SPACECRAFT MECHANISMS
Product Catalog
NEA Electronics
a subsidiary of Ensign-Bickford Aerospace & Defense Company

RIGHT FOR YOUR MISSION
FROM LAUNCH TO DEEP SPACE
Global Leader
NEA® Electronics, Inc. is a global leader in spacecraft mechanisms. Our low shock release devices are relied upon for spaceflight applications more than any other device.

Reliable
Our designs are reliable, simple, insensitive to adverse environments and backed up by years of heritage and loyal customers.

Quality Assured
NEA, a trusted supplier of mission critical components, is certified to ISO 9001:2008 and AS9100:2009 C

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Mission Success

NEA® Electronics, Inc. is dedicated to building mankind’s legacy in space by supporting our customers in the aerospace industry through on time delivery of innovative products that exceed expectations and assure mission success.
About NEA Electronics

Global Leader
NEA® Electronics, Inc. is a global leader in spacecraft mechanisms. Our low shock release devices are relied upon for spaceflight applications more than any other device.

Reliable
Our designs are reliable, simple, insensitive to adverse environments and backed up by years of heritage and loyal customers.

Quality Assured
NEA, a trusted supplier of mission critical components, is certified to ISO 9001:2008 and AS9100:2009 C.

Introduction to NEA

NEA® Electronics, Inc. designs and manufactures mission critical spacecraft mechanisms and is the largest supplier of non-explosive hold down and release mechanisms for spaceflight use in the world. NEA embraces our corporate parent EBA & D’s mission and vision.

Mission

To improve people’s lives
By providing technologies that help put people and satellites in space, and protecting the armed service men and women around the world as they protect our freedoms at home, NEA Electronics Inc. continuously seeks to improve the lives of people.

Vision

NEA Electronics seeks to be a leader in mission critical hardware and services.

Capabilities

In addition to release mechanisms, NEA has extended its Split-Spool technology to additional products including: Battery Cell Bypass Switches, Pin Pullers, Electrical Interconnect Devices and Non-pyrotechnic Valves for the Space and Defense industries. NEA is a proven supplier of quality products and systems for most U.S. and International Prime Contractors and government agencies (NASA, ESA, JAXA, ISRO).

NEA has successfully addressed a need expressed in recent years by both the National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA) to find a preferred alternative to the traditional explosive actuator. NEA satisfied NASA’s objective by developing reliable, fast acting, sure release, and low shock output, non-explosive Separation Mechanisms with redundant release features. NEA mechanisms eliminate the residue and shock produced by explosive devices and are factory refurbish-able for extended use in support of system level testing. NEA separation devices and systems are used to hold down and deploy solar arrays, reflectors, antennas, platforms, rocket stages and small satellites.

NEA has expanded its technical capabilities to support design and analysis of motors and gearboxes allowing an expanded product offering including: gimbals and pointing mechanisms, solar array drives, deployment actuators and other custom electromechanical actuators. NEA’s initial standard actuator offering is our P3 family of precision pointing mechanisms available in single axis and dual axis (gimbal) configurations with both three phase and four phase motor windings.

NEA Products

NEA offers a broad range of mechanism and actuator products that enable our customers in mission critical space applications.

Hold Down & Release Mechanisms (HDRMs)

NEA Hold Down and Release Mechanisms (HDRMs) utilize NEA’s unique Split-Spool Release Device technology to offer unprecedented performance in a low shock spacecraft release mechanism and have made NEA the worldwide leader in non-pyrotechnic release devices for space applications.
Mission Success
NEA® Electronics, Inc. is dedicated to building mankind’s legacy in space by supporting our customers in the aerospace industry through on time delivery of innovative products that exceed expectations and assure mission success.

About NEA Electronics

Battery Cell Bypass Switches
NEA Battery Cell Bypass Switches build on NEA’s Split-Spool technology and were developed to facilitate the isolation and bypass of a failed battery pack or a failed battery cell within a battery pack, thereby eliminating the need to shut down the entire battery if a failure occurs. NEA switches are used with both Lithium Ion and Nickel Hydrogen cells.

Pin Pullers
NEA’s Pin Puller devices are also derived from NEA’s core technology and provide a low shock replacement for pyrotechnic based Pin Pullers.

