TELEDYNE ENGINEERED SYSTEMS
SEGMENT OVERVIEW
Teledyne Technologies is focused on companies, technologies, and specialized products with a high barrier to entry, that are advanced technically, and are not likely to commoditize. Our products span the globe and can be found from deep space to deep sea.
Teledyne Technologies Markets
2018 Sales ≈ 2.9B\textsuperscript{(a)}

(a) Total revenue reflects annualized sales for 2018
(b) Includes Marine Instrumentation for offshore energy and hydrographic survey, Engineered Systems for energy and power generation, and other product lines
(c) Includes Environmental Instrumentation and electronic Test & Measurement Instrumentation
(d) Other includes commercial electronics for microwave and satellite communications, industrial interconnect systems and other product lines

Sales by Geography\textsuperscript{(b)}

- U.S. Commercial: 30%
- Europe: 23%
- Other Americas: 22%
- Asia Pacific: 19%
- MEA and Other: 3%
- U.S. Government: 11%
- Other: 7%

Markets\textsuperscript{(b)}

- Offshore Energy: 27%
- Commercial Imaging and Machine Vision: 20%
- Other Marine Instrumentation\textsuperscript{(e)}: 8%
- Commercial Aerospace: 8%
- Other Industrials\textsuperscript{(e)}: 9%
- Analytical and Electronic Test and Measurement\textsuperscript{(d)}: 5%
- U.S. Government: 23%
- Other: 8%
Teledyne Technologies Quick Facts

- TDY Stock Symbol
- ~29% of revenues from Aerospace and Defense
- $2.8B * in 2018 revenues, financially strong
- >100 countries exported to
- Developed first chip-scale atomic clock
- Developed hardware on the furthest objects still operating in space
- 58 Successful Technology Company Acquisitions
- >10,000 employees
- 65+ years of experience
- Provide monitoring worldwide to protect air and water quality
- Develop X-Rays with higher quality images and lower X-Ray dose
- Support oil and gas exploration and production around the globe

Develop avionics systems for large passenger aircrafts

*Total revenue reflects annualized sales for the first half 2018
Teledyne Technologies, Inc.

**Instrumentation**
- Marine, environmental, and industrial mission-critical, harsh environments
- Measurement & monitoring instruments
- Power & communications for distributed instrumentation networks
- Electronic test & measurement equipment

**Digital Imaging**
- Industrial, government and medical applications
- Micro Electro-Mechanical Systems (“MEMS”)
- High-performance sensors, cameras and systems
- Visible, infrared, ultraviolet and X-ray spectra

**Aerospace and Defense Electronics**
- Government and commercial applications
- Sophisticated component, subsystem, & communications electronics
- Defense electronics
- Data acquisition & communications for aircraft
- Harsh environment interconnects
- Components & subsystems for wireless & satellite communications
- General aviation batteries

**Engineered Systems**
- High-reliability defense, space, environmental, & energy applications
- Systems engineering, integration, test, deployment, and operations
- Complex manufacturing capability & composite parts production
- Hydrogen/oxygen generators, thermoelectric converters & radioisotope power systems
- Small turbine engines

**Research and Development**
- Government, Customer, and Teledyne funded R&D
- Materials - Structural and functional, Electronics
- Information Sciences: Technical Thrusts
- Optical Systems: Information science, Image processing, Neuroscience

**Industrial, Government and Medical Applications**
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Teledyne Technologies Four Segments

Aerospace & Defense Electronics

Instrumentation

Digital Imaging

Engineered Systems
Engineered Systems Quick Facts

- Provide Radiological Testing for Nuclear Plants
- 346K Square feet of manufacturing space
- Supplied power source for Curiosity Rover
- Partnering in Space since the birth of the Space Program
- Safely destroy chemical weapons for the government
- Host hyperspectral and scientific payloads on the ISS
- Design and build SWCS vehicles for Navy SEALS
- Develop real-time threat testing software, EADSIM
- Provide subsea power solutions for maritime applications
- Responsible for operations on the International Space Station
- Participating in ITER international nuclear fusion project
- Provide composite parts for aviation
- Host hyperspectral and scientific payloads on the ISS
Teledyne’s Values are the foundation for all actions and relationships with our customers, partners, employees and community.

