

xBolt

Components

EXTREME™



Objectives

- Learn the function of each major xBolt component
- Learn the function of each minor xBolt component

Major xBolt Components

- Mud Pulse Pulser Options
 - MOP
 - xBolt R-Pulser
- EM Gap Probe
 - XGP
- Dual Telemetry Probe
 - XDT
- Gamma Probe Options
 - XGM (XEM Gamma)
 - XDAG
- Directional Probe Options
 - SOCD (XEM D&I)
 - XDAG
- Battery Probe Options
 - DOBA (XEM Battery)
 - XBT

Minor xBolt Components

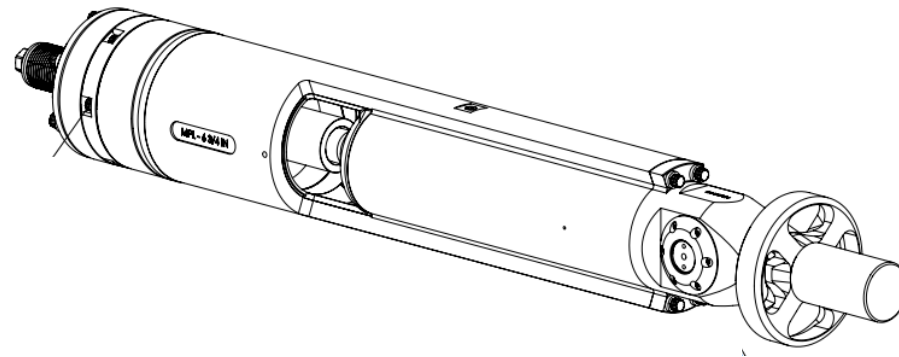
- RSS Communication Probes
 - XHOP
 - Babelfish
- End Termination Options
 - R-Fishing Head
 - XET
 - End Stabilizer (XEM Termination)
- Field Resizable Centralizers
- Bowsprings
- MOP Interface Probe
- Realtime Extensions
- EM Fishing Head
- xBolt Muleshoe Sleeve
- Connector Housing

Major xBolt Components

Mud Operated Pulser (MOP)

Mud Operated Pulsar (MOP)

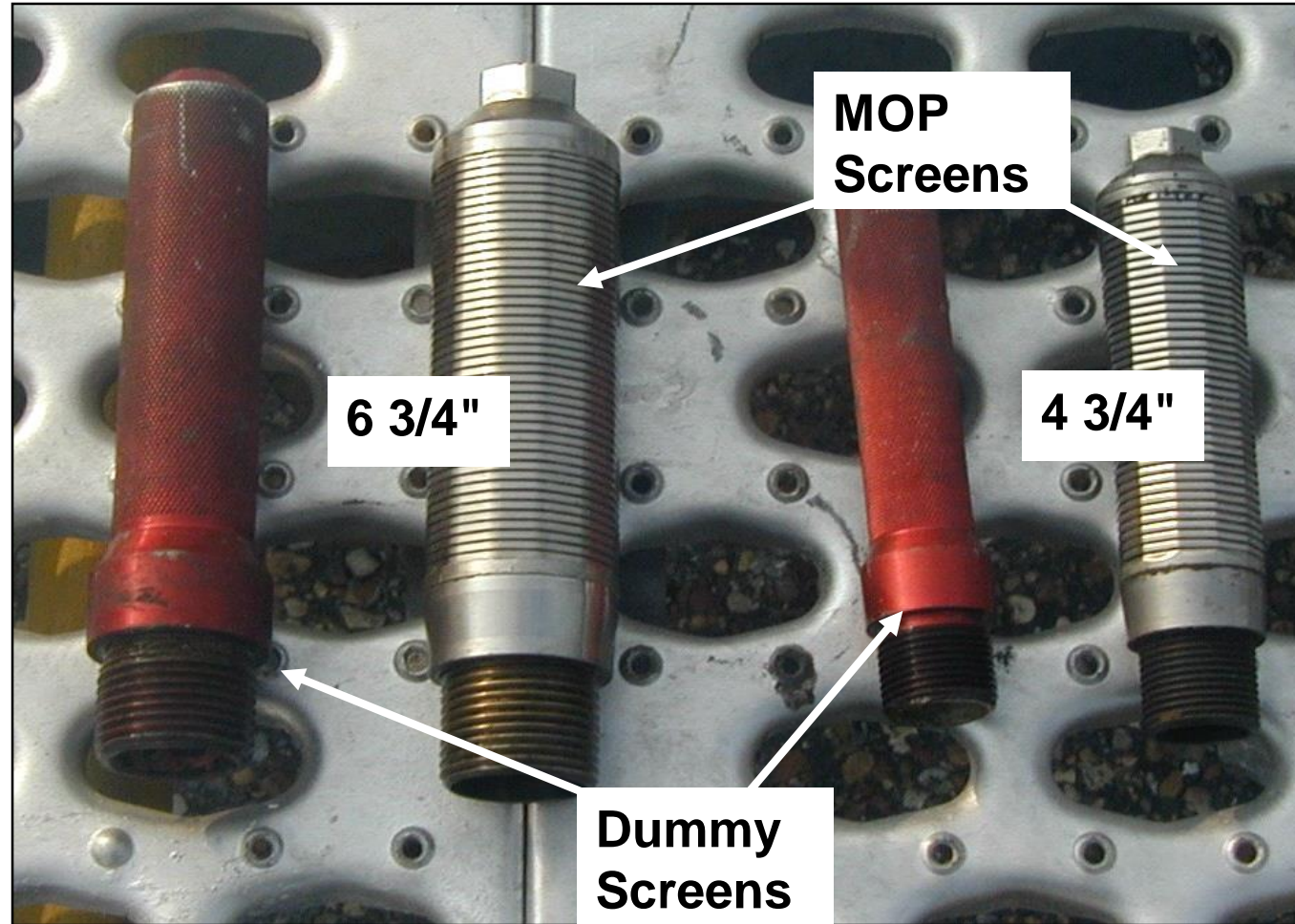
- Creates pressure drop across orifice
- Under XDT control
 - The Pilot valve opens high pressure mud to the back of the power piston
 - The piston forces the poppet into the orifice, restricting mud flow through drill pipe and causing a pressure pulse
 - Pressure pulse travels up the drill pipe to the surface where it is picked up by the stand pipe sensor
 - Telemetry (data) encoded in pressure pulses