Connectors & Disconnects
NEA Electrical Interconnect Devices provide zero separation force between the plug and receptacle connectors and incorporates standard contact arrangements based on military specifications. NEA also produces a laser initiated umbilical connector designed and developed for use in separating missile stages. NEA manufactures dead-face connectors that provide thermal and electrical protection in critical applications.

Non-Pyrotechnic Valves
NEA Non-pyrotechnic Valves are designed and developed as a drop in replacement for the traditional pyrotechnic valves for use with liquid or gas lines. NEA-manufactured Non-pyrotechnic Valves are electrically redundant with low shock and positive isolation provided in the normally closed or normally open position.

Gimbals & Pointing Mechanisms
NEA’s precision pointing mechanisms are designed to be compatible with the majority of existing customer applications, can be provided in multiple single axis and gimbal configurations and feature performance superior to many competitor products. The actuator design has been developed in-house using modern methods with an emphasis on low risk, design to cost, and shorter lead times.

Solar Array Drive Actuators
NEA’s Solar Array Drive Actuators are based on our pointing mechanism technology and feature the same in-house designed high performance motor technology. NEA Solar Array Drives can be provided with either slip rings or lower cost twist capsule modules to transfer power and signals over the rotating interface.

Deployment Actuators
For non-pointing applications where torque and efficiency are a priority, NEA can provide Deployment Actuators that feature and efficient brushless DC motor coupled to small high torque planetary gearbox. Deployment actuators can be used for deployment of mechanisms, opening and closing of instrument covers, berthing and docking mechanisms and even rover wheel and surface drilling applications.
Global Leader
NEA® Electronics, Inc. is a global leader in spacecraft mechanisms. Our low shock release devices are relied upon for spaceflight applications more than any other device.

Reliable
Our designs are reliable, simple, insensitive to adverse environments and backed up by years of heritage and loyal customers.

Quality Assured
NEA, a trusted supplier of mission critical components, is certified to ISO 9001:2008 and AS9100:2009 C

History
NEA was founded in 1996 and quickly grew to be a major supplier of hold down and release mechanisms largely on the strength of the performance of its products. No other company offers the combination of specific performance, simplicity, tolerance to environments, limited shock and reliability.

In 2010 NEA Electronics was acquired by Ensign-Bickford Aerospace & Defense and became a subsidiary of one of the oldest privately held corporations in the United States, founded in 1836. Ensign-Bickford Aerospace & Defense, which has supported the space program since the 1950’s with stage separation, fairing separation and launch termination energetics, has invested in NEA through improvements in facilities, equipment and personnel to position NEA for growth in the spacecraft mechanisms and actuator market. In 2012 NEA acquired Rocketstar Robotics to augment NEA’s release mechanisms capability with electromechanical spacecraft actuators.

Quality
NEA is well aware of the responsibility that comes with mission critical spacecraft systems. This level of responsibility requires our organization to consider quality an integral aspect of everything we do. From our personnel to our products, from our management team to our customers, we adhere to the highest standards of reliable peak performance.

Continuous Improvement
We consistently strive to improve our products, performance and productivity. NEA’s state of the art progressive quality policies include disciplines such as Lean Manufacturing, Six Sigma and Kaizen.

Certified
NEA’s comprehensive quality system has been certified to ISO 9001 and AS9100 C. Additionally NEA technicians are certified for soldering per NASA-STD-8739.3 and for crimping per NASA-STD-8739.4 and get regular training at the Jet Propulsion Laboratory. NEA also has a certified trainers and technicians on staff for soldering to IPC J-STD-001.

Facilities
NEA is located just north of Los Angeles in Moorpark, California on sprawling 89-hectare (220 acre) campus that includes 5,110 m² (55,000 ft²) of office space and 10,700 m² (115,000 ft²) of manufacturing space.

Engineering Design and Analysis
NEA’s engineering team features industry experts with over a half century of combined experience in the design of spaceflight mechanisms, release devices and actuators. NEA’s engineers regularly participate in internal peer reviews to verify design integrity, bring additional perspective to the design process and to provide mentoring and cross pollination of ideas. NEA, as a subsidiary of Ensign-Bickford Aerospace & Defense (EBAD), also has direct access to the engineering organization of EBAD which shares all of the same design tools and access to shared databases, analysis tools and CAD vaults. Both NEA and EBAD benefit from this close relationship and frequently share technical expertise, design developments and personnel.
About NEA Electronics

Mission Success
NEA® Electronics, Inc. is dedicated to building mankind’s legacy in space by supporting our customers in the aerospace industry through on time delivery of innovative products that exceed expectations and assure mission success.

