

Deep Sea Coral Observatory Design Review

Project Goal

Design a time-lapse camera system that can observe changes in a coral community on a time scale of months.

DiSCO Functional Requirements

1. The DiSCO shall image a fixed area of a chosen coral community. The area should be large enough to be relevant to abundance studies.
2. The DiSCO shall capture images of substantial resolution to identify 10 cm organisms.
3. The DiSCO shall be engineered to operate without maintenance for up to one year.
4. The DiSCO shall be deployable at sites as deep as Sur Ridge. 4k preferable.

DiSCO Functional Requirements

5. The DiSCO shall capture images at the frequency necessary to study changes in community structure. Every hour sufficient.
6. The DiSCO shall be deployable as a free vehicle.
7. The DiSCO shall leverage to the extent possible from previously developed technology and COTS solutions.
8. The DiSCO shall be operated and maintained by non-engineering personnel.
9. The DiSCO shall be deployable from the Western Flyer. Nice to have Rachel Carson.

Smith Time-Lapse Camera Tripod



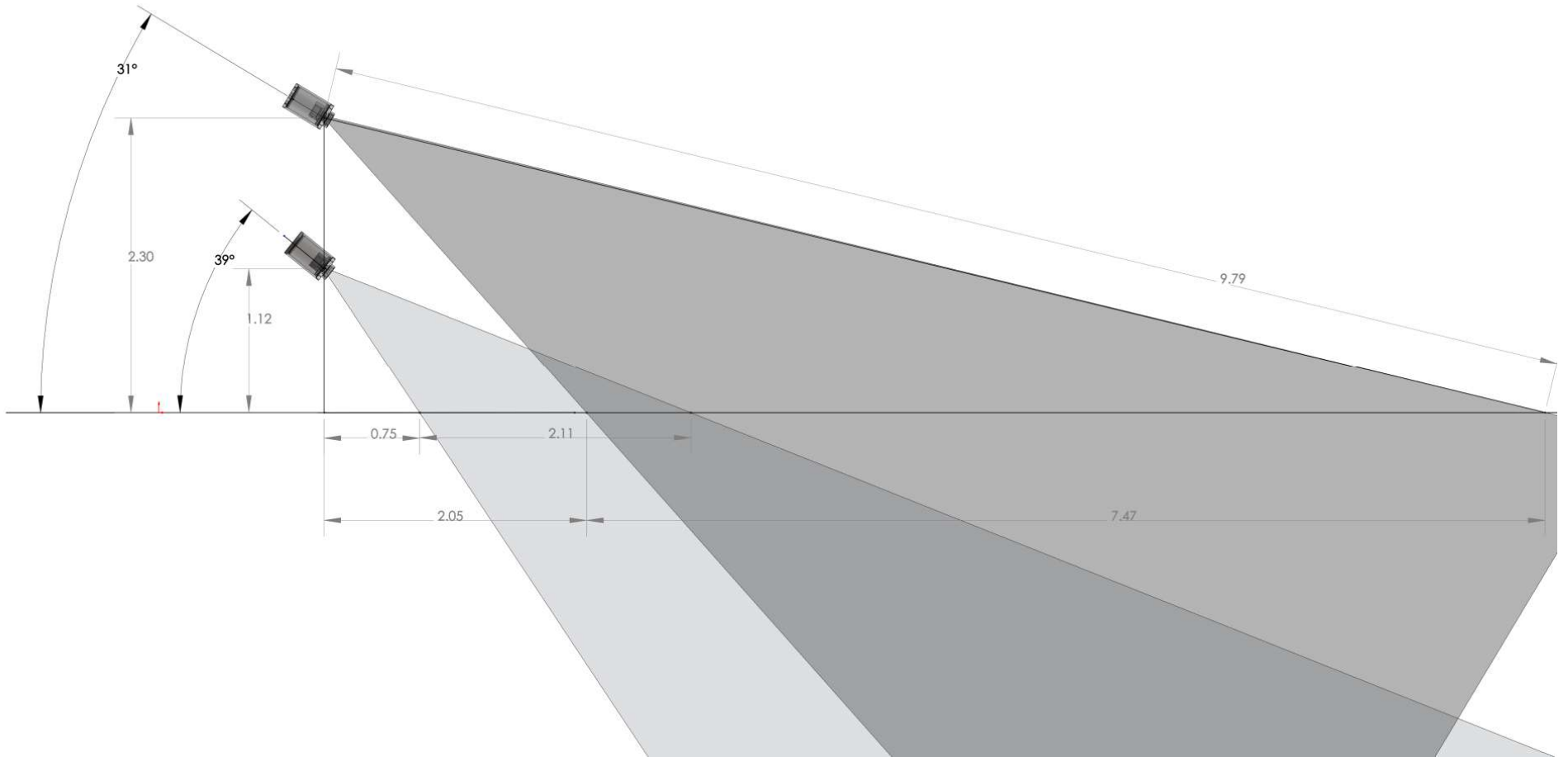
1 picture/hour

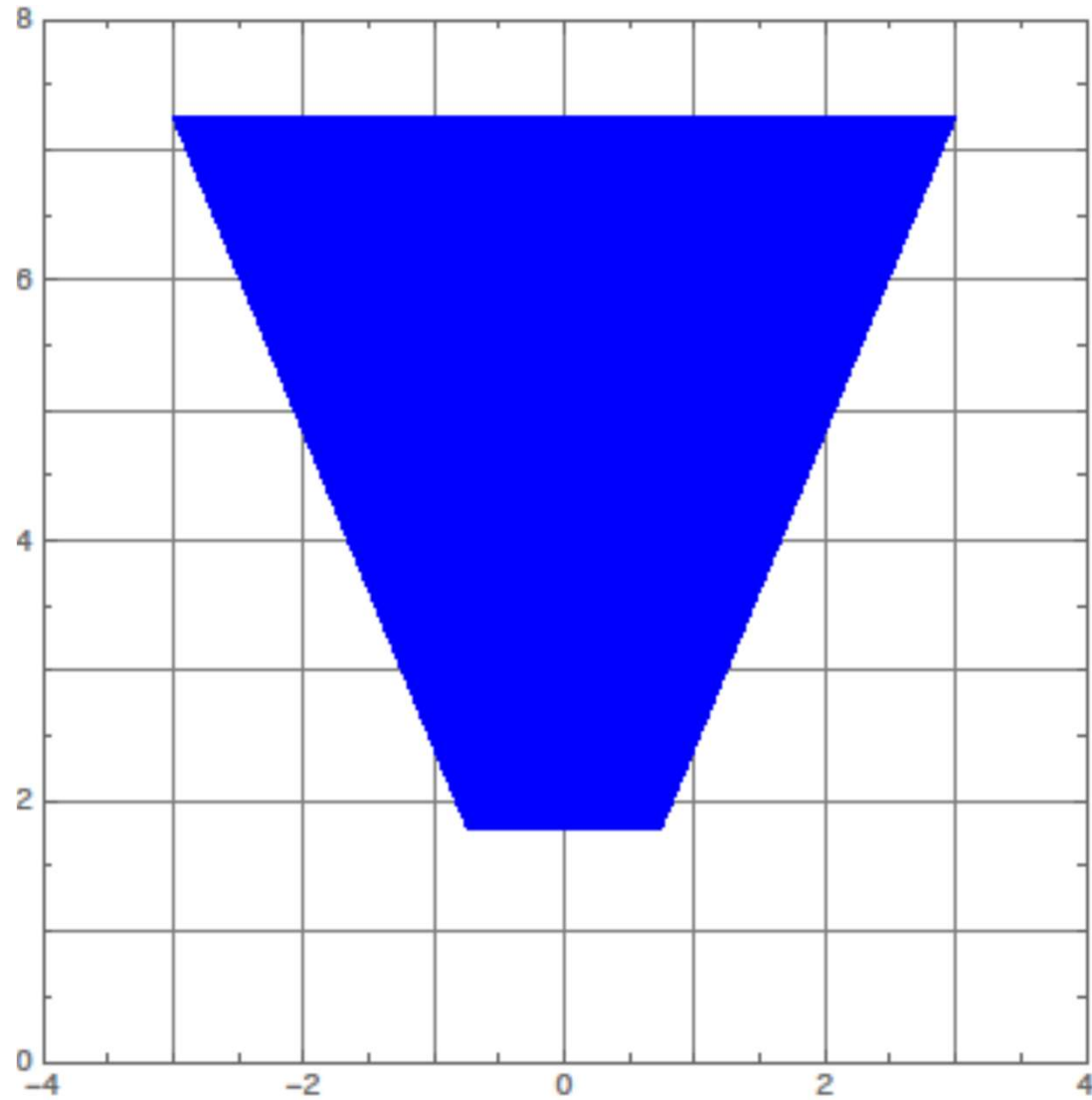
Images 20m² of
seafloor

Duration: 1 year

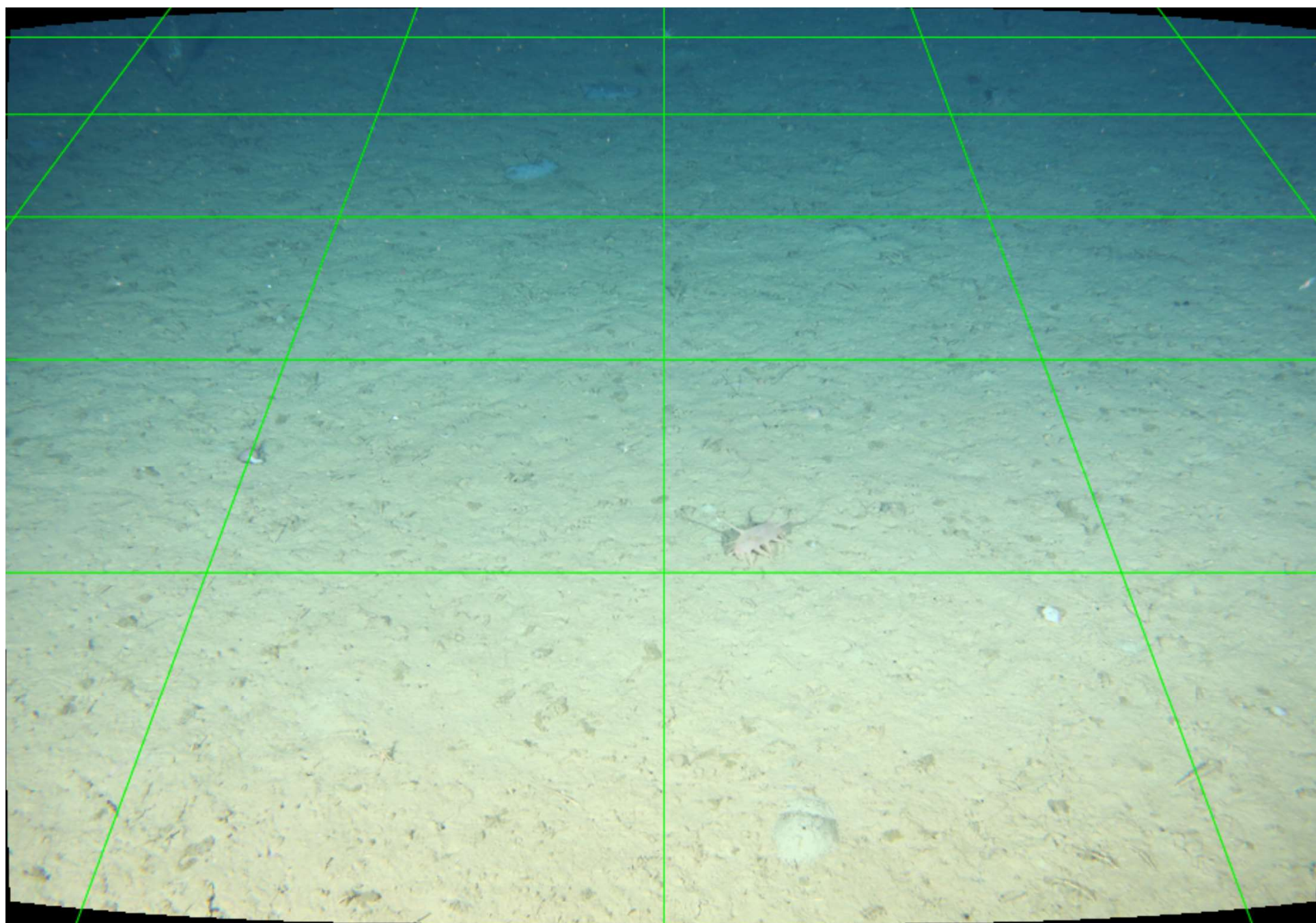
Successful in
field for many
years

Smith Dual Tripod FOV



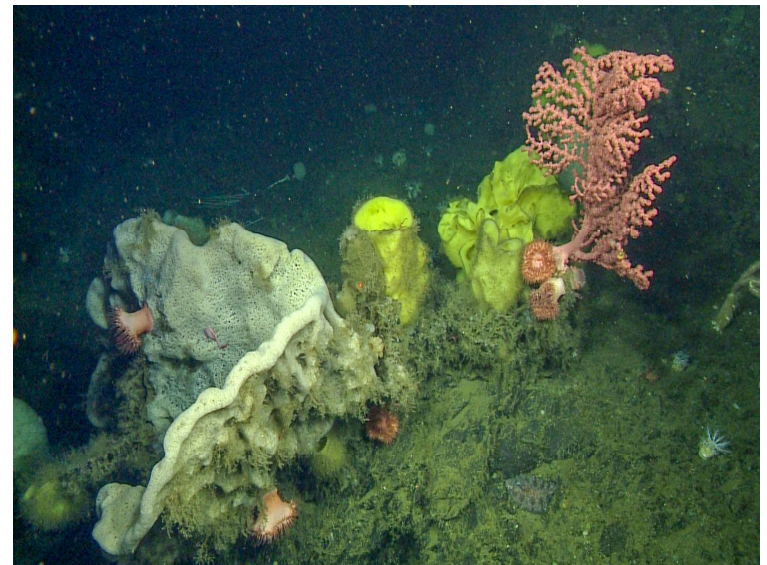
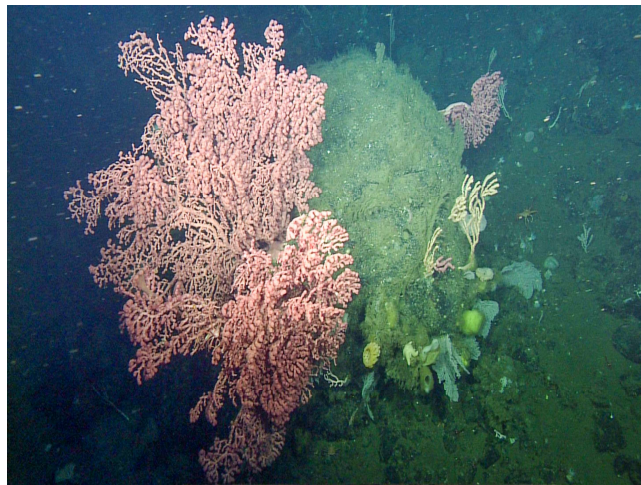


