DRIVER ALCOHOL DETECTION SYSTEM FOR SAFETY TECHNOLOGY

A Vehicle Safety Technology Approach to Reducing Alcohol-Impaired Driving – A Status Update

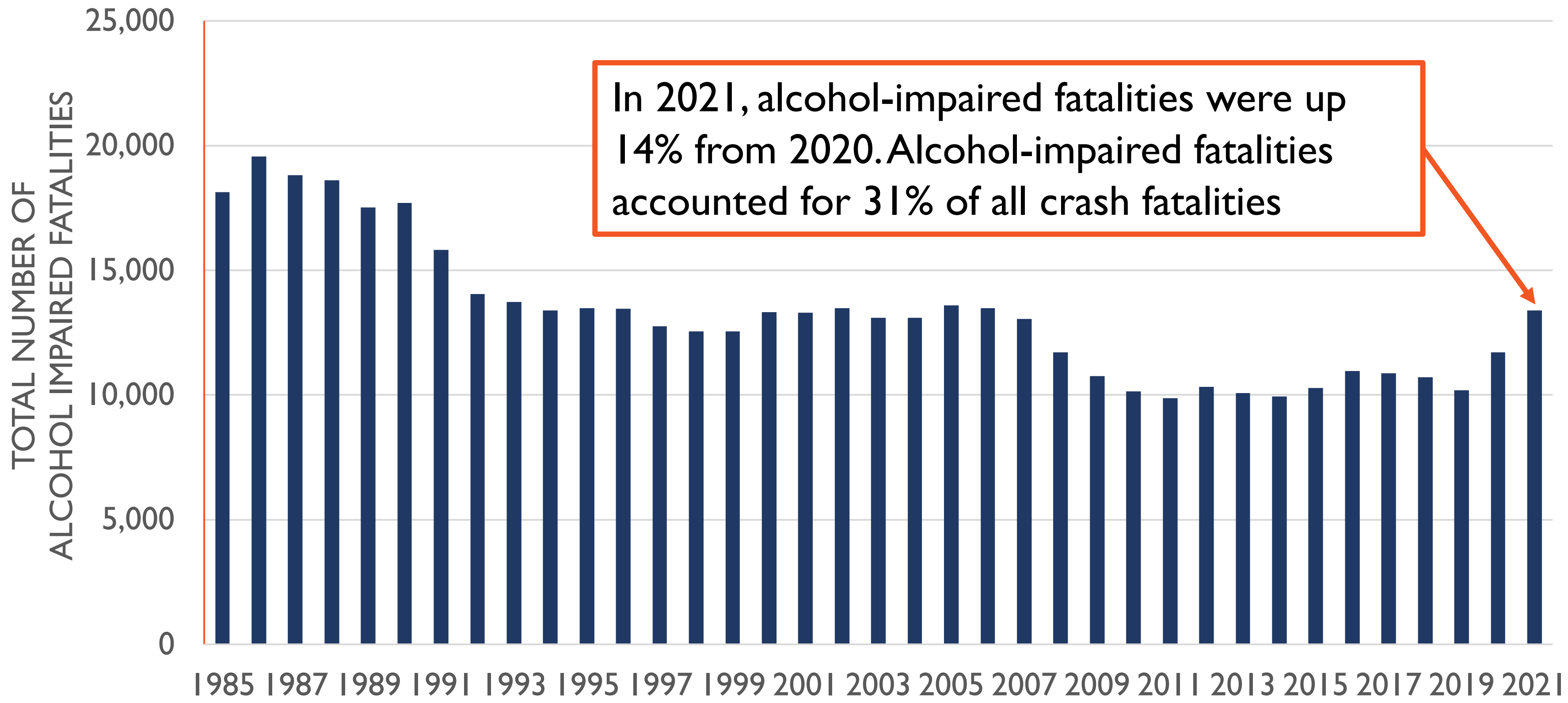
2023 AIIPA Annual Conference

Bud Zaouk

KEA Technologies, Inc.

ALCOHOL–IMPAIRED FATALITY TREND

THE LARGEST, MOST PERSISTENT TRAFFIC SAFETY PROBLEM



Alcohol-impaired crashes are crashes that involve at least one driver or a motorcycle operator with a blood alcohol concentration of 0.08 grams per deciliter or above, the legal definition of alcohol-impaired driving in most states

Source: National Center for Statistics and Analysis. (2022, October). Traffic safety facts 2020: A compilation of motor vehicle crash data (Report No. DOT HS 813 375). National Highway Traffic Safety Administration

POTENTIAL SAFETY BENEFITS

- ✓ **IIHS projects 9,400 deaths could be prevented annually**
- ✓ **Over 15 years:**
  - Almost **59,000 deaths** and approximately **1.25 million nonfatal injuries** could be avoided; and an
  - Estimated **$342 billion** in injury–related costs avoided (University of Michigan)

- ✓ **Drunk driving is the still the #1 cause** of traffic fatalities, costing the U.S. an estimated **$194 billion annually**

Sources:
Farmer, C. M. (2020) Potential lives saved by in–vehicle alcohol detection systems. IIHS. Available at https://www.iihs.org/topics/bibliography/ref/2209.