Manufacturing and Test
NEA’s manufacturing strategy is to have control over all sensitive processes to minimize quality and schedule risk. This is achieved through investment in extensive in-house manufacturing and test capabilities. NEA’s investment does not end with equipment; we also invest heavily in our people. Training is another major component of our manufacturing strategy.

NEA’s facilities are well equipped to support our customer base and include:

- A 213 m² (2,300 ft²) Cleanroom, ISO Class 6 & 8 (FED-STD-209E Class 1,000 and 100,000)
- 2 ISO Class 5 (FED-STD-209E Class 100) Laminar Flow Benches
- Soxhlet Extractor
- 4 Thermal Vacuum Chambers
- Random Vibration Shaker Table and Slip Plate
- Pneumatic Shock Table
- Shock Response Spectrum Plate
- 4 Test Equity 123C Thermal Chambers
- 2 Thermodron SE300 Temperature Humidity Chambers
- Thermodron ATS320 Thermal Shock Chamber
- Thermodron SE600 Temperature Humidity Chamber
- Russell Cryo Chamber
- ESD Simulator
- X-ray Inspection Facility
- Browne & Sharpe CMM
- Cross Section Laboratory
- Durometer (Shore A) & Hardness (Rockwell)
- Vacuum Oven
- Fatigue Tester
- Scanning Electron Microscope — 500,000x (SEM)
- Energy Dispersive Spectroscope (EDS)
- Simulated Transmission Electron Microscope (STEM)
- Gas Chromatograph / Mass Spectrometer (GC/MS)
- Prototype Machine Shop
NEA Hold Down & Release Mechanisms

Hold Down & Release Mechanisms

NEA is the global leader in non-pyrotechnic Hold Down & Release Mechanisms (HDRM) for the spacecraft market. Hold Down & Release Mechanisms, also sometimes referred to as Separation Nut Release Mechanisms, are offered in a range of sizes with load capacities up to a 500 kN (112,000 pounds force).

Applications

Typical applications include:
- Antennas
- Scientific instruments
- Solar arrays
- Reflectors
- Satellite, spacecraft and payloads
- Booms and masts
- Launch locks for gimbals, thrusters
- Stage separation
- Caging mechanisms

Principle of Operation

The NEA HDRM is an electrically initiated, one-shot release mechanism that has the ability to carry a very high tensile preload until commanded to release. The preload is applied through a release rod held in place by two separable spool halves which are in turn held together by tight winding of restraining wire. The restraint wire is held in place by redundant electrical fuse wires; actuation of either circuit allows release, assuring maximum reliability. When sufficient electrical current is applied, the restraint wire unwinds allowing the spool halves to separate releasing the release rod and the associated preload.

The actuation is simple and reliable and forms the basis of actuation for many of NEA’s other products including Pin Pullers, Battery Cell Bypass Switches, and Non-Pyrotechnic Valves.

NEA Electronics has the capability to pair our HDRMs with other hardware such as custom release rods, preload nuts, extractors, bolt catchers, mounting brackets, springs, connectors and electrical harnessing to provide low-shock, high reliability release assemblies.

Technical Advantages

NEA release device technology provides significant advantages.

Low Shock

There are three sources of shock with traditional pyrotechnic release devices; those include the pyrotechnic initiator and the resulting transfer of kinetic energy within the mechanism. The NEA approach eliminates both of these sources of shock. There is no pyrotechnic initiator required so there is no initial shock and the restraint wire release mechanism is also not a significant contributor to shock.

A third source of shock is the energy stored in the release rod itself as well as any of the other components that are in the preload path. The nature of NEA device’s gentle release of preload allows this stored energy to be dissipated over the release event minimizing the stored energy contribution to shock as well.
NEA Hold Down & Release Mechanisms

**Fast Acting**
With respect to shock, the action of NEA devices is quite gentle yet the release event itself is still very fast. Since the bridge wire is extremely small the release event can be triggered in milliseconds. This capability allows multiple NEA devices to be used in parallel where simultaneous release is required, such as large solar array panels and spacecraft stage separations.

**Reliable**
With simplicity comes reliability. The basic design of the NEA HDRM is very simple with a minimum of moving components. The devices are robust and not sensitive to extreme environments or contaminants. High reliability is supported both analytically and by an extensive history of successful operation in mission critical applications.