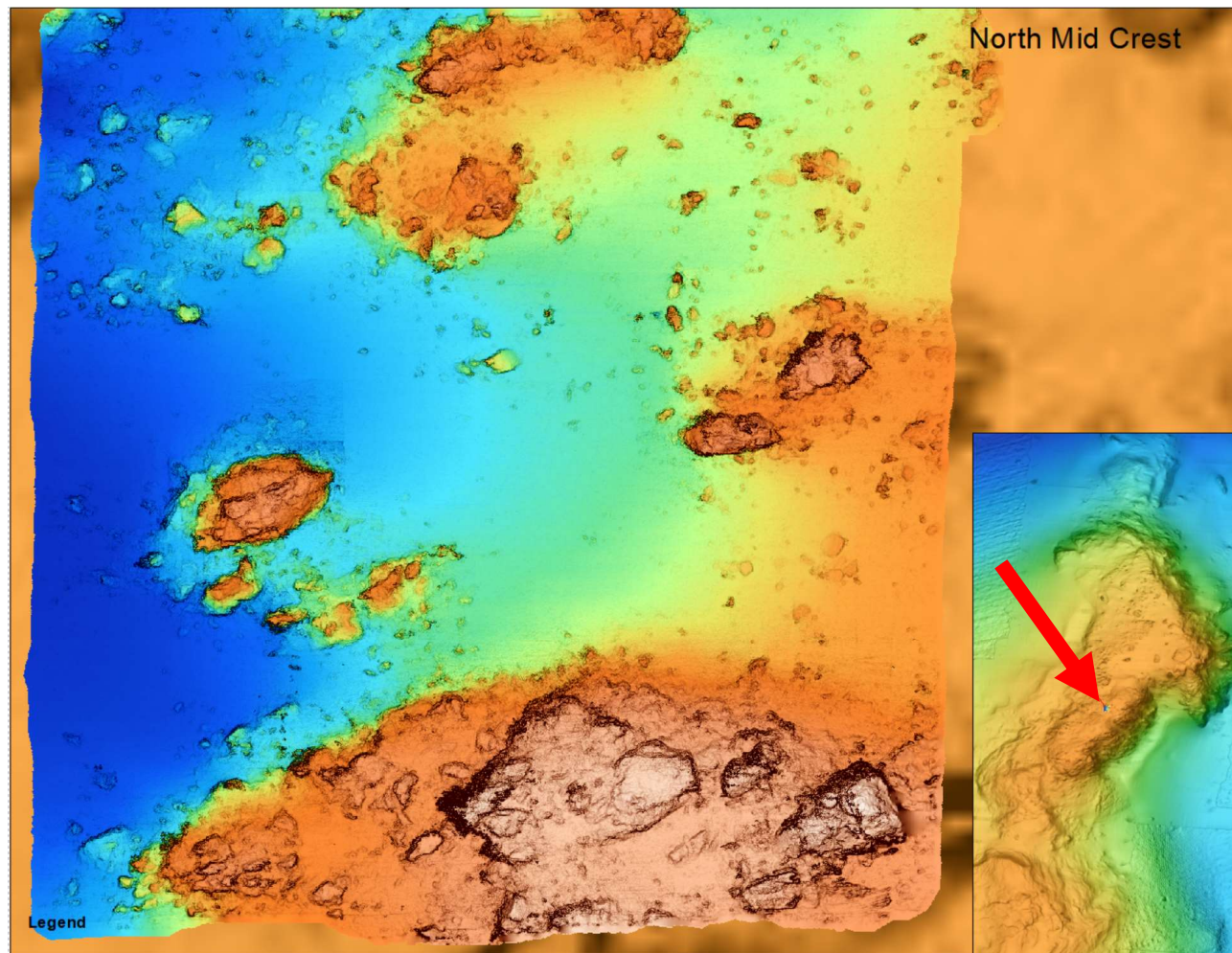
Seafloor area viewed



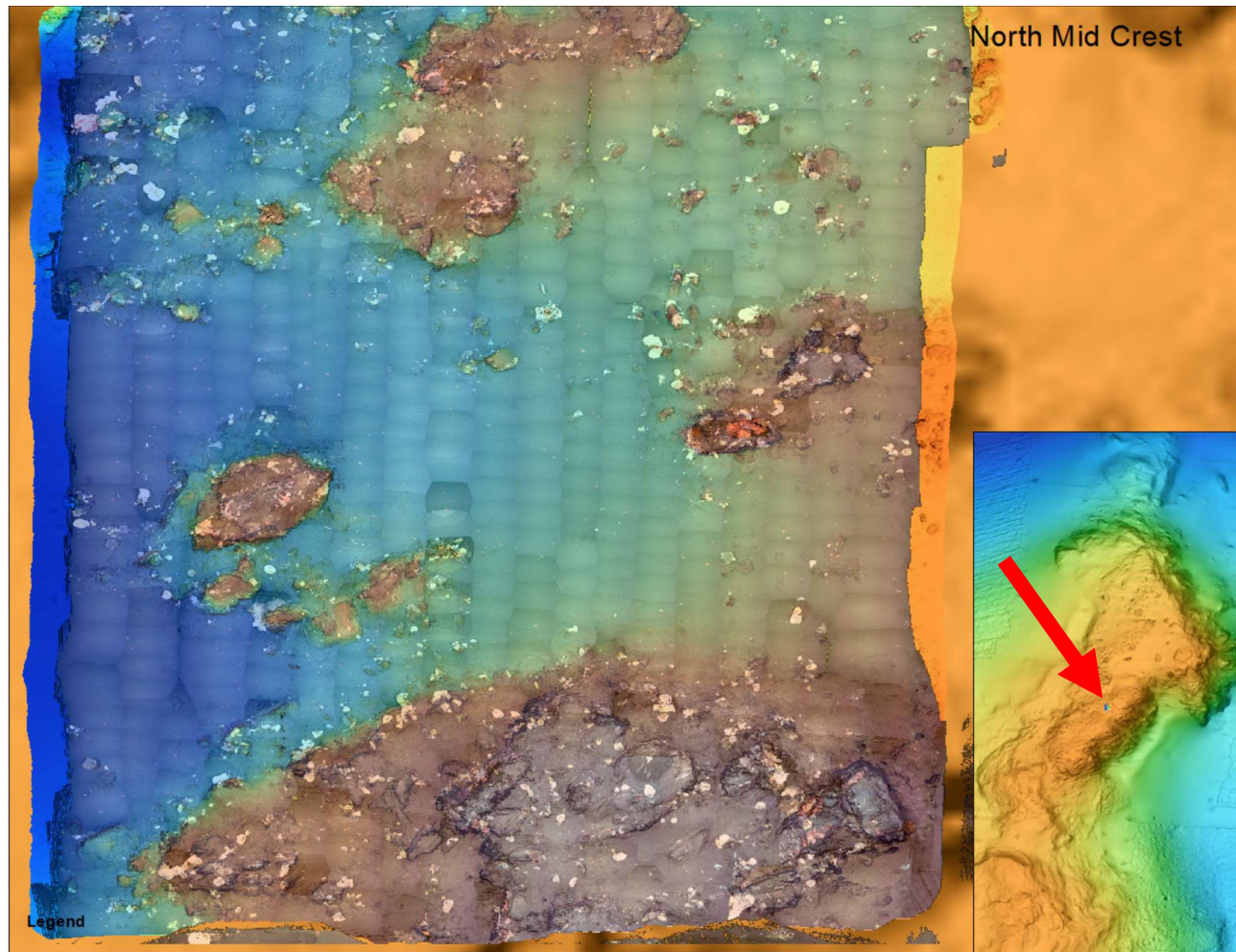
DiSCO Challenges

- More topography
- More visually dynamic targets
- More active area- high currents
- Must be positioned to area of interest