Carter, P. M., Flannagan, C. A., Bingham, C. R., Cunningham, R. M., & Rupp, J. D. (2013) Alcohol ignition interlock installation in new vehicles as a primary prevention measure to decrease alcohol involved crash fatalities and injuries. In *Alcoholism-Clinical and Experimental Research, 37*, pp. 149A-149A . Wiley-Blackwell: Hoboken, NJ

HIGH LEVEL OBJECTIVES
DADSS PROGRAM

- Public–Private partnership between the **Automotive Coalition for Traffic Safety, Inc. (ACTS)**, a nonprofit, and the U.S. Department of Transportation's **National Highway Traffic Safety Administration (NHTSA)**
- Successfully develop and commercialize one or more vehicle–integrated technologies to rapidly measure a driver's blood alcohol concentration (BAC) *in–situ* with the high precision and accuracy needed
- Facilitate the deployment of commercialized DADSS technologies as widely as possible as rapidly as possible through:
  - Patent coverage in areas of the world where motor vehicles are manufactured
  - Ensuring that ACTS and its licensees have clear title and freedom–to–operate
  - Open licensing

TECHNOLOGY OVERVIEW
DADSS PROGRAM

- Developing first–of–its–kind technology to detect when a driver is impaired with an alcohol concentration at or above the legal limit in the United States and prevent the car from moving
- Two technologies being researched: Breath–based and touch–based systems
- Programmable for a zero–tolerance limit for the underage driver
- Made available as a safety option in new vehicles, much like AEB, LDW, other ADAS technologies or other DMS technologies
- Ultimate goal is fast, accurate, reliable and affordable technology that will not hassle sober drivers

PROGRAM ORGANIZATION

DADSS PROGRAM

dadss
Driver Alcohol Detection System for Safety

ACTS AUTOMOTIVE COALITION FOR TRAFFIC SAFETY	DADSS Program	Program Management & Oversight
dadss Driver Alcohol Detection System for Safety	DADSS Research Program	Technology R & D Pilot Field Trials
DRIVEN TO PROTECT POWERED BY DADSS	Driven to Protect Initiative	Trial Deployments Consumer Acceptance

FUNDERS & ADVOCATES
DADSS PROGRAM

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Driver Alcohol Detection System for Safety

FUNDERS

NHTSA
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

ACTS
AUTOMOTIVE COALITION FOR TRAFFIC SAFETY

VIRGINIA DMV
www.dmvNow.com

MDOT
MARYLAND DEPARTMENT OF TRANSPORTATION
MOTOR VEHICLE ADMINISTRATION

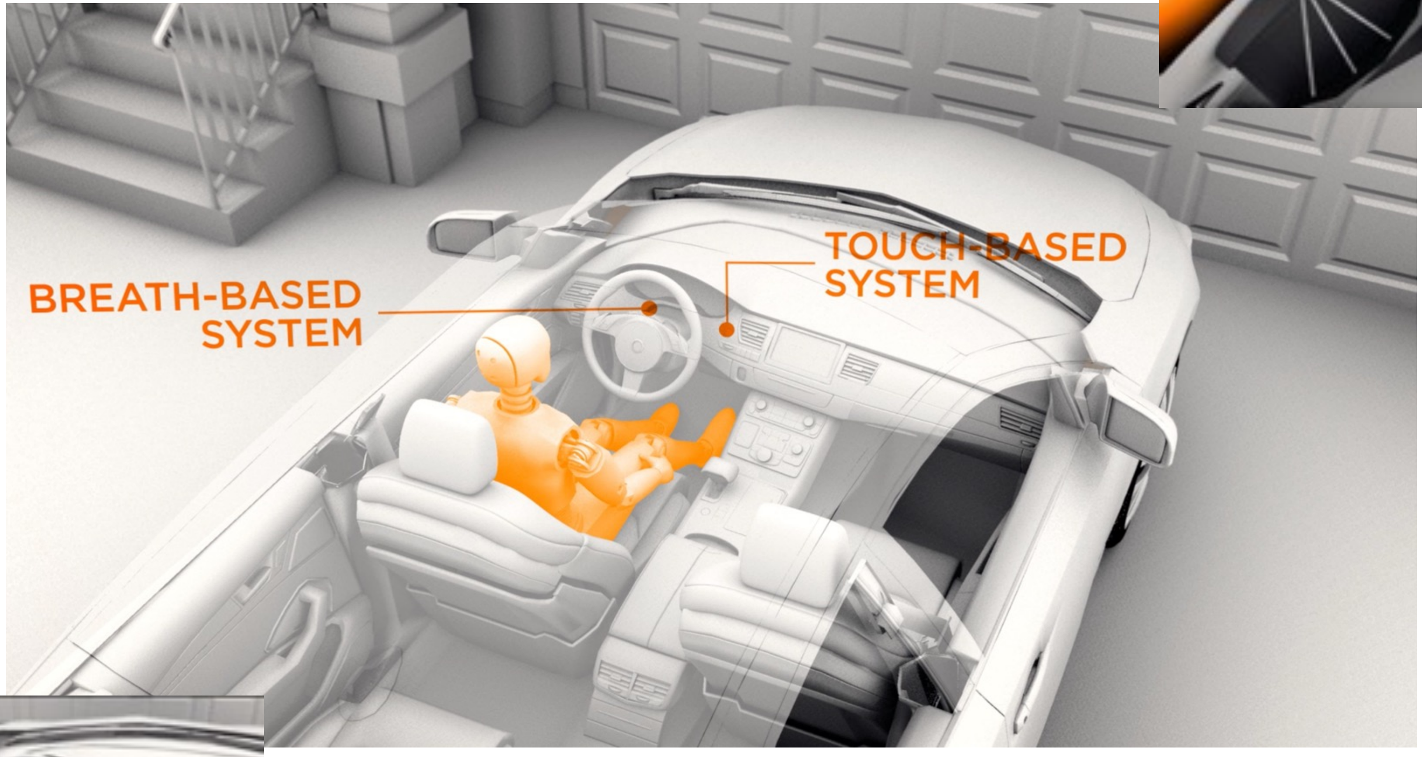
BMW GROUP
Ford
gm
HONDA
HYUNDAI
KIA
mazda
Mercedes-Benz
MITSUBISHI
NISSAN
PORSCHE
STELLANTIS
SUBARU
TOYOTA
VW
VOLVO

