Power & Mobility (P&M)

ADVANCED COMBAT TRANSMISSIONS - THE SAPA ACT1000, ACT850 & ACT1075

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A Brief History of SAPA

Power & Mobility (P&M)

SAPA History:

- 1573 – Chartered as Arms Supplier in Placencia, Spain
- 1777 & 1778 – Supplied Arms to American Efforts During Revolution
- 1862 – Arms Factory for Spanish and French Armies
- 1888 – Placencia Arms Company
- 1933 – **S**ociete **A**nonima de **P**lacencia de las **A**rmas (SAPA) Incorporated
- 1946 – SAPA IRAD Started for Anti-Aircraft Systems
- 1972 – Start of Vehicle Propulsion Efforts
- 1985 – SAPA IRAD Delivers Improved Anti-Aircraft System
- 1994 – Spanish Leopard Program, Including APU
- 2002 – SAPA Placencia R&D Center Opened
- 2004 – SG850 IRAD Starts (120M USD Investment)
- 2014 – SG850 Selected for Pizarro IFV (35t)
- 2016 – SAPA SG850 Selected for Bradley Mobility Demonstrator
- 2021 – Piranha V, 35t Wheeled Vehicle Using SW624 (800 Vehicles)

SAPA Transmission US History:

- 2003 - US Company Founded as Subsidiary of SAPA Operaciones Spa
- 2011 – High Efficiency Powertrain Award – SW624 for 35t Wheeled Vehicles
- 2015 – Advanced Combat Transmission Award
- 2018 – 48K ft^2 R&D Center Opened in Shelby Township, MI (leased)
- 2020 – 110K ft^2 R&D and Production Center Completed in Shelby Township, MI

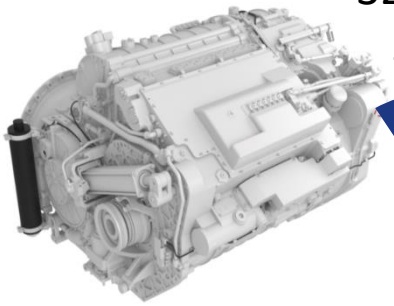
ACT Technology Path

Power & Mobility (P&M)

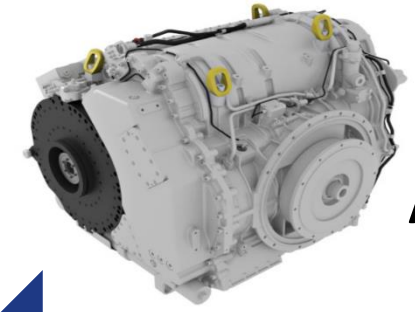
SG850

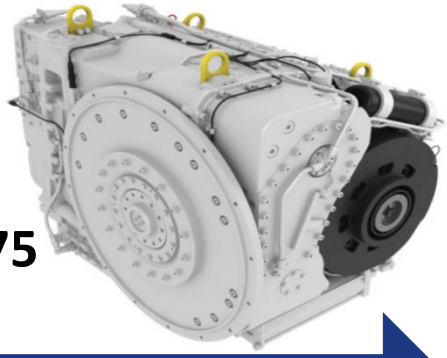
32 Speed / 20:1 Spread
Scalable & Modular Design

ACT1000



Drive By Wire





ACT850 **ACT1075**

ACT850	Model	**ACT1075**
35 to 55 ton	Vehicle Weight	**55 to 75 ton**
600 to 1000Hp	Engine Power	**1000 to 1500Hp**

ACT1000 Development Program Goals

Power & Mobility (P&M)

Parameter	Threshold	Objective	Unit
Efficiency	90	92	%
Steering Efficiency	90	91	%
Forward Speed	42	45	mph
Reverse Speed	20	30	mph
Maximum TE	1.0		-
Continuous TE	0.7		-
0-30mph Acceleration Time	22	16	s

