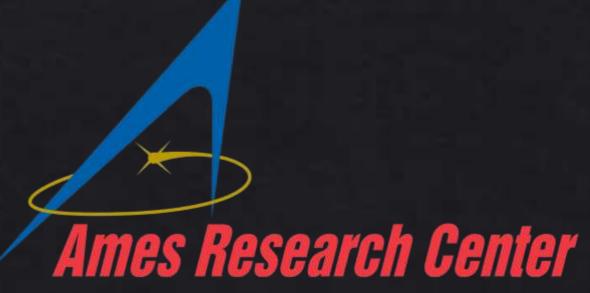


Capstone Senior Design 2018–2019

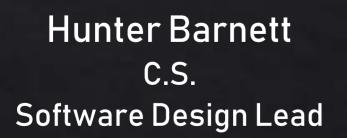


SPACE COMMUNICATION UTILIZING BACKBONE EXISTING NETWORKS

Preliminary Design Review December 2018



Meet the Team



Avery Brock E.E. Electrical Design Lead Team Lead

YiYang E.E. **Electrical Design** Budget Manager

SCUBEE PDR

Hunter Kanniainen M.E. Mechanical Design Lead Client POC

Tim White M.E. Mechanical Design Secretary





Project Objectives

Objective MIS-1

 The project shall develop the hardware module and software package required to achieve a live network connection from a cube satellite in low earth orbit to a remote ground-based server using the Iridium Core 9523 satellite communication module

Objective MIS-2

 The project shall further develop and optimize the Tube Deployable Reentry Vehicle (TDRV), a three-stage reentry vehicle launched from an orbital payload at the Von Karman altitude







SCUBEE 54

Project Research



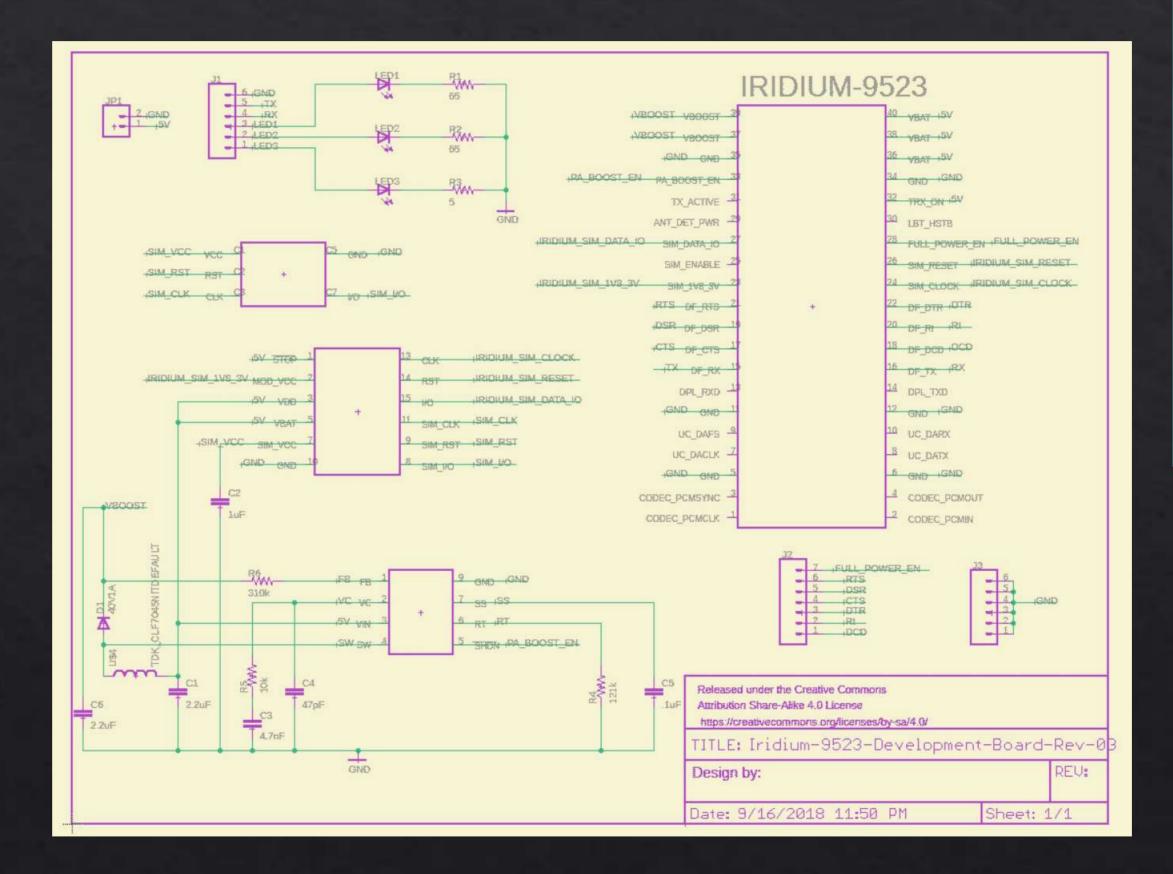
Team Rocket 2016-2017

Team Goals:

- Creation of carrier PCB for Iridium 9523
- Initial development of Arduino library
- Testing of NAL A3LA-RS Iridium module

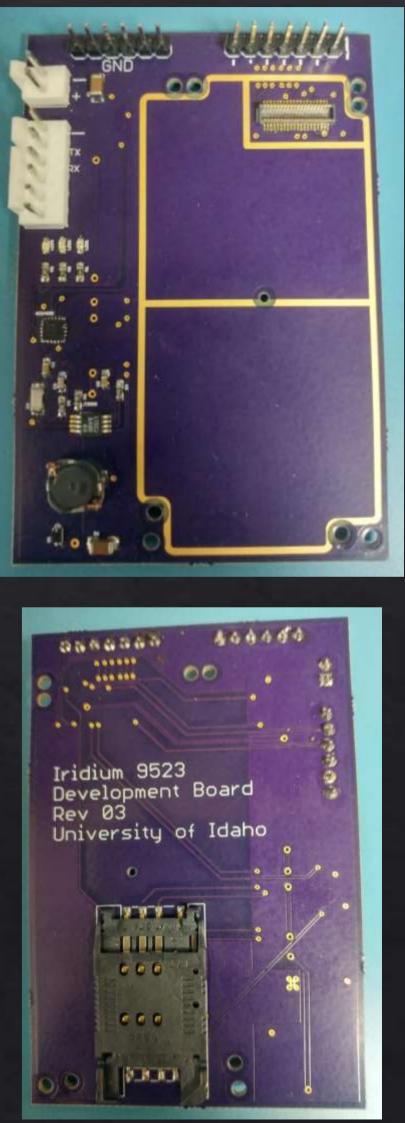
Results:

- Unable to communicate with 9523 on custom PCB
- Successful communication with NAL module (handshake)
- Unreliable satellite network connection



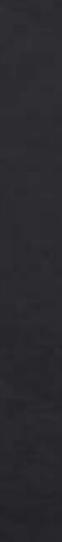
SCUBEE PDR

Team Rocket Schematic and PCB





5



Team ACOM 2017-2018

Team Goals:

- Develop software for the Raspberry Pi to use the 9523 as a dial-up modem
- Create a remote server to send data to
- Test a ZigBee mesh network
- Create and test fly a prototype TDRV

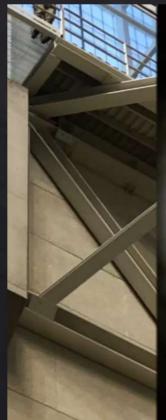
Results:

- Unable to establish dial-up connection
- Initial ZigBee code written, no mesh testing
- Single TDRV test in Kibbie
 Dome

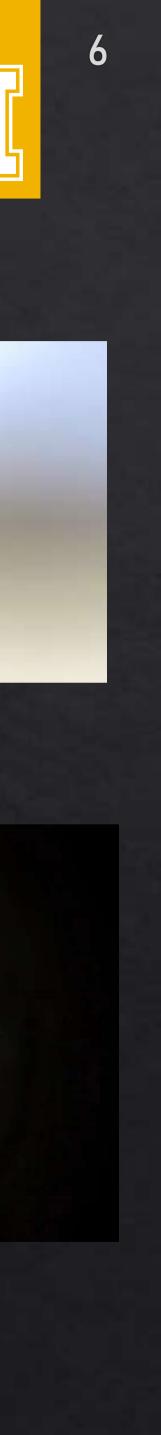








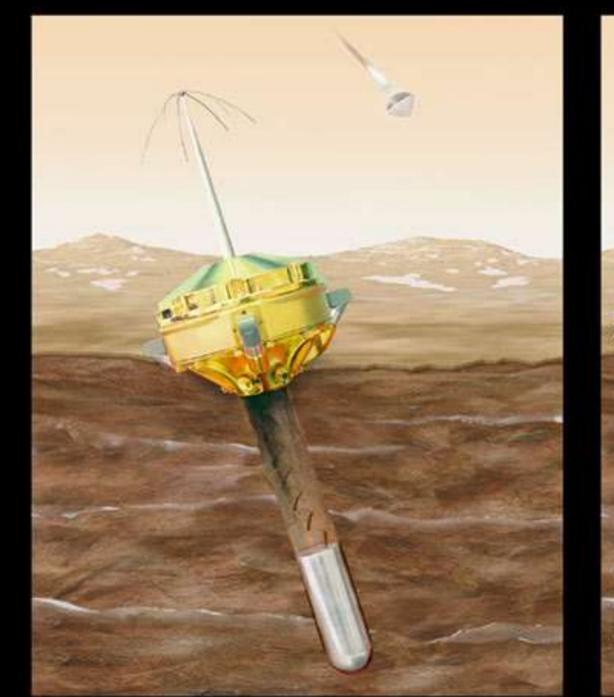


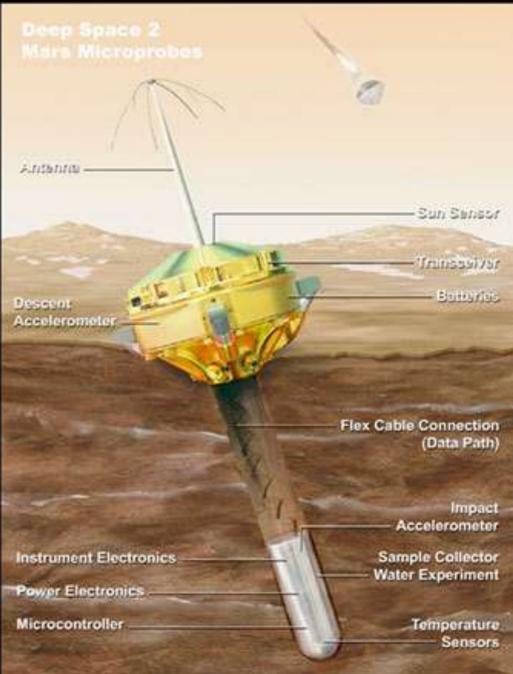


Deep Space Two

- Purpose: •
 - Use a two part probe modeled as the DS2 shape to penetrate the surface of Mars to test the working design for spacecraft landing without a parachute.
- Result: •
 - Mission declared failure after no • communication with probes could be established.
- Possible Reasons for Failure: •
 - Radio/probe destruction upon impact • (too rough of terrain)
 - Battery charge failure •







NASA JPL







Iridiu





um Cores O	verview			S	CUB
Iridium [®] IoT	reaching network to exte	nd the high value of intelligent	verage the power of the world's data beyond the barriers of terre cations, this range of proven ha	estrial	· iridium [.] Everywhere
Reliable Data Connectivity for Fixed and Mobile Use.		omers to quickly utilize Iridium's	unrivalled global network to co		
Absolutely Everywhere.	A CEFE	THE REAL PROPERTY OF THE REAL	Entrate and		
	Iridium 9602	Iridium 9603	Iridium Core 9523	Iridium 9522B	Iridium Edge ™
FORM FACTOR	Board-to-Board	Board-to-Board	Board-to-Board	Black Box	IP67 rated
DIMENSIONS	41 x 45 x 13mm	31.5 x 29.6 x 8.1mm	70.44 x 36.04 x 8.9mm (H)	162 x 81 x 28mm	130 x 80 x 30 (H)
INTERFACES	AT + Command	AT + Command	AT + Command	AT + Command, RS 232 Digital/Analogue	RS232 AT command interface On/Off Control lines
POWER REQUIREMENTS	+5 V +/- 0.5 V	+5 V +/- 0.5 V	+3.2 V to +6 V	+4.0 VDC to +32 VDC	Power Supply (9-32V), SAE J1455, Load dump protected Reverse Polarity Protection
POWER CONSUMPTION	Idle 35 mA Transmit 140 mA Receive 40 mA	Idle 34 mA Transmit 145 mA Receive 39 mA	Idle 70 mA Transmit 300 mA Receive 110 mA	Idle 220 mA Transmit 800 mA Receive 800 mA	1.6W (peak for short transmit burst), Low Power Modes: < 200uA
OPERATING TEMP RANGE	-40°C to +85°C	-40°C to +85°C	-30°C to +70°C	-30°C to +70°C	-40°C to +85°C
VIBRATION AND SHOCK	EN60068-2-14:2000 EN 60068-2-36:1996 EN60068-2-27:1993 J1455	EN60068-2-14:2009 IEC60068-2-64: 2008 EN60068-2-27: 2009 SAE J1455	EN60068-2-14:2009 IEC60068-2-64: 2008 EN60068-2-27: 2009 SAE J1455 MILSTD 810	EN60068-2-14:2000 EN60068-2-32:1993 EN60068-2-27:1993 EN 60068-2-6:1996 SAE J1455:1994	SAE J1455 SAE J1555
TYPICAL APPLICATIONS	Personnel and asset tracking, fleet management, environ- ment and safety monitoring, remote automation and control	Personnel and asset tracking, fleet management, environ- ment and safety monitoring, remote automation and control	Maritime, aviation and mobile markets	Maritime, aviation and mobile markets	Asset tracking, fleet management, environ- ment and safety monitoring, remote automation and control
DEVELOPMENT KIT AVAILABLE	YES	YES	YES	N/A	YES
SERVICES	SBD [™] , Iridium Burst [●]	SBD sM , Iridium Burst®	SBD [™] , CSD, SMS, RUDICS, TELEPHONY	SBD SM , CSD, SMS, RUDICS, TELEPHONY	SBD sM , Iridium Burst®
AVERAGE LATENCY	<20 seconds per 340 bytes (MO)	<20 seconds per 340 bytes (MO)	<45 seconds for 1KB message (MO and MT)*	<45 seconds for 1KB message (MO and MT)*	<20 seconds per 340 bytes (MO)
MAJOR NETWORK AND REGIONAL CERTIFICTIONS	FCC, IC, RED, CE, Anatel, Australia, RoHS, others	FCC, IC, RED, CE, Anatel, Australia, RoHS, others	FCC, IC, RED, CE, Anatel, Australia, RoHS, others	FCC, IC, RED, CE, Anatel, Australia, RoHS, others	Iridium® satellite network certification, FCC, IC, RED, CE, Anatel, Australia, RoHS





Iridium 9523 Core Overview

Iridium 9523 consists of a single PCB with components mounted on top and bottom sides.