ADVOCATES

AAMVA American Association of Motor Vehicle Administrators
American Highway Users Alliance
Distilled Spirits Council of the United States
FIA FOUNDATION
Foundation for Advancing Alcohol Responsibility
GHSA
IIHS HLDI
madd
madd Saving Lives, Supporting Victims
NOYS National Organizations for Youth Safety
nsc
Nationwide
WE SAVE LIVES HIGHWAY SAFETY ADVOCATES
SAFE KIDS WORLDWIDE

DADSS TECHNOLOGIES

The **Breath System** measures the alcohol in a driver's naturally exhaled breath. A small sensor compares the amount of carbon dioxide molecules with alcohol molecules in the driver's breath using infrared light.



The **Touch System** measures the blood alcohol concentration under the skin's surface by shining an infrared-light through the fingertip or the palm of the driver.

DISTANT SPECTROSCOPY
DADSS BREATH SYSTEM

Senseair

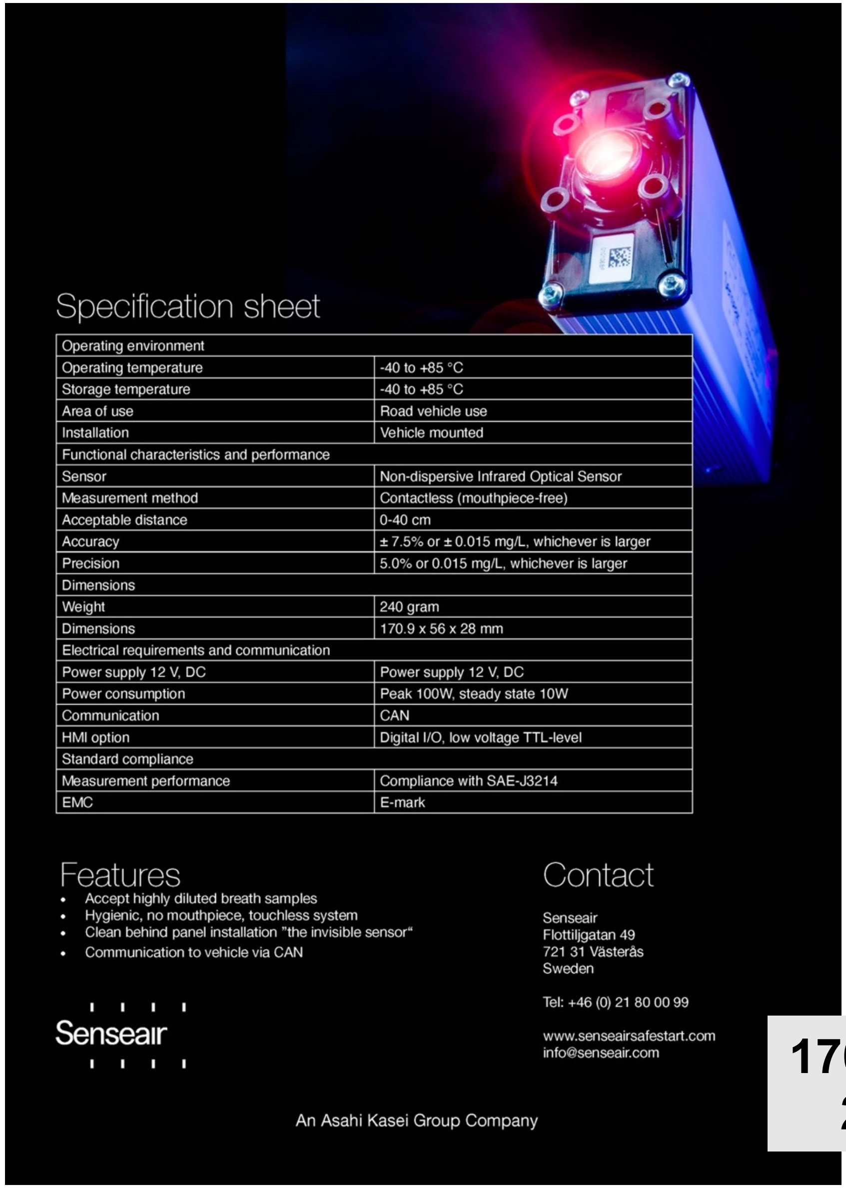
AsahiKASEI

Manufacturing Partners

- Uses infrared detectors that simultaneously measure the concentrations of ethyl alcohol (ethanol) and carbon dioxide is a driver's expired breath
- Carbon dioxide in the breath sample provide an indication of the degree of dilution of the alcohol concentration
- Diluted breath is drawn into a measurement cavity (optical bench assembly) where optical detectors measure the infrared light absorbed by the ethanol and carbon dioxide in the sample
- Using these measurements, the driver's breath alcohol concentration is calculated

FIRST PRODUCT POWERED BY DADSS TECHNOLOGY

- GEN 3.3 Breath Sensor
- Directed Breath
- Zero Tolerance
- Intended use:
  - Fleets
  - Newly–licensed (underage) drivers
- Released Dec. 2021



