

# TURRET AIMING AND STABILIZATION DRIVE SYSTEM

**CURTISS -  
WRIGHT**

CURTISSWRIGHTDS.COM



+ Products + Capabilities + Solutions



REMOTE WEAPON  
STATIONS



LIGHT ARMORED  
VEHICLES



MAIN BATTLE  
TANKS

# ABOUT CURTISS-WRIGHT DRIVE TECHNOLOGY

Curtiss-Wright Drive Technology is part of the Curtiss-Wright Defense Solutions Division and has been a global leader in the development and manufacturing of electromechanical systems used in the industrial and defense industries for over 60 years, providing both industries with comprehensive solutions for all customer requirements as well as cost-effective options through the use of standard products. This means we have a solution for any size program.

Our core competency is the development of customized drive solutions through customer partnerships. Following the V-Model for system development guarantees well defined processes, and leads to the success of large, complex projects using state of the art methodologies.

As a Swiss company, quality, reliability, and environmental protection are the foundation of our business. High quality standards are met through use of sophisticated test equipment, centralized quality and lean management, compliance to the Restriction of the use of certain Hazardous Substances directive (RoHS) and the regulation on Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH), and model based software development in accordance with EN 61508. Curtiss-Wright Drive Technology is certified according to ISO 9001:2008.

## *State of the art technologies, features and processes:*

Dynamic Finite Element Analysis (FEA) supported mechanical designs

System FFT acquisition, digital FIR-filtering, stabilization loop control

Generic system software in accordance to EN 61508 & IEEE12207

Automated analysis of target system characteristic

Fast embedded OS, high integrated FPGA design

Four quadrant power analysis - motor test bench

System emulation with stabilization test bench

3D system modeling and simulation

Built-in Test (BIT) and diagnostics

Reliability Verification Tests (RVT)

Shock and vibration analysis

Design for Test (DFT)