Drive-By-Wire (Shift / Steer / Brake) Required

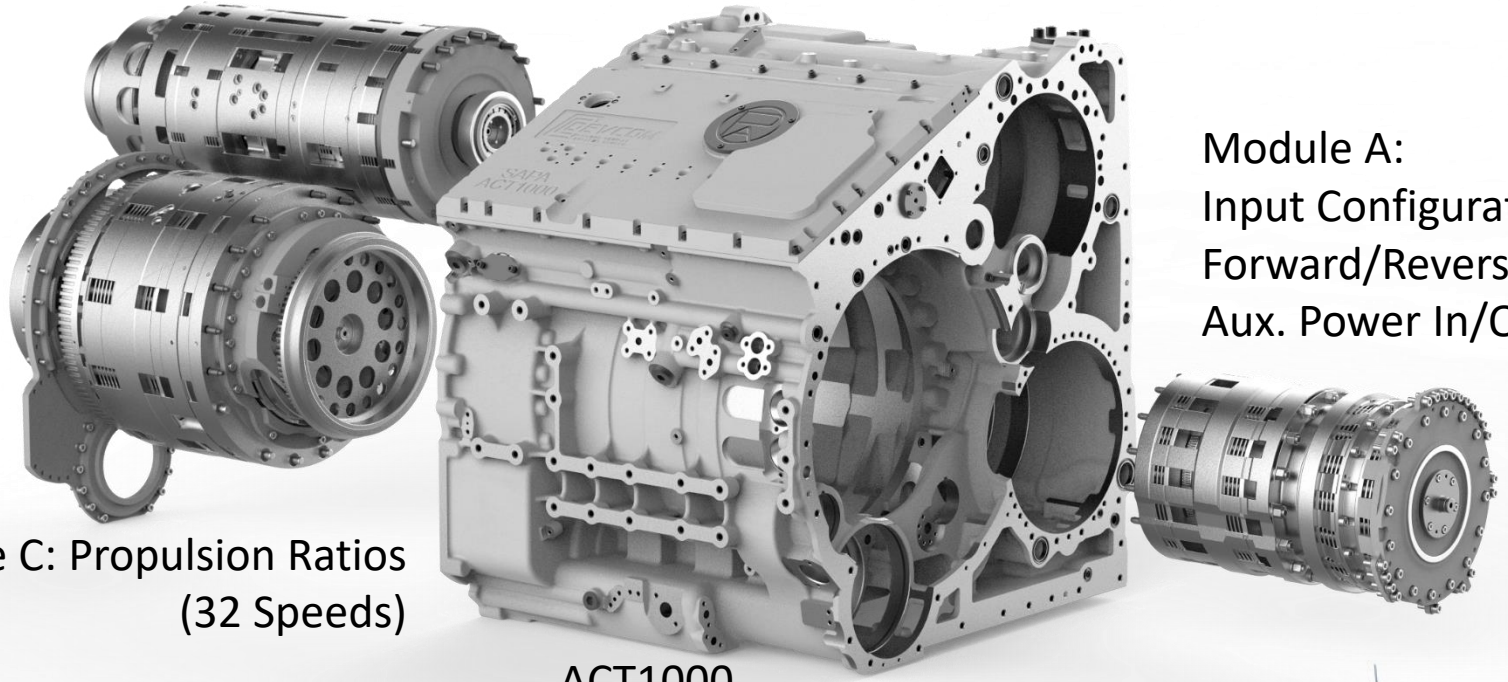
Additional SAPA ACT Development Goals

Power & Mobility (P&M)

Parameter	Threshold	Objective	Unit
Maximum Transmission Specific Heat Rejection	15	10	% of ICE Rated Power
Transmission Input Power Required for 4rpm Pivot Turn @ 0.5 TE	5	4	kW Power Input/Ton
Vehicle Speed Reduction While Executing 100ft Radius Turn at 25 mph - Constant Engine Power	5%	0%	%
Impact of 10% Increase in Vehicle Weight – Constant Engine Power	7	5	Speed loss on 10% grade (mph)