- Integrity and Ethics
- Respect and Transparency
- Commitment and Accountability
- Leadership and Teamwork
Engineered Systems Segment
Companies & Locations

- Independent Research Lab owned by Teledyne
- Engineered Systems Segment HQ
  Huntsville, Alabama
- United States
- United Kingdom
We differentiate ourselves from competitors by having a customer and company-sponsored applied research center that augments our product development expertise.

**Teledyne Scientific’s Central Research Laboratory**

- Government, Customer, and Teledyne funded R&D
  - Materials
    - Structural and functional
  - Electronics
    - MEMS/III-V semiconductor fab
    - RF/mm Wave/Mixed-signal ICs
  - Information Sciences: Technical Thrusts
    - Autonomous Systems
    - Sensor Exploitation
    - Neuroscience and Neurotechnology
    - Cyber Security & Anti-Tamper
  - Optical Systems
    - Information science
    - Image processing
    - Neuroscience
• Approximately 1.4 million square feet in 8 locations in 5 states and the United Kingdom
• Manufacturing square footage totaling 346,000 including 200,000 in Huntsville, Alabama
• ~1,400 employees
Teledyne Engineered Systems Segment
Adapting Technology & Capabilities in Advancing Markets
Teledyne Brown Engineering

Mission Systems

Maritime Systems & Manufacturing

Geospatial

Space Systems

Energy & Environment

Energy Systems
Hunt Valley, MD

CML
Bromborough, UK

Turbine Engines
Toledo, Ohio

Teledyne Brown Engineering
Huntsville, AL
Teledyne Brown Engineering

Quality Focused

- AS9100D, Third-Party Registered (Aerospace)
- ISO 9001:2015, Third-Party Registered
- SEI CMMI Maturity Level 4
- NASA SSP-41173 Compliant
- NQA-1 – Nuclear Quality Assurance System 2008/2009a
- 10CFR50 Appendix B – QA Criteria for:
  - Nuclear Power Plants
  - Fuel Reprocessing Plants
- ASME Nuclear Stamps and Certificates:
  - N Stamp, Nuclear Components, #N-2983
  - NPT Stamp, Nuclear Partialis, #N-2984
  - U Stamp, Pressure Vessels, #33,360
  - NS Certificate, Nuclear Supports, #N-3874
  - National Board - R Stamp, Repairs, #R-2240
- ASNT Level III Certified
- NAVSEA Note 5000
- P-9290 Certification for Deep Submergence Systems
- Nadcap Certified
  - Welding
  - Non-Destructive Testing
  - RT, PT

*Certificates shown are for TBE only and are not applicable to every program.
Teledyne Brown Engineering Recognition

2018
Raytheon’s Supplier Excellence Award
3 Stars

2017
Bechtel’s Large Business Subcontractor of the Year Award

2016
Mentor Protégé of the Year Award

Awarded 3 Times
James S. Cogswell Outstanding Industrial Security Achievement Award from Defense Security Service (DSS)

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Full Life Cycle Capabilities

Research and Technologies

Systems Concept Development

Systems Design and Analysis

Manufacturing and Assembly

Systems Integration and Test

Management and Operations

Sustainment and Recapitalization

Full-Spectrum Engineering and Advanced Manufacturing

- **Engineered Systems** – Concept definition and prototyping through product lifecycle
- **Engineering Services** – Support the customer at any phase of the lifecycle
- **Hardware Manufacturing** – Design and analysis through fabrication, assembly and test, production, and installation and operations
Manufacturing, Inspection and Test
High Bay Manufacturing Building

- 22,466 Total sq ft
- Building Capabilities
  - Machining
  - Assembly
  - High Bay Lift (2 20-Ton Cranes)
- New Equipment
  - 6 Axis Machine
  - 5 Axis Machine
High Bay Manufacturing Building