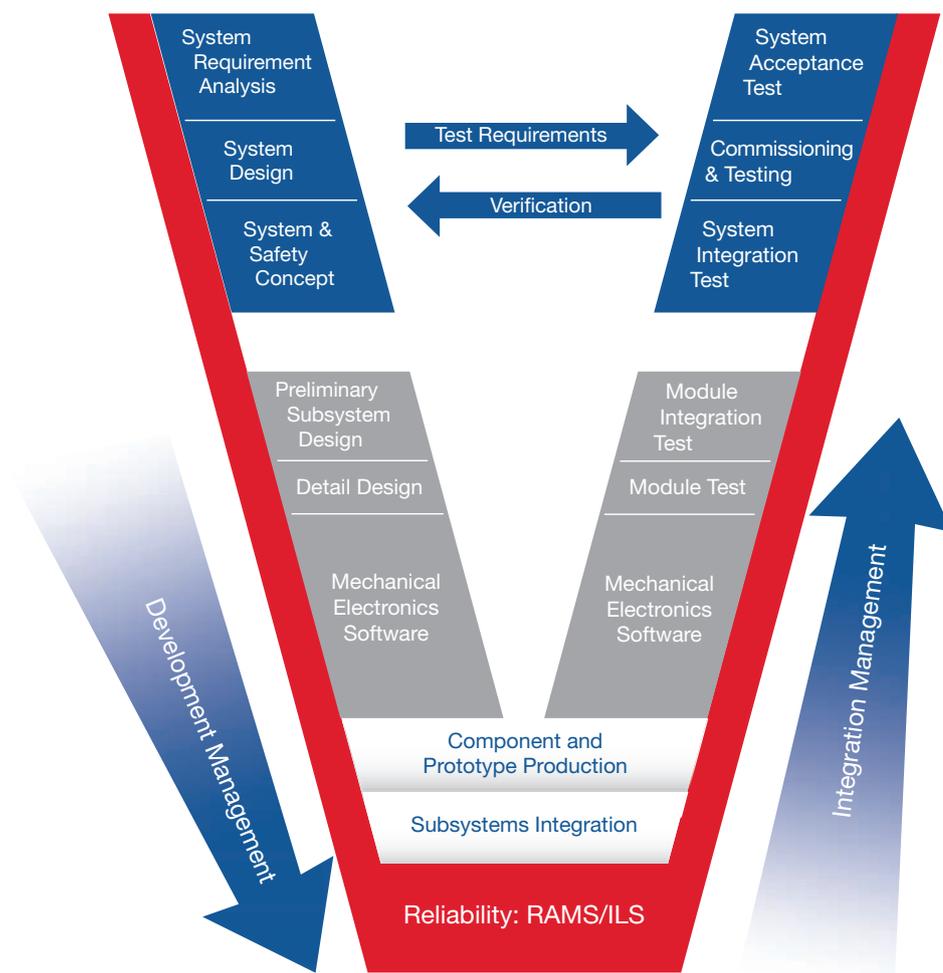


# Services

In addition to drive technology development we also offer the following services:

- Program management
- Drive integration and commissioning
- Spare parts service
- Maintenance, Repair and Overhaul (MRO)
- Staff training
- Technical consulting
- Integrated logistics support
  - + Analysis of Reliability, Availability, Maintainability and Safety (RAMS)
  - + Logistic Support Analysis (LSA)
  - + Level of Repair Analysis (LORA)
  - + Configuration management
  - + Preventive services e.g. obsolescence management

# System Development



V-Model for system development

# ABOUT CURTISS-WRIGHT DEFENSE SOLUTIONS

In air, ground and naval defense, aerospace and border security applications, Curtiss-Wright Defense Solutions, a division of Curtiss-Wright, is an industry-leading supplier of sophisticated electronics products. We are recognized around the world as one of the most innovative designers and manufacturers of rugged solutions, built from the ground up to deliver optimal, reliable performance at sea, on the ground, in the air, or in space.

Our expansive range of industry-leading products includes Boards and Subsystems, Flight Test and Avionics, Turret Aiming and Stabilization, Shipboard Helicopter Handling, and Instrumentation and Control systems.

For more information, visit [www.curtisswrightds.com](http://www.curtisswrightds.com)



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# TURRET AIMING AND STABILIZATION DRIVE SYSTEM

Modern armored land vehicles are vitally important on today's battlefield. Due to their size and speed, they can often be an obvious target, traversing rugged, harsh terrain. Their armor and weaponry becomes essential for self-protection. The ability to accurately locate a target and stabilize the shot while moving out of the line-of-sight could make all the difference.

The Curtiss-Wright Turret Drive Servo System (TDSS) is designed to offer a flexible choice of standard configurations with a clear upgrade path from a manually operated system to a Turret Drive Servo System (TDSS) with excellent stabilization that is globally recognized for its high performance and reliability.

The system is made up of building blocks to enable a selection of modular components and functionalities, creating an aiming and stabilization solution that meets your needs. Standard system configuration enables you to jump-start your program by getting to demo and production quickly. Additionally, the time and cost of requirements definition is reduced through preconfigured products.

These building blocks allow easy adaptation to different turrets to meet the end user's dynamic performance and precision expectations. The unique modularity of the TDSS enables an upgrade path from a lower cost solution to a fully stabilized system. Pre-defined system configurations are available that start with an expandable manual drive, easily converting to an electromechanically driven system. The motor controllers include the electrical interfaces that enable an upgrade path from the electromechanical drive to a fully stabilized system.

If it's a small gun or a Main Battle Tank (MBT) turret that needs to simply be moved electrically or requires sophisticated stabilization, the TDSS can be configured to meet your needs.

The TDSS consists of the following building blocks:



Rotary Gear Drives



Linear Gear Drives



Motor Controllers



Hand Controllers



Gyroscopes



Software

## Typical TDSS Performance Specification

- Slow speed tracking  $< 0.3 \text{ mrad/s}$
- Max. speed  $1 \text{ rad/s}$
- Acceleration  $2 \text{ rad/s}^2$
- Stabilization quality  $1\sigma$  value  $0.3 \text{ mrad}$
- Typical electrical interfaces are available (e.g. RS-422, RS-485, CANbus)

*Excellent stabilization that is globally recognized for its high performance and reliability*