ACT Scalable and Modular Design for Efficiency

Module B: Steering Function

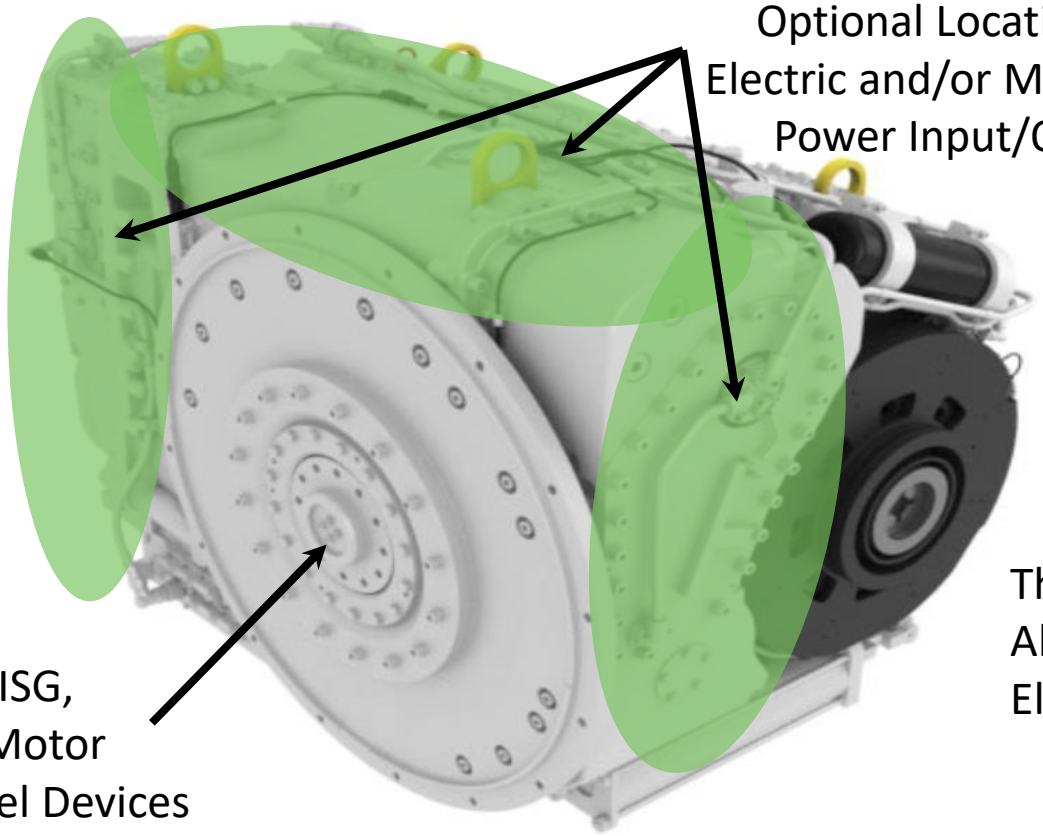


Module A:
Input Configuration
Forward/Reverse
Aux. Power In/Out

Module C: Propulsion Ratios
(32 Speeds)