Specification sheet

Operating environment	
Operating temperature	-40 to +85 °C
Storage temperature	-40 to +85 °C
Area of use	Road vehicle use
Installation	Vehicle mounted
Functional characteristics and performance	
Sensor	Non-dispersive Infrared Optical Sensor
Measurement method	Contactless (mouthpiece-free)
Acceptable distance	0-40 cm
Accuracy	± 7.5% or ± 0.015 mg/L, whichever is larger
Precision	5.0% or 0.015 mg/L, whichever is larger
Dimensions	
Weight	240 gram
Dimensions	170.9 x 56 x 28 mm
Electrical requirements and communication	
Power supply 12 V, DC	Power supply 12 V, DC
Power consumption	Peak 100W, steady state 10W
Communication	CAN
HMI option	Digital I/O, low voltage TTL-level
Standard compliance	
Measurement performance	Compliance with SAE-J3214
EMC	E-mark

Features

- Accept highly diluted breath samples
- Hygienic, no mouthpiece, touchless system
- Clean behind panel installation "the invisible sensor"
- Communication to vehicle via CAN

Contact

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info@senseair.com

Senseair

An Asahi Kasei Group Company

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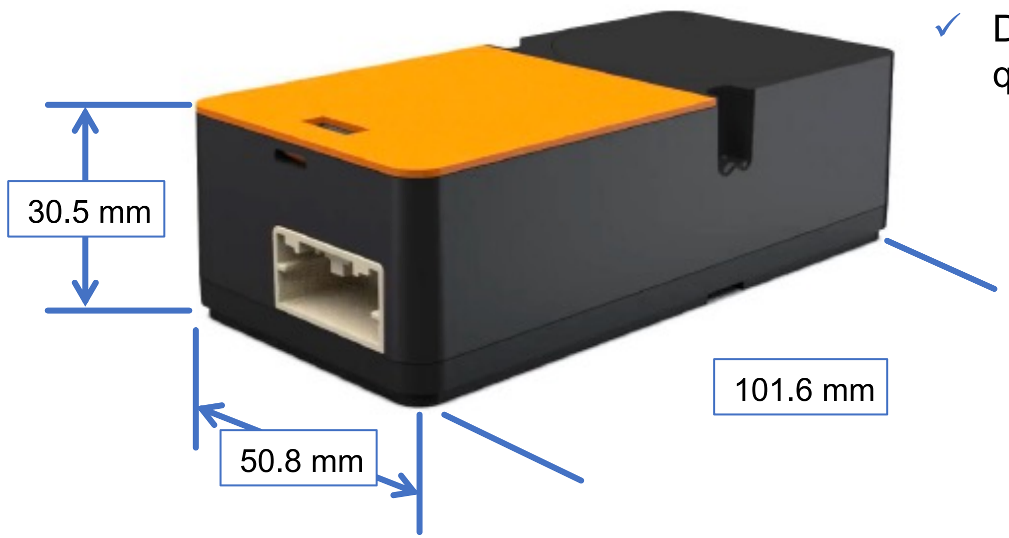
Driver Alcohol Detection System for Safety

170.9 x 56 x 28 mm
267,971.2 mm^3

SENSEAIR GO | POWERED BY DADSS

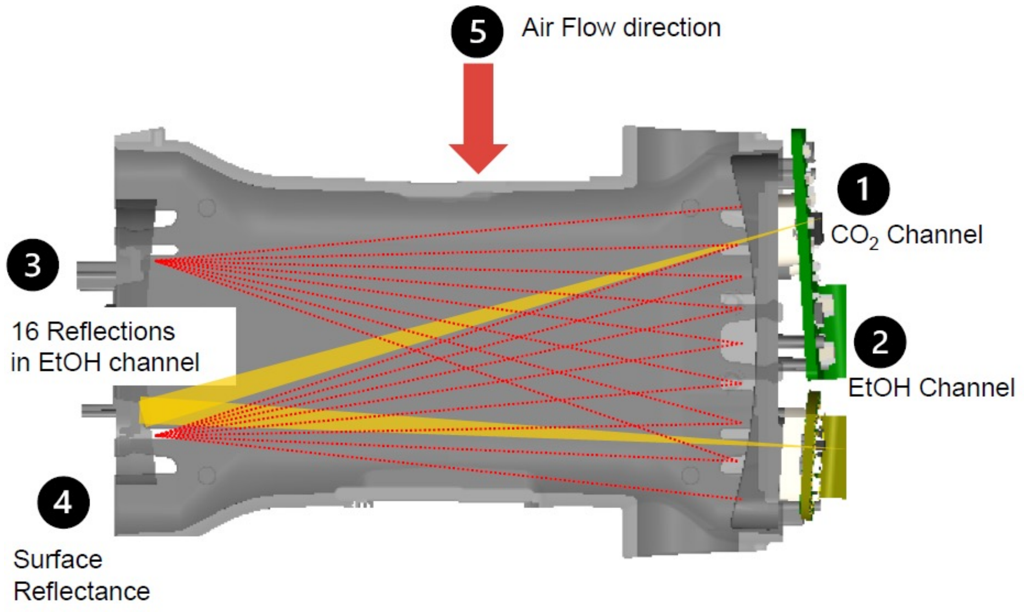
- GEN 3.3 Breath Sensor
- Stationary or mobile applications
- Access control for entry into safety–sensitive areas
- Screening of employees with safety–critical job functions
- Aftermarket vehicle installations

GEN 4.0 PASSIVE SENSOR
DADSS BREATH SYSTEM



<u>GEN 4.0 vs. GEN 3.3</u>

- ✓ Reduced size of form factor by 40% to 50%
- ✓ Redesigned optical bench assembly (OBA)
- ✓ Improved signal–to–noise ratio via two new alcohol detectors
- ✓ Designed for manufacturing in automotive quantities and to automotive quality standards