- **SNK (2018 model)**
  - X travel 246"
    - Part length 312"
  - Y travel 150"
    - Part width between columns 133"
  - Supports 40,000 lbs billet
  - 6,000 RPM spindle
- **Niigata 1250s (2018 model)**
  - X travel 86.6"
    - Part length 98.4"
  - Y travel 69.7"
    - Part height 78.7"
  - Supports 25,000 lbs billet
  - 15,000 RPM spindle
- **Niigata 1000s (2011 model)**
  - Bed geometry same as 1250s
  - 8,000 RPM spindle
  - Supports 25,000 lbs billet
- **Viper (2010 model)**
  - X travel 180"
  - Y travel 85"
  - 6,000 RPM spindle
  - Supports 27,000 lbs billet
Mission Systems

- Modeling and Simulation/Test and Evaluation
- Situational Awareness
- Missile Targets
- Weapon Systems Engineering and Integration
- Software Development
- Medical Modeling & Planning Logistics
- Hypersonic Modeling
• Teledyne continues to expand the capabilities of our tools to address evolving threats
Objective Simulation Framework (OSF)
Tactical Range Air Defense Missile (TACRAM)
Maritime Systems

- Maritime Systems Design, Development and Integration
- Marine Hardware and Vehicles
- Depot Maintenance, Logistics
- Offshore and Harbor Security Monitoring Systems
- Communications/ISR/Imaging
- Deep Submergence Systems Certification
- Missile Launch Systems
Maritime Vehicles

Payload Size and Sophistication

Unit and Operational Cost

LDUUV

Defense Systems

Maritime Surface & Diving Vessel

Unmanned Surface Vehicles (USVs)

Surface Vessel / Inland & Coastal

Deep Flows

Autonomous Underwater Vehicles (AUVs)

Giders

Towed Vehicles

Deep Towed System

5000m AUV

Mid-towed System

Towed Vehicles

Deep Flows

Remote Operated Vehicles (ROVs)

MiniROVs

Inspection Class ROVs
A Sea of Solutions
SWCS: Shallow Water Combat Submersible
Pluto Gigas
Gun Mission Modules (GMM)
Airborne Mine Neutralization System (AMNS)
AQS-20 Minehunting Sonar System
Glider
Geospatial Solutions

- Multi User System for Earth Sensing Platform (MUSES)
- TCloud Amazon Cloud Data Management System
- Hosted Payloads from Low-Earth Orbit
- Payload Operations as a Service
- Hyperspectral Imagery
MUSES: Multi-User System for Earth Sensing
Hosted Payloads
Payload Operations
Low Earth Orbit Hyperspectral Imagery

- **Vegetation**
- **No Vegetation**

**VEGETATION INDEX**

**SUSPENDED MATTER**

**DISSOLVED ORGANIC MATERIAL**
Space Systems

- Space Flight Hardware
- Ground Support Equipment
- Mission Planning and Control Center Operations
- Payload Integration Testing and Astronaut Training
LVSA: Launch Vehicle Stage Adaptor
MO&I: Mission Operations and Integration
Energy and Environment

- Hardware and Process Systems Design, Integration, Testing, Analysis, and Fabrication
- Radiological Laboratory Services
- Chemical, Biological, Radiological and Nuclear Hardware and Systems
- Petro/Chemical Plant Laboratory Operations and Services
- Renewable Energy Evaluation and Implementation
- Classified Laboratory
Laboratory Management and Operations
Nuclear Hardware
Chemical and Biological Systems
Mission Systems

Space Systems

Energy & Environment

Turbine Engines
Toledo, Ohio

CML
Bromborough, UK

Energy Systems
Hunt Valley, MD

Maritime Systems & Manufacturing

Geospatial

Teledyne Brown Engineering
Huntsville, AL
Teledyne Turbine Engines

- Small Turbine Engines for Tactical/Strategic Cruise Missiles, Decoys, Targets, and UAVs
- Turbine Engine Test Facility Services
- Advanced Turbine Engine Manufacturing Center
Teledyne CML Composites