# Upgradeable System Configurations

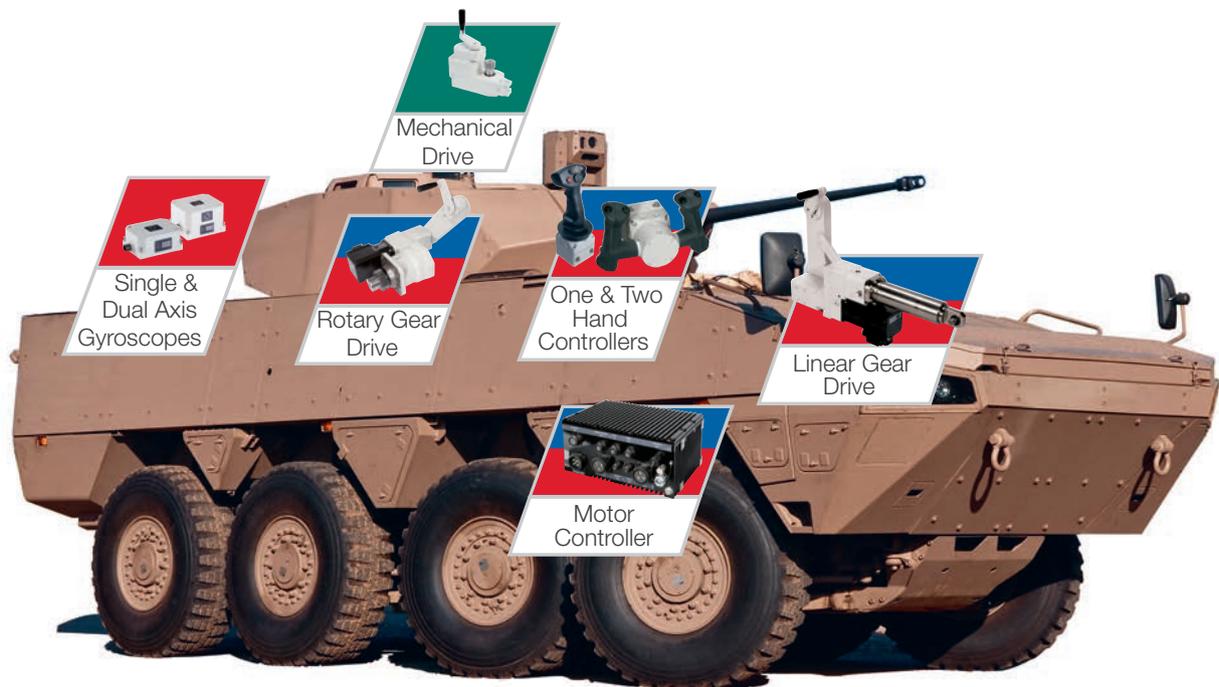
The TDSS is comprised of three different upgradeable configurations that provide a range of aiming and stabilization functionality, matched to the needs of your mission, across the full range of turret sizes. Each configuration includes a range of selectable options that increase system performance and functionality.

Choose **Customization** or...

**1 Manual**  
Mechanical movement with manual drive

**2 Electromechanical**  
Electrical movement with servo drive

**3 Stabilized**  
Electrical movement with basic to high performance stabilization



## Configuration 1:

The basic TDSS configuration is a hand drive that can mechanically move the turret in azimuth and the gun in elevation.

## Configuration 2:

A servo drive provides basic electromechanical aiming of the turret and the gun and a hand drive interface can be provided for backup. This system configuration includes rotary and/or linear drives, motor controllers, and optional hand controllers.