Top side: three reservoir capacitors, the RF connector, and a screening can covering all remaining circuits.

Bottom side: a Molex 40-pin multi-way user interface connector



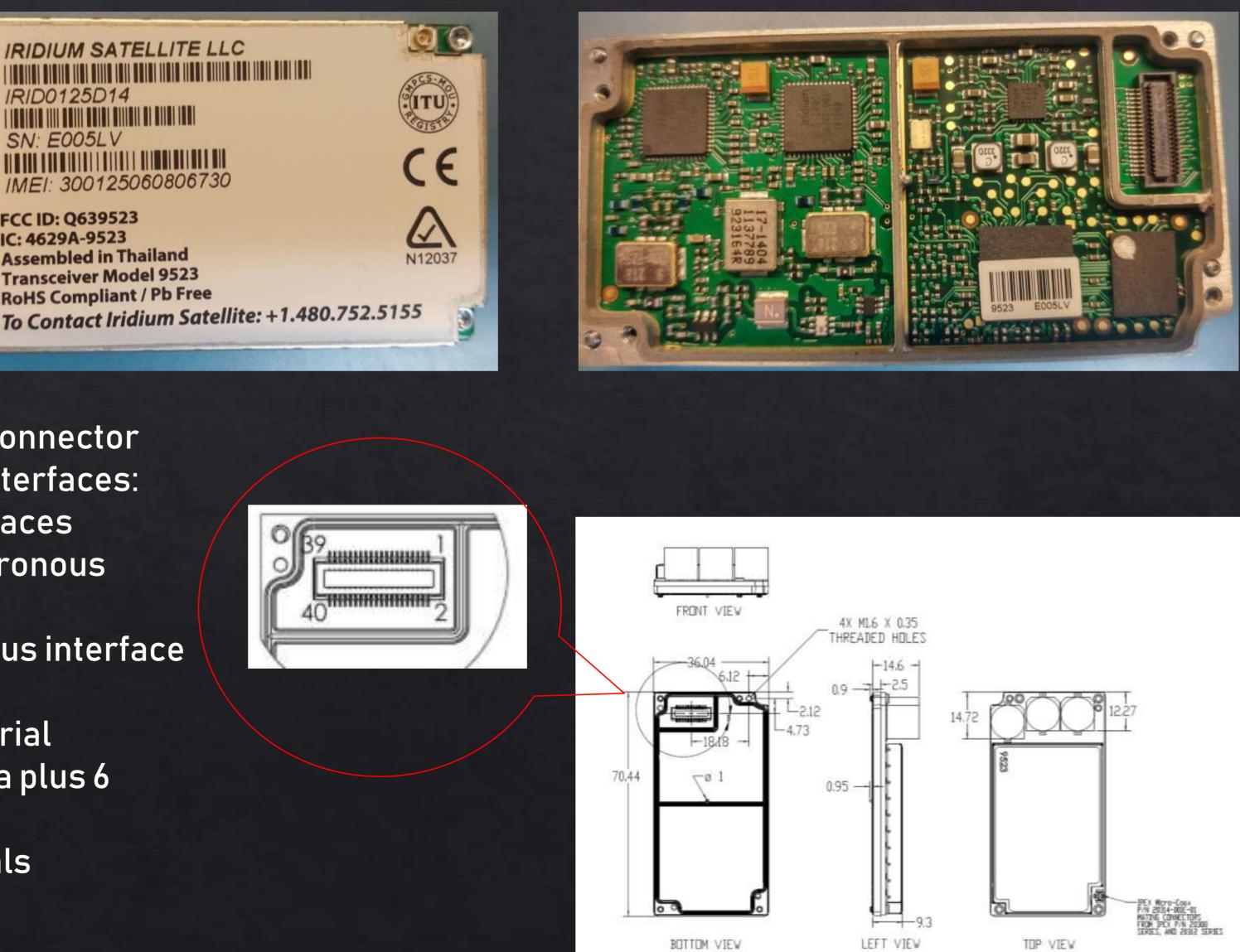
IRID0125D14 SN: E005LV IMEI: 300125060806730

FCC ID: Q639523 IC: 4629A-9523 **Assembled in Thailand Transceiver Model 9523 RoHS Compliant / Pb Free**

40-way inter-PCB connector with the following interfaces:

- Digital audio interfaces
- DPL serial asynchronous control port
- Serial asynchronous interface for SIM
- Data/Fax port serial asynchronous data plus 6 control signals
- GPIO control signals
- Power

SCUBEE **PDR**



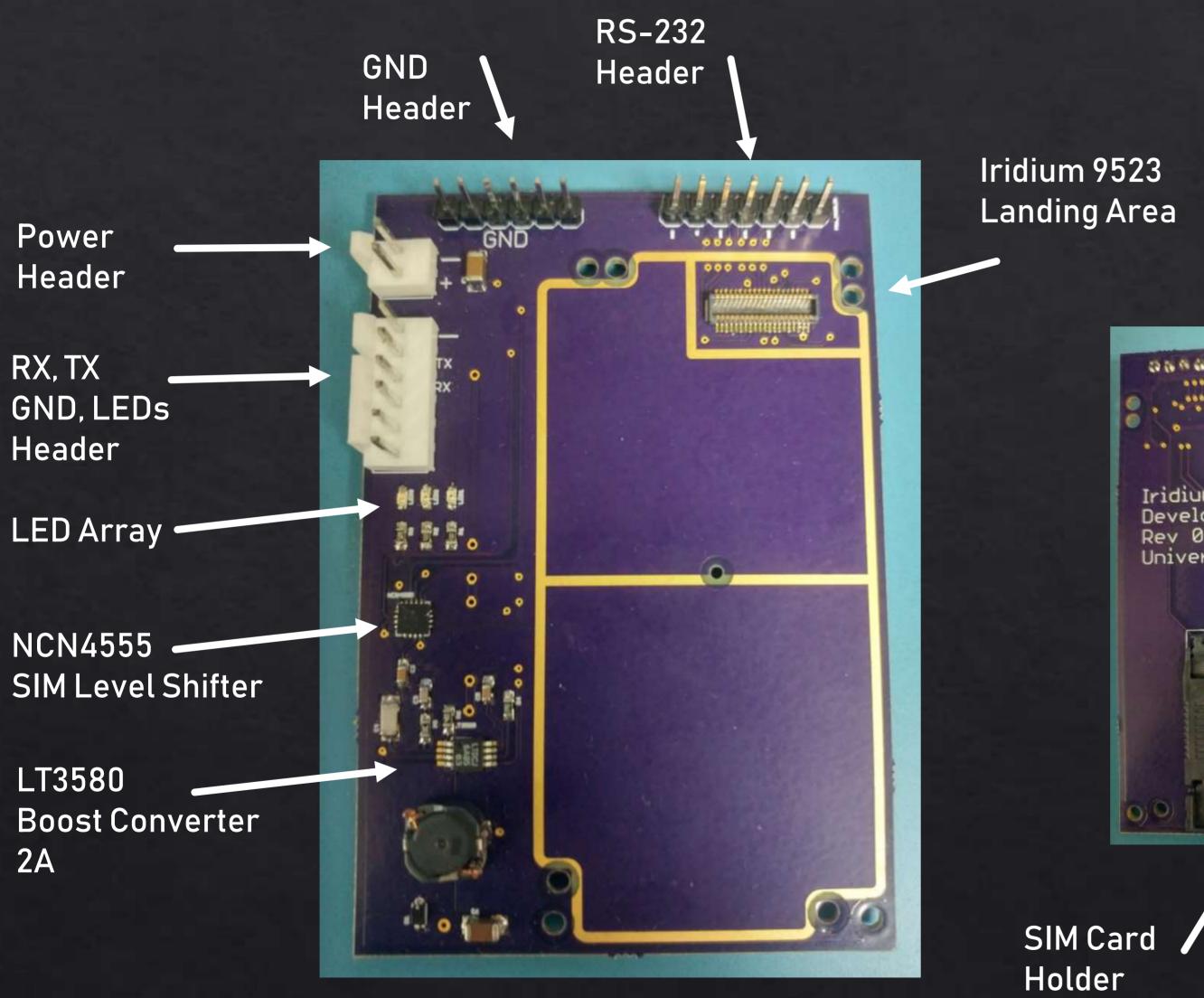
BOTTOM VIEW



TOP VIEW

9

Existing PCB Analysis

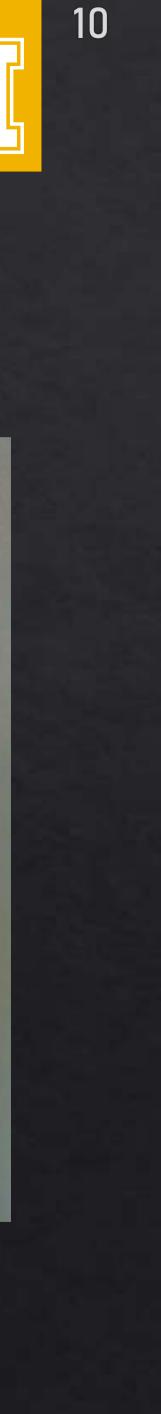


SCUBEE PDR



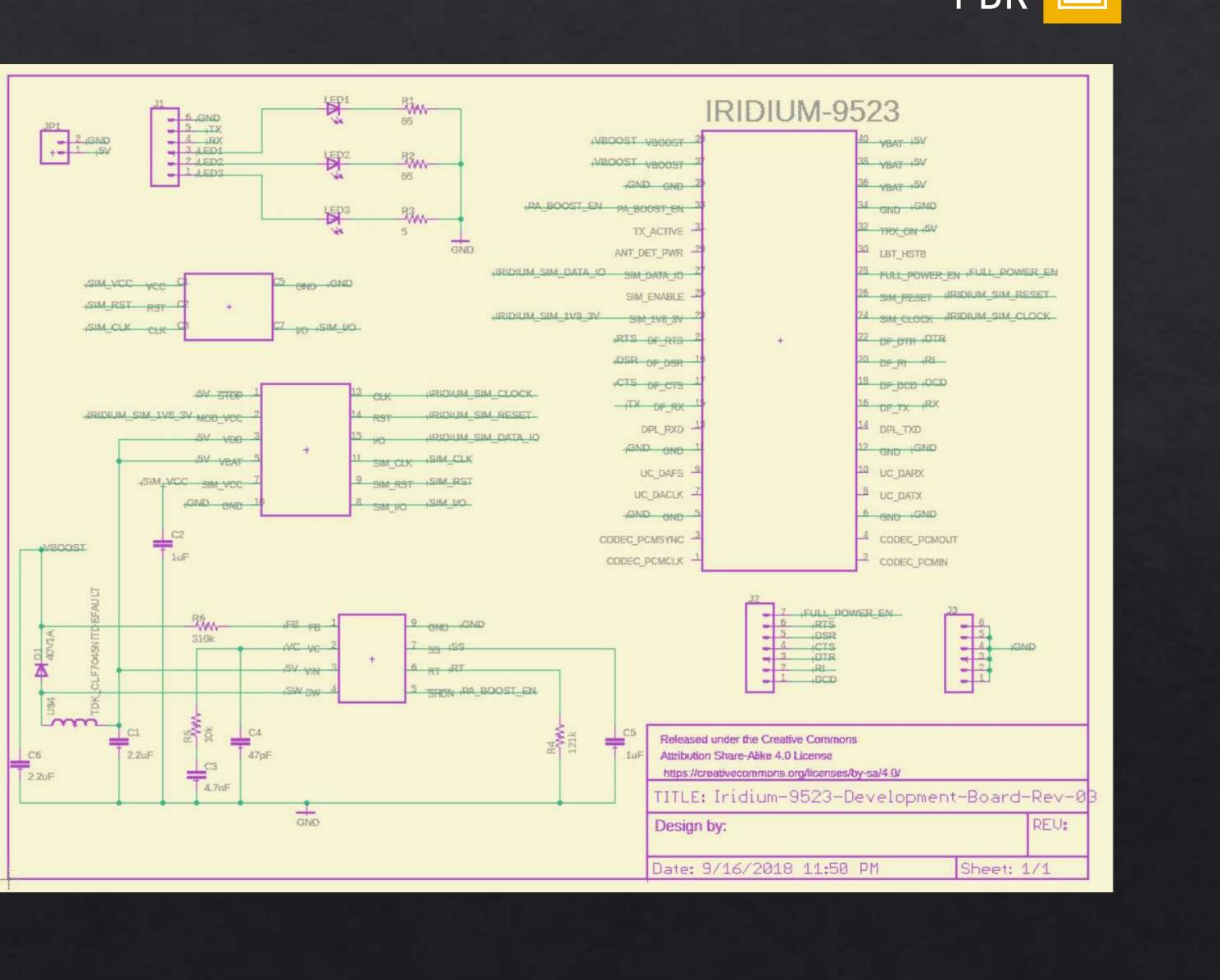
9523 Footprint Test



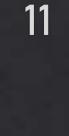


Existing PCB Analysis

- All components are Iridium recommended
- What purpose do LEDs serve?
- Why is there a six-pin ground header?
- Why does the Iridium not function?