- Comprehensive Composite Manufacturing and Test Capabilities
- High-Quality Manufactured Composite Components and Assemblies for Aircraft Structures and Systems
Teledyne Energy Systems, INC. (TESI)

- Advanced Power/Energy Solutions for Harsh Environments
- Electrical Power Generator Cooling via Hydrogen Gas
- Fuel Cells
- Electrochemical Energy Conversion
- Classified Specialized Battery Facility
- Cell Development/Battery Solutions
- Battery Power
Mars Curiosity Rover

Nuclear Power Source by Teledyne Energy

Photo taken with Teledyne DALSA imaging hardware.

12 Teledyne DALSA and E2V image sensors

MMRTG

Chemcam

Two right nav cams

Two left nav cams

Right mast cam

Two pairs of rear hazcams

Two pairs of front hazcams

Mars Hand Lens Imager (MAHLI)

Alpha particle x-ray spectrometer

Robotic arm

Mars Descent Imager (MARDI)
Seafloor Power
Why Teledyne

Teledyne distinguishes itself by solving the most difficult challenges in markets that require the utmost in precision, performance and reliability

We are the best option when:

- High degree of complexity and quality is required
- Close partnership is required
- Long-term supply and financial stability are essential
- Stringent specifications exist
- On-time delivery is a must
- The end product will encounter harsh environments

We’re probably not your best choice if your application is:

- Technically simple
- Able to be completed by many suppliers
- Solved with commodity solutions
- Driven by low price as your primary goal
Teledyne Technologies

DIGITAL IMAGING

INSTRUMENTATION

AEROSPACE & DEFENSE ELECTRONICS

ENGINEERED SYSTEMS
Sophisticated electronic components and subsystems and communications products
- Defense electronics
- Harsh environment interconnects
- Data acquisition and communication equipment for aircraft
- Wireless and satellite communications
• Monitoring and control instruments for marine, environmental, industrial and defense
  • Electronic test and measurement
  • Power and communications connectivity devices for distributed instrumentation systems and sensor networks deployed in mission critical, harsh environments
  • Marine navigation instruments, imaging, and a broad array of underwater vehicles
  • Subsea pipeline corrosion monitoring detectors, pressure and temperature sensors and flow integrity monitoring solutions
Teledyne Technologies - Digital Imaging

Aerospace & Defense Electronics  Instrumentation  Digital Imaging  Engineered Systems
High-performance sensors, cameras, and systems within the visible, infrared, ultraviolet, and X-ray spectra
  - Medical applications
  - LIDAR systems
  - Industrial uses

Research laboratories for government programs and business
  - Materials research
  - DARPA/IARPA
  - Advanced Imaging
• Infrared and visible sensors
• Detector packaging
• Focal plane electronics
• Standard camera products
• Custom cameras
• Laser eye protection & sensor protection

High Performance Tactical LWIR Arrays
Custom Visible & IR Arrays for DoD Space Applications
1-D Photodiode Array
320x256 Array
Thermoelectrically Cooled Packaging

Compact Camera Electronics
High Speed (1600 Hz) LWIR Camera for Lab Instrumentation
Custom Visible & IR Arrays for DoD Space Applications
Space Flight Packaging NASA JWST 4 Mpixel
Photodiode

High Speed Camera for Laser Communication System
Micro-Cam™ Infrared Microscope Camera
Aircrew Laser Eye Protection
Sensor Protection Filters
H4RG-10 H4RG-15
16 Million Pixel Astronomy Arrays
Teledyne Technologies - Engineered Systems

- Aerospace & Defense Electronics
- Instrumentation
- Digital Imaging
- Engineered Systems
Engineered Systems

- Innovative Systems Engineering
- Integration
- Advanced Technology Development
- Manufacturing Solutions
- Modeling and Simulation
- Full Systems Lifecycle Capabilities