Bathymetry
834 – 845 m
65 m across



Overlain
Video mosaic

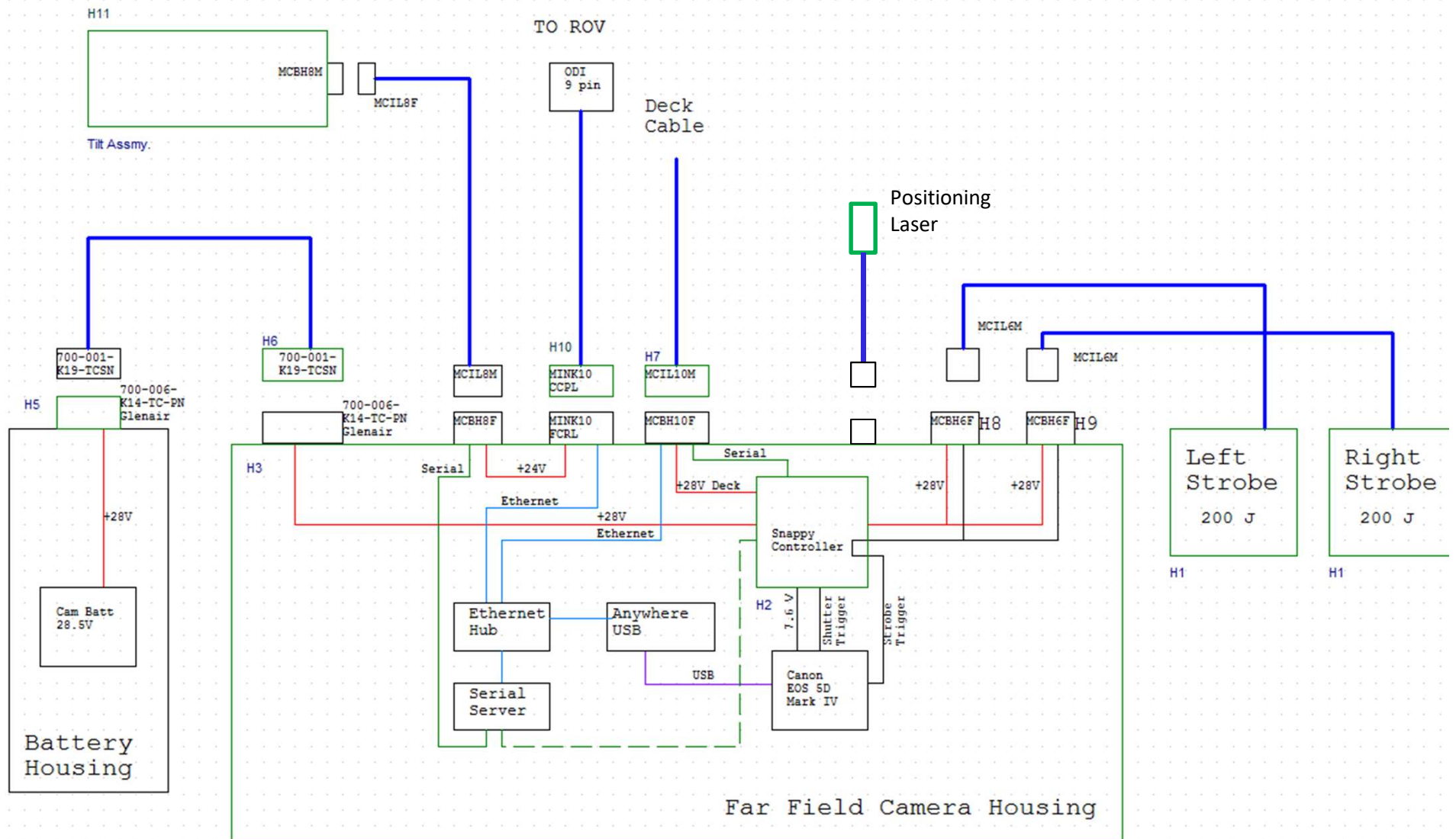


Close up
Rock is 7 m long

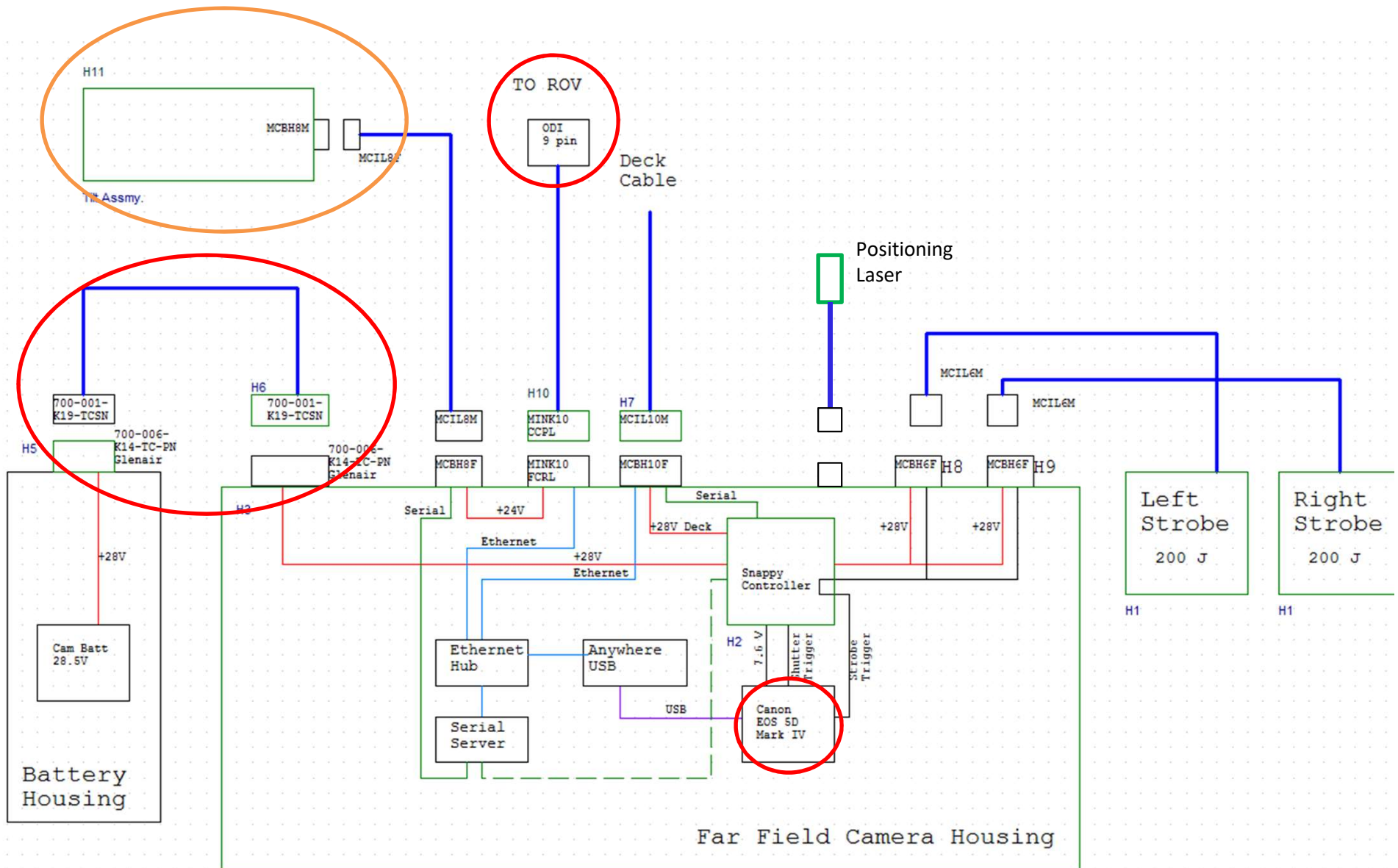
DiSCO Development

- Reuse as much of the Smith system as possible
- Enable real-time image feedback to optimize camera settings
- Build frame that is ROV-moveable and optimized for imaging deepsea coral

DiSCO Block Diagram