**Light Weight**
NEA devices offer extremely high preload release capacities versus unit mass. Some NEA HDRM models have specific preload release capacities greater than 300N/g.

**Temperature Insensitive**
The simplicity of the NEA release device mechanism is an asset not just for reliability but also with respect to temperature sensitivity. NEA HDRMs are insensitive to extreme temperatures. NEA HDRMs are being qualified for operation at 25K. The extreme low mass of the bridge wire results in actuation performance that is insensitive to initial conditions.

**Low Risk**
NEA HDRMs have an extensive history of use on a broad variety of spaceflight applications and are currently the baseline release device of choice on most major spacecraft buses. This history of reliability and mission success makes NEA HDRMs our customers’ low risk option.

**Compatible**
NEA HDRM devices have been designed to work with existing pyro firing circuits. The flexibility of the design however also allows operation with lower firing current if required.

**Key Features**
- Extremely low release shock
- Redundant or non-redundant actuation circuit
- Near simultaneous release of multiple hold-down points (<10 ms)
- Internal torque containment
- Allows up to 6° of angular misalignment
- Extended operating temperature range
- Can be operated with pyrotechnic initiation circuitry
- Range safety friendly
- Space-rated materials
- Factory refurbishment
**Global Leader**
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**Reliable**
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**Quality Assured**
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**Model 9100 Product Data Sheet**

NEA is the global leader in non-pyrotechnic Hold Down & Release Mechanisms (HDRM) for the spacecraft market. Hold Down & Release Mechanisms, also sometimes referred to as Separation Nut Release Mechanisms, are offered in a range of sizes. The NEA Model 9100 supports ultimate loads as high as 8 kN (1,800 lbf).

**Applications**
Typical applications include:
- Antennas
- Scientific instruments
- Solar arrays
- Reflectors
- Satellite, spacecraft and payloads
- Booms and masts
- Launch locks for gimbals, thrusters
- Stage separation
- Caging mechanisms

**Principle of Operation**
The NEA HDRM is an electrically initiated, one-shot release mechanism that has the ability to carry a very high tensile preload until commanded to release. The preload is applied through a release rod held in place by two separable spool halves which are in turn held together by tight winding of restraining wire. The restraint wire is held in place by redundant electrical fuse wires; actuation of either circuit allows release, assuring maximum reliability. When sufficient electrical current is applied, the restraint wire unwinds allowing the spool halves to separate releasing the release rod and the associated preload.

The actuation is simple and reliable and forms the basis of actuation for many of NEA’s other products including Pin Pullers, Battery Cell Bypass Switches, and Non-Pyrotechnic Valves.

NEA Electronics has the capability to pair our HDRMs with other hardware such as custom release rods, preload nuts, extractors, bolt catchers, mounting brackets, springs, connectors and electrical harnessing to provide low-shock, high reliability release assemblies.

**Key Features**
- Extremely low release shock
- Redundant or non-redundant circuit
- Near simultaneous release of multiple hold-down points
- Internal torque containment
- Extended operating temperature range
- Can be operated with pyrotechnic initiation circuitry
- Range safety friendly
- Space-rated materials
- Factory refurbishment

**Actuation Time**

![Typical Actuation Curve for NEA Hold Down & Release Mechanisms (ambient conditions)](chart.png)
NEA Model 9100
Hold Down & Release Mechanism

Model 9100 Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Capability</th>
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</thead>
<tbody>
<tr>
<td>Ultimate Load Rating</td>
<td>8 kN (1,800 lbf)</td>
</tr>
<tr>
<td>Proof Load Rating</td>
<td>7.6 kN (1,700 lbf)</td>
</tr>
<tr>
<td>Release Load Rating</td>
<td>6 kN (1,360 lbf)</td>
</tr>
<tr>
<td>Shock @ Preload&lt;sup&gt;1&lt;/sup&gt;</td>
<td>&lt;300 g's @ 6 kN (1,360 lbf)</td>
</tr>
<tr>
<td>Fuse Wire Resistance</td>
<td>1.2 to 2.0 Ω @ 25°C</td>
</tr>
<tr>
<td>Actuation Current&lt;sup&gt;2&lt;/sup&gt;</td>
<td>4 Amps for 25 ms</td>
</tr>
<tr>
<td>No-Fire Current&lt;sup&gt;3&lt;/sup&gt; (continuity)</td>
<td>250 mA</td>
</tr>
<tr>
<td>Release Time&lt;sup&gt;4&lt;/sup&gt;</td>
<td>&lt;50 ms</td>
</tr>
<tr>
<td>Qualification Temperature Range&lt;sup&gt;5&lt;/sup&gt;</td>
<td>-135°C to +135°C</td>
</tr>
<tr>
<td>Maximum Angular Misalignment</td>
<td>6° Cone</td>
</tr>
<tr>
<td>Mass&lt;sup&gt;6&lt;/sup&gt;</td>
<td>70 g (0.15 lb)</td>
</tr>
</tbody>
</table>

