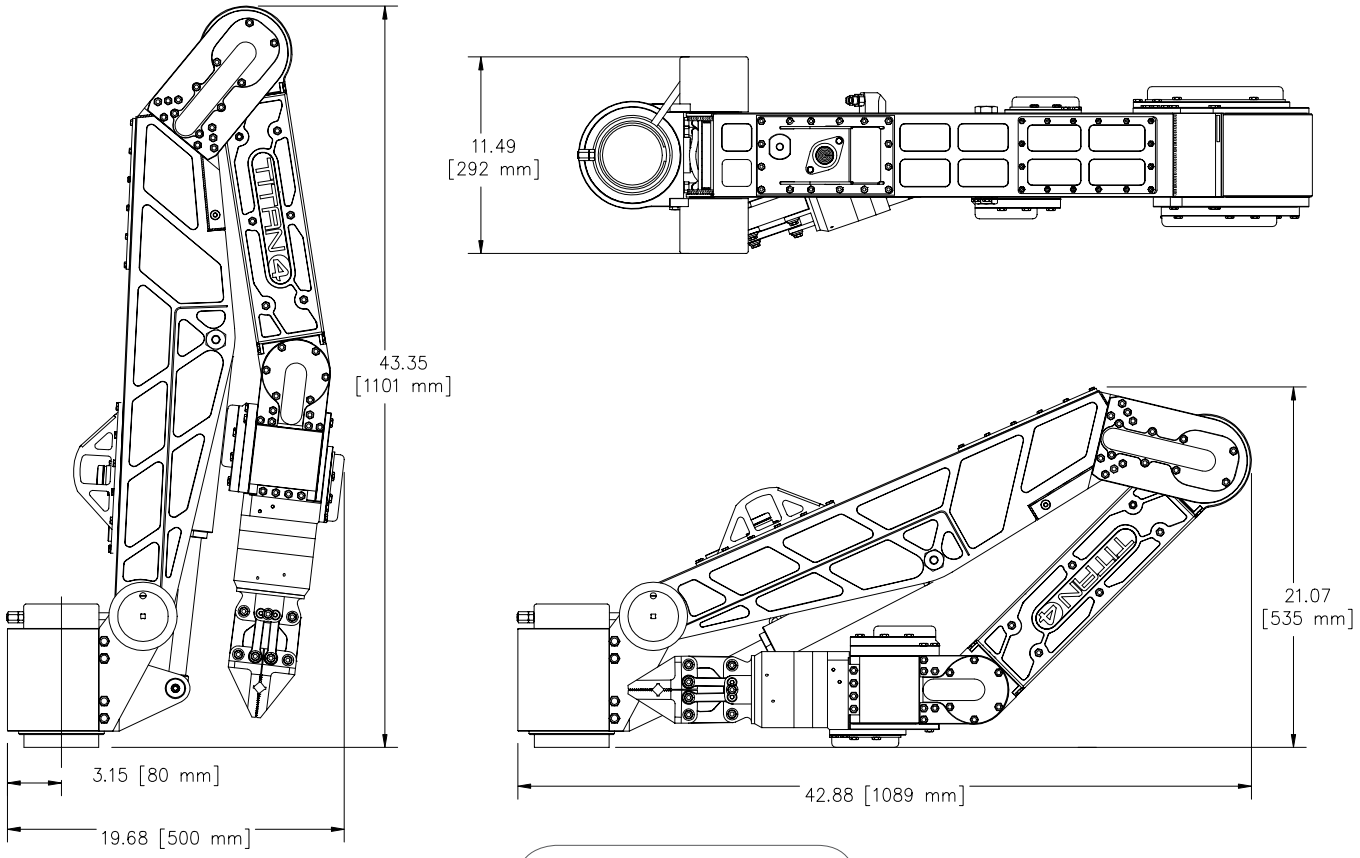


System Overview #3
90-260 VAC Power Configuration
(used if 24 VDC is unavailable)