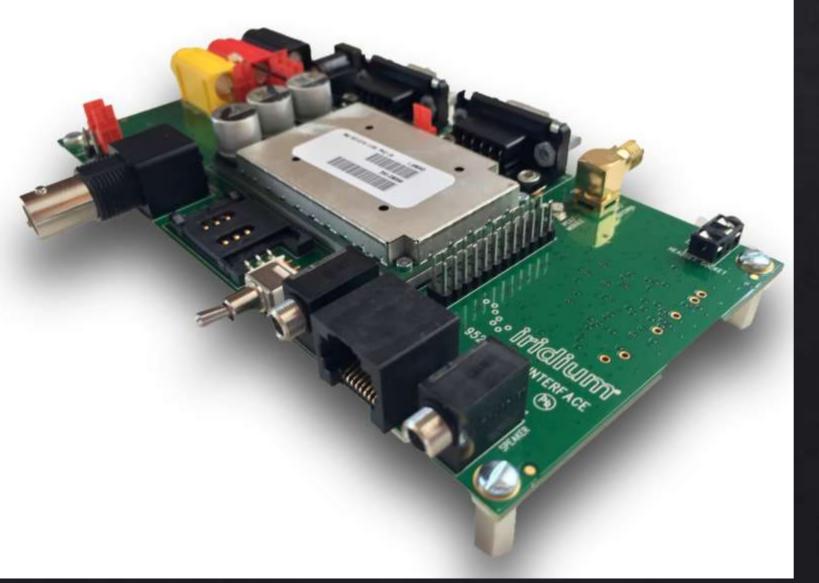


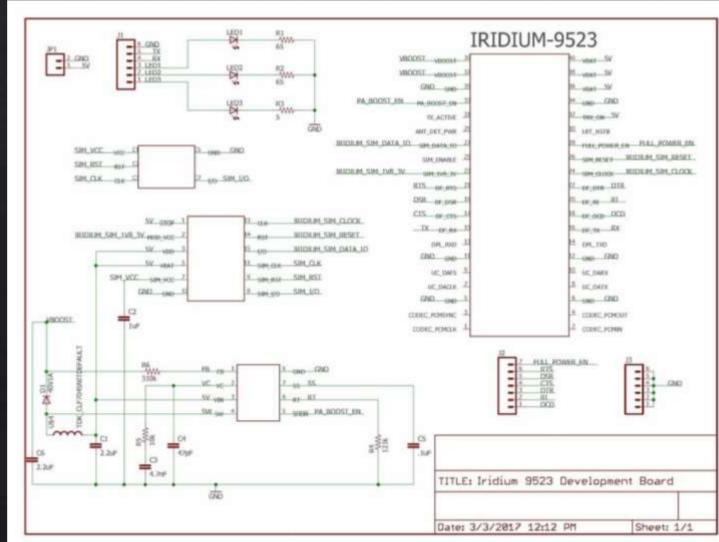




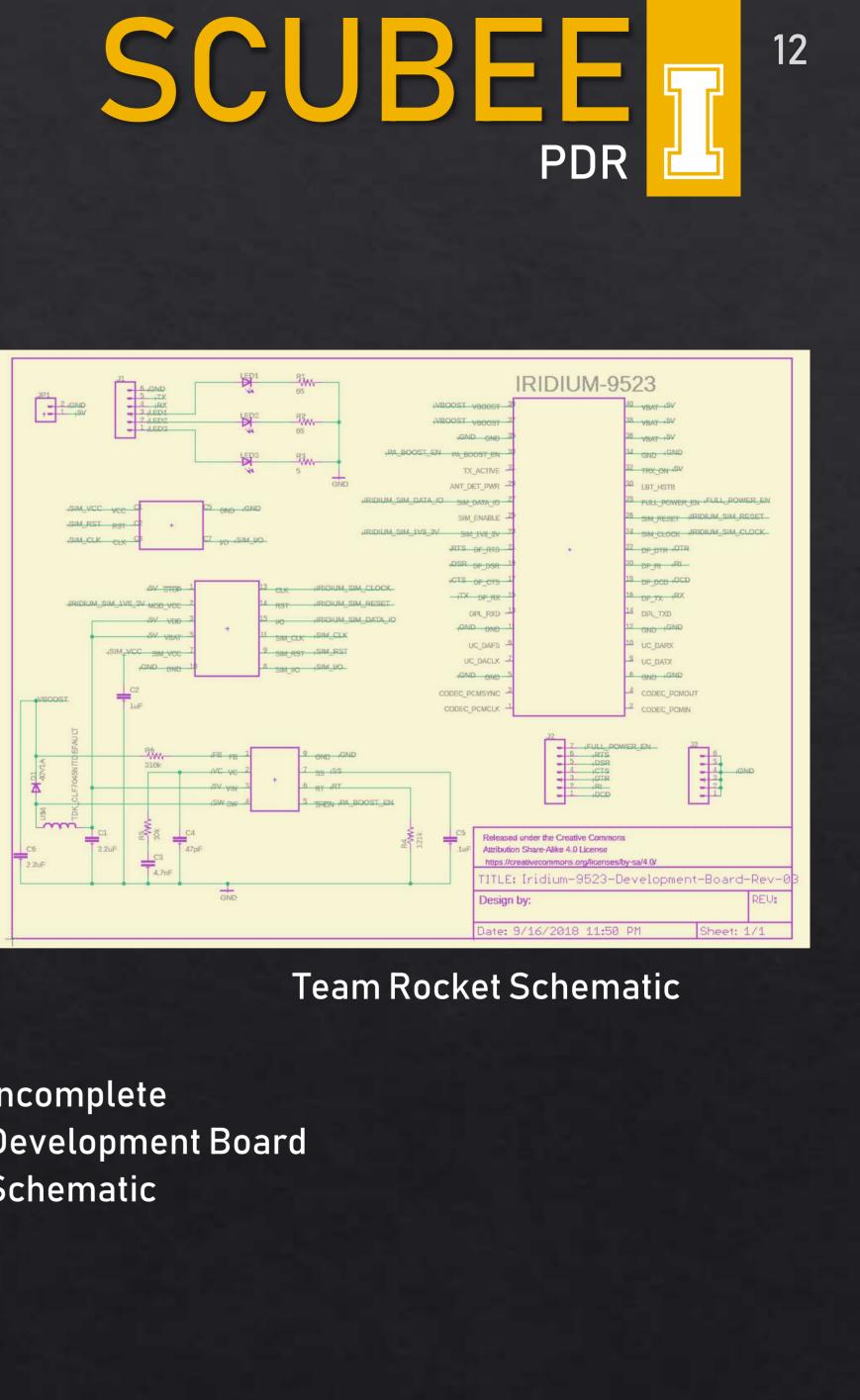
Existing PCB Analysis

- PCB is an incomplete copy of the 9523 Development Board
- Pin 30 (mode select) and GPIO float
- Iridium likely never entered modem mode •





PDR





Incomplete **Development Board** Schematic

Existing Software Analysis

Team ROCKET - Does not collect data - Uses short-burst data - Does not log data

+ Initializes the modem - Uses CRLF as a command terminator - Uses a 340/270 byte buffer + Has documentation

Team ACOM + Collects data - Uses short-burst data + Logs data

- Does not initialize the modem + Uses CR as a command terminator - Does not use a buffer Does not have documentation

SCUBEE PDR

at+sbdwt="test" Sent: at+sbdwt="test" at+sbdwt="test"

at+sbdi Sent: at+sbdi at+sbdi

+SBDI: 1, 7, 0, 0, 0, 0

at+sbdwt="moscow,id" Sent: at+sbdwt="moscow,id" at+sbdwt="moscow,id"

at+sbdi Sent: at+sbdi at+sbdi at+sbdi Sent: at+sbdi +SBDI: 1, 8, 0, 0, 0, 0 100001 (000 10001 100000

ACOM SBD Test



NAL A3LA-RS Analysis

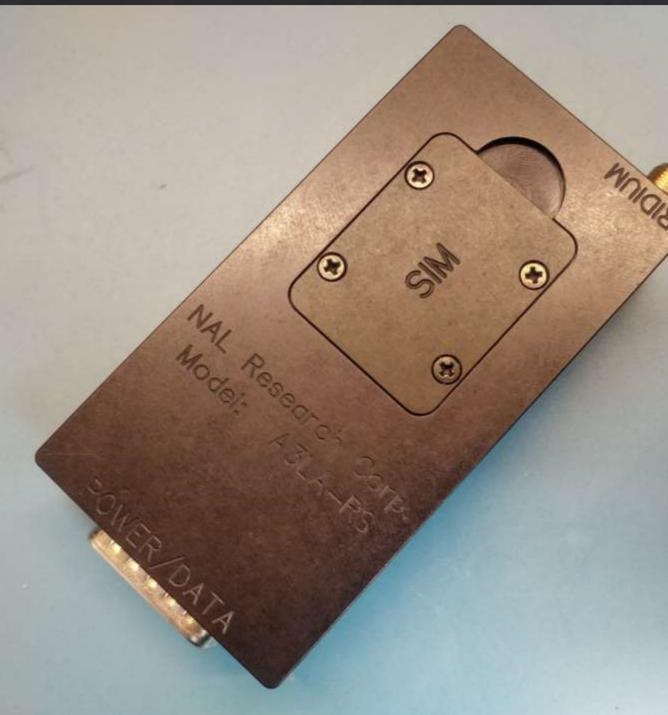
- Iridium 9523 'black box' known to work
- Standard RS-232 DB-15 via ST3237
- Obviously taken apart several times

Same main components:

- NCN4555
- LT3580 \bullet

Missing four M1.6-.35 screws holding 9523 to PCB













SCUBEE 7 15 PDR

Iridium Module Development





Iridium 9523 Module Requirements

IR-1.1: the current TES electronics stack

IR-1.2:

IR-1.3:

IR-1.4:

and retrieval



- The Iridium 9523 module shall be able to integrate with
- The Iridium 9523 module shall act as an internet modem to stream data from TES subsystems
- The Iridium 9523 module shall be able to establish a reliable link to a ground-based server
- A ground-based server shall securely store all data received from the Iridium 9523 module for later review





Iridium Power Requirements

Dual voltage supply: VBAT: 3.2-6VDC, 500mA VB00ST: 27-32VDC, 1A

VB00ST supplies RF transmit circuitry 8.3ms pulse every 90ms

Relies on charging ~1000uF of Aluminum electrolytic capacitors to supply internal buck converter

Capacitors will likely fail in expected -30-60°C hard vacuum

SCUBE PDR

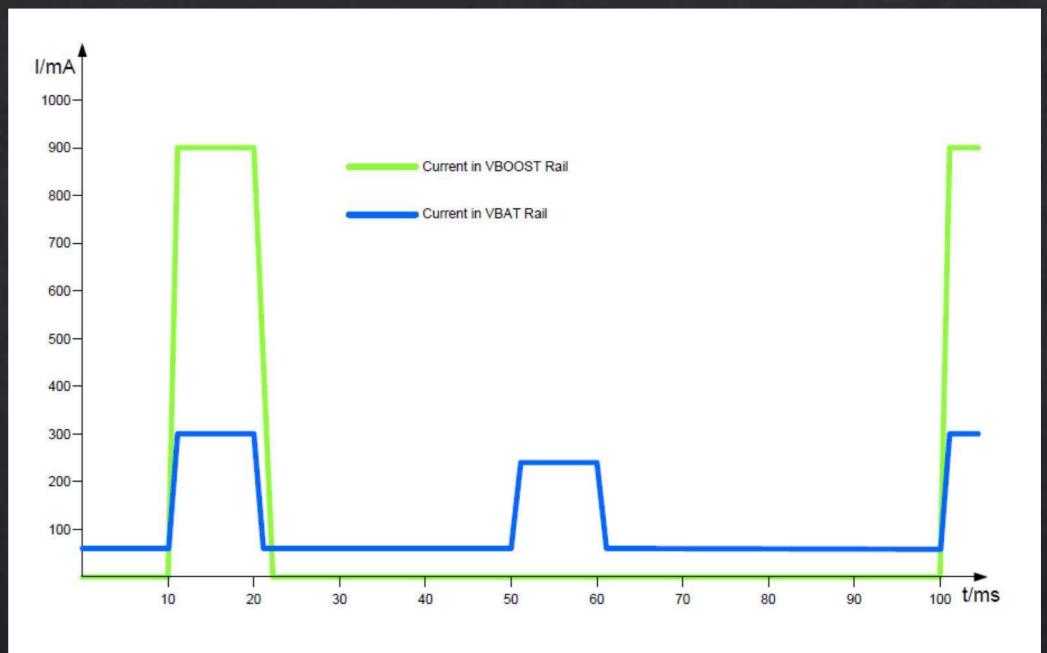
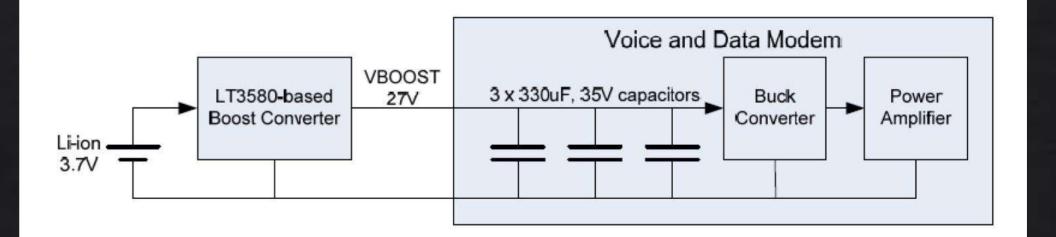


Figure 7. Current profile of supply rails.