Notes:

<sup>1</sup> Shock is preload dependent, contact applications engineering for shock at other preloads.
<sup>2</sup> Actuation can be achieved using a range of current, the value in the table is the value used for qualifying this device.
<sup>3</sup> No-fire current for 5 minutes or less as ambient temperature, consult NEA applications engineers for other no-fire current requirements.
<sup>4</sup> Release time is dependent on actuation current, contact applications engineering for more specific information on actuation time as a function of current.
<sup>5</sup> The values presented for qualification temperature range are not a measure of the limits of the device.
<sup>6</sup> Mass does not include harnessing and lead wires.

Model 9100 Mechanical Interface Drawing

Note: Model 9100 Release Mechanism shown. Different configurations available with alternate release rods, mounting features, and connectors. Metric configurations are also available.

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NEA Model 9102G
Hold Down & Release Mechanism

Model 9102G Product Data Sheet

NEA is the global leader in non-pyrotechnic Hold Down & Release Mechanisms (HDRM) for the spacecraft market. Hold Down & Release Mechanisms, also sometimes referred to as Separation Nut Release Mechanisms, are offered in a range of sizes. The Model 9102G supports ultimate loads as high as 26.7 kN (6,000 lbf).

Applications
Typical applications include:
- Antennas
- Scientific instruments
- Solar arrays
- Reflectors
- Satellite, spacecraft and payloads
- Booms and masts
- Launch locks for gimbals, thrusters
- Stage separation
- Caging mechanisms

Principle of Operation
The NEA HDRM is an electrically initiated, one-shot release mechanism that has the ability to carry a very high tensile preload until commanded to release. The preload is applied through a release rod held in place by two separable spool halves which are in turn held together by tight winding of restraining wire. The restraint wire is held in place by redundant electrical fuse wires; actuation of either circuit allows release, assuring maximum reliability. When sufficient electrical current is applied, the restraint wire unwinds allowing the spool halves to separate releasing the release rod and the associated preload.

The actuation is simple and reliable and forms the basis of actuation for many of NEA's other products including Pin Pullers, Battery Cell Bypass Switches, and Non-Pyrotechnic Valves.

NEA Electronics has the capability to pair our HDRMs with other hardware such as custom release rods, preload nuts, extractors, bolt catchers, mounting brackets, springs, connectors and electrical harnessing to provide low-shock, high reliability release assemblies.

Key Features
- Extremely low release shock
- Redundant or non-redundant circuit
- Near simultaneous release of multiple hold-down points
- Internal torque containment
- Extended operating temperature range
- Can be operated with pyrotechnic initiation circuitry
- Range safety friendly
- Space-rated materials
- Factory refurbishment

Actuation Time

[Graph showing typical actuation curve for NEA Hold Down & Release Mechanism (applied conditions)]
Mission Success

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NEA Model 9102G
Hold Down & Release Mechanism

Model 9102G Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultimate Load Rating</td>
<td>26.7 kN (6,000 lbf)</td>
</tr>
<tr>
<td>Proof Load Rating</td>
<td>22.2 kN (5,000 lbf)</td>
</tr>
<tr>
<td>Release Load Rating</td>
<td>17.8 kN (4,000 lbf)</td>
</tr>
<tr>
<td>Shock @ Preload¹</td>
<td>&lt;350 g’s @ 17.8 kN (4,000 lbf)</td>
</tr>
<tr>
<td>Fuse Wire Resistance</td>
<td>1.2 to 2.0 Ω @ 25°C</td>
</tr>
<tr>
<td>Actuation Current²</td>
<td>4 Amps for 25 ms</td>
</tr>
<tr>
<td>No-Fire Current³ (continuity)</td>
<td>250 mA max</td>
</tr>
<tr>
<td>Release Time⁴</td>
<td>&lt;50 ms</td>
</tr>
<tr>
<td>Qualification Temperature Range⁵</td>
<td>-135°C to +135°C</td>
</tr>
<tr>
<td>Maximum Angular Misalignment</td>
<td>6° Cone</td>
</tr>
<tr>
<td>Mass⁶</td>
<td>130 g (0.29 lb)</td>
</tr>
</tbody>
</table>