Mud Operated Pulsar (MOP)

- MOP Assemblies w/xBolt
 - Flowswitchless / Solenoid
 - Pressure compensated oil reservoir
 - XDT supports vibration activated flow switch
 - Solenoid operated, spring return pilot valve
 - Power Piston
 - Piston pushes poppet into the orifice

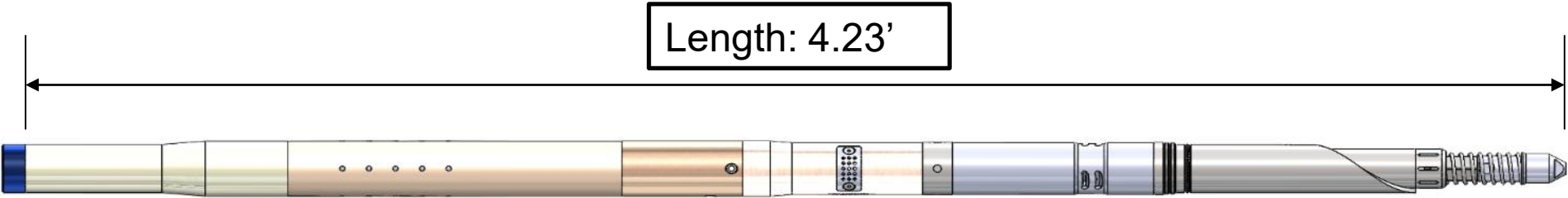
Mud Intake & Dummy Screens



Major xBolt Components

xBolt R-Pulser (XPR)

xBolt-R Pulser (XPR)



Length: 4.23'

xBolt-R

774.91023 Main Valve Assembly



102859258 ASSEMBLY 1.875 DIA. ACTUATOR BRUSHLESS 240 WATT xBolt



xBolt-R Pulser (XPR) – Main Valve Details

- Used as high side orientation reference
- No changes from original Telepacer Main Valve
- Flow causes main valve to retract
- Servo motor controls main valve actuation
- Spring forces main valve down when servo motor opens
- Main valve generates positive pulse by blocking orifice



xBolt-R Pulser (XPR) – Brushless Actuator Details

- The Servo Valve controls the Main Valve by regulating the hydraulic pressure inside the Piston Housing.
- Upgraded 240 Watt motor capable of generating QPSK signal (2 BPS max)
- Upgraded compensator boot seal housing
- Improved T-Seal design



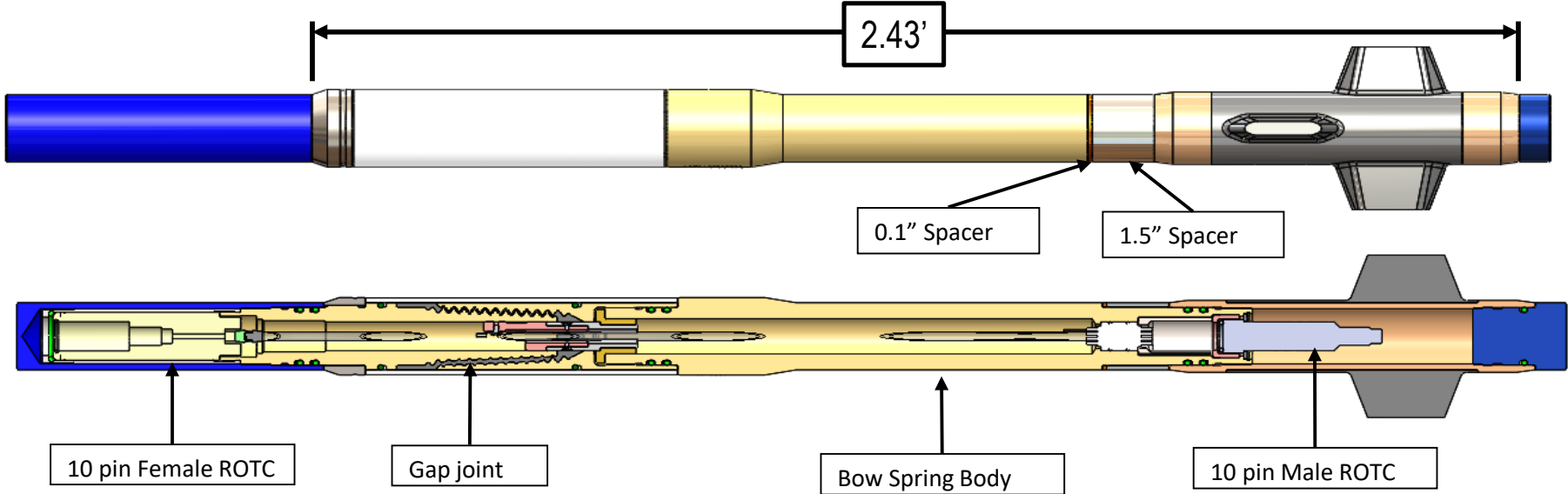
xBolt-R Pulsar (XPR) – Pulsar Precautions

- Servo valve will not stroke below 40° F due to cold weather affects on the Compensator Boot.
- All pulsers should be stored at >60° F
- Pulsar hrs should not exceed 300 circ hrs
- All Pulsers should be replaced after coming out of the hole, if it has over 200 circulating hours accumulated.
- Pulsers exposed to 320 F circulating temps should not be re-run.
- Always use the Pulsar Protective Sleeve to protect the Main Valve Tip when hoisting the MWD tool to the rig floor.