DEPLOYMENT STRATEGIES

Gen 3.3  Directed Breath Sensing

Accessory
mounted after
normal production

Behind Panel
Installation

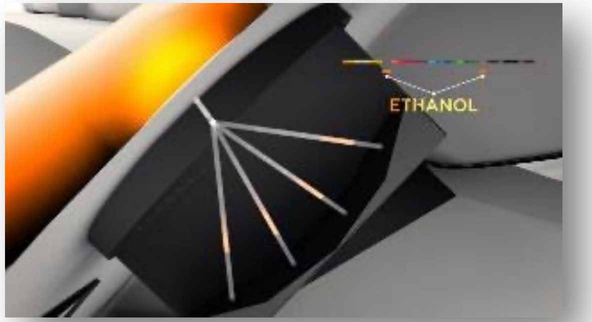
Commercial Fleets

Gen 4.0  Passive sensing

Behind Panel
Installation in factory
Passive / Discrete

Private Vehicles

TISSUE SPECTROSCOPY
DADSS TOUCH SYSTEM



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Driver Alcohol Detection System for Safety

Laser System

Sensalight Technologies

Nanosystems and Technologies GmbH
nanoplus

Tier 1/ Tier 2 Manufacturing Partners
currently being vetted

Manufacturing Partner

- Touch sensor allows the estimation of BAC by measuring the ethanol concentration in the capillary blood in the dermis layer of the skin (finger pad, back of finger, thenar)
- Driver touches a pad with an optical module and near infrared (NIR) light shines on the driver’s skin and propagates into the tissue
- A portion of the light is reflected back, where it is collected by the touch pad.
- This light transmits information about the tissue’s chemical properties, including the concentration of the ethanol present
- The touch sensor consists of the laser diodes, the laser guiding system to relay the laser light into the skin, the detectors to receive the reflected signal, a reference sensor, and electronics to power and control the system

TISSUE SPECTROSCOPY
LASER SYSTEM DEVELOPMENT

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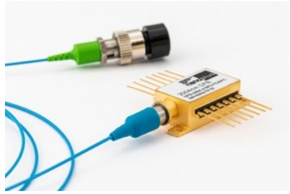
Driver Alcohol Detection System for Safety

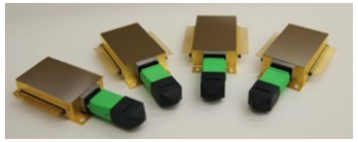
2016



1 laser chip in 40 individual butterfly packages interrogating 40 discrete IR wavelengths

GEN 1

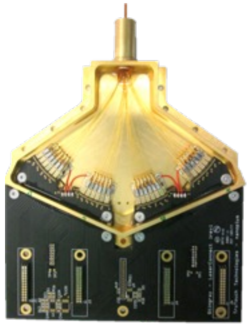
Individual Packages



10 laser chips per butterfly package; 4 butterfly packages interrogating 40 discrete IR wavelengths

GEN 2/3

Butterfly Packages

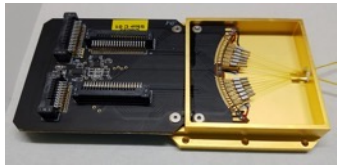


20 laser chips interrogating 40 discrete IR wavelengths

GEN 4SR

Stingray Package

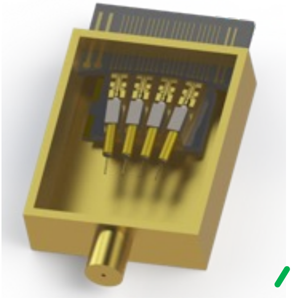
2018



10 laser chips interrogating 40 discrete IR wavelengths

GEN 4DZ

Dozen Package

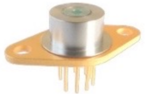


4 tunable laser chips scanning the upper and lower IR range

GEN 5

Tunable Package

2022



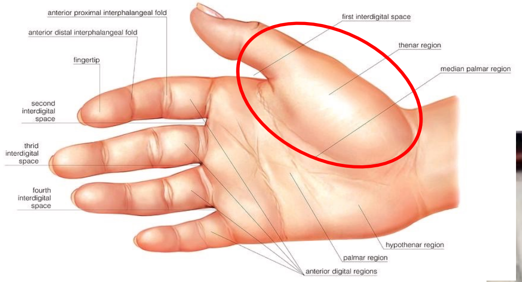
4 widely tunable laser chips scanning upper and lower IR range

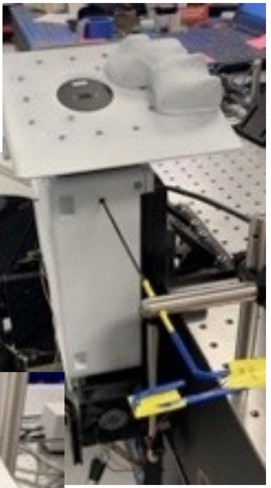
"Step-D Lasers"

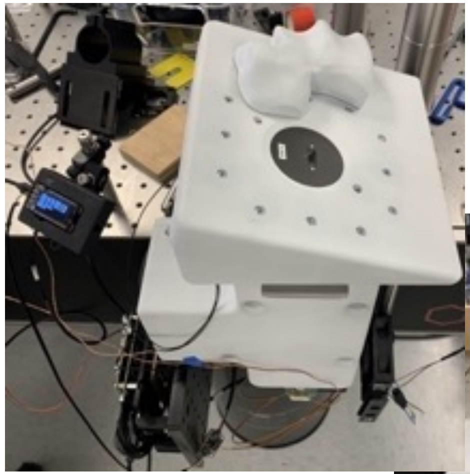
GEN 6

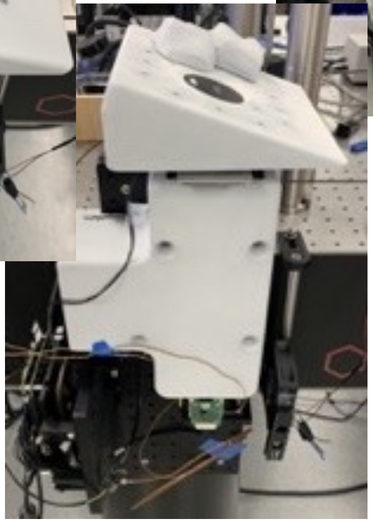
Widely Tunable Package

CURRENT STATUS
DADSS TOUCH SENSOR (RADIANT)