ACT1000

Hybrid and Electric / Mechanical Power Flexibility

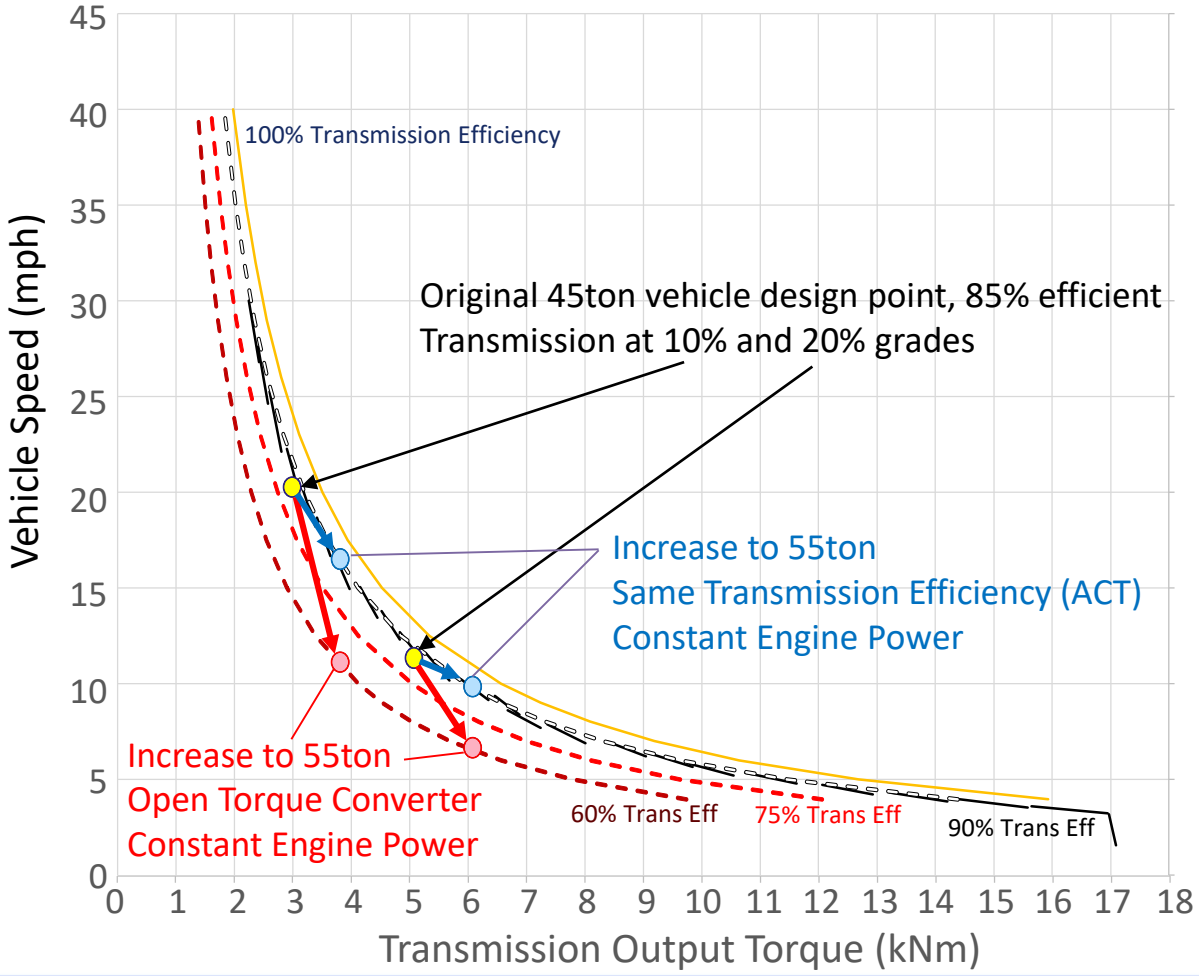


Shaded Areas Depict Optional Locations for Electric and/or Mechanical Power Input/Output