Major xBolt Components

xBolt Gap Probe (XGP)

xBolt Gap Probe (XGP)



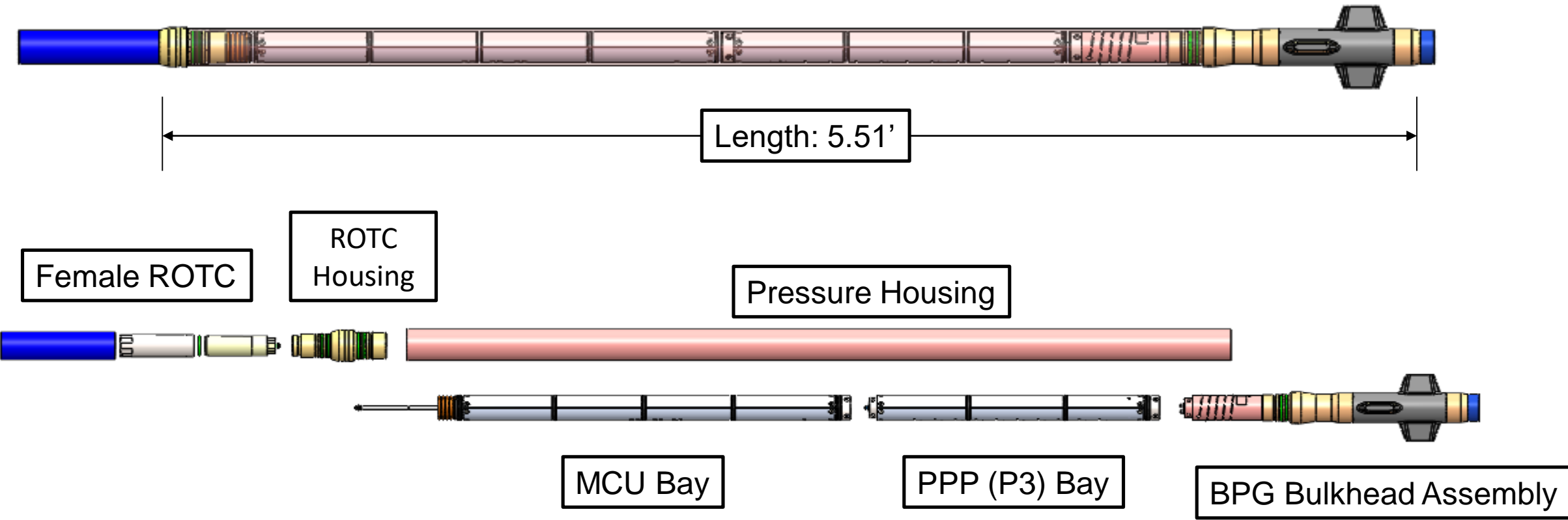
xBolt Gap Probe (XGP) - Details

- Provides insulated gap to transmit EM signal.
- Provides electrical contact to the ID of Drill collar through the bow spring.
- Long insulation length (7.5") that protects gap surface from mud contamination by the PEEK Sleeve and seals.
- Easy installation of bow spring and resizable in the field
- Adaptable to any xBolt tool configuration

Major xBolt Components

xBolt Dual Telemetry Probe (XDT)

xBolt Dual Telemetry Probe (XDT)



XDT Functions

- Detect flow on and off, broadcasts flow to other boards
 - Contains on board vibration flow switch
- Acquires data from all tools in the string
- Encodes data for transmission
- Controls the EM and Mud Pulse uplink
- Decodes EM downlinks
- Measure internal drill string pressure for EM safety
- Stores pressure, EM waveforms and other diagnostic data

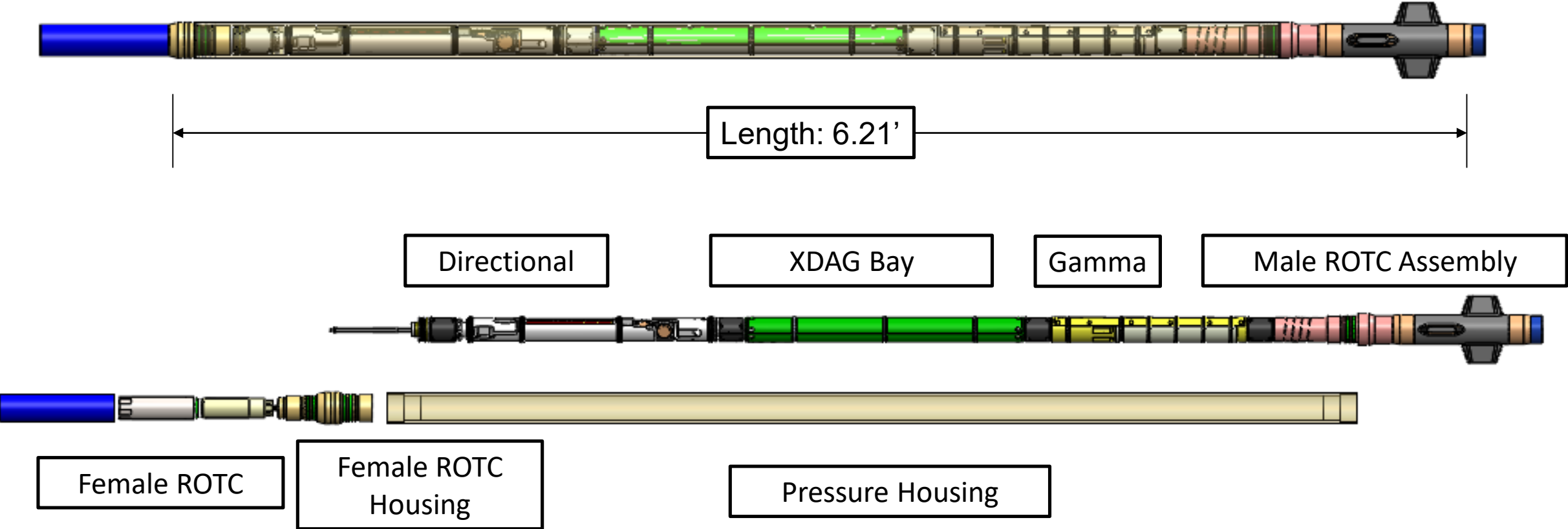
XDT Nodes

- **MCU (Telemetry)**
 - Microcontroller Unit / Telemetry Control
 - Contains EM Driver board
 - Records EM diagnostic data (waveforms, voltage, current)
 - Stores gamma and directional data without configuration request
 - 64MB Storage
- **PPP (Pressure Pulsar Processor)**
 - Controls mud pulse functionality
 - Contains pressure sensor electronics
 - Records MP diagnostic data (pressure values and waveforms)
 - 64MB Storage