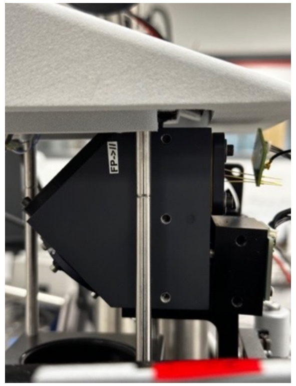








- Currently measuring ethanol in human tissue (thenar) in reflectance across multiple human subjects and multiple tests using optical bench research (OBR) tool
  - Implemented stable reference channel
  - Implemented tunable laser in the upper near infrared band—the most challenging band
  - Improved laser modules (power output, thermal management, operating stability)
  - Improved optical assembly (light transmission, coupling efficiency, stray light, back reflections)
  - Improved tissue illumination (beam shape and quality)
  - Improved electronics (data synchronization and noise)
- Compact Reflectance Sensor Ver. 2 developed, fabricated and now undergoing testing



COMMERCIALIZATION CADENCE
BREATH SENSOR DEVELOPMENT & DEPLOYMENT

BREATH SENSOR SENSOR CHARECTERISTIC	[Completed] GEN 3.3	B-Sample GEN 4.0	C-Sample GEN 4.0	Ref. Design GEN 4.0
Target Completion Date*	**2021****	**2023**	**2024**	**2025**
Market Application	Fleet vehicles & accessory sales	Development	Consumer vehicles	
Vehicle Integration	After mass production (Upfitter or dealer installed)	Benchtop and Test Vehicle	During mass production; fully integrated system	
Alcohol (Ethanol) Set Point	0.02%	0.05 or 0.08%		
Operating Characteristics	Contactless, Directed–breath, single IR channel	Contactless, Passive-breath, dual IR channel		

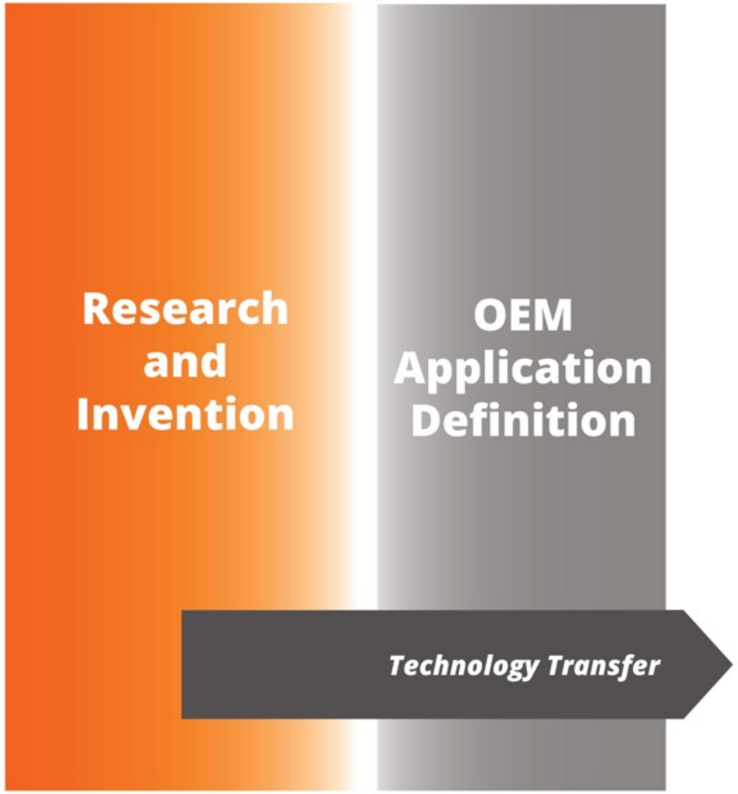
*The time for integrating a DADSS sensor into a finished product will vary by the type of product and the product–level validation and verification necessary. In all instances, this is likely to be at least 18 to 24 months or longer.
** GEN 3.3 Breath Sensor Reference Design released for open licensing for use in commercial vehicles in December 2021.