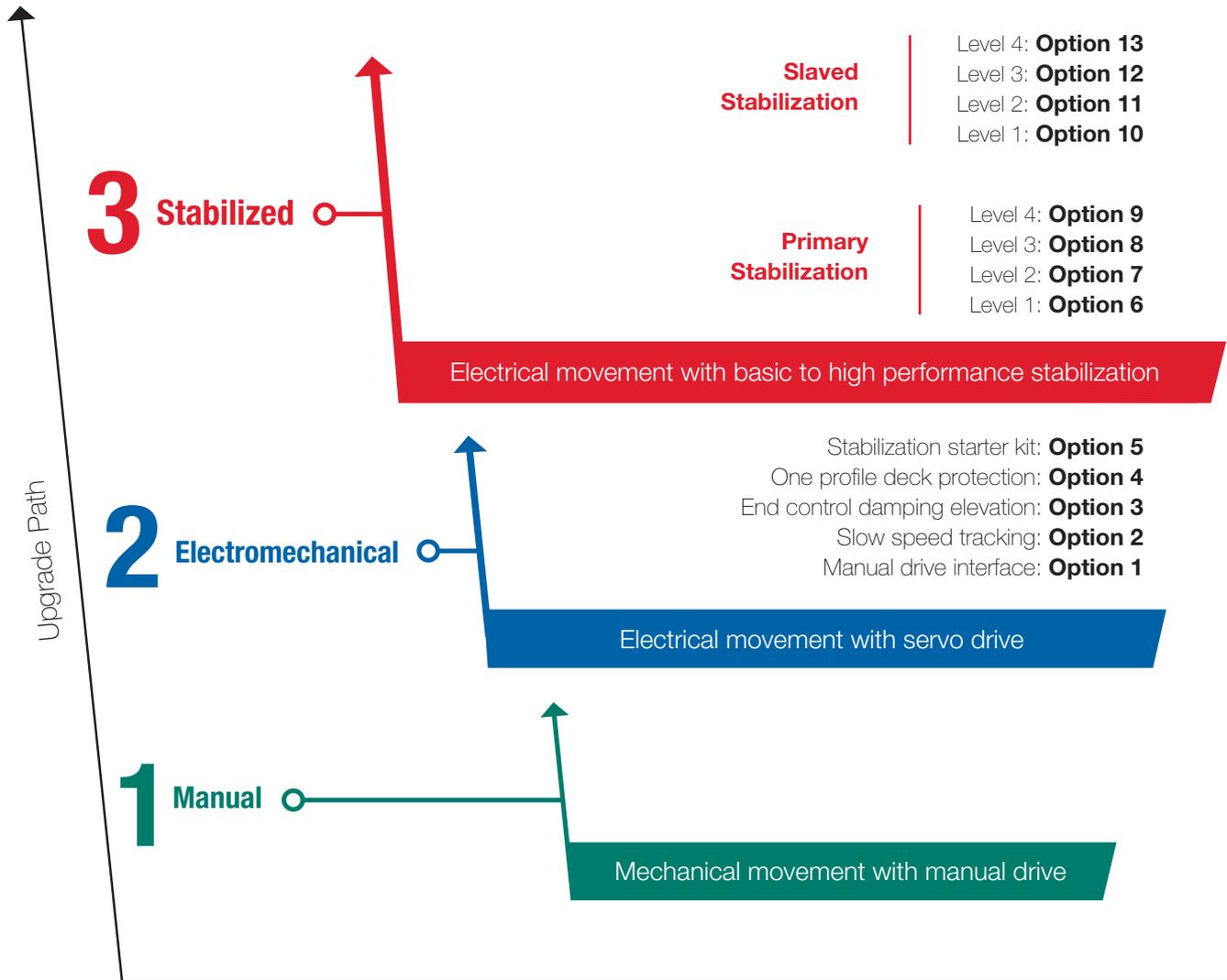
## Configuration 3:

This configuration includes everything in configuration 2 with the addition of gyroscopes for stabilized turret control.

**Customized:** We work in close collaboration with you to develop a completely customized solution based on your requirements. Even the actual drive design is adaptable to your turret requirements.

# System Configuration Options

Create a completely **Customized** system or select your desired configuration...



Within each system configuration you have the option to incrementally gain functionality through upgrades as the needs of your mission change. This means that while you have Configuration 2 installed, for example, you can easily step up to Configuration 3, a stabilized system, by adding gyroscopes, without the need to replace the existing hardware. If your mission demands fall outside of the pre-defined configurations listed, a completely customized system can be developed to your requirements.



ERG 100L



ERG 400N



ERG 800



ERG 1500

## Electrical Rotary Gear Drives

The Electrical Rotary Gear (ERG) line of drives provide a critical component in the traverse and elevation of a turret by accurately transferring the motor's motion, both while aiming at constant low speeds as well as in stabilize mode, controlling highly dynamic movements.