Major xBolt Components

xBolt Directional and Azimuthal Gamma (XDAG)

xBolt Directional and Azimuthal Gamma (XDAG)

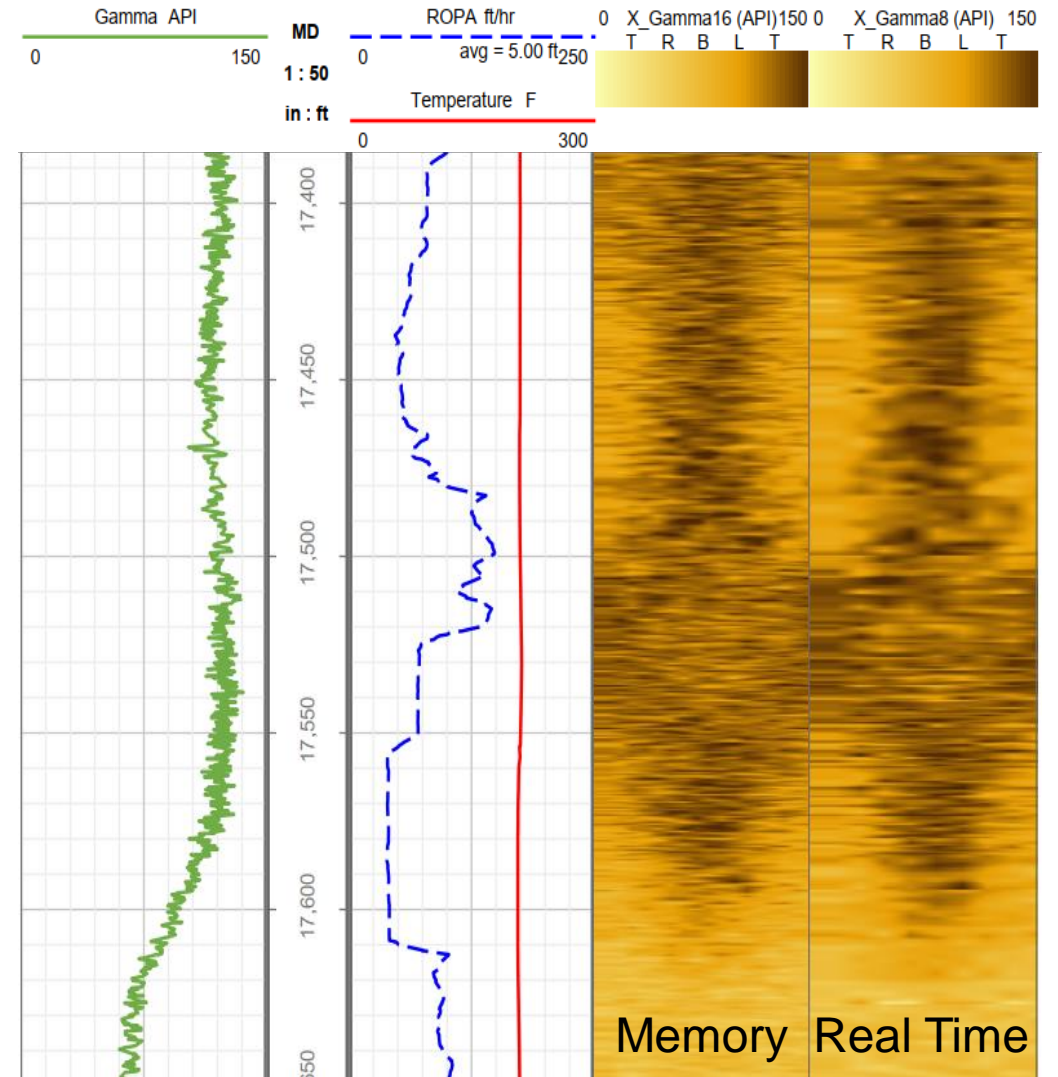


XDAG Functions - Directional

- 3 Accelerometers
- 3 Magnetometers
- Temperature sensor
- MTF/GTF readings
- Continuous Inc/Azi
- 3 Gauss magnetometer saturation for ranging applications
- CRPM, Stickslip, NRPM readings
- Detects RPM downlinks

XDAG Functions - Gamma

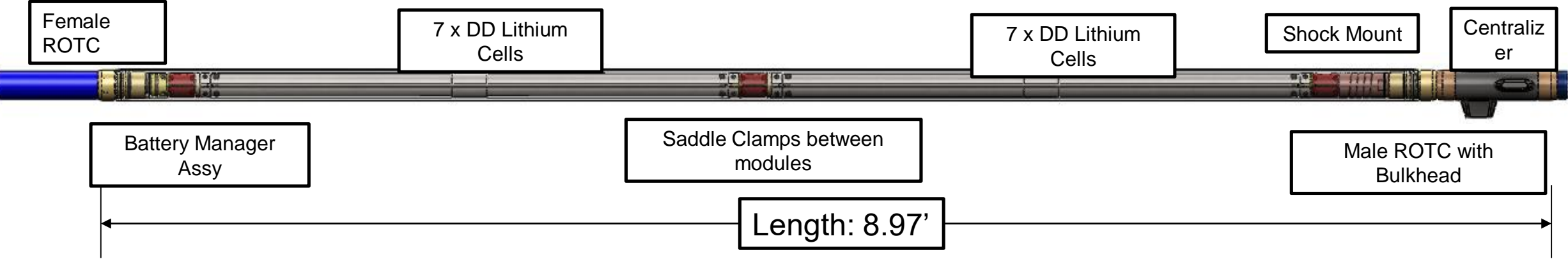
- 8 Sector RT Azimuthal Gamma
- 16 Sector RM Azimuthal Gamma
- Average Gamma
- 0-1200 API readings
- Configurable Azimuthal Gamma Ranges
 - 0-150 API
 - 0-300 API
 - 0-600 API
 - 0-1200 API
- XDAG has 512MB of memory