Notes:
¹ Shock is preload dependent, contact applications engineering for shock at other preloads.
² Actuation can be achieved using a range of current, the value in the table is the value used for qualifying this device.
³ No-fire current for 5 minutes or less as ambient temperature, consult NEA applications engineers for other no-fire current requirements.
⁴ Release time is dependent on actuation current, contact applications engineering for more specific information on actuation time as a function of current.
⁵ The values presented for qualification temperature range are not a measure of the limits of the device.
⁶ Mass does not include harnessing and lead wires.

Model 9102G Mechanical Interface Drawing

Note: Model 9102G Release Mechanism shown. Different configurations available with alternate release rods, mounting features, and connectors. Metric configurations are also available.

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Attention: The information and recommendations described in this brochure cannot possibly cover every application of the products or variation of conditions under which the products are used. The recommendations herein are based on the manufacturer’s experience, research and testing. They are believed to be accurate, but no warranties are made, express or implied. In addition, the specifications contained herein are all nominal which represent our current production. The products described may be subject to change. Please feel free to contact NEA® Electronics Inc. for verification. No Warranties or Liabilities: The products described herein are sold “AS IS” and without any warranty or guaranty, express or implied, arising by law or otherwise including without limitation any warranty of merchantability or fitness for a particular purpose. Buyer and user agree further to release and discharge seller from any and all liabilities whatsoever arising out of the purchase or use of any product described herein whether or not such liability is occasioned by seller’s negligence or based upon strict products liability or upon principles of indemnity or contribution. Content © 2014 NEA® Electronics, Inc., Moorpark, CA 93021, U.S.A.

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Model 9103 Product Data Sheet

NEA is the global leader in non-pyrotechnic Hold Down & Release Mechanisms (HDRM) for the spacecraft market. Hold Down & Release Mechanisms, also sometimes referred to as Separation Nut Release Mechanisms, are offered in a range of sizes. The NEA Model 9103 supports ultimate loads as high as 52 kN (11,690 lbf).

Applications

Typical applications include:
- Antennas
- Scientific instruments
- Solar arrays
- Reflectors
- Satellite, spacecraft and payloads
- Booms and masts
- Launch locks for gimbals, thrusters
- Stage separation
- Caging mechanisms

Principle of Operation

The NEA HDRM is an electrically initiated, one-shot release mechanism that has the ability to carry a very high tensile preload until commanded to release. The preload is applied through a release rod held in place by two separable spool halves which are in turn held together by tight winding of restraining wire. The restraint wire is held in place by redundant electrical fuse wires; actuation of either circuit allows release, assuring maximum reliability. When sufficient electrical current is applied, the restraint wire unwinds allowing the spool halves to separate releasing the release rod and the associated preload.

The actuation is simple and reliable and forms the basis of actuation for many of NEA’s other products including Pin Pullers, Battery Cell Bypass Switches, and Non-Pyrotechnic Valves.

NEA Electronics has the capability to pair our HDRMs with other hardware such as custom release rods, preload nuts, extractors, bolt catchers, mounting brackets, springs, connectors and electrical harnessing to provide low-shock, high reliability release assemblies.

Key Features

- Extremely low release shock
- Redundant or non-redundant circuit
- Near simultaneous release of multiple hold-down points
- Internal torque containment
- Extended operating temperature range
- Can be operated with pyrotechnic initiation circuitry
- Range safety friendly
- Space-rated materials
- Factory refurbishment

Actuation Time

Typical Actuation Curve for NEA Hold Down & Release Mechanisms (ambient conditions)
Mission Success
NEA® Electronics, Inc. is dedicated to building mankind’s legacy in space by supporting our customers in the aerospace industry through on time delivery of innovative products that exceed expectations and assure mission success.