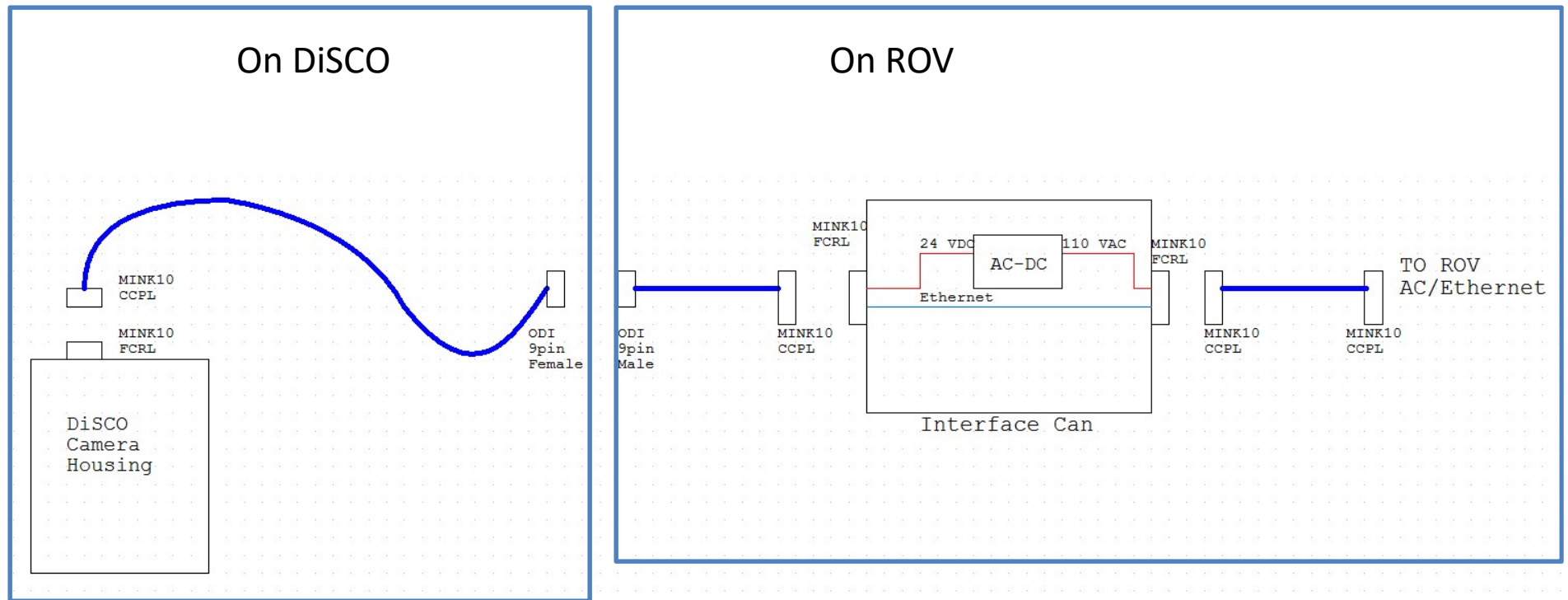
New Components



Real-time Comms with ROV

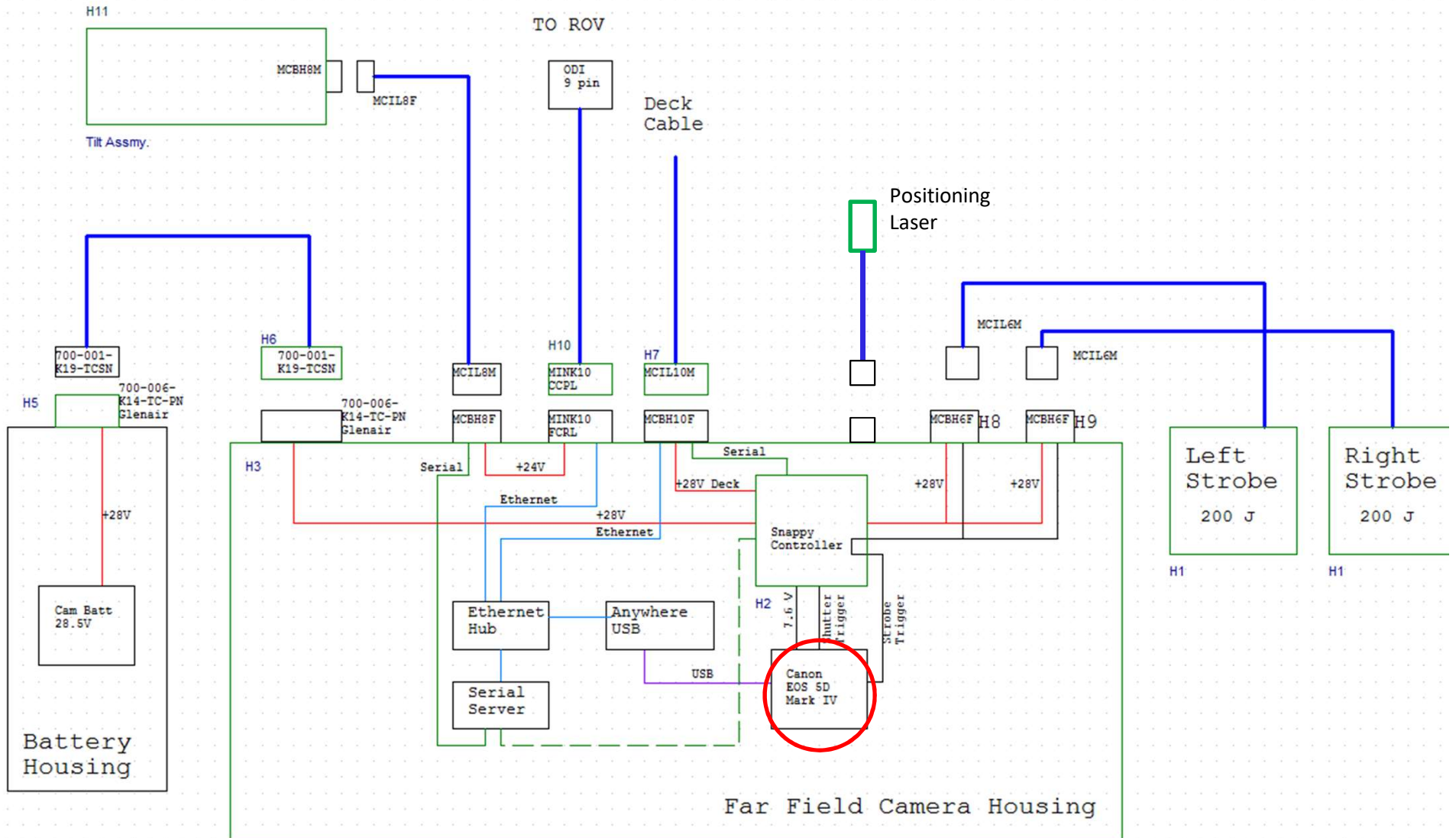
- Talk Ethernet <-> USB to controller and camera
 - Capture and view images
 - Adjust camera settings at start of mission
- Use tilt motor to adjust camera angle. Tilt motor powered from ROV, only on when ODI plugged in
- Does not power or control laser