Major xBolt Components

xBolt Battery Probe (XBT)

xBolt Battery Probe (XBT)



xBolt Battery Probe (XBT)

- Module contains BM2 electronics and two battery bays
 - Primary / Reserve battery stick
- Each stick made of 7 “DD” cell batteries
 - Sticks each provide 25.2 volts
 - 3.6 volts per cell x 7 cells = 25.2 volts
- 150°C and 165°C battery options (58 Max AH / 50 Max AH)
- Up to 3 batteries in tool string
- Probe contains 8MB of memory

xBolt Battery Probe (XBT)

- Battery will request help from other batteries under below conditions:
 - Current draw exceeds 2Amp average
 - Bus voltage drops below 17.5V for more than 2 seconds
- Battery will go into “protection mode” under below conditions:
 - Cell voltage drops below 14V
 - When cells are more than 2V different from each other for 5 seconds
- “Auto Turn On” capabilities for collar loaded tool strings in shop
- Shop technicians can reset / preset the amp-hr usage
 - Reset amp-hrs to 0 if a new battery stick installed
 - Preset amp-hrs if not a new battery (known amp-hr value)
 - Can not test amp-hrs used/remaining, must be monitored

Lithium Battery Safety

- Design uses Telepacer battery layout with Extreme designed battery manager 2 for battery regulation and safety
- xBolt batteries were developed mainly to provide more energy per unit length than the 14V Extreme battery design

Lithium Battery Safety

- The properties that result in a high energy density also contribute to potential hazards if the energy is released at a fast uncontrolled rate.
- Safety has been incorporated into the design and manufacturing of batteries for Extreme. However, abuse or mishandling of lithium batteries can still result in hazardous conditions.

Minor xBolt Components

RSS Communication Probes

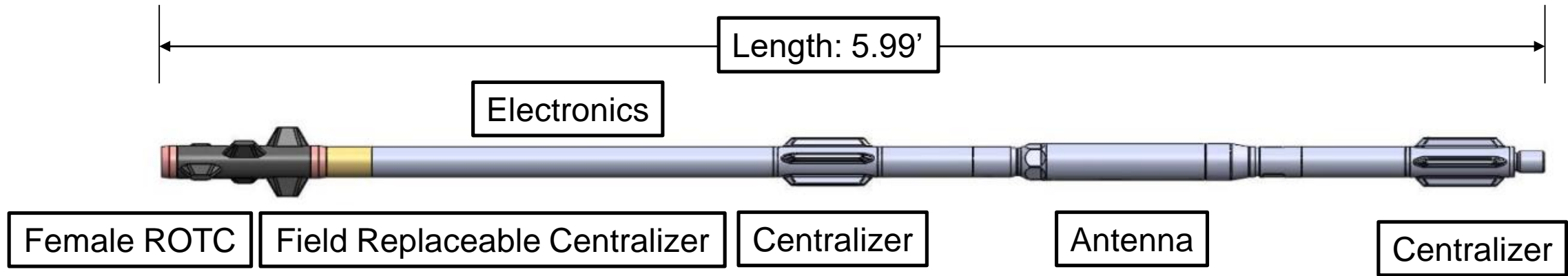
XHOP



XHOP Details

- Provides RT Communication to RSS via Emag
- Serves as end termination for tool string
- Contains 8MB memory for diagnostics
- Uses Standard, Extended and Flexible Shorthop Communications
- Assembled as bottom probe on string
- Programming/dumping individually or through XHOP Test Box
- XHOP details can be found in ITC# [6411234](#)

Babelfish (Field Test)



Babelfish Details (Field Test)

- Provides RT Communication to RSS via Emag
- Serves as end termination for tool string
- Contains 8MB memory for diagnostics
- Uses Standard, Extended and Flexible CLink Communications
- Assembled as bottom probe on string
- Programming/dumping individually or through XHOP Test Box
- Improved HOP distance compared to XHOP
- Babelfish details can be found in ITC# [7102408](#)

XHOP and Babelfish Key Consideration

- ALWAYS VERIFY POWERDRIVE OST FOR RT COMMS PROTOCOL **BEFORE** PICKING UP TOOL

ToolType	4	✓ ToolType (PDX6=0,Archer=1,XTRA=2,Orbit=3,CoPiBana=4)	Tool Parameters
UplinkType	4	✓ Uplink Type (0=Std.ShortHop, 1=Ext.ShortHop, 2=Std.Clink, 3=Ext.Clink, 4=Flex.Shorthop, 5=Flex.Clink)	Real Time

XHOP

Tool Configuration Parameters

Name	Value	Units	Report Name	Group
CollarSize	6.75		Collar Size	Tool Description
DlnkBitPeriod	18	s	Bit period of automated flow downlinks	Initial Steering Settings
DrillingCycle	180		Duration of drilling cycle	Initial Steering Settings
DesiredSteeringMode	0		Initial steering mode: 0=build and turn (Default), 1=PowerV	Initial Steering Settings
DesiredToolface	0	deg	Initial toolface angle	Initial Steering Settings
DesiredSteeringRatio	0	% max	Initial steering ratio	Initial Steering Settings
DesiredToolfaceMode	2		Initial toolface mode, 1=Magnetic (default), 2=Gravity	Initial Steering Settings
ROPIIndex	0	ft/h	ROP index (IH). 0 = 20-100ft/hr, 1= 80-400ft/hr	Initial Steering Settings/Inclination Hold
DropRate	15	%	Drop rate (IH)	Initial Steering Settings/Inclination Hold
SlewRate	4	RPM	Neutral slew rate(CU Rotation speed)	Initial Steering Settings
SlewMode	0		Neutral slew mode(Abs=0,Rel=1)	Initial Steering Settings
MuleShoeAn	250.2768	deg	Mule Shoe phase angle	Tool Parameters
TFShiftAn	60	deg	TF phase shift angle(Orbit=60, Xtra=90, X5=120, Archer 675=163, Archer 475=135, PiG PiP CoPiBana=146, CoPiBana AE=128.5)	Tool Parameters
ToolType	3		ToolType (PDX6=0,Archer=1,XTRA=2,Orbit=3,CoPiBana=4)	Tool Parameters
UplinkType	3		Uplink Type (0=Std.ShortHop, 1=Ext.ShortHop, 2=Std.Clink, 3=Ext.Clink, 4=Flex.Shorthop, 5=Flex.Clink)	Real Time