Boost Regulator Selection

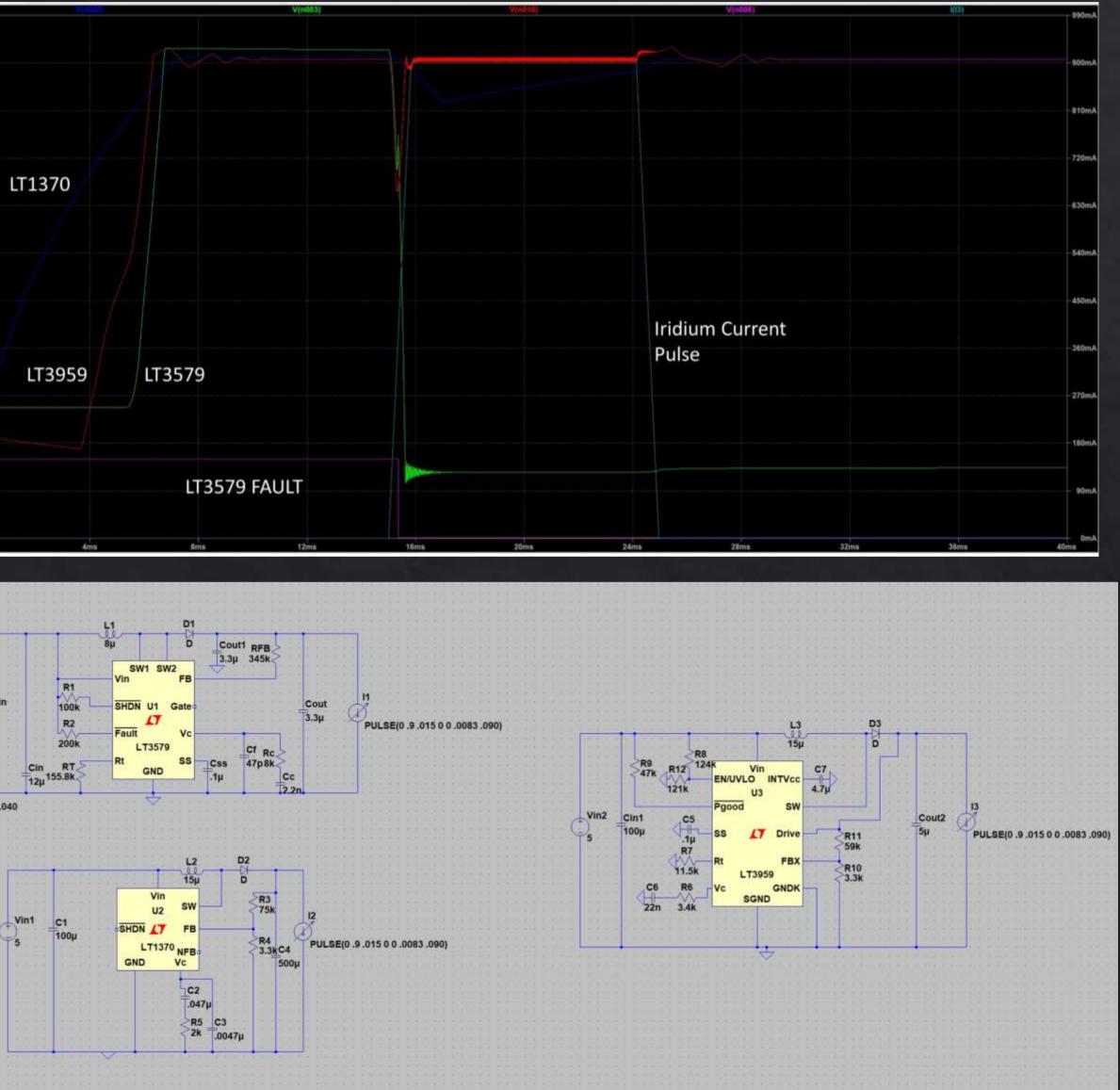
Requirements: Boost 5VDC to 30VDC 1A

Initial choices:

100	Part	Cost	Max Current	Max Vout	Freq Range	PKG	Temp range	CAD Model Available?	Notes
	LT1268	\$12.69	7.5A	60V	150KHz	5-DDPAK	0-125°C	Yes	-No EN Pin -Simple Circuit -Bare-Bones
1. Street	LT1370	\$14.86	7A	35V	500KHz	D2PAK-7	-40-125°C Variant	Yes	-EN Pin -Simple Circuit -Bare-Bones
	LT3957	\$7.38	6A	40V	100KHz-1MHz	36-QFN	-40-125°C	Yes	-Programmable Frequency -EN Pin -Simple Circuit
	LT3959	\$7.66	7A	40V	100KHz-1MHz	36-QFN or 38-TSSOP- EP	-40-125°C	Yes	-EN pin -PWR status pin -Simple Circuit
	LT3579	\$7.50	7.5A with FETs in parallel	42V	200KHz -2.5MHz	20-QFN or 20-TSSOP- EP	-40-125°C	Yes	-Fault protection -Programmable frequency -EN pin -Temperature Output -Fault warning -Simple Circuit - 42V master/slave switches

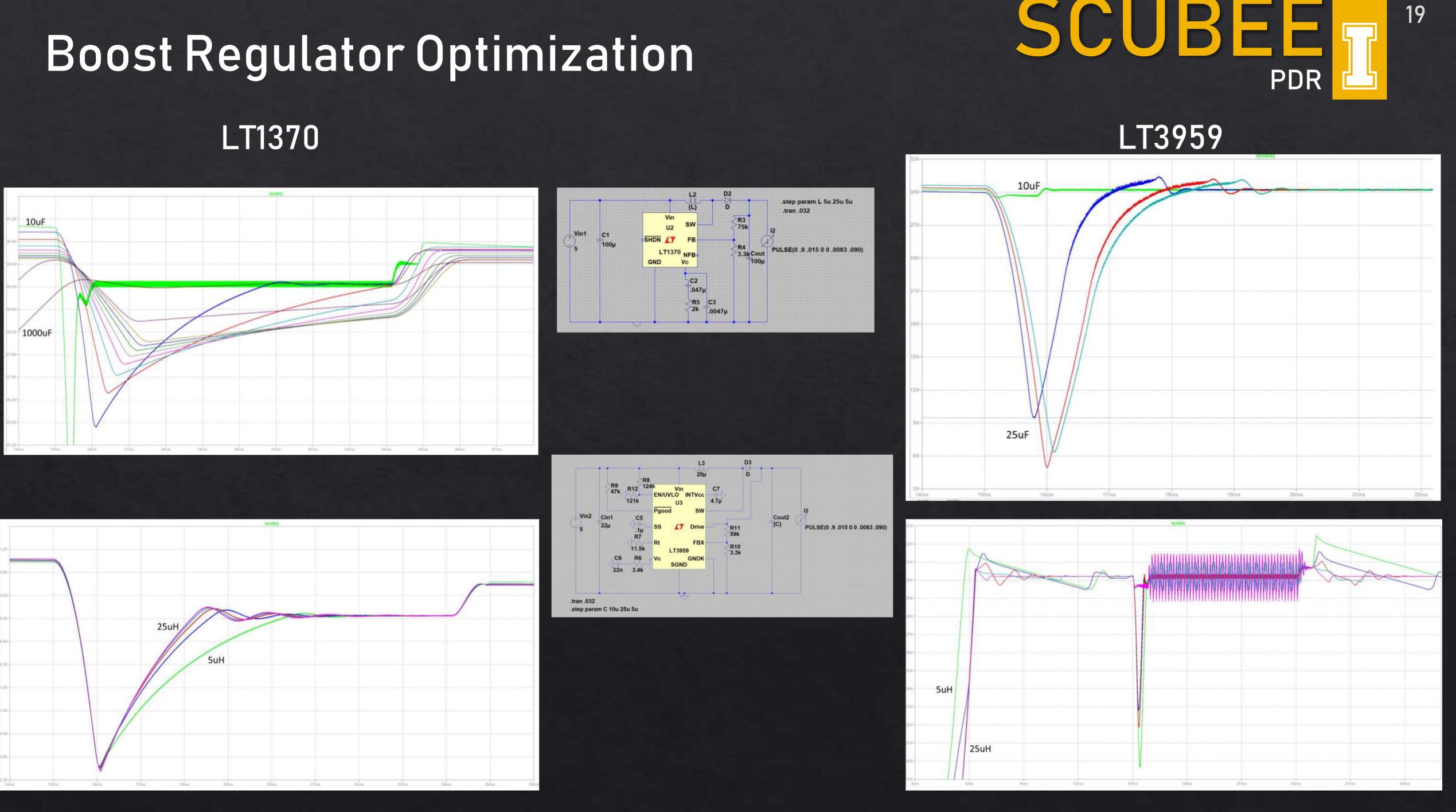
LT1268, LT3957 disqualified LT3579, 1370, 3959 simulated LT3579 Fails

.tran .040









SCUBEE

Results

LT1370: 6uH-8uH Inductor 900uF minimum capacitance

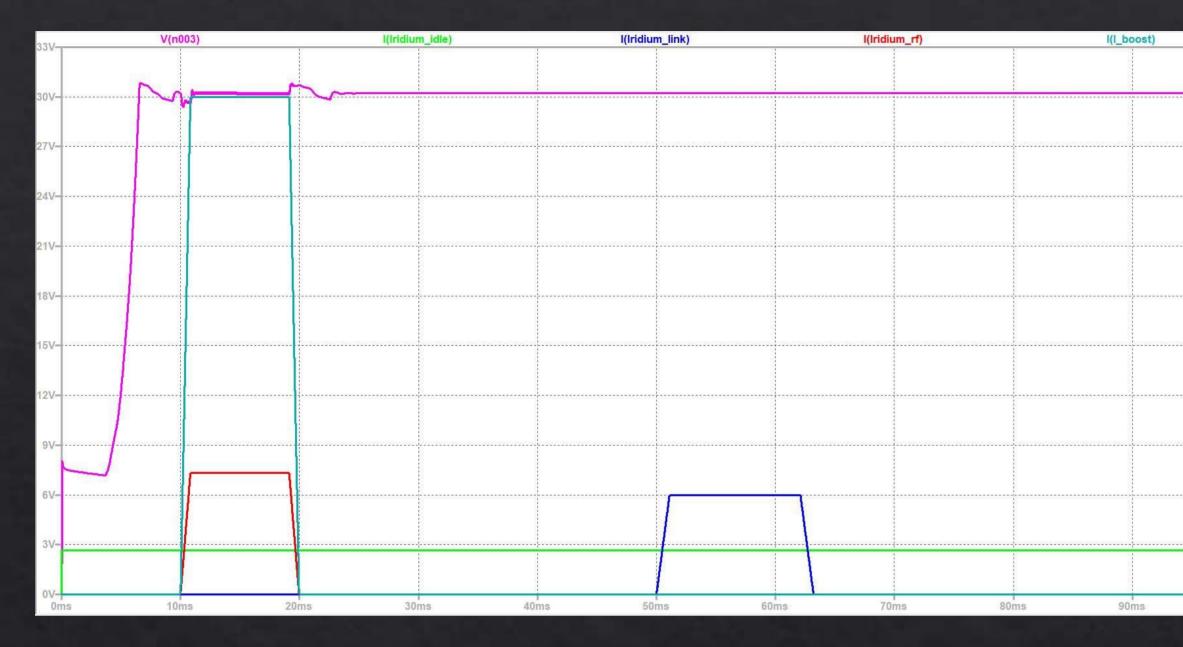
LT3959 20uH-25uH Inductor 6uF-13uF capacitance