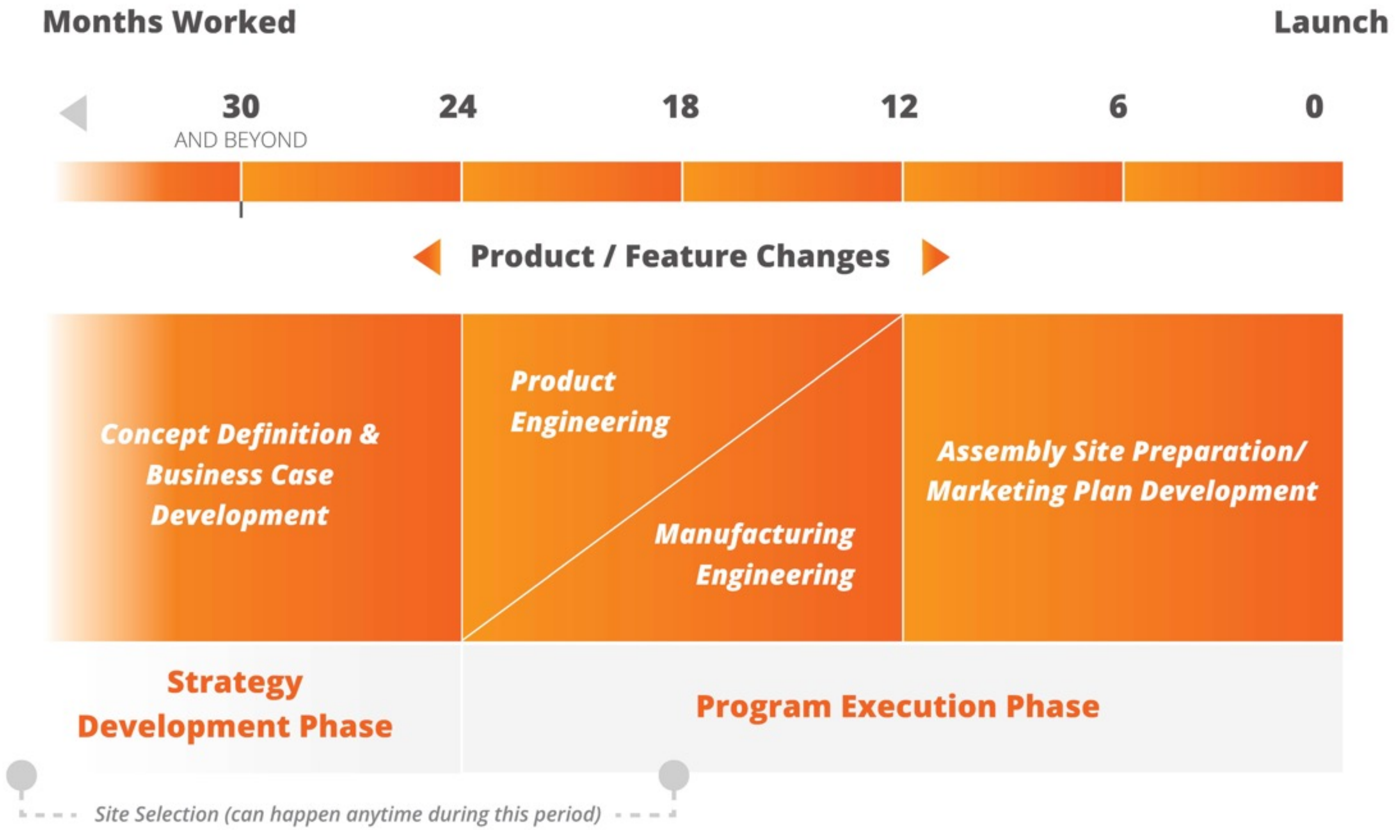
COMMERCIALIZATION CADENCE
TOUCH SENSOR DEVELOPMENT & DEPLOYMENT

TOUCH SENSOR METRIC	[Completed] Benchtop Dev. Unit	Functional Sample Radiant	A-Sample Radiant	B-Sample Radiant
Program Target Completion Date*	**2022**	**2023**	**2024**	**2025**
Market Application	Development			
Vehicle Integration	Benchtop	Benchtop or Test Vehicle		
Alcohol (Ethanol) Set Point	Up to 0.12%			0.05 or 0.08%
Operating Characteristics	Passive, tunable single–laser, registered user		Passive, compact tunable multi-laser, registered user	

*The time for integrating a DADSS sensor into a finished product will vary by the type of product and the product–level validation and verification necessary. In all instances, this is likely to be at least 18 to 24 months or longer.

AUTOMOTIVE PRODUCT DEVELOPMENT & TECHNOLOGY TRANSFER





CONSUMER VS. AUTOMOTIVE GRADE ELECTRONICS

Automotive Grade

- Mission critical applications
- Failure can mean life–or–death
- Harsh operating environment (temperature, weather, other conditions)
- Long product life cycles and useful life

	Consumer	Automotive
Ambient Temperature Range	0^{o} to 85^{o}C	–40^{o}C to 150^{o}C
Expected Operating Life	2 – 3 years	15+ years
Acceptable Failure Rate	300 parts per million	Zero
Supply Lifetime	2 – 3 years	15 – 20 years

PERFORMANCE SPECIFICATION DEVELOPMENT

- Current standards are focused on Instruments **having a mouthpiece** and measuring breath alcohol for drink-driving-offender programs and for general preventive use
  - EN 50436 Part 1 and 2, CSA Z627, NHTSA Model Specifications for BAIIDs (2013 and 2015)
- New generation of sensors are being developed that do not require a mouthpiece
  - Designed to be OEM integrated, factory mounted or aftermarket
- Critical need for an international standard focused on instruments with or without a mouthpiece

SAE J3214

- SAE J3214 – Published 01 JAN 2021
  - Establishes the performance specifications for Zero-Tolerance Breath Alcohol Detection Sensors to reduce the risks of driving under the influence of alcohol.
    - Fleet owners
    - Parents with teenagers
  - Specifies test methods and essential performance requirements for the directed-breath, breath alcohol detection system
  - Takes into consideration sensors **without a mouthpiece**

PERFORMANCE SPECIFICATION DEVELOPMENT

Directed / Active

Laboratory

PROMOTING CONSUMER AWARENESS, ACCEPTANCE, & DEMAND

- **As the research progresses, we are simultaneously working to increase:**
  - **Awareness** of the technology and how it works
  - **Acceptance** of the technology as a good auto safety system worth buying
  - **Demand** for the technology in their own car or their children’s cars
- **We are doing this in several ways:**
  - ✓ **Showcasing technology at public events**
    - Presence at nearly 30 events in Virginia over the past 3 years
  - ✓ **Securing top-tier media coverage**
    - Local and national media coverage is very positive
  - ✓ **Tracking public opinion research**
    - Focus groups, phone surveys are consistently positive