Babelfish

Minor xBolt Components

End Termination Options

End Termination Options

- R-Fishing Head
 - Used for all xBolt-R configurations
- XETL
 - Used when field replaceable centralizer is on bottom of last probe
- End Stabilizer (XEM Termination)
 - Used when Legacy XEM probe is last probe in string



R-Fishing Head



XETL



End Stabilizer (XEM Termination)

End Termination Functions

- Seals tool off from mud invasion
- Internal resistor stabilizes XBUS Communications
- R-Fishing Head serves as a means to lift tool from ground to rig floor
- XETL has adapter cut out for collar loadout removal
- R-Fishing Head and End Stabilizer provide stabilization for string



R-Fishing Head



XETL



End Stabilizer (XEM Termination)

Minor xBolt Components

Field Resizable Centralizers

Field Resizable Centralizers

- Stabilize tool string
- Protect male ROTC
- Interchangeable in field to reduce COSD
- Use caution when removing as damage can occur to male ROTC while removing
- Used on all new xBolt probes
- Will be incorporated to XEM probes in future



Field Resizable
Centralizers

Minor xBolt Components

Bowsprings

Bowsprings

- Provide point of EM contact on one side of gap
 - Second EM contact created by pulsers or EM fishing head contacting subs
- Must be used in applications with $>1\text{Ohm}$ gap impedance (all OBM applications, some WBM applications)



Bowsprings

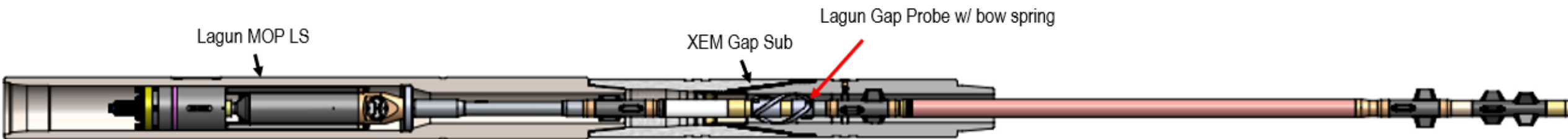
Bow Spring Guide – xBolt-L Dual Telemetry

BOW SPRING PLACEMENT

- Install on Gap Probe
- Use 1.5” Spacer Below Bow Spring (Without 0.1” Spacer)
- Recommended Use in >1 Ohm Gap Impedance Applications (OBM and some WBM)

xBolt-L DT Bow Spring Chart

Bow Spring P/N	No-Go Gauge	Tool Size	Gap Probe Centralizer Size
103121534	Red	475	2 11/16"
103121535	Yellow	675	3 1/4"
103232578	Blue	800	3 1/2"



xBolt-L String w/MOP LS and Gap Sub

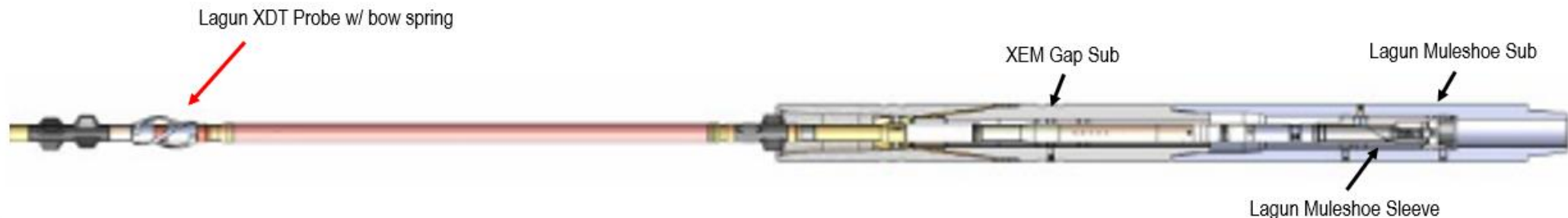
Bowspring Guide – xBolt-R Dual Telemetry

BOW SPRING PLACEMENT

- Install Bow Spring on XDT Connector Housing
- Use 1.5" and 0.1" Spacer on Gap Probe
- Recommended Use in >1 Ohm Gap Impedance Applications (OBM and some WBM)

xBolt-R DT Bow Spring Chart

Bow Spring P/N	No-Go Gauge	ID Range	Gap Probe Centralizer Size
103121534	Red	2 11/16" to 2 13/16"	Same as NMDC ID
103121535	Yellow	2 13/16" to 3 1/4"	Same as NMDC ID
103232578	Blue	3 1/4" to 4 1/4"	Same as NMDC ID