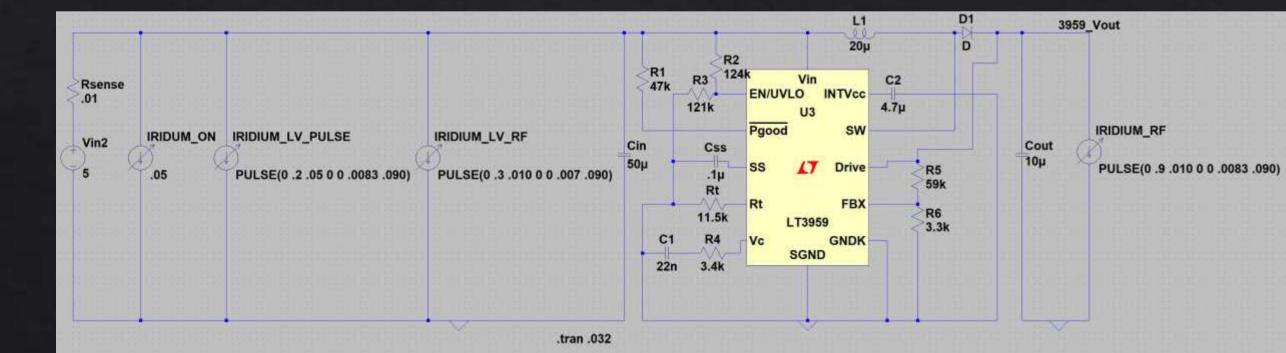
3959 has overall better performance



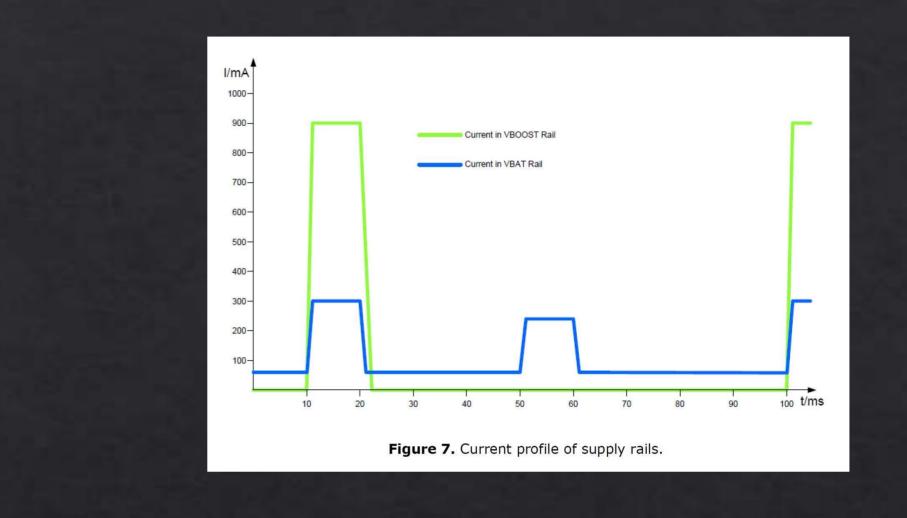


LT3959 Verification





SCUBEE PDR



810m

720mA

630mA

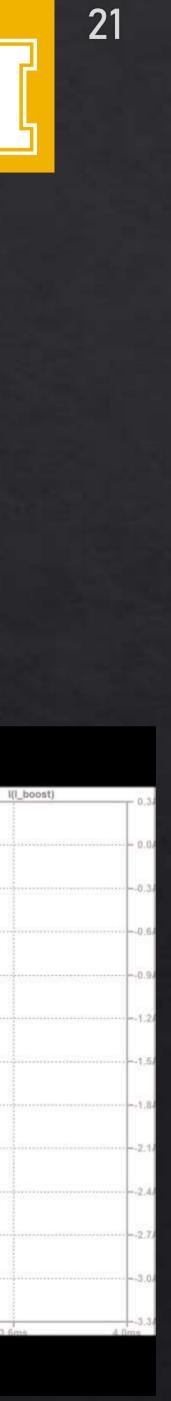
540m

450m

270mA

0m.





Iridium 9523 Requirements

Must Tri-state port pins to prevent latch-up

Must not enable board without first applying power

Must disable local GPS devices to prevent damage

Minimum 20cm safe distance from antenna at full power

Minimum 2s delay between shutdown/boot

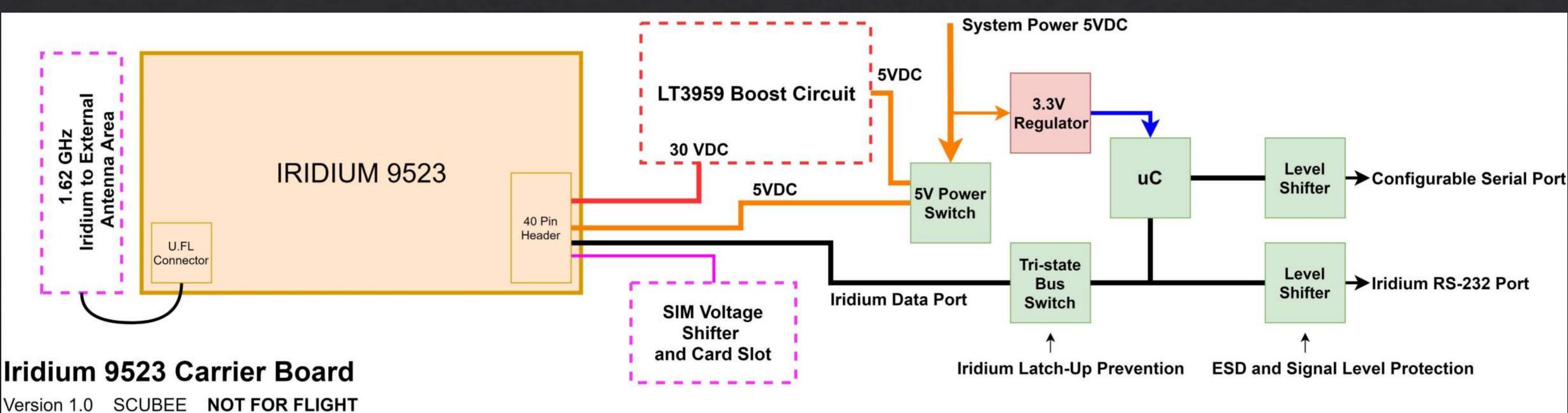
SCUBEE PDR

Analog area Must have solid ground plane

Power area Ideally solid ground plane

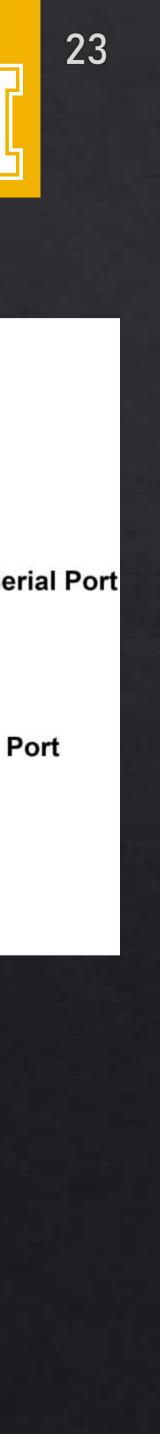


Iridium Carrier Diagram

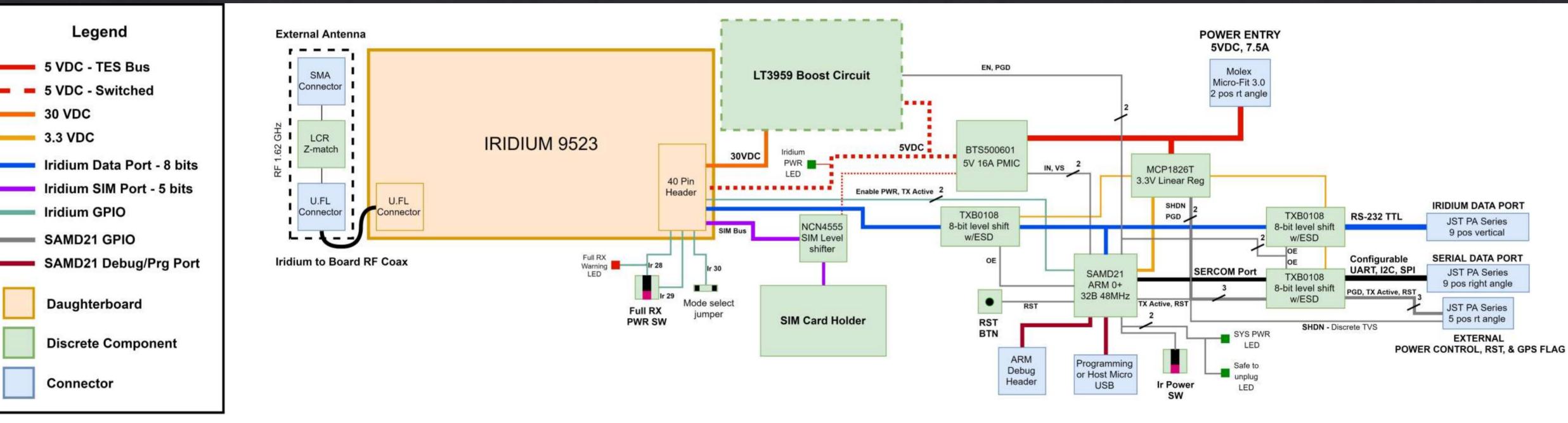


Microcontroller provides configurable communication interface and performs modem setup, translation, and shut down tasks

Initial testing shall be conducted using a Raspberry Pi connected to the Iridium RS-232 port, then code will be ported to the uC



Iridium Carrier Diagram



Iridium 9523 Carrier Board Details

Version 1.0 SCUBEE NOT FOR FLIGHT

Flight Modifications:

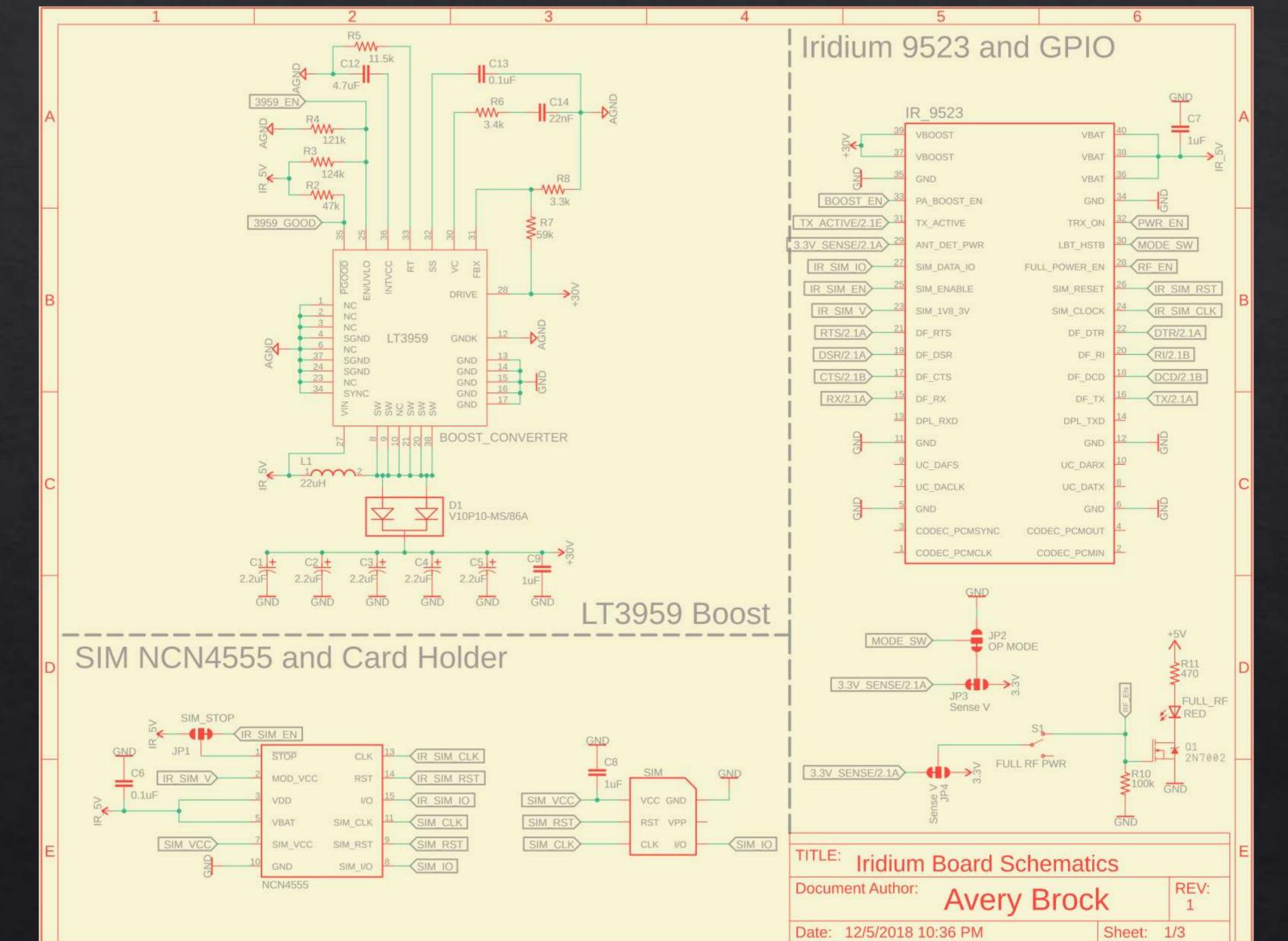
- Direct Iridium port connection and associated components, LEDs, and configuration ulletswitches/jumpers to be removed
- Data and External control ports shall be combined to a single 9-pin connector