All linear drives are modular where the servo drive and hand crank can be repositioned when location and space restraints require. Dual redundant brakes and a manual backup drive (for use when power is off) are also included for system security.

Technical Specifications	ERG 100L	ERG 400N	ERG 800	ERG 1500
Typical traverse drive turret size	1,500 kg 3306.93 lb	5,500 kg 12125.42 lb	8,000 kg 17636.98 lb	20,000 kg 44092.45 lb
Typical elevation drive weapon calibre	20 mm 0.78"	90 mm 3.54"	105 mm 4.13"	120 mm 4.72"
Nominal output torque	100 Nm	400 Nm	800 Nm	1,500 Nm
Gear ratio motor: pinion	17:1 to 91:1	16:1 to 64:1	16:1 to 40:1	14:1 to 31:1
Rigidity with motor shaft blocked	>60 kNm/rad	>200 kNm/rad	>360 kNm/rad	>600 kNm/rad
Backlash with motor shaft blocked	<5 arc minutes	<5 arc minutes	<5 arc minutes	<3 arc minutes
Weight with motor	16 kg 35.27 lb	40 kg 88.18 lb	80 kg* 176.36 lb*	145 kg* 319.67 lb*
Dimensions (l x w x h)	336 x 137 x 198 mm 13.23 x 5.39 x 7.79"	460 x 145 x 250 mm 18.11 x 5.71 x 9.84"	580 x 210 x 450* mm 22.83 x 8.27 x 17.72"	720 x 290 x 450* mm 28.35 x 11.42 x 17.72"

\* Including 2 pinion gearheads

# Mechanical Rotary Gear Drive



MRG 40

Technical Specifications	MRG 40
Typical traverse drive turret size	1,000 kg 2204.62 lb
Typical elevation drive weapon calibre	20 mm 0.78"
Nominal output torque	40 Nm
Gear ratio	max. 3 mm max. 0.11"
Backlash	<50 arc minutes
Approximate weight	11.5 kg 25.35 lb
Approximate dimensions (l x w x h)	200 x 245 x 200 mm 7.87 x 9.65 x 7.87"





ELG 10



ELG 30



ELG 60

## Electrical Linear Gear Drives

Linear drives from Curtiss-Wright can be used in a wide range of applications and consist of a linear roller screw spindle, transmitting the rotation of the motor linearly. For upgrades and replacements of existing elevation hydraulic drives, an Elevation Linear Gear (ELG) can be easily installed within the available space.

All linear drives are modular where the servo drive and hand crank can be repositioned when location and space restraints require. Dual redundant brakes and a manual backup drive (for use when power is off) are also included for system security.

Technical Specifications	ELG 10	ELG 30	ELG 60
Typical application (weapon calibre)	20 mm 0.78"	105 mm 4.13"	120 mm 4.72"
Nominal output force	10 kN	30 kN	75 kN
Gear ratio	1:1	1.5:1 to 2.62:1	1.5:1 to 4.9:1
Screw pitch	10/15/20/25 mm 0.39/0.59/0.78/0.98"	10/15 mm 0.39/0.59"	10/15 mm 0.39/0.59"
Rigidity with motor shaft blocked	>50 MN/m	>90 MN/m	>200 MN/m
Backlash with motor shaft blocked	<0.1 mm	<0.05 mm	<0.05 mm
Approximate weight with motor and manual backup	25 kg 55.11 lb	49 kg 108.02 lb	85 kg 187.39 lb
Dimensions (l x w x h)	650 x 90 x 232 mm 25.59 x 3.54 x 9.13"	875 x 192 x 246 mm 34.45 x 7.56 x 9.69"	750 x 255 x 300 mm 29.53 x 10.04 x 11.81"

- Notes: 1. ELG 30 comes without a hand crank  
2. Working stroke in accordance with requirements

## Mechanical Linear Gear Drive



MLG 10

Technical Specifications	MLG 10
Typical application (weapon calibre)	20 mm 0.78"
Nominal output force	10 kN
Gear ratio motor: screw	1:1
Screw pitch	5/10 mm 0.39/0.59"
Backlash	<0.1 mm
Approximate weight	12 kg 26.45 lb
Approximate dimensions (l x w x h)	490 x 90 x 130 mm 19.29 x 3.54 x 5.12"





Nano Controller 80A



Twin X 300A (2 Axis)



Twin X 600A (2 Axis)

## Motor Controllers

Curtiss-Wright's range of motor controllers has been developed for use on weapons stations or main battle tanks. The system power, I/O, performance and assembly have been designed for the most demanding dynamics and precision requirements and can be easily modified to your specification. The entire range of motor controllers include EMI filtering, power electronics, embedded system software, control algorithm, a common service tool, and the electrical interfaces required.