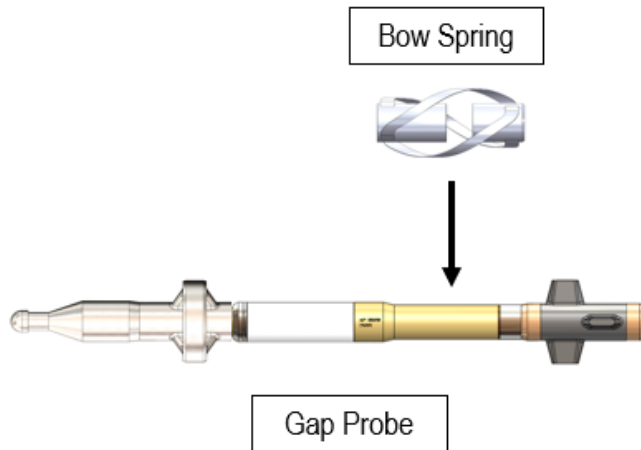


xBolt-R String w/Muleshoe and Gap Sub

Bow Spring Guide – xBolt EM Only

BOW SPRING PLACEMENT

- Install on Gap Probe
- Use 1.5” Spacer Below Bow Spring (Without 0.1” Spacer)
- Recommended Use in >1 Ohm Gap Impedance Applications (OBM and some WBM)

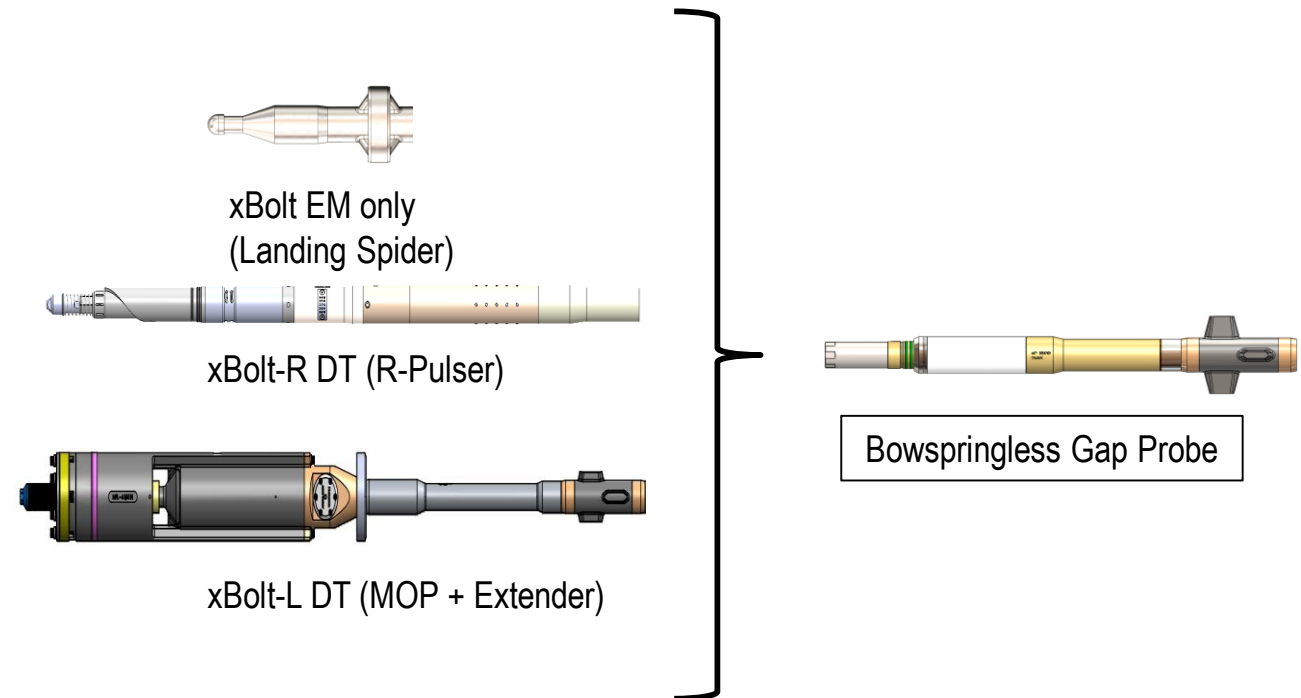


xBolt-L DT Bow Spring Chart			
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Bowstringless Operations

BOWSPRINGLESS OPERATION GUIDELINES

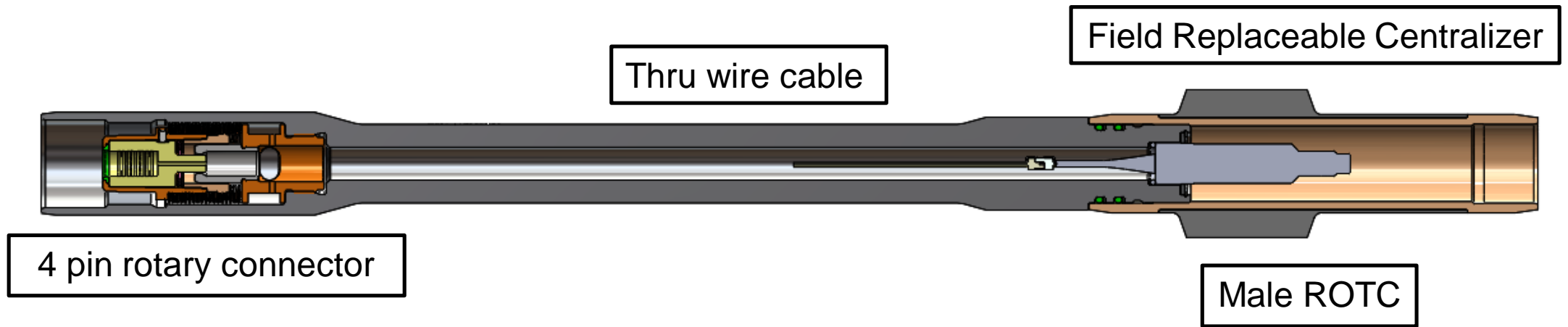
- Only Use In $<10\Omega$ Gap Impedance Applications
- All Brine Applications should be Bowstringless
- Recommended running bowsprings in unknown gap impedance WBM applications to verify gap impedance
- Running without bowsprings improves COSD
- Requires 1.5" and 0.1" Spacer