SCUBEE **PDR**



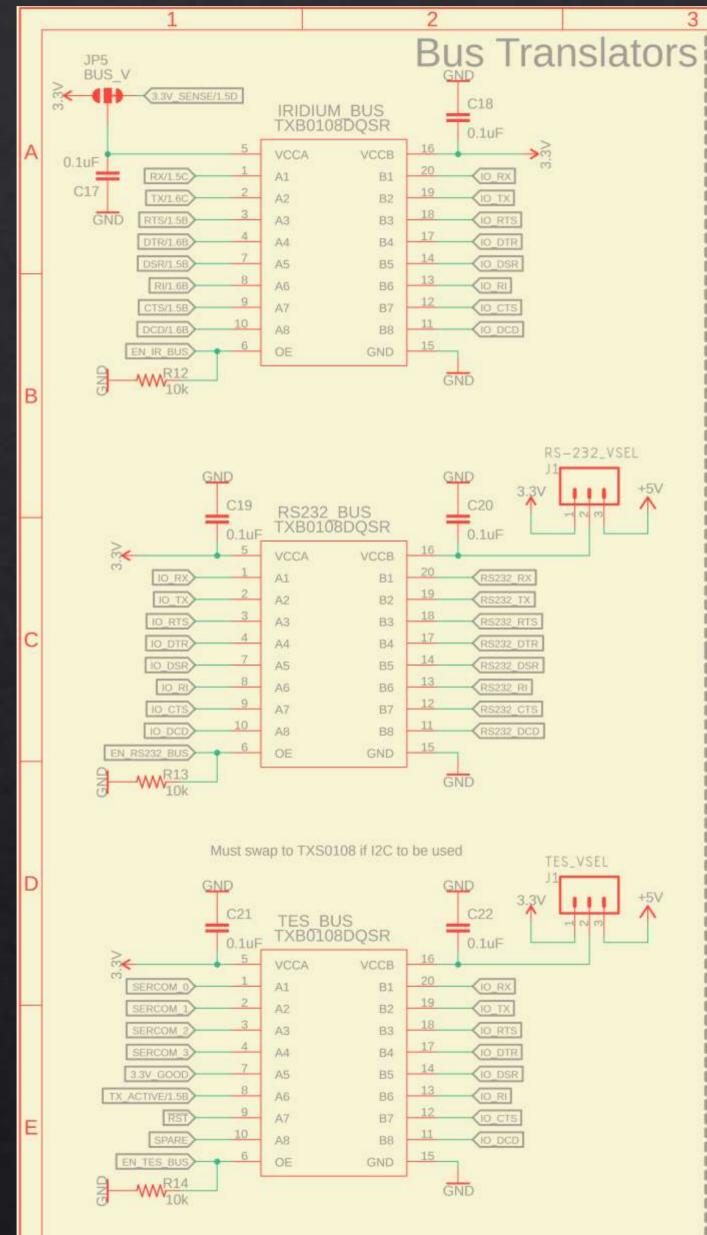
24

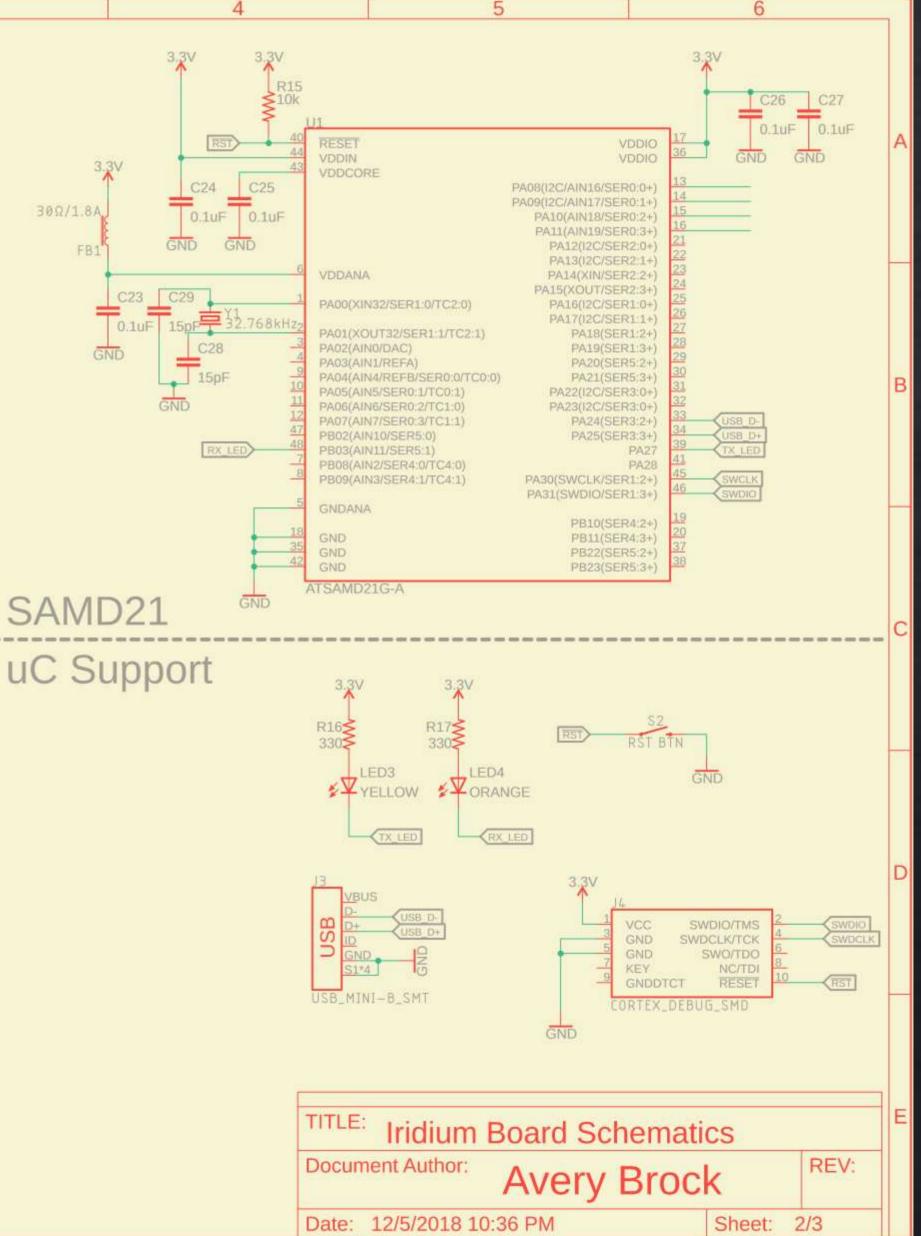
Iridium Carrier Schematic





Iridium Carrier Schematic







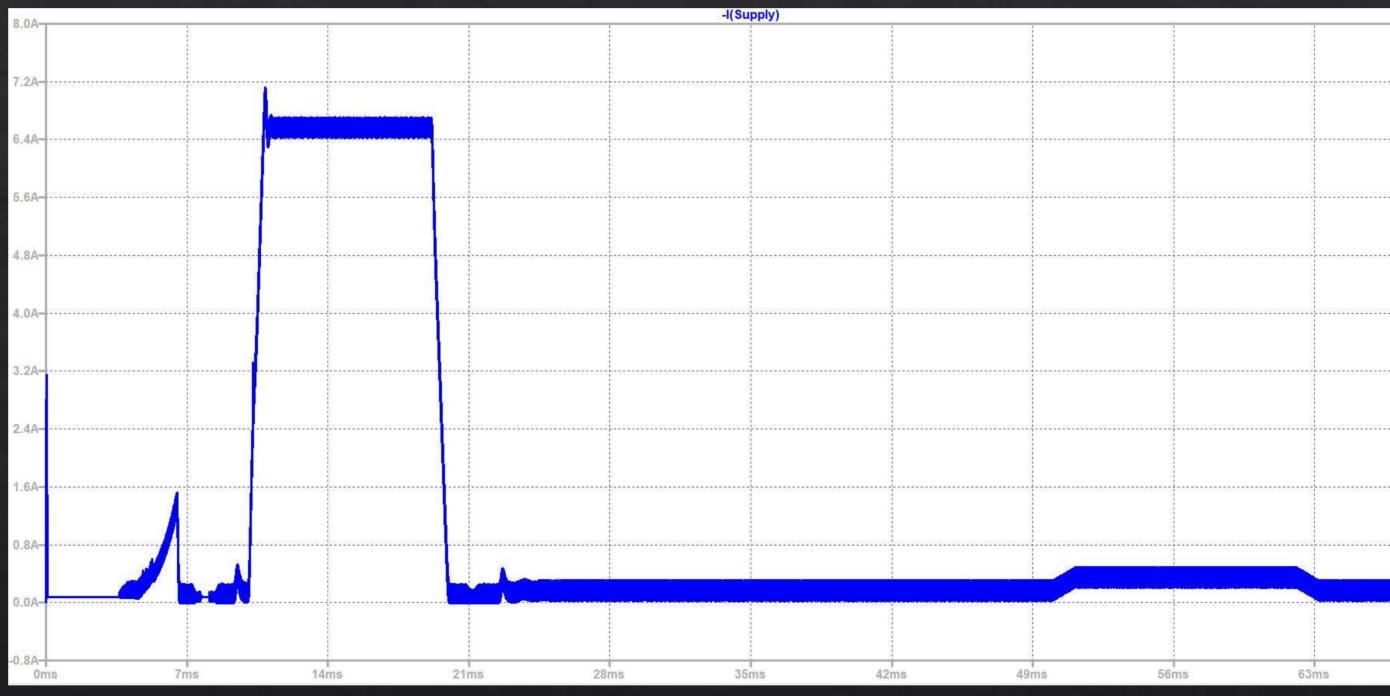
Power and Communication

Power Supply:

- 5 VDC
- 7A Peak Consumption
- Dual voltage feed would reduce current consumption

Communication:

- 3.3/5VTTLRS-2329-wire
- 3.3/5V SPI, I2C, Serial
- TTL signals for additional control
- Special considerations needed if I2C/SMBus desired





Iridium Antenna

The Iridium 9523 should be connected to a certified Iridiumband antenna with the following antenna connector characteristics:

General RF Parameters

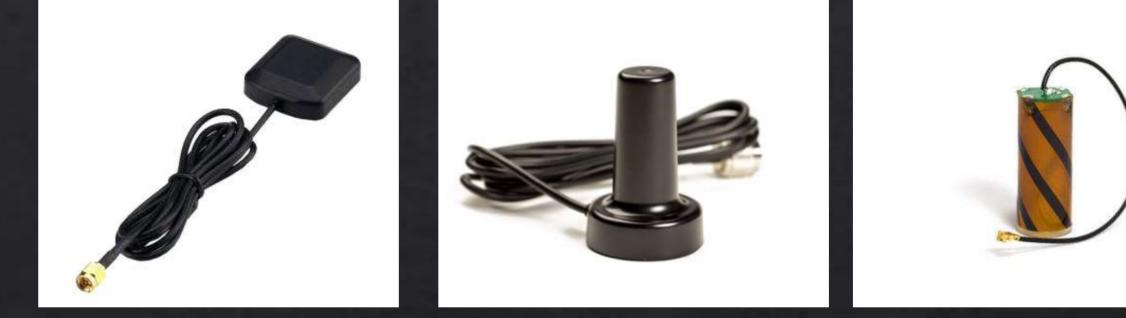
PARAMETER	VALUE
VSWR	1.5 : 1
Maximum Gain	3 dBic
Nominal Impedance	50 Ohms
Polarization	Right Hand Circular (RHCP)

Antenna Characteristics

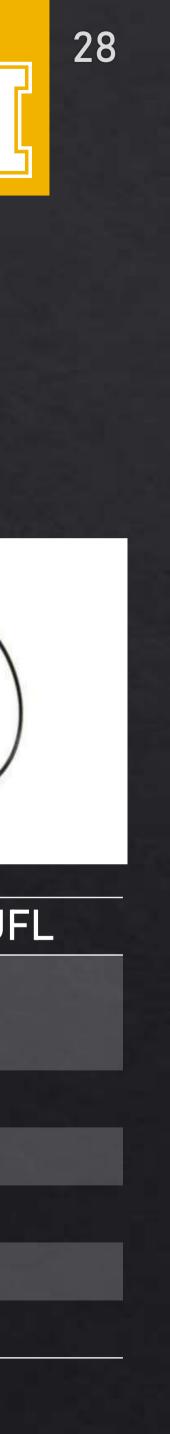
PARAMETER	VALUE
Frequency Range	1616 MHz to 1626.5 MHz
Duplexing Method	TDD (Time Domain Duplex)
Input/Output Impedance	50 Ohms
Multiplexing Method	TDMA/FDMA

Size(mm) Frequency(M Peak Gain(dE Efficiency Weight(gram

Price(\$)



	IAA.01.121111	M1621HCT-EXT	M1621HCT-P-UF
	25.86	56.97	Waiting for quotation
	40.5*38*12.3	52.2*36	33*13.2
MHz)	1616-1626.5	1616-1626	1616-1626
Bic)	lacking		2.8
	lacking	50%	60%
ns)	lacking	52	30



Iridium Software

Project Goal + Collects data + Uses data streaming + Logs data

+ Initializes the modem + Uses CR as a command terminator + Uses a 128 byte buffer + Has documentation

SCUBEE **PDR**

Remaining Tasks - Does not collect data - Does not send data

- Does not have documentation





SCUBEE 530 PDR

TDRV Development



Previous Testing

Background:

- Previous testing of TDRV designs consisted of a singular drop test
- Experiments such as dropping the TDRV from the University of Idaho Kibbie Dome not only tested the capability of electrical components surviving impact, but validated the use of descent arrestors in drag force braking

Results:

Results showed promising criteria for slowing the TDRV, but lacked adequate stabilization upon descent. Future TDRV arrestors will be modified to further stabilize the return trip.