ICE, ICE+ISG, Electric Motor Or Parallel Devices

The ACT Modular Design Allows for Flexibility in Electrification Choices

Impact of Increased Vehicle Weight

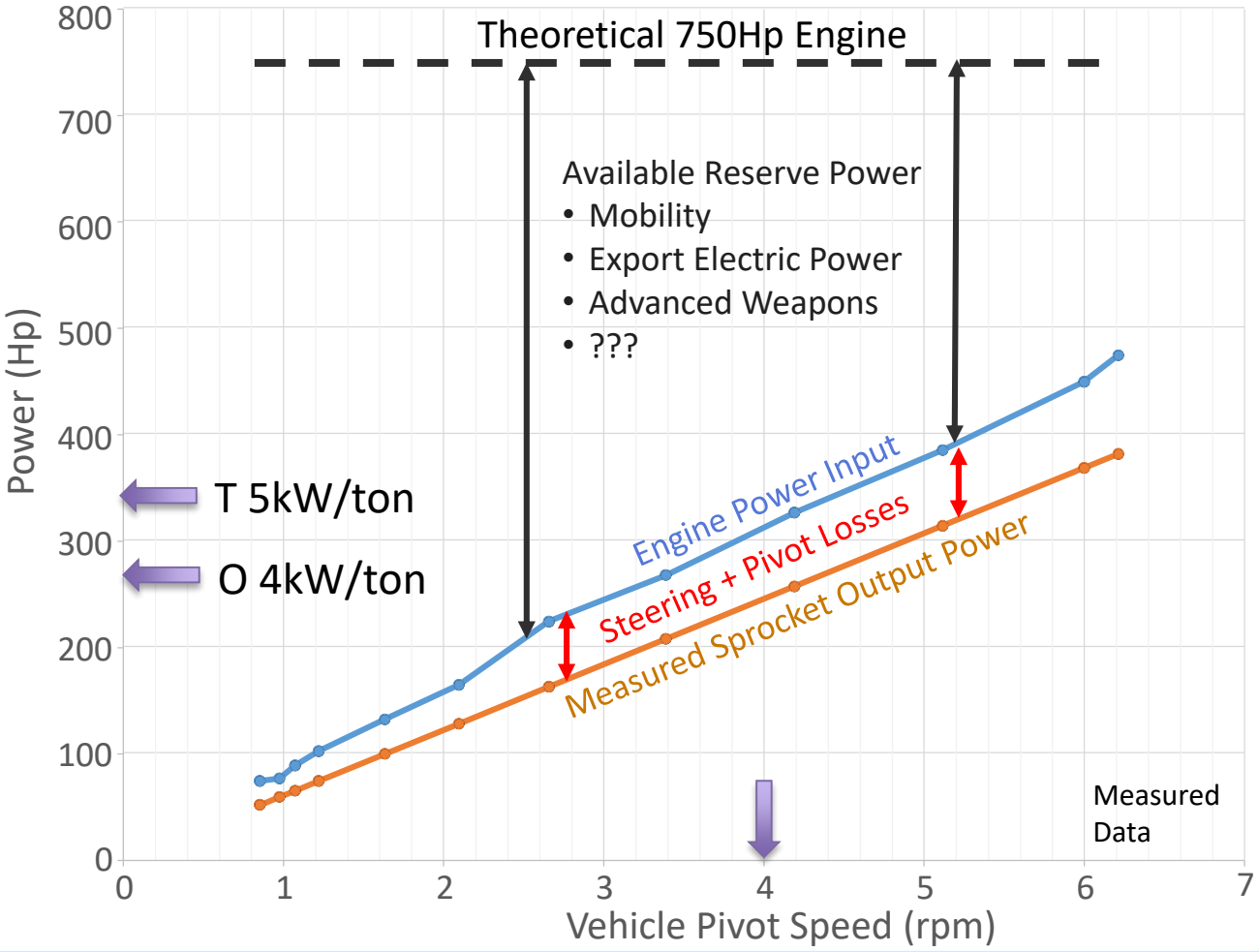


Impact of 10ton Increased Vehicle Weight on Speed (mph):

Grade	ACT	OTC
10%	-4.5	-9.5
20%	-1	-5

Consistent High Efficiency Yields Less Performance Loss as Vehicle Mass Increases

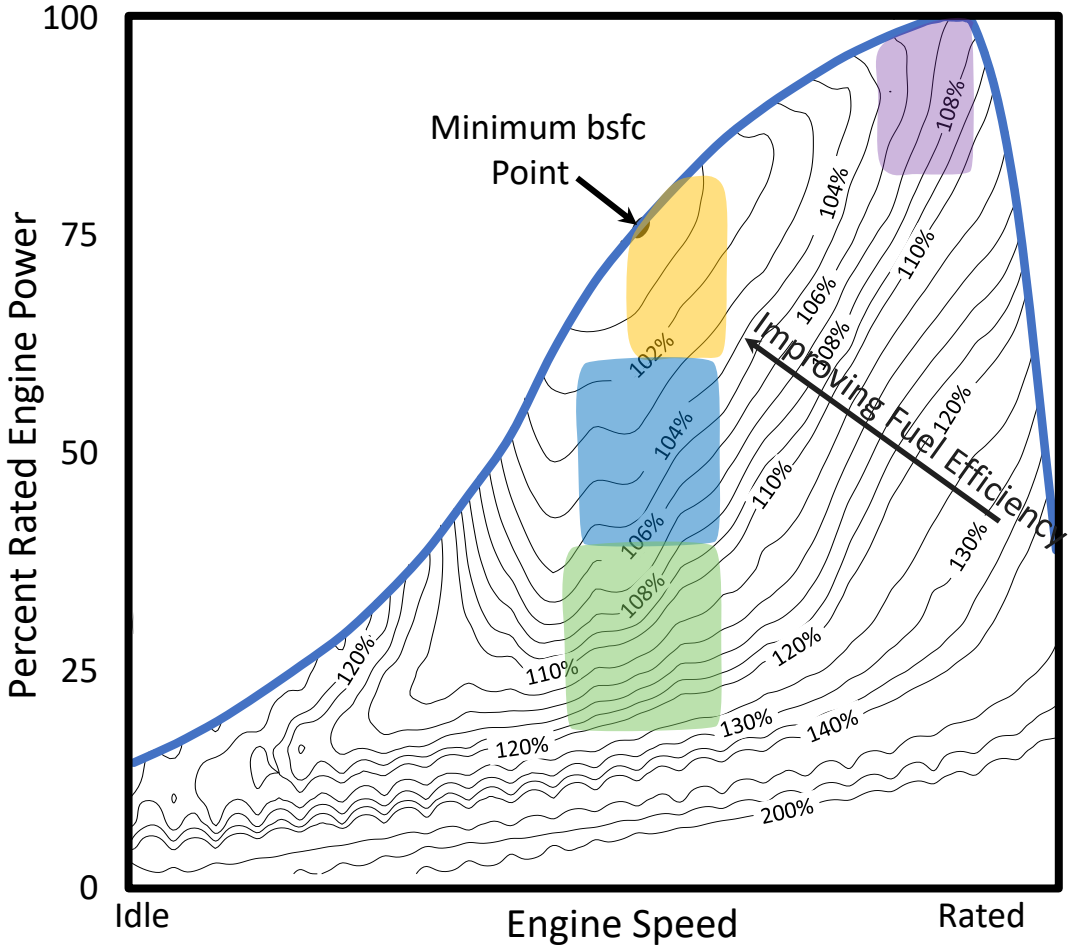
Vehicle Pivot Performance



Pivot performance @ 0.5TE & 50ton vehicle:

- Less Than 5kw/ton Input Power at 4 rpm Pivot Speed Required
- Enables Use of Smaller Electric Machines for Silent Maneuverability

Enabled System Efficiency



Full Throttle Accelerations or Continuous High TE Operation: Ratios and Shift Points Selected for Performance Near Rated Power

Increasing Demand

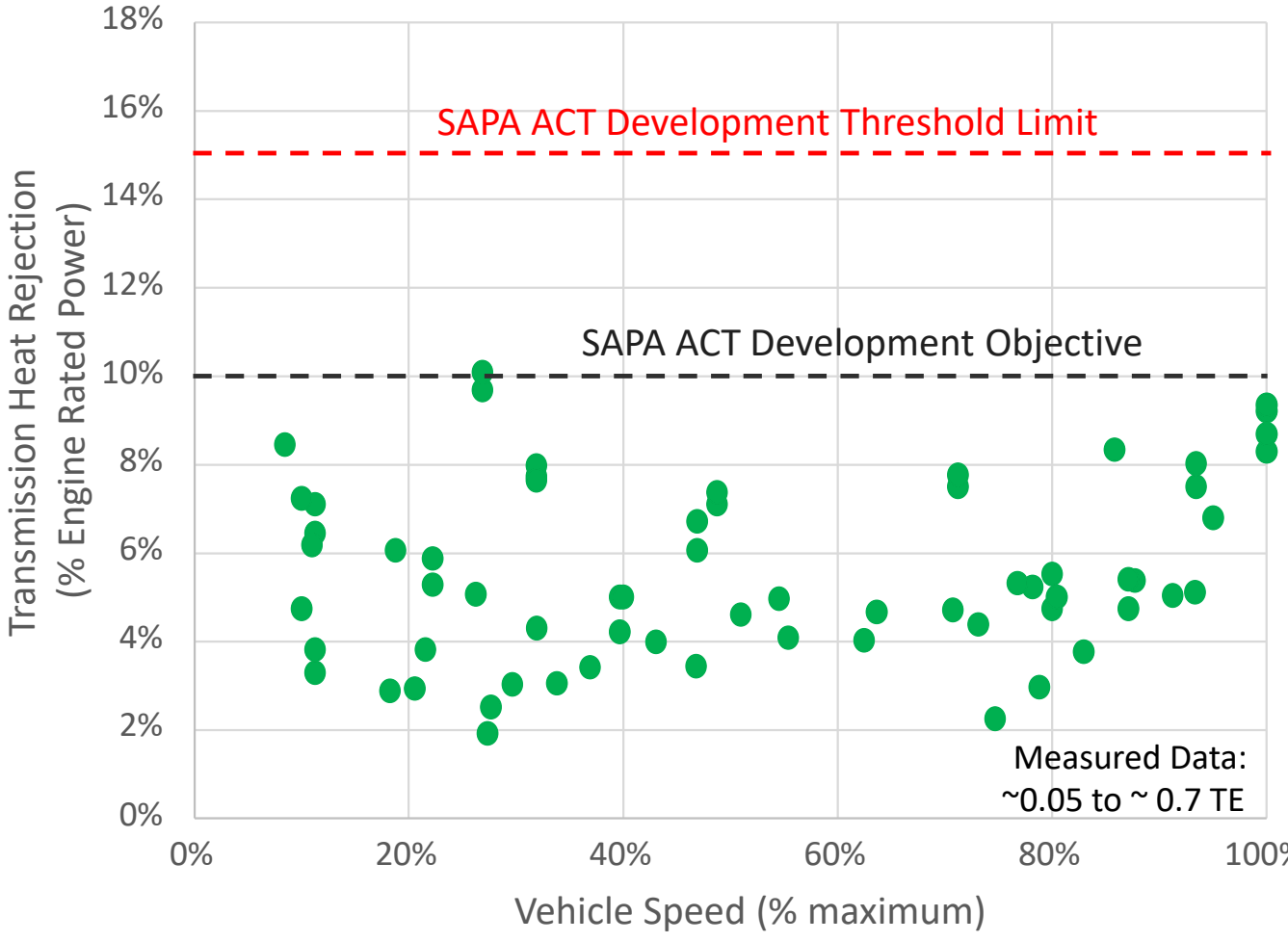
0% Grade Riverbed Steep Grades

Ratios and Shift Points Selected to Minimize Engine Fuel Consumption @ Required Power Level