*Designed for the most demanding dynamics and precision requirements*

Technical Specifications	Nano Controller 80A	Twin X 300A	Twin X 600A	DACS III NG 900 (Axcon NG and 2 DRUi NG 900A)
<b>Power Supply Voltage and Motor Currents</b>				
MIL-STD-1275 power	18 to 32VDC	18 to 32VDC	18 to 32VDC	18 to 32VDC
Motor phase peak current	80A	300A	600A	900A
Motor phase continuous current	20A	75A	150A	210A
<b>Signal Interfaces</b>				
Analog inputs	2	-	-	-
Digital I/O	4/2	10/7	10/7	8 to 16/1 to 8
Emergency stop	√	√	√	√
CANbus	1	2 (customer + hand controller)	2 (customer + hand controller)	2 (customer + hand controller)
RS-422 and RS-485	√	√	-	√
Gyro-interface	√	√	√	√
<b>Motor and Brake Interfaces</b>				
Brake control	√	√	√	√
Hyperface Resolver and Encoder	√	√	√	√
<b>Mechanical</b>				
Dimension (l x w x h)	135 x 110 x 95 mm 5.31 x 4.33 x 3.74"	327 x 238 x 159 mm 12.87 x 9.37 x 6.26"	420 x 285 x 160 mm 16.54 x 11.22 x 6.3"	Axcon: 223 x 256 x 99 mm 8.78 x 10.08 x 3.9" DRUi: 267 x 241 x 257 mm 10.51 x 9.49 x 10.12"
Weight	2.1 kg 4.62 lb	17 kg 37.47 lb	25 kg 55.11 lb	Axcon: 6 kg 13.22 lb DRUi: 25 kg 55.11 lb
<b>Connectors</b>				
Connectors	D38999	D38999 Power: Cannon	D38999 Power: Cannon	D38999 Power: Cannon
<b>Environmental Qualifications</b>				
EMI/EMC: MIL-STD-461 ground army	-	√	√	√
Environmental: MIL-STD-810 ground army	-	√	√	√
<b>Special Features</b>				
Galvanic isolation	√, and inrush current limitation	√	√	√
Power on self test and BIT	√	√	√	√
Overcurrent and temperature protection	√	√	√	√



1-Hand Controller



2-Hand Controller

## Hand Controllers

One product, many options and numerous applications.

The Hand Controller (HC) is an important interface between operator and machine and has been developed to meet the high demands of the military sector while providing reliability and optimal user comfort. HCs are available as a one or two hand grip shell style. Each of the ergonomically designed motion control handles can hold up to 12 independent sealed switches which are adaptable to customer's requirements.

Digital HCs process data via a central processing unit (CPU) that enables BIT and customers to define output characteristics. The standard version is equipped with an RS-422 or CANbus data link interface and typically connects to servo electronics or the customer's subsystem. All HCs are fully galvanic isolated and equipped with electrostatic discharge (ESD) protection and can be integrated into tanks, UAVs, ships, simulators or other military vehicles.



Fix



Deflection



Compact



Ergonomic Symmetric



Classic



Left-handed



Right-handed



Classic Deflection



Ergonomic Deflection



Portable HC "Prototype"

### 1-Hand Controllers

- Smaller dimensions than 2-Hand Controller
- One handed operation
- Connectors can be mounted on any side

### 2-Hand Controllers

- Horizontal and vertical grip shell
- Precise handling with excellent user grip during movement in heavy terrain

## Grip Types

The output signal can either be derived from the force on the thumb sensor (type - fix) or from the deflection of the grip (type - deflection).