Minor xBolt Components

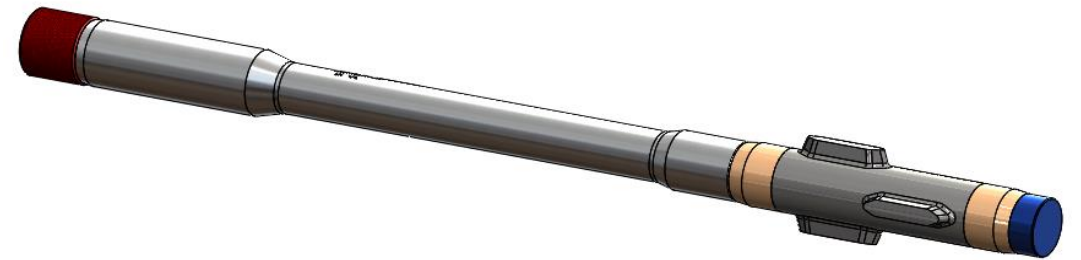
MOP Interface Probe

MOP Interface Probe



MOP Interface Probe Functions

- Adapter to connect MOP to xBolt string
- Crossover between uLan and XBUS connections
- Length provides proper alignment of gap probe inside gap sub
- Provides stabilization for top of tool string



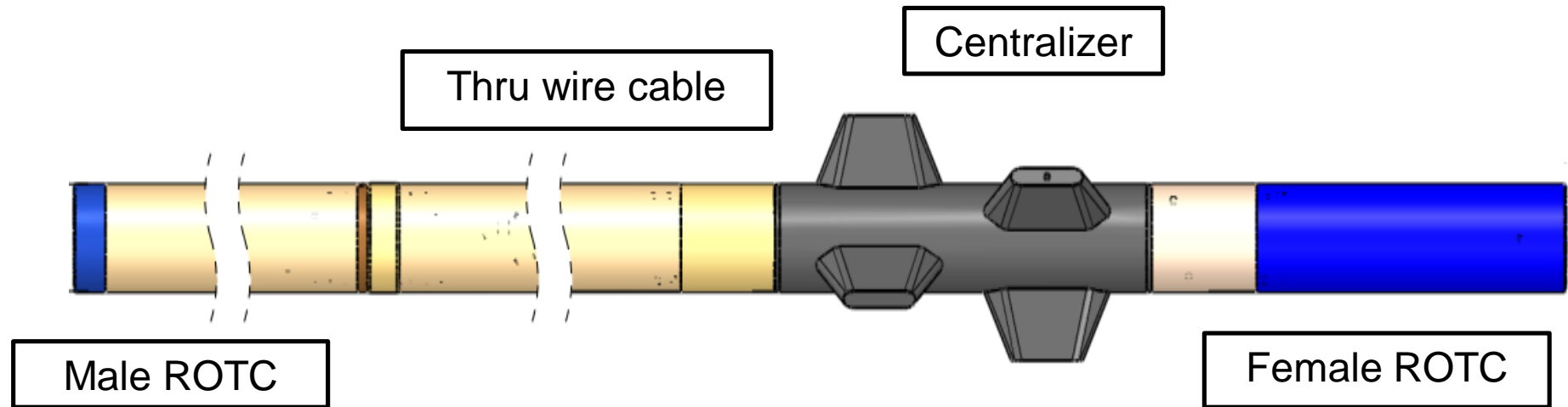
MOP Interface Probe

Minor xBolt Components

Realtime Extensions

Realtime Extension Details

- Used to decrease distance between XHOP and PD internals
- Two size options
 - 1.50' (short)
 - 2.67' (long)



Minor xBolt Components

EM Fishing Head

EM Fishing Head

- Only used when running xBolt in EM only configuration
- Used for pulling and inserting tool
- Creates a second EM contact above the Gap
- Serves as high side for toolstring
- Three sizes based on gap sub size: 475, 650, 800



EM Fishing Head

Minor xBolt Components

xBolt Muleshoe Sleeve

Muleshoe Sleeve

- Uses same orifices and flow rates as Telepacer-R Muleshoe Sleeves
- Two Sizes: 3 ¾" & 3 ¼"
- Pressure Actuated Locking Mechanism for EM Contact and Tool Stability

Muleshoe OD	Sleeve OD	Orifice OD	Orifice #	Jet Holes	Jet Hole ID	Max Flow	Med Flow	Min Flow	TFA (sq-in)
9 ½" – 6¼"	3 ¾"	2.75"	10	8	0.375	1000	850	700	1.669
			9	8	0.348	900	750	600	1.546
			8	8	0.328	800	675	550	1.461
			7	6	0.348	700	575	450	1.356
			6	6	0.328	550	475	400	1.292
			5	5	0.339	500	425	350	1.053
			4	4	0.328	450	375	300	.939
			3	3	0.328	350	275	200	.855
4 ¾"	3 ¼"	2.50"	3	3	0.328	350	275	200	.855
			2	3	0.281	280	230	170	.780
			1	2 (flutes)	.390 (wide)	220	180	130	.681



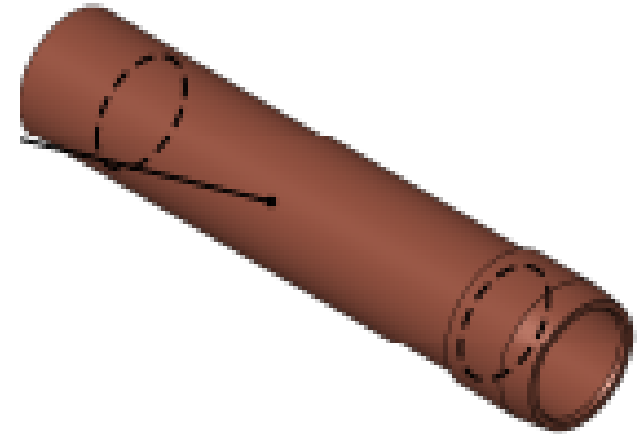
xBolt Muleshoe Sleeve

Minor xBolt Components

xBolt Connector Housing

Connector Housing

- Replaces centralizer in xBolt-R dual telemetry configuration
- Bow spring will be installed on housing instead of on XGP



xBolt Connector Housing

Summary

- Learn the function of each major xBolt component
- Learn the function of each minor xBolt component