ROV Connection



ODI on Disco will be on long enough leash to reach the front porch and be stowed in a dummy receptacle.

DiSCO Block Diagram



New Camera

- EOS 5D Mark III now obsolete
- EOS 5D Mark IV is same form factor, sensor size
- Bench testing has not yet revealed any significant issues interfacing with our existing electronics.

	Mark III	Mark IV
Sensor	22.3 Mpixel Full frame	30.4 Mpixel Full frame
FOV (in water, in housing)	h FOV: 44.9 deg vFOV : 33.3 deg	h FOV: 44.9 deg vFOV : 33.3 deg

Energy budget

Energy Use Each Image	
	Energy per image (WHr)
Canon EOS 5D MarkIII	0.02
Strobes (2)	0.446
SUM=	0.466

Hotel power	
	Energy per year (WHr)
Snappy Controller	17

Total Energy per year at one image per hour (WHr)	
Canon + strobes	4082.16
Snappy	17
Sum=	4099.16

Li pack derated= 4.2 kWhr ->8975 pics
(8760 pics/1 yr)

To Be Determined

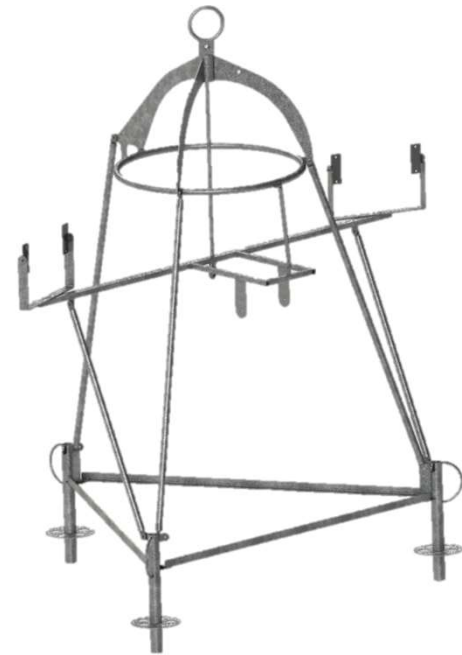
- USB Server
- Connector schedule
- Software changes

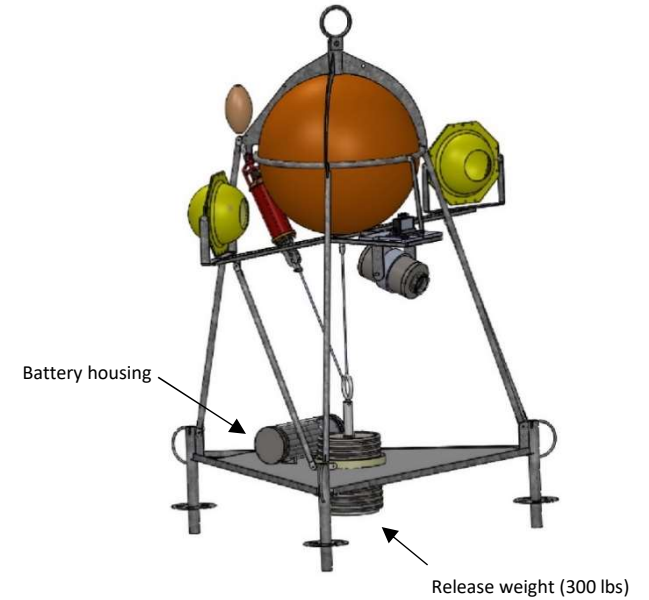
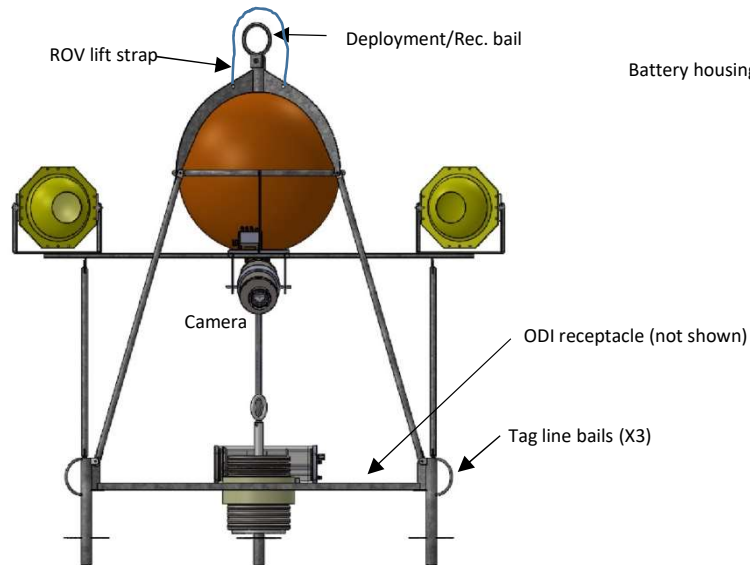
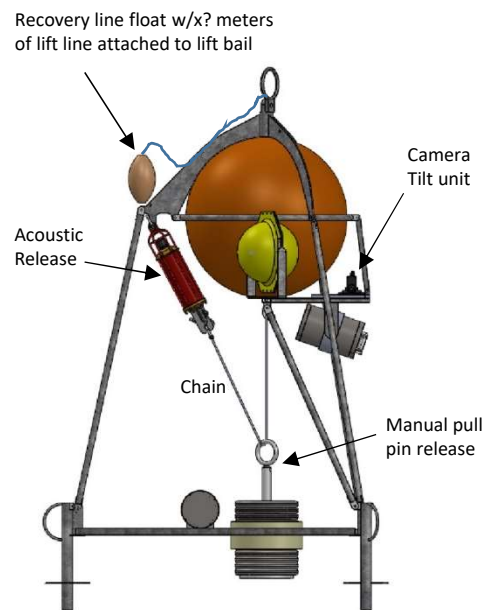
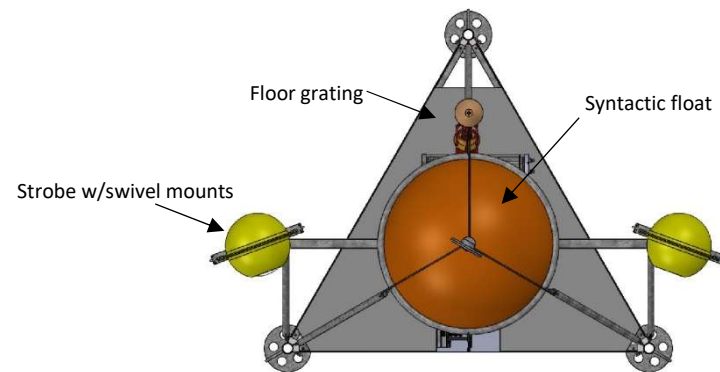
Mechanical Requirements:

- Deploy & recover off the Flyer & Carson
- 2000 meter depth rating (4000 meter would be nice)
- ROV able to move and manipulate position
- Hold position on seafloor in up to 1 knot of current
- Camera approximately 1.5 meters above seafloor
- Acoustic release plus backup manual release by ROV
- Capability to fine tune position of camera