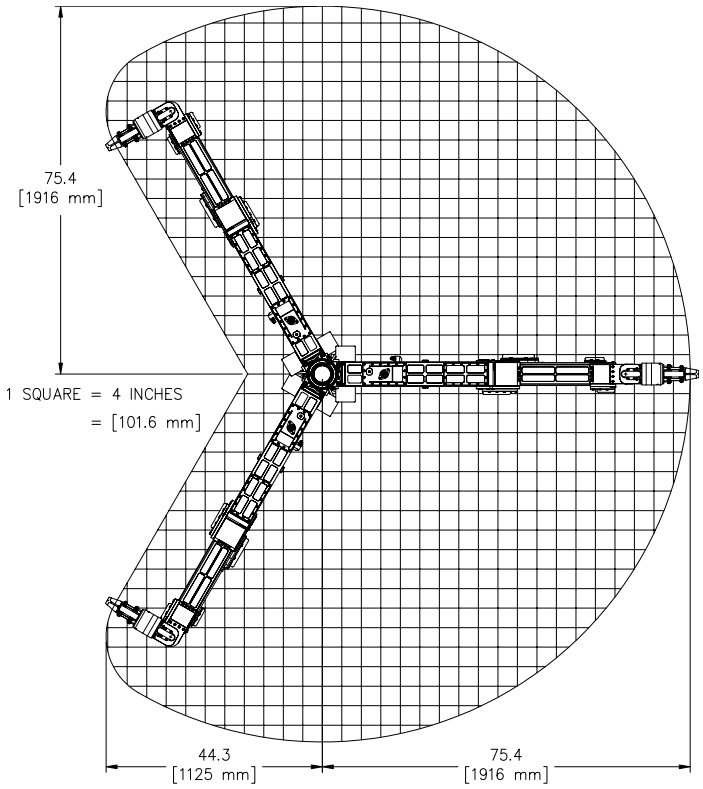
A small, optional power module (available separately) converts 90-260 VAC power to 24 VDC for slave arm electronics.



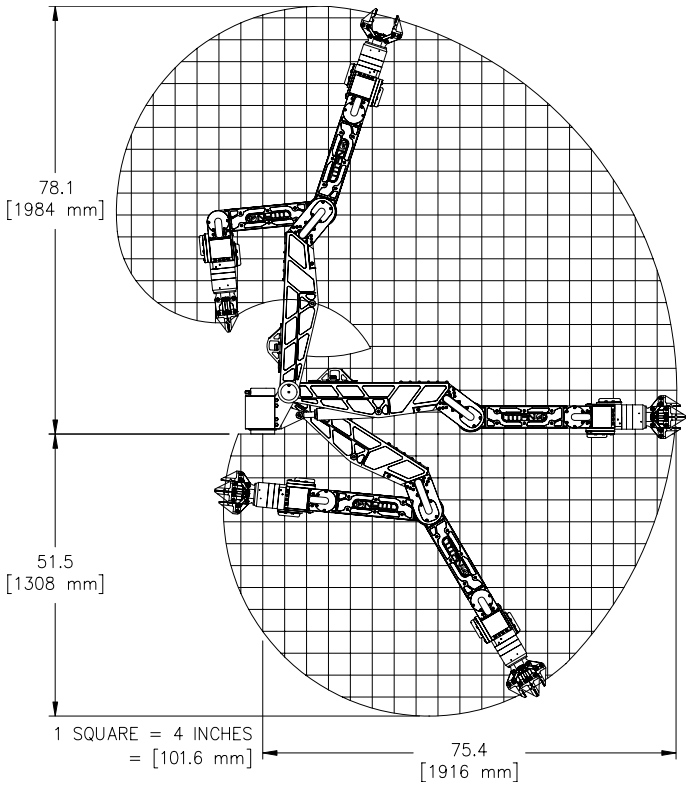
Slave Arm Dimensions (with Arm Extended)



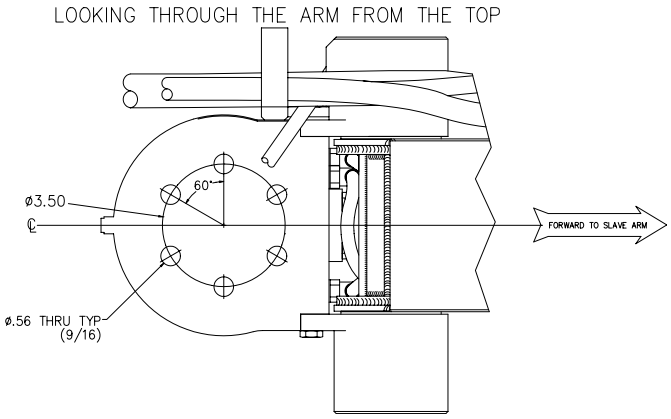
Stow Dimensions



Range of Motion, Top View



Range of Motion, Side View



Slave Arm Mounting

So Deep, No One Comes Remotely Close

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