0 – 2% Grade Firm Surface

32 Available Ratios Allow the Engine (or e-Machine) to be Kept Near Optimal Efficiency for the Power Demanded

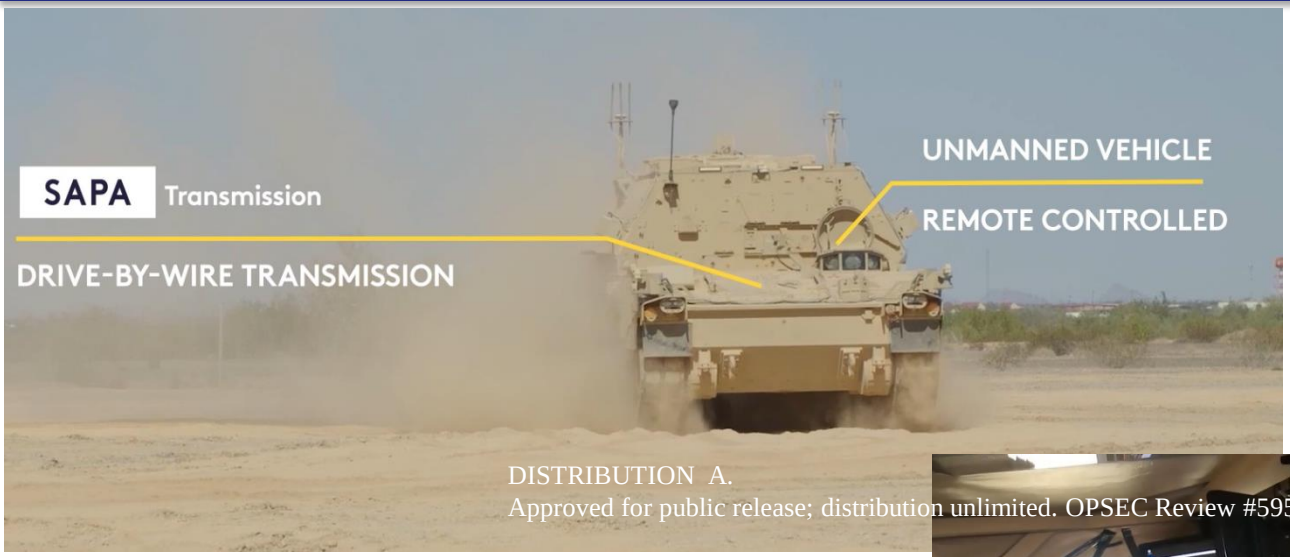
Transmission Heat Rejection



Transmission Heat Rejection Objective Levels Attained

High Efficiency at ALL Operating Conditions Minimizes Heat Rejection and Vehicle Cooling Power Needs

Unmanned / Remote Controlled AMERCA Demo



Remote Controlled, Unmanned Operation Enabled by SAPA Drive-By-Wire Technology

DVIDS - Video - AMERCA video (dvidshub.net)

SAPA Transmission Laboratory - Shelby Twp MI

Power & Mobility (P&M)