Tripod Frame

- Make design flexible to adapt to future changes/requirements
- Galvanize steel members to reduce cost
- Bolt together frame
- Frame dimensions 10.5'(h) x 9.1'(w) x 5.5'(d)





Air/water weights w/2000 meter foam

- In air weight = 1402
- Drop weight = 300
- In water weight w/drop weight = 111
- In water weight wo/drop weight = -149

Note: 4000 meter foam loses 79 lbs of buoyancy and adds 77 lbs to in air weight

Coral observatory weights						
Item	Qty.	Weight in air	Weight in air (total)	Weight in water	Wt H2O (total)	
Float	1	539	539	-395.00	-395.00	
Flasher	1	2	2	1.40	1.40	
Iridium Beacon	1	8	8	5.00	5.00	
Tilt	1	5	5	3.50	3.50	
Drop weight assembly			351.59		299.51	
Drop weight	1	300	300	259.95	259.95	
Sonardyne release	1	44.09	44.09	33.06	33.06	
Chain	5	1.5	7.5	1.30	6.50	
Camera assembly			47.3		20.77	
Tube	1	17.5	17.5	-3.23	-3.23	
EC front	1	12.4	12.4	9.50	9.50	
EC Rear	1	12.4	12.4	9.50	9.50	
Internals	1	5	5	5.00	5.00	
Battery housing assembly			87.768		42.75	
Tube	1	39.82	39.82	-0.65	-0.65	
EC front	1	11.974	11.974	9.20	9.20	
EC Rear	1	11.974	11.974	9.20	9.20	
Internals	1	24	24	25.00	25.00	
Strobe assembly			74.4		-38.00	
Glass ball (13")	2	24	48	-24.00	-48.00	
Hard hat	2	8.2	16.4	0.00	0.00	
internals	2	5	10	5.00	10.00	
U bracket	2	5.75	11.5	5.00	10.00	
Swivel mounts	4	1.04	4.16	0.90	3.60	
Frame assembly			287.41		171.06	
Frame feet	3	12.2	36.6	10.60	31.81	
Frame base rails	3	10.73	32.19	9.33	27.98	
Frame diagonals	3	8.94	26.82	7.77	23.31	
Strobe support bar	1	18.3	18.3	15.91	15.91	
Strobe diagonal	2	5.95	11.9	5.17	10.34	
Hardware	1	10	10	8.69	8.69	
Lift bail assembly	1	57.5	57.5	49.98	49.98	
plastic floor	1	84	84	-5.75	-5.75	
Camera frame bar	1	1.2	1.2	1.04	1.04	
Camera frame assembly	1	8.9	8.9	7.74	7.74	
Total			1402.468		110.99	

Deployment Opportunities

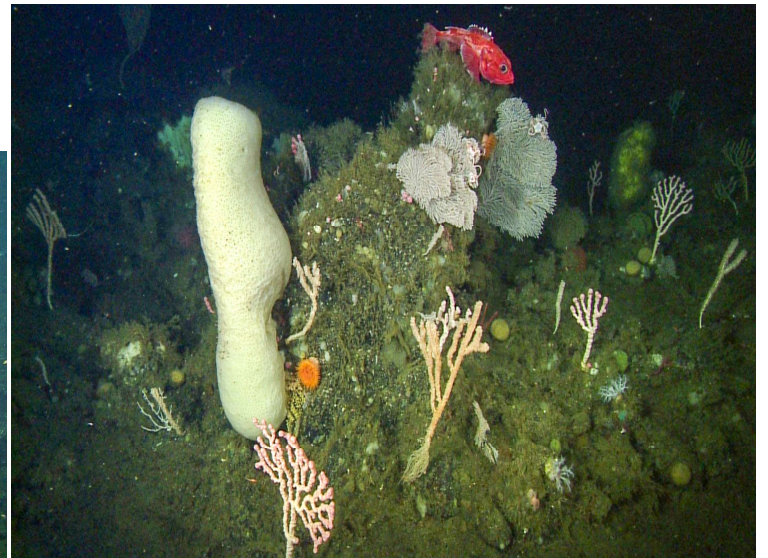
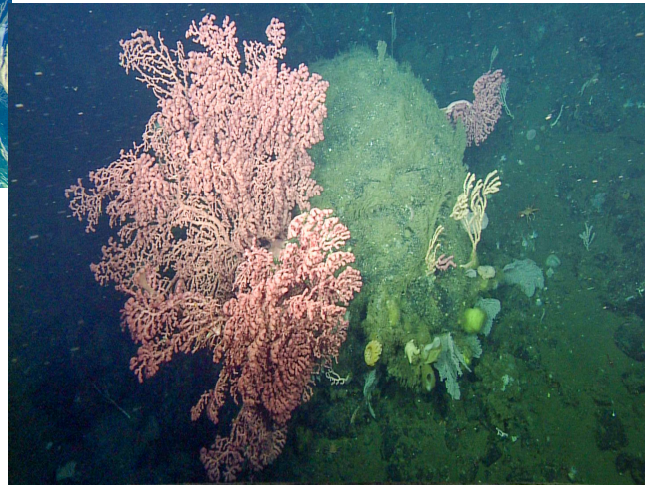
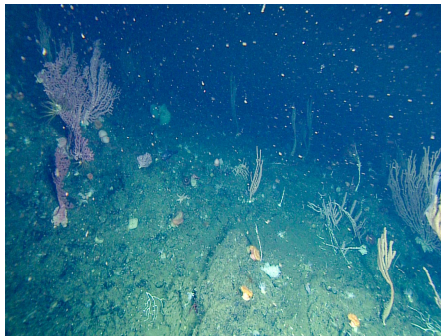
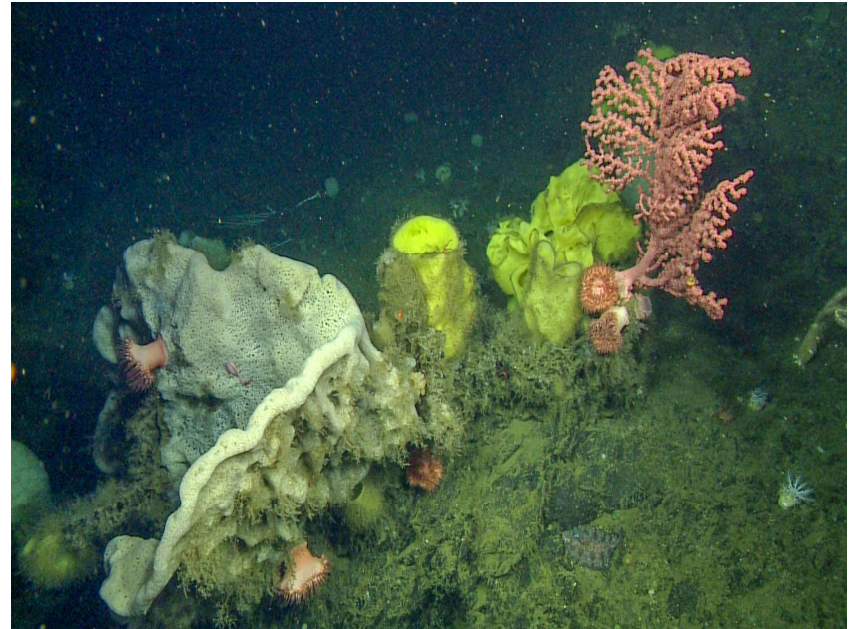
- End of August
- November

Safety Issues

- Battery Housing is pressure vented
- Hard connection to ROV during testing
- Glass spheres housing strobes

Questions?

Supplemental Materials



Glenair Ti Connectors

Pros: cheaper than Seacon Ti connectors

Cons: long lead times



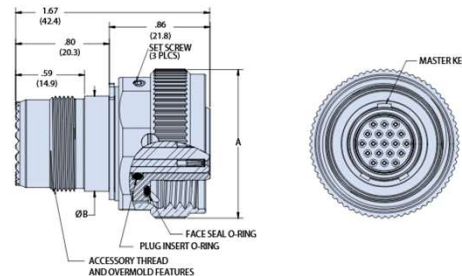
SERIES 70 10K PSI / 700 BAR / 7000 M
SeaKing™ High-Pressure Subsea Connectors, Cables, and PBOF Assemblies
 700-001 cable connector plug (CCP)



SeaKing Plug - How To Order						
Sample Part Number	700	-001-	K19	-Z1	S	N
Product Series	700 = SeaKing™					
Connector Style	001 = Cable connector plug					
Shell Size-Contact Arrangement	See SeaKing contact arrangements table (pgs. 4-5)					
Barrel Material	Z1 = 316 Stainless steel TC = Titanium					
Contact Style	S = Socket					
Alternate Key Position	A, B, C, N = Normal (see alternate key positions table)					

NOTES

- Double O-ring sealing in mated condition
- Mates with 700-006 / -007 series SeaKing receptacles of the same size and polarization
- Retractable coupling nut facilitates O-ring servicing
- Material/Finish
 - Barrel: 316 stainless steel or titanium
 - Coupling nut: marine bronze
 - Contacts: Copper alloy, gold plated
 - Insulator: Composite thermoplastic
 - Set screw: 316 stainless steel
 - O-ring: Nitrile (NBR)