Fix



Deflection



Deflection

Fixed type benefits:

- No unintended movement in heavy terrain
- No moving mechanical parts
- Smaller dimension and weight

Deflection type benefit:

- Fine graduation by angle of rotation

## Buttons and Switches and their Position

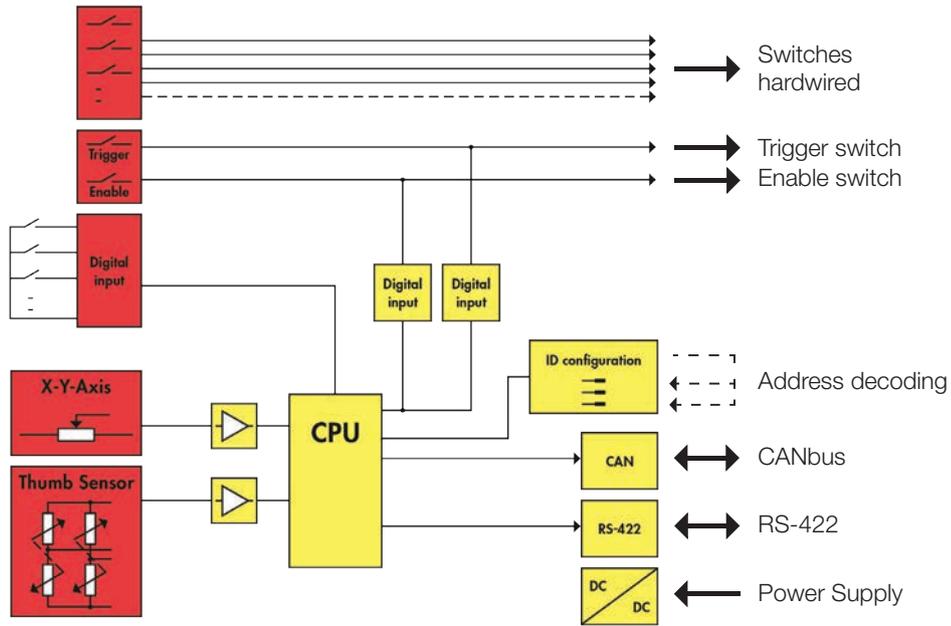
We offer precision switches and buttons with over 1 million life cycles; switches with digital and analog output options; high performance, snap action, push button, toggle slide and rotary switches.



## Switch Setting and Transfer Data

- Flexible modular system
- Switches hardwired or via digital interface
- RS-422, CANbus or analog
- Up to five storable output characteristics
- Discrete signals by second connector

The output characteristics are individually programmable with the ability to store up to five polynomial functions that can be selected during operation via the data link.



Hand Controller Wiring



## Numbers of Connectors and Outlet Positions

Because it is important to optimally utilize the space available you can choose where the connector should be located on the device.

## Color and Printing Options

Hand controllers can be painted and labelled as per your specifications.

Technical Specifications	
1-Hand controller deflection	+/- 20°
2-Hand controller deflection	+/- 24°
Electronic supply voltage	18 to 32VDC according to MIL-STD-1275
Max. rating	2W
Discrete switches supply voltage	5-36VDC - 0.2A continuous
Palm and fire supply voltage	5-36VDC - 0.2A continuous
Customer signal interface	RS-422 up to 115,200 bps, CANbus up to 1 MHz, analog and others on request
Output signal	5 programmable polynomial functions
EMI/EMC protection	According to MIL-STD-461 ground army
ESD protection	According to ICE 61000-4-2
Environmental	According to MIL-STD-810 ground mobile
Dead zone	+/- 3% mechanical dead band Electrical adjustable due to polynomial output function
Temperature range	-40°C to +51°C operation (-46°C to 71°C operation on request) -51°C to 71°C storage
1-Hand grip weight	1.9 kg 4.18 lb
1-Hand grip fixed type weight	1.4 kg 3.08 lb
2-Hand grip weight	2.7 kg 5.95 lb

# Gyroscopes

Single and dual-axis Fiber Optic Gyroscopes (FOG) have been developed for high performance military applications and are of the highest quality. The FOGs provide compensated angle or yaw rates to the asynchronous or synchronous digital Integrated Ballistics Identification System (IBIS) interface.