Test Engine

Ratings:
400 to 1500Hp
1000 to 3000ft-lb

Test Data Acquisition Systems

Dyno (Left)	Base Rating	Over Load
Power (kW)	400	566
Torque (Nm)	12000	17000

Inertia Wheel

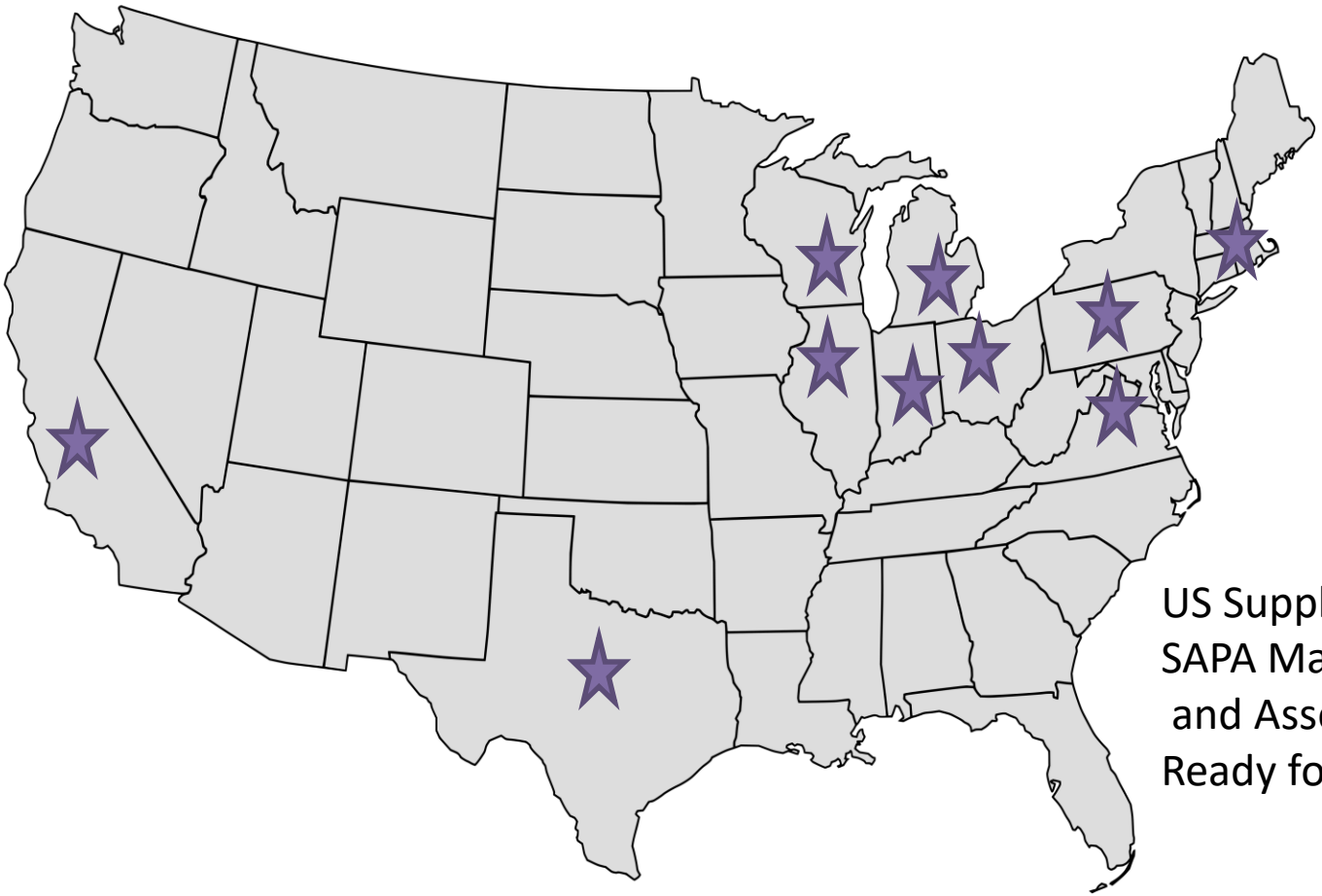
SAPA Transmission:
ACT850
ACT1000
ACT1075

Inertia Wheel

Dyno (Right)	Base Rating	Over Load
Power (kW)	400	566
Torque (Nm)	12000	17000

SAPA Transmission US Base

Power & Mobility (P&M)



US Supply Base, Backed By SAPA Machining, Manufacturing and Assembly Expertise Will Be Ready for LRIP December 2023

Summary

- SAPA has a long history, including support of the US Army.
- The scalable and modular ACT product line covers vehicle applications from 35ton thru 75ton and input power from 600Hp to 1500Hp. Designs allow for
  - Hybridization or parallel power inputs;
  - U, L, or T configurations; and
  - Flexible PTO locations.
- The ACT product line delivers high efficiency, enabling improved performance, lower heat rejection and lower fuel consumption & Green House Gas emissions
- The advanced steering technology requires less power input, enabling use of smaller electric motors for silent watch maneuverability
- Drive-By-Wire has been successfully incorporated in and demonstrated by the ACT product line.
- SAPA Transmission has invested heavily in our Shelby Township facility for development, testing, manufacturing and assembly, and in our US supply base for US sourced components.

Questions?