SERIES 70 10K PSI / 700 BAR / 7000 M
SeaKing™ High-Pressure Subsea Connectors, Cables, and PBOF Assemblies
 700-006 flange connector receptacle (FCR)

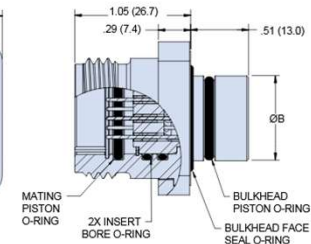
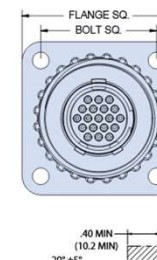


SeaKing FCR - How To Order						
Sample Part Number	700	-006-	O19	-Z1	P	N
Product Series	700 = SeaKing™					
Connector Style	006 = Flange connector receptacle					
Shell Size-Contact Arrangement	See SeaKing contact arrangements table (pgs. 4-5)					
Shell Material	Z1 = 316 Stainless steel TC = Titanium					
Contact Style	P = Pin					
Alternate Key Position	A, B, C, N = Normal (see alternate key positions table)					

NOTES

- Double O-ring sealing:
 - Flange and piston O-rings to bulkhead
 - Dual piston O-rings at insert
 - Flange and piston O-rings in mated condition
- Mates with 700-001 series SeaKing
- Material/Finish
 - Shell: 316 stainless steel or titanium
 - Contacts: Inconel X750, gold plated
 - Insert: Inconel X750
 - Insulator: Fused vitreous glass
 - O-ring: Nitrile (NBR)

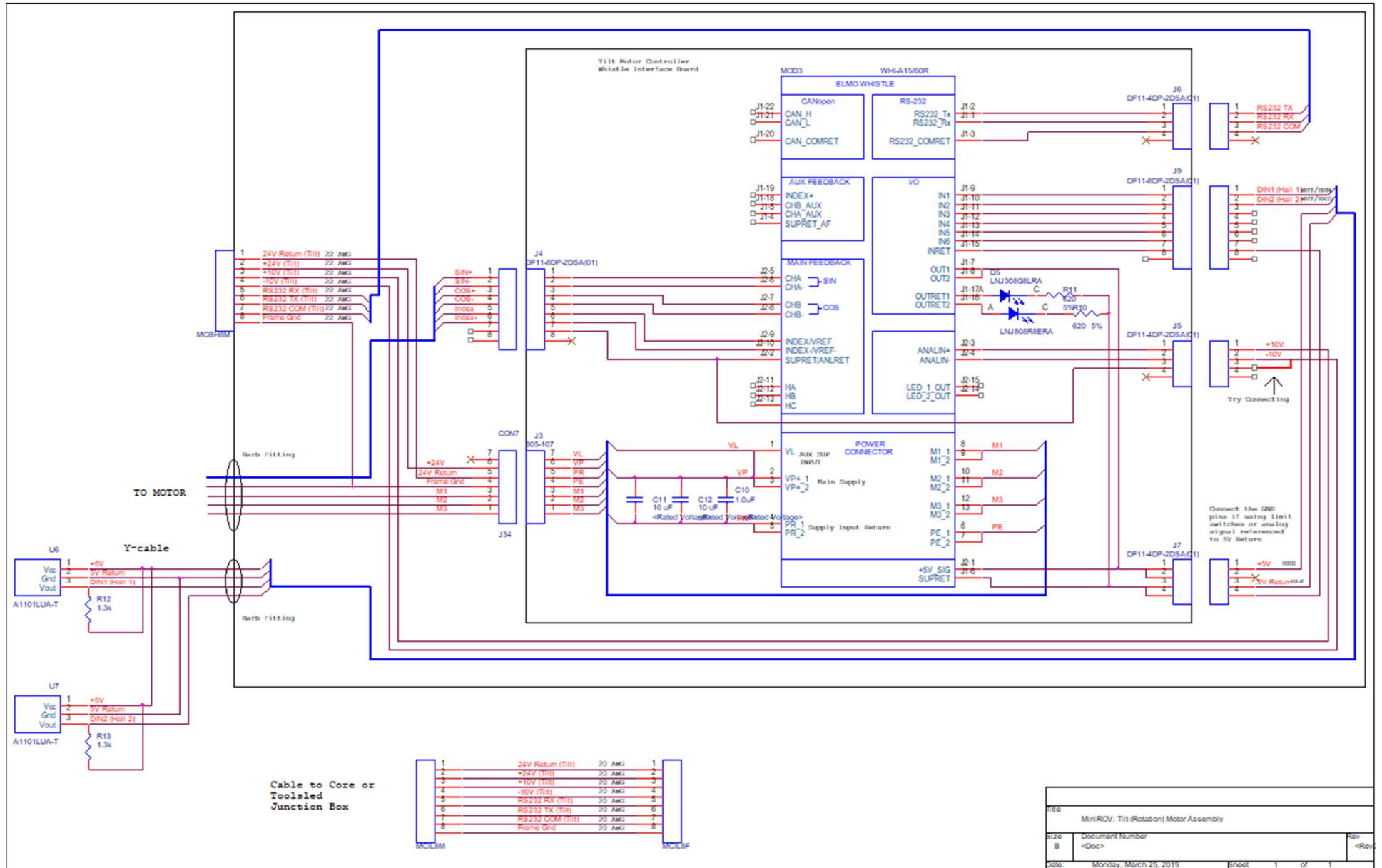
Alternate Key Positions



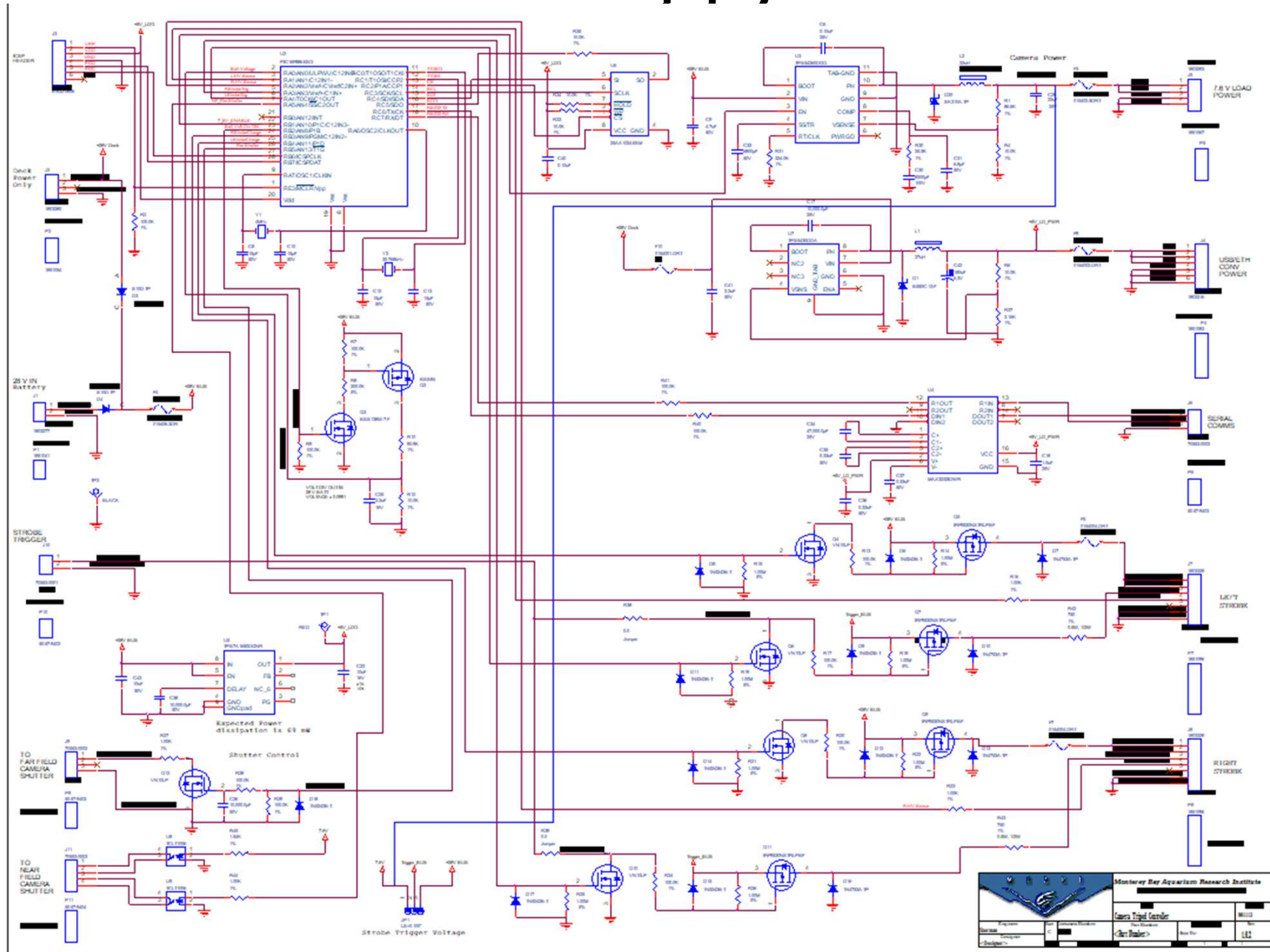
EPWATER: SEAKING™

PWATER: SEAKING™

Tilt Motor



Snappy



Snappy Energy budget

Camera Tripod Battery pack:

Lithium primary,

48 D-cells total in a configuration: 8S6P

D-cell are Electrochem p.n. CSC93

Each D-cell: 30 AHr, 3.5 Vnom, 3.9 Voc

Tripod Pack: 31.2Voc, 28Vnom

Each cell derated for cold by 16% so 25 AH per cell

Pack estimated capacity: $6 * 25 \text{ AHr} * 28 \text{ V} = 4.2 \text{ kWhr}$

Energy per image (camera + strobes) = 0.44 WHr (conservative estimate, bench measurements were closer to 0.343 WHr/image)

For a one year deployment: 365 days * 24 images/day = 8760 images ->

$8760 \text{ images} * 0.44 \text{ WHr/image} = 3.854 \text{ kWhr}$ for one year of images

Energy left for controller: $4.2 \text{ kWhr} - 3.9 \text{ kWhr} = 0.3 \text{ kWhr}$

Controller duty cycle is approximately 2 min per 60 min so awake for 3% of the time asleep for 97 % of the time.

Awake current estimate (based on Rover wakey): 2 mA

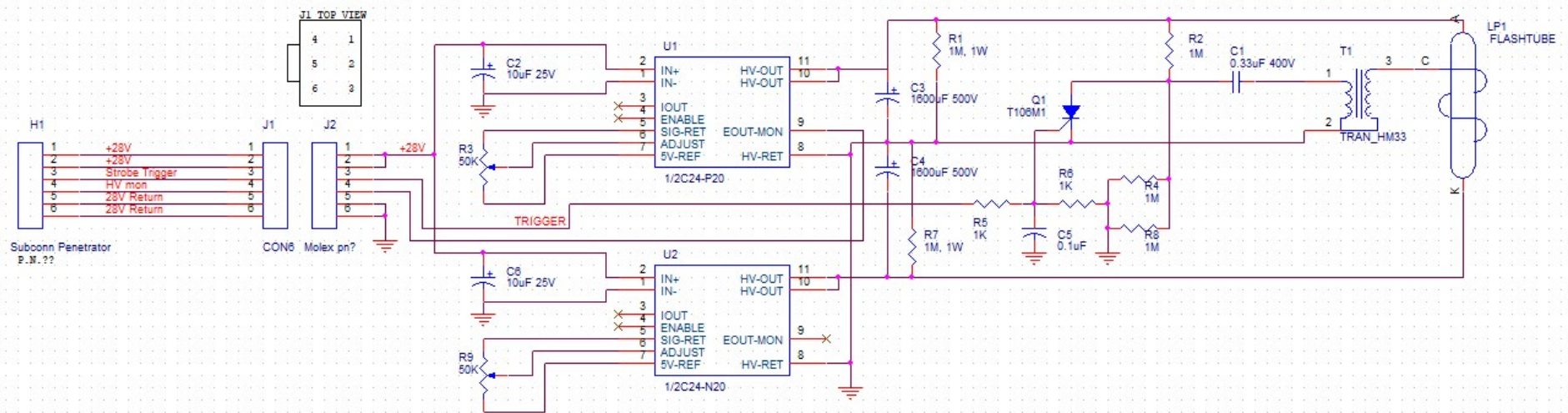
Sleep current estimate: 30 uA

$(8760 \text{ hours/year} * 0.97) = 8497 \text{ hours}$

$8497 \text{ Hrs} * 30 \text{ uA} * 28 \text{ V} = 7.2 \text{ WHr}$

$263 \text{ Hrs} * 2 \text{ mA} * 28 \text{ V} = 9.8 \text{ WHr}$

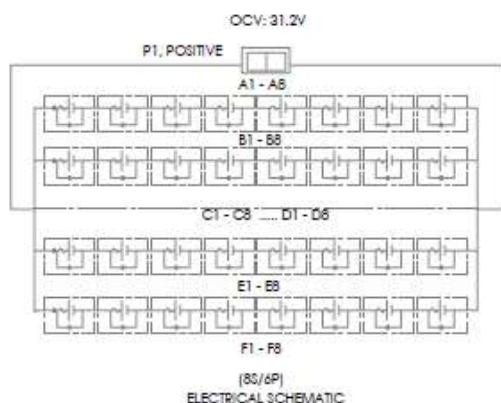
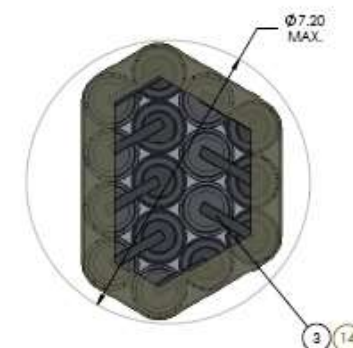
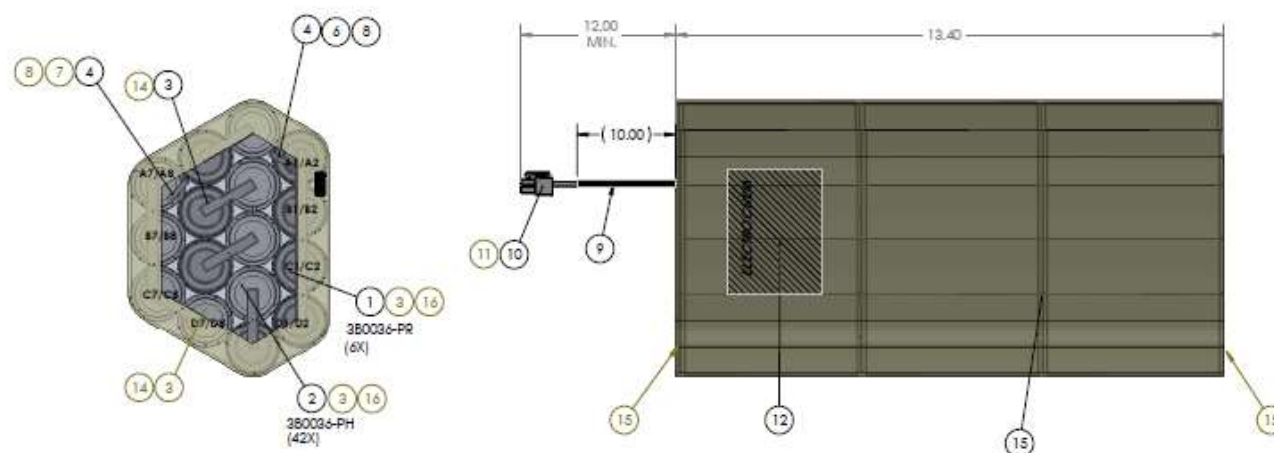
Strobe



Ultravolt 1/2C24-N20
Input: +23-30V
Up to +32 for derated power

ITEM NO.	QTY.	DESCRIPTION	PART NUMBER
1	6	CELL MODEL CSC92 DO (SERIES/SHUNT)	380036-PP
2	42	CELL MODEL CSC92 DO (SHUNT)	380036-PH
3	41	LEAD NICKEL .005 X .125 X 1.50 LGS	90019C-05
4	2	LEAD NICKEL .005 X .250 X 1.50 LGS	90019C-06
5	A/R	HOTMELT ADHESIVE	90110-02
6		WIRE TFL INSUL 15.00 LGS. (18AWG - RED)	90131-53
7	1	WIRE TFL INSUL 15.00 LGS. (18AWG - BLK)	90131-57
8	2	SHRINKTUBE .093 DIA.	90104-03
9	1	SHRINKTUBE .187 DIA.	90104-02
10	1	CONNECTOR HOUSING (MOLEX: 39-01-2020)	50016-86
11	2	TERMINAL CRIMP (MOLEX: 39-00-0039)	50017-53
12	1	LABEL BP	383936
13	1	SHRINKWRAP PVC	90088-0
14	A/R	TAPE KAPTON	90098-03
15	3	INSULATOR VULC FIBER	90104-02
16	16	SHRINKWRAP PVC (CELL STRINGS)	90088-03

REVISIONS				
REV.	DESCRIPTION	DATE	BY	ECN #
1	CONCEPT	10/11/10	ML	



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		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL: $\pm$ ANGULAR: MACH $\pm$ BEND $\pm$ TWO PLACE DECIMAL $\pm$ 0.02 THREE PLACE DECIMAL $\pm$ 0.010		Greatbatch	
		MATERIAL		Clarence, NY ELECTROCHEM Raynham, MA	
		FINISH		ASSY. BATTERY PACK (8S/6P)	
		DO NOT SCALE DRAWING		DWG. NO. 3PD1516	
NEXT ASSY		USED ON		SCALE: 1"=1"	
APPLICATION				WEIGHT:	
				SHEET 1 OF 1	