Soon, Cars May Take Away the Keys of a Drunken Driver

The New York Times

STATE PARTNERSHIPS
DRIVEN TO PROTECT INITIATIVE

James River Transportation

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Driver Alcohol Detection System for Safety

Virginia

Naturalistic Human Subjects On-Road Driving Tests

1,686
Total Days

146,296
Total Samples

99,119
Total Miles Driven

6
Total Vehicles

35,878
Total Sensor Operation Hours

STATE PARTNERSHIPS

DRIVEN TO PROTECT INITIATIVE

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Driver Alcohol Detection System for Safety

Virginia

Naturalistic Human Subjects On-Road Driving Tests

313
Total Days

77,956
Total Samples

184,486
Total Miles Driven

7
Total Vehicles

19,483
Total Sensor Operation Hours

STATE PARTNERSHIPS
DRIVEN TO PROTECT INITIATIVE

Maryland

Naturalistic Human Subjects On-Road Driving Tests

845
Total Days
(Including pause for COVID pandemic)

93,627
Total Samples

86,731
Total Zero BrAC Samples

6,896
Total Positive BrAC Samples

40,956
Total Miles Driven

7
Total Vehicles

5,235
Total Sensor Operation Hours

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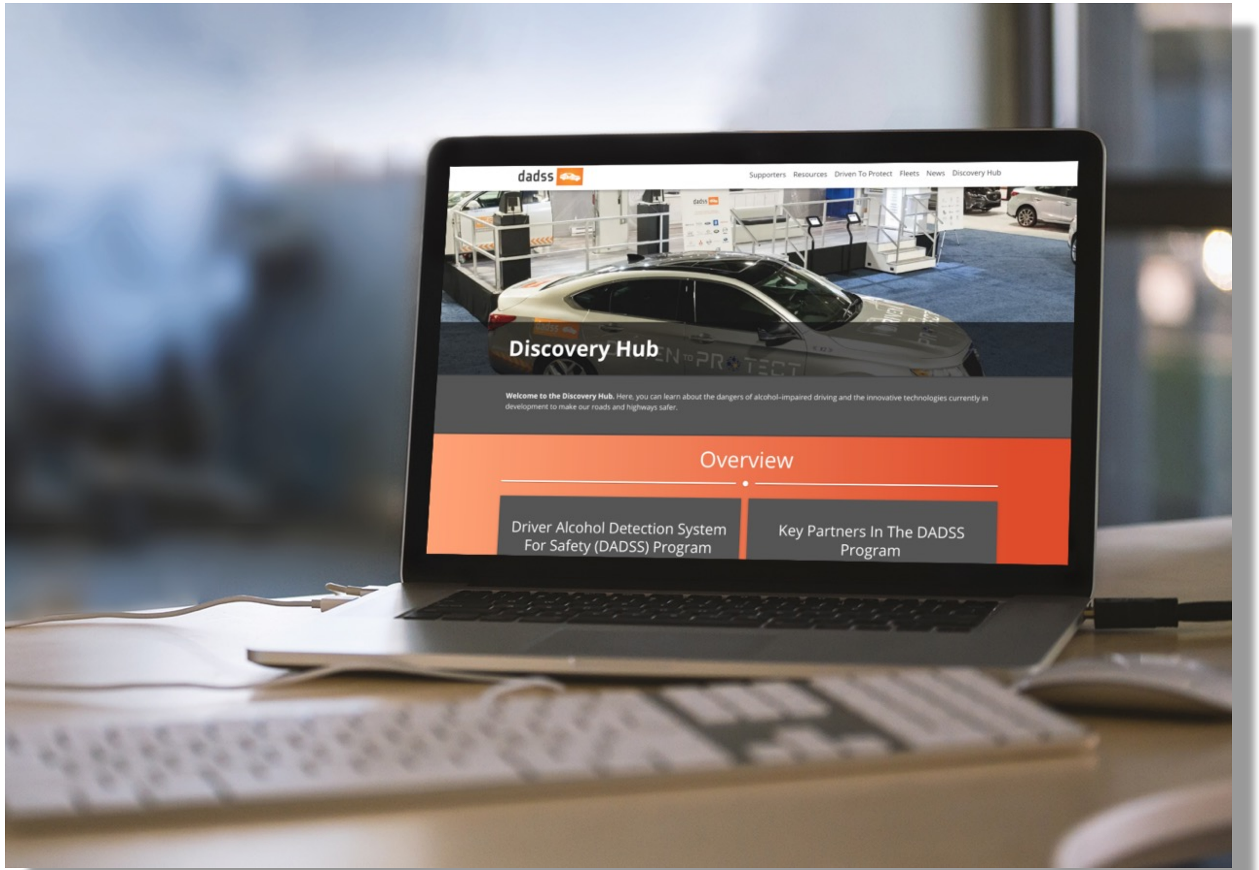
Driver Alcohol Detection System for Safety

STATE PARTNERSHIPS
DRIVEN TO PROTECT DISCOVERY HUB

In 2020, in collaboration with the Virginia Department of Education, Driven to Protect launched the Discovery Hub, a virtual learning platform with a series of STEM lessons that put students in the shoes of the engineers and data analysts working on the DADSS technology.



https://www.dadss.org/discovery-hub

dadss
Driver Alcohol Detection System for Safety

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