SCUBEE 7 PDR





31



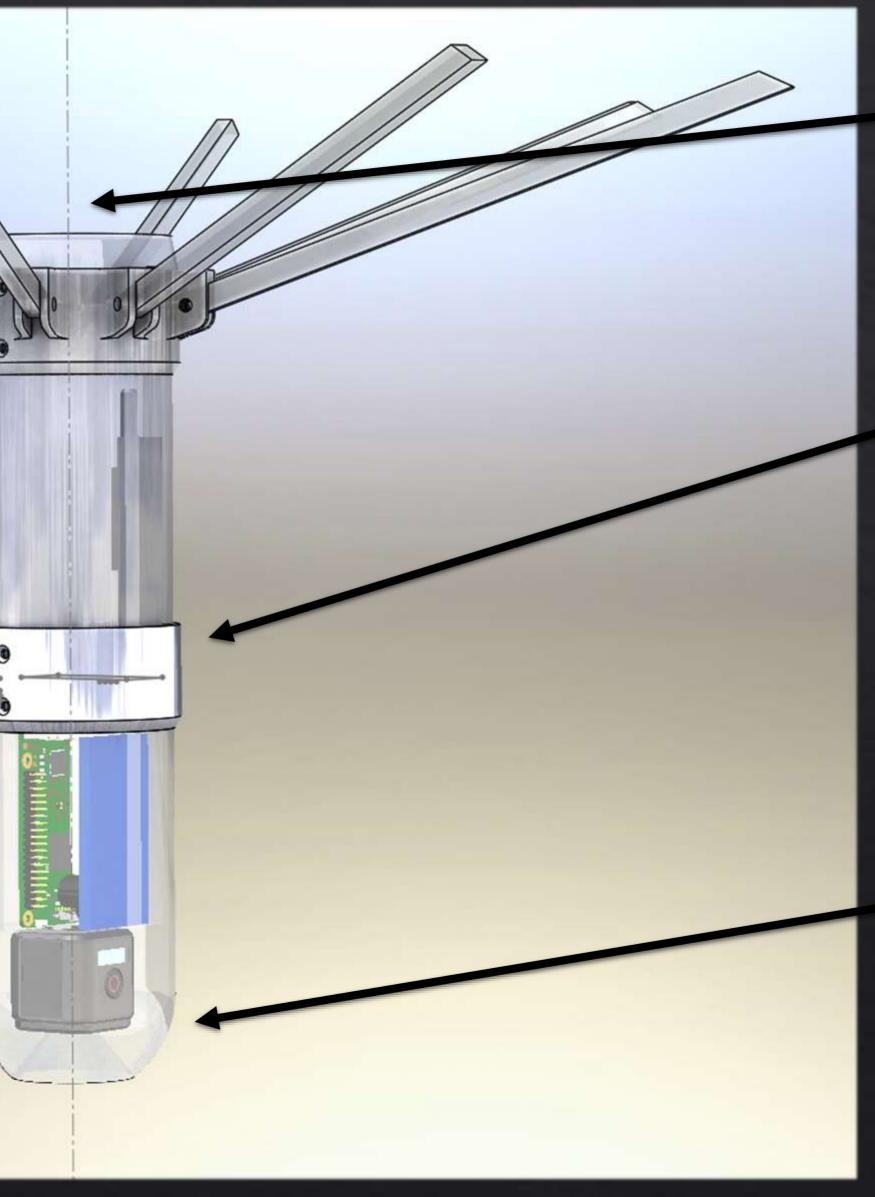
Planned TDRV Improvements

Replace felt material with high strength conductive nylon descent arrestor to improve GPS signal quality. Integrate FM **APRS** antenna into struts. Shorten struts to reduce drag

Replace railmounted end cap with threaded end cap

Reconstruct interior to accept configurable electronics tray

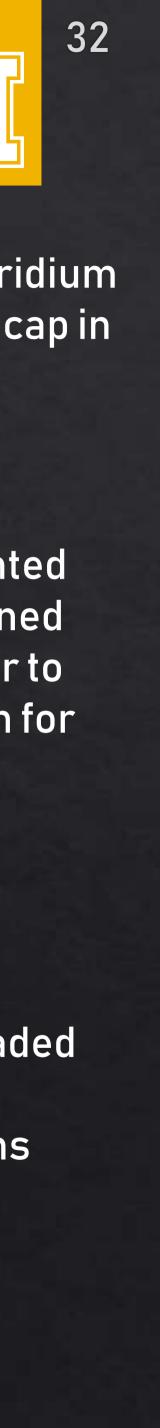




Mount GPS and Iridium Antennas to end cap in addition to drop mechanism

Replace 3–D printed body with machined tube; scale larger to allow more room for customization

Introduce threaded nose cap with transparent lens



Planned TDRV Improvements

Nose Cap

- Nose will be separated from body to allow for access to GoPro camera.
- Cap will be threaded on outer edge for secure fitting to primary TDRV body.

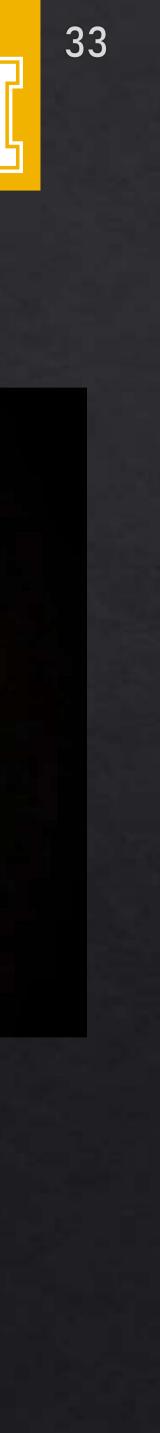
• Descent Arrestors

- Current arrestors provide too much drag with little stability.
- Arrestors will be shortened for smaller drag surface area.
- Angle of attack will be increased by allowing further arrestor deployment before hard stop is initiated on connecting bracket.

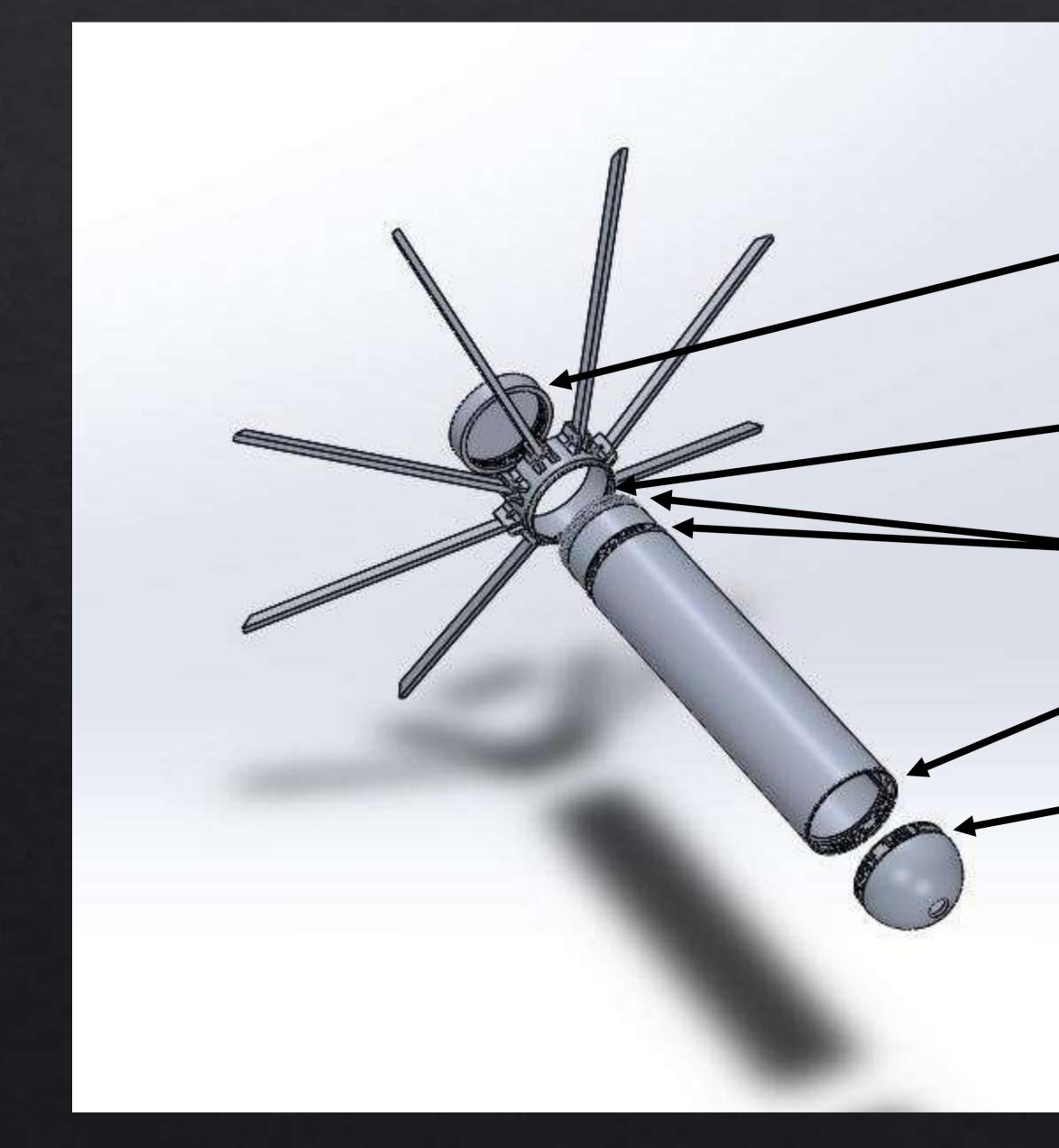
Questions:

- Preferred material for TDRV shell construction?
- Finalized accepted dimensions of TDRV?





Current TDRV CAD



SCUBEE **PDR**

Threaded female end cap without modification for antennae

Threaded female end strut ring

Threaded male end main body

Threaded female end main body

Threaded male end nose cap





Current TDRV CAD

Flow Asse	mbly	.SLDASM	Drag free	e fall 120 n	nph [Defa	ult]]			
Goal Name	Unit	Value	Averaged Value	Minimum Value	Maximum Value	Progress [%]	Use In Convergence	Delta	Criteria
GG Force (Y) 1	[lbf]	-50.368345	-45.17135361	-50.368345		Contraction Theorem and the second) Yes	5.134318356	and a second and a second a s
Equation Goal 1	[lbf]	-0.035847535	-0.032148797	-0.035847535		1) Yes	0.003654134	
Iterations	[]: 8	1							
Analysis ir	terv	al: 34							
rho =	.07775	lb/ft3	0.000045	(lb/in3)					
A =	53^(2/3	3)		in2					
Cd =			0.035847535						
Weight =			3.5	lb					
Terminal velocity									
v = sqrt(2*w/(Cd*rh	10*A))		556.7357317	in/s					
er understere zwarten in die der Biege			31.6	mph					
			46.3						

body asse	embly	.SLDASM	[Project(1) [Default					
Goal Name	Unit	Value	Averaged Value	Minimum Value	Maximum Value	Progress [%]	Use In Convergence	Delta	Criteria
GG Force (X) 1	[lbf]	-18.07204481	-18.50522451	-19.02152156	-18.07204481	100	Yes	0.949476745	3.309087256
C_d	[]	-0.006042074	-0.0061869	-0.006359515	-0.006042074	100	Yes	0.000317441	0.001106336
Iterations	s <mark>[]: 4</mark>	0							
Analysis i	nterv	al: 20							



- The first spreadsheet represented • iterations ACOM ran to determine C_d
- The second spreadsheet was a test \bullet our team ran to familiarize ourselves with the SolidWorks testing protocol



TDRV Descent Methods

3 possible descent modes for future TDRV \bullet

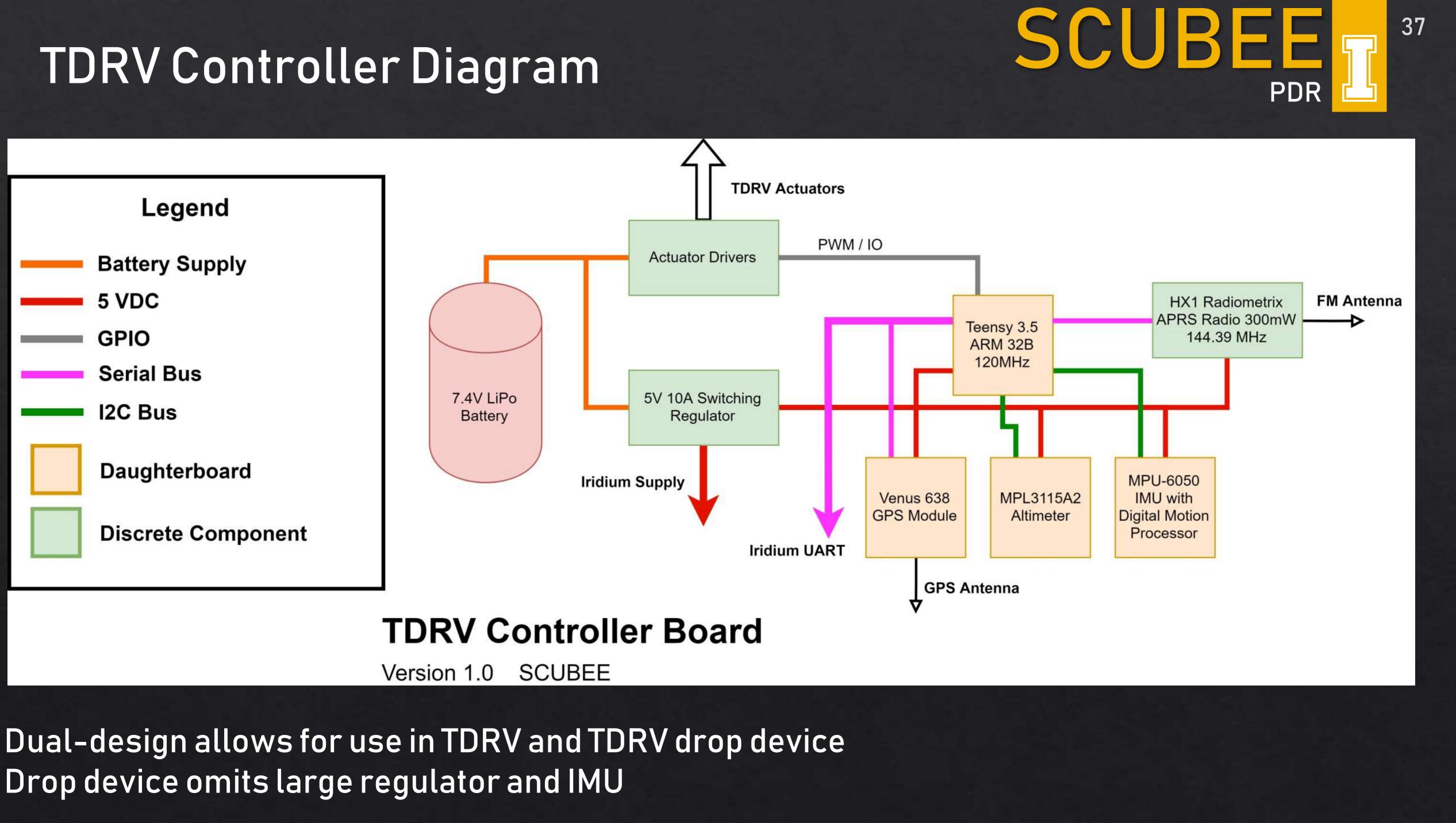
- Shell design with delayed opening of descent arrestor fins
- Descent arrestors that immediately deploy \bullet
- \bullet