Developed for use in particularly harsh environments, the gyroscopes can withstand extreme shock and vibration in accordance with MIL-STD-810 ground mobile use, are fully digitized, include online BIT, and have no moving parts.



Single-Axis Gyroscope



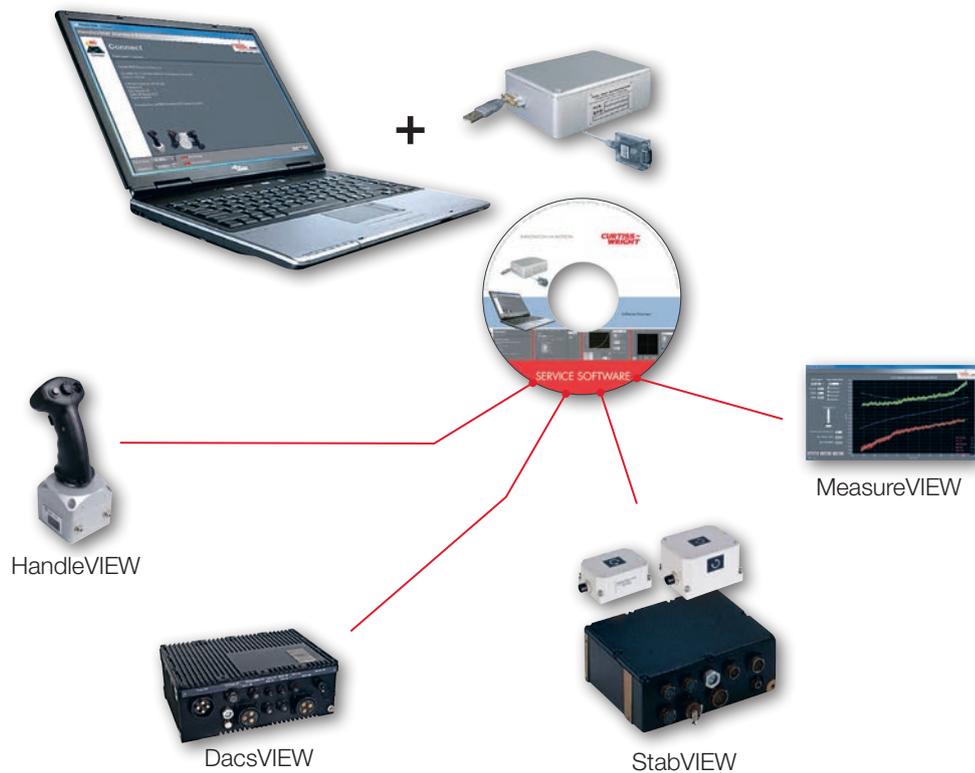
Dual-Axis Gyroscope

## Technical Specifications

Power supply	18 to 32VDC
Max. measurement range	up to +/- 8.7 rad/sec
Resolution	up to 2 $\mu$ rad/sec
Signal interface	Digital synchronous data transfer/RS-485
EMI/EMC	MIL-STD-461 ground army
Environmental	MIL-STD-810 ground mobile
Weight	Single-axis: 0.88 kg 1.94 lb Dual-axis: 1.54 kg 3.39 lb
Dimensions (l x w x h)	Single-axis: 122 x 90 x 56 mm 4.8 x 3.54 x 2.2" Dual-axis: 135 x 115 x 86 mm 5.31 x 4.53 x 3.39"

# Software

Tightly integrated, proprietary service software enables commissioning, performance measurements, parameter handling, analysis and maintenance operation via a graphical user interface connected to the controller cards of the electromechanical drives. Each system component has specialized software available that has been developed based on customer feedback. The software enables a connection to the controller that the user is able to monitor and control. The converter box needed to connect the HC to the computer or portable device (e.g. tablet), as well as any necessary cables, are also provided.



## Features:

- Version check
- Software update
- Measurement (monitoring) mode
- Active motor control
- Automated system characterization measurements and analysis
- Maintenance and diagnostics
- Built-in Test
- Several analysis tools
- Motor calibration

## Benefits:

- Reduce maintenance time
- Easy system setup
- Easily analyze system status with BIT
- Additional tools provide a system integration advantage



## Find Your Sales Representative

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