Descent arrestors along with a parachute deployed at lower altitude









SCUBEE 738 PDR

Next Steps



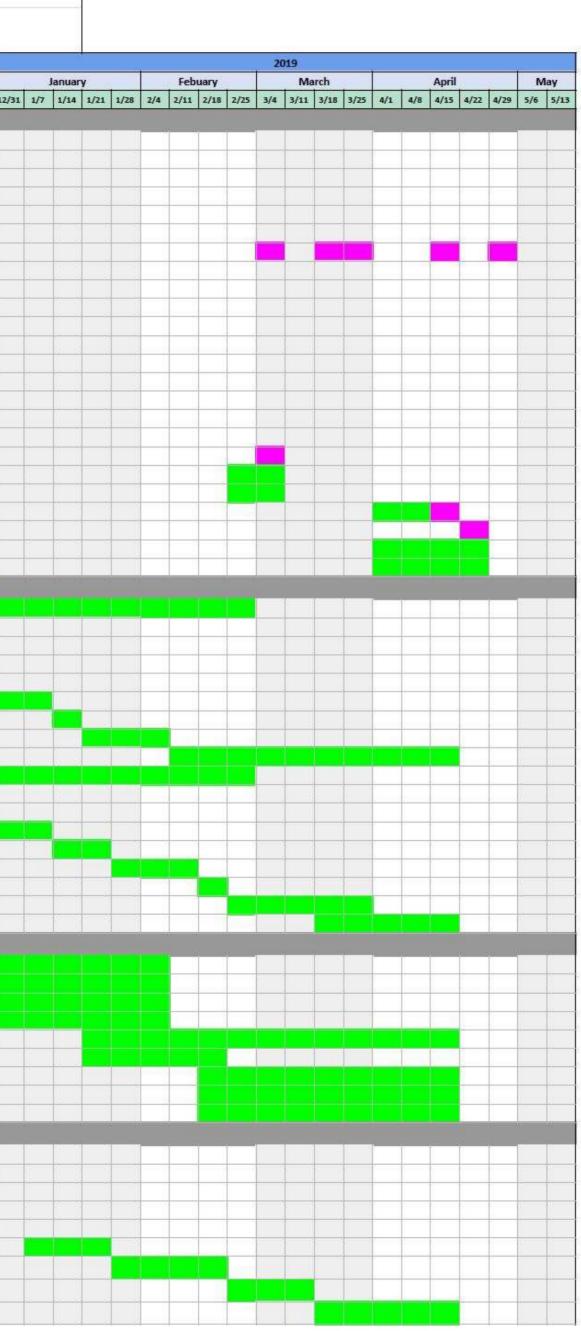
Project Budget

Project			N	ASA Ame	s-Subor	bital Fligh	t Communi	cation					
Last Updated	1				1								
		20	158				2019			Item Total	Total Spent	Actual	1
xpense items	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May				8
entransist i tras entransiste													
idium		<u> </u>	2 3		2-1	3	-	2. 8		2			
ridium Data Plan		8	3 8	\$ 70	\$ 7	0 5 70	\$ 70	\$ 70		\$ 350	í.		
CB# 0			8 2	5 12		-	-	8 8	_	5 12			
CB# 1		-	15 /		5 1	-	3	18 <i>G</i>		\$ 12			- 8
*CB# 2						5 12				5 12			
CB# 3	2 0		5 3			Q **	5 12	5 - 6		\$ 12		1	
CB# 4								5 12		5 12			
CB part#1		ŝ	12 1		\$ 10	0		12 . 3		\$ 100			- 8
CB part#2			-		\$ 10	0				\$ 100			1
iPo battery		5	2 8		5 6	0	<u>s</u>	8 8		\$ 60		<u></u>	
light Control		2	3 8		\$ 5		1	3 6		\$ 50	()		8
iPS and Indium Antenna					\$ 5	0				\$ 50	000000		
	3		\$ 1		1			\$ 0		\$ 770	Total Spent=		33
DRV													
CB# 0		Ô.	8 8	5 12	2	0	10	8 8		\$ 12			81
PCB# 0 part				\$ 238						\$ 238			
CB# 1			8 8		\$ 1	2	1	8 8		\$ 12			8
CB# 1 part		8	8 8		\$ 23	8	30	8 6		\$ 238	8		- 8-
CB# 2						\$ 12				5 12			
CB# 2 part		í.	5 8		8	5 238		S 8		\$ 238			2
PCB# 3							\$ 12			5 12			
CB# 3 part	0 0		8 8		10	0	\$ 238	8- 8		\$ 238		0	<u> </u>
CB#4								5 12		5 12			
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		-	C		<u>^</u>		-	07201104202			Total Spent=		1
aunch(He)		6	8 8		3	3	36	0 0					8
arachute fabric			8 8		5 2	0		8 8		\$ 20	2		- S
Conductive fabric					5 3		1	1		\$ 30		1	
volt linear actuator		1	8 2		\$ 8			R 2		\$ 80	0		
	1	· · · · ·					1			\$ 130	Total Spent=	1	
ravel(4)		6	2 2		2	2	1	12 8					8
light(4)		-	×		1		1	\$ 1,136		\$ 1,136			
lotel(2 or 3rooms, 2 night)	1	6	Q - 2		2	3	*	\$ 440		\$ 440			<u> </u>
iental Cars		5	16 2		2		*	\$ 363		\$ 363		*	6
er Diems	1	-	27 V				1	\$ 854		\$ 854		*	
dilease.		É	8 7		ŭ.	8	*	\$ 23			/	*	8
Uneage Dther	1	-	10		-		-	F 43		\$ 23	-		
Autor			8 8	-	-		-	8 8			Total Spent=	+	83
		-	R	-	12	×2	-	8 8	<u> </u>	\$ 1,680	Total Spenc=	4	
a star and star and			0 0		5		-	0 8				<u>86</u>	
Moscow High School(\$1000)	-		12 - 3		2	-	+	6 8			we can get from last semest	er	
			9 Ø		0	0		6) D		12 2		+	
supplies Sent from Ames		É.	8 3		0	6	-	8 8		0	2 6		1
and the second		-	2 0		2		-	12 (i)			2	+	1
Assembly Bits	-	-	8 3			2		8 8	<u> </u>			+	
older: Rester 65/01.001" dimmeter	-	-	03 (j	-		5	25	63 (d)		\$ 3			
older Paste: WG Chemical 65/57 no clean 35# stringe	-	-	2 3		5 2		-	15 2		5 21			
older Wick: NTE Electronics SW02-10 =4 blue	-	-	2	-		5	-	2 8		\$ 6		4	35
Weller Tio: WESD61 1/52" long conical tip	-				5	4	-			\$ 4			
		£	13 1		5		1	1 1		\$ 36			22
												15	2



SCUBEE Schedule

PROJECT TITI		SCUBEE Capsto	vie nesidij						NAME						rsity o	uan	8						
PROJECT MAI	A CONTRACTOR AND A CONTRA	Avery Brock	Trada Stream 12.5				DATE							10/23	1/18								
	Scheduled Time Event Date		Past-Due W Late Modifi																				
						PCT OF TASK				1					2018					1			
WBS NUMBER	TASK TITLE	TASK OWNER	START DATE	END DATE	DURATION	COMPLETE	1	Septe 9/10	mber 9/17	9/24	10/1		0ctobe 10/15		10/29	11/5	Nove 11/12	mber 11/19	11/26	12/3		mber 12/17	12/24 12
1	Project Milestones				10																		10 V
1.1	Team Formation	TEAM	9/18/18	9/24/18	6	100%																	
1.1.1	Team Contract		9/18/18	10/6/18	18	100%														-	-		
1.2 1.2.1	Project definition and intial requirements Preliminary Requirements Document	TEAM	9/18/18 9/19/18	10/27/18 10/28/18	39 39	50%		-												-	-	-	-
1.3	Project Wikipage development	Hunter B	5/15/10	10/20/10	0	50%										_				-	-		-
1.3.1	Project Wikipage finalization - Fall	10000000000	10/23/18	12/7/18	44	50%	12 13			-													
1.3.2	Project Wikipage finalization - Spring			ad la	0	0%-													-				
1.5	Preliminary Design Review	TEAM	11/19/18	12/6/18	17	40%											1						
1.5.1	Presentation Creation		11/19/18	12/6/18	17	40%																	
1.6	Snapshot 1	TEAM	10/9/18	10/9/18	0	100%																	
.6.1	Poster Creation		10/1/18	10/9/18	8	100%																	-
1.6.2	Portfolio Update	-	10/2/18	10/10/18	8	100%		-		i.	_									14			5 15
1.7	Snapshot 2	TEAM	11/30/18	11/30/18	0	38%				-					-	_	-	-		-	-		
1.7.1 1.7.2	Poster Creation Portfolio Update		11/26/18	11/30/18 11/30/18	4	25% 50%	3 - 3			1							-	-		-	-	2	<u>s</u>
1.7.2	Detailed Design Review	TEAM	1/28/19	2/9/19	11	50%																	
1.8.1	Presentation Creation				0															-			- <u>k</u> r
1.9	Snapshot 3	TEAM	3/5/19	3/5/19	0															1	1		
1.9.1	Poster Creation	1.0216303	2/18/19	3/5/19	17	0%												1	1				
1.9.2	Portfolio Update		2/19/19	3/6/19	17																		
1.10.	NASA AMES Trip	TEAM	<u>4/18/19</u>	4/19/19	1	0%													1	1			
1.11	EXPO	TEAM	4/26/19	4/26/19	0																		
1.11.1	Poster Creation		4/1/19	4/26/19	25						_	_	_	_			-		-	-	-		
1.11.2	Portfolio Finalization		4/2/19	4/27/19	25	0%		-					_										
2	Electrical	American	10/11/10	0.14.14.0	450	0715		_		1													
2.1	Iridium Testbed Development System Block Diagram	Avery/Yi	10/1/18	3/1/19 11/25/18	150 33	27%														-			
.1.1	Component Selection		11/5/18	11/25/18	20	90%							-						-	-			
2.1.3	Schematic Creation		11/6/18	12/2/18	26	25%																	
.1.4	PCB Layout		12/3/18	12/23/18	20	-0%																	
2.1.5	PCB Creation		12/24/18	1/20/19	26																		
2.1.6	PCB Assembly		1/14/19	1/20/19	6						- Û								1				
2.1.7	Software Development		1/21/19	2/10/19	19	(1%)																	
2.1.8	Testing	· Distantization	2/11/19	4/21/19	70	108.																	
2.2	TDRV Controller Development	Avery/Yi	10/1/18	3/1/19	150	22%				-													
2.2.1	System Block Diagram		10/22/18	11/25/18	33	100%	6 - 3												-				5 60
2.2.2 2.2.3	Component Selection Schematic Creation		11/5/18	11/25/18	20 19	75%														-	-		
2.2.3	PCB Layout		1/14/19	1/13/19	13		0-0										-			-	-	-	Ť
2.2.5	PCB Creation		1/14/19	2/17/19	19												-	-	-	-	-		-
2.2.6	PCB Assembly		2/18/19	2/24/19	6		0.00											1	1			-	
2.2.7	Software Development		2/25/19	3/25/19	30	.06																	
2.2.8	Testing		3/18/19	4/15/19	27	0%-					- C										1		
3	Software							N	11	10			-										
3.1	Library Development Raspberry Pi	Hunter B	10/22/18	2/10/19	108	26%																	
3.1.1	Modem Initialization		11/12/18	2/10/19	88	70%														ļ			
3.1.2	Network Stack / TCP/IP Communication		12/3/18	2/10/19	67	(0%-								-					()				
3.1.3	Data Collection / Logging	Hunter D	10/22/18	2/10/19	108																		
3.2 3.2.1	Library Development Microcontroller Port from RPi to Microcontroller	Hunter B	1/21/18	4/21/19 4/24/19	450 452												-			-	1	-	
3.2.2	Modem Initialization		2/18/19	4/24/19	63					-								-	-	-	-	-	
3.2.3	Network Stack / TCP/IP Communication		2/18/19	4/21/19	63															-			
3.2.4	Data Collection / Logging		2/18/19	4/21/19	63														Î	1	1		
4	Mechanical				en			-		. vi							эХ		6c	(A)	÷0	··	
4.1	Background research	Hunter K	9/10/18	10/1/18	21	100%	1				10			4					1		045	For a	
4.2	Background research	Tim	9/10/18	10/1/18	21	100%	1 - A												1				- Y.
4.2	Get Prototype Specifics	Hunter K	10/1/18	11/19/18	48	100%																	
4.3	3D Model Body Prototype Excluding Tray	Hunter K / Tim		12/10/18	21	25%				a)											1		
4.4	Fabrication of Prototype Body	Hunter K / Tim		12/31/18	21																		
4.4	Testing Prototype Rev 1	Hunter K / Tim		1/29/19	22															1			
4.5	Design and Construction of Rev 2	Hunter K / Tim	11100-00000-0000-000	2/25/19	26																-		
4.6	Testing Prototype Rev 2	Hunter K / Tim	2/25/19	3/18/19	23																		
4.0			a bit of the second sec														-	-	-	-			









Capstone Senior Design 2018–2019



SPACE COMMUNICATION UTILIZING BACKBONE EXISTING NETWORKS

Preliminary Design Review December 2018