NEA Model 9103
Hold Down & Release Mechanism

Model 9103 Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultimate Load Rating</td>
<td>52 kN (11,690 lbf)</td>
</tr>
<tr>
<td>Proof Load</td>
<td>41 kN (9,217 lbf)</td>
</tr>
<tr>
<td>Release Load Rating</td>
<td>35 kN (7,868 lbf)</td>
</tr>
<tr>
<td>Shock @ Preload 1</td>
<td>&lt;350 g's @ 35 kN (7,868 lbf)</td>
</tr>
<tr>
<td>Fuse Wire Resistance</td>
<td>1.2 to 2.0 Ω @ 25°C</td>
</tr>
<tr>
<td>Actuation Current 2</td>
<td>4 Amps for 25 ms</td>
</tr>
<tr>
<td>No-Fire Current 3 (continuity)</td>
<td>250 mA</td>
</tr>
<tr>
<td>Release Time 4</td>
<td>&lt;50 ms</td>
</tr>
<tr>
<td>Qualification Temperature Range</td>
<td>-135°C to +135°C</td>
</tr>
<tr>
<td>Maximum Angular Misalignment</td>
<td>6° Cone</td>
</tr>
<tr>
<td>Mass 4</td>
<td>170 g (0.37 lb)</td>
</tr>
</tbody>
</table>

Notes:
1 Shock is preload dependent, contact applications engineering for shock at other preloads.
2 Actuation can be achieved using a range of current, the value in the table is the value used for qualifying this device.
3 No-fire current for 5 minutes or less as ambient temperature, consult NEA applications engineers for other no-fire current requirements.
4 Release time is dependent on actuation current, contact applications engineering for more specific information on actuation time as a function of current.
5 The values presented for qualification temperature range are not a measure of the limits of the device.
6 Mass does not include harnessing and lead wires.

Model 9103 Mechanical Interface Drawing

Note: Model 9103 Release Mechanism shown. Different configurations available with alternate release rods, mounting features, and connectors. Metric configurations are also available.
NEA Model 9106B
Hold Down & Release Mechanism

Model 9106B Product Data Sheet

NEA is the global leader in non-pyrotechnic Hold Down & Release Mechanisms (HDRM) for the spacecraft market. Hold Down & Release Mechanisms, also sometimes referred to as Separation Nut Release Mechanisms, are offered in a range of sizes. The NEA Model 9106B supports ultimate loads as high as 195 kN (44,000 lbf).

Applications

Typical applications include:
- Antennas
- Scientific instruments
- Solar arrays
- Reflectors
- Satellite, spacecraft and payloads
- Booms and masts
- Launch locks for gimbals, thrusters
- Stage separation
- Caging mechanisms

Principle of Operation

The NEA HDRM is an electrically initiated, one-shot release mechanism that has the ability to carry a very high tensile preload until commanded to release. The preload is applied through a release rod held in place by two separable spool halves which are in turn held together by tight winding of restraining wire. The restraint wire is held in place by redundant electrical fuse wires; actuation of either circuit allows release, assuring maximum reliability. When sufficient electrical current is applied, the restraint wire unwinds allowing the spool halves to separate releasing the release rod and the associated preload.

The actuation is simple and reliable and forms the basis of actuation for many of NEA’s other products including Pin Pullers, Battery Cell Bypass Switches, and Non-Pyrotechnic Valves.

NEA Electronics has the capability to pair our HDRMs with other hardware such as custom release rods, preload nuts, extractors, bolt catchers, mounting brackets, springs, connectors and electrical harnessing to provide low-shock, high reliability release assemblies.

Key Features

- Extremely low release shock
- Redundant or non-redundant circuit
- Near simultaneous release of multiple hold-down points
- Internal torque containment
- Extended operating temperature range
- Can be operated with pyrotechnic initiation circuitry
- Range safety friendly
- Space-rated materials
- Factory refurbishment

Actuation Time

![Typical Actuation Curve for NEA Hold Down & Release Mechanism](image)
NEA Model 9106B
Hold Down & Release Mechanism

Model 9106B Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultimate Load Rating</td>
<td>195 kN (44,000 lbf)</td>
</tr>
<tr>
<td>Proof Load Rating</td>
<td>178 kN (40,000 lbf)</td>
</tr>
<tr>
<td>Release Load Rating</td>
<td>142 kN (32,000 lbf)</td>
</tr>
<tr>
<td>Shock @ Preload&lt;sup&gt;1&lt;/sup&gt;</td>
<td>&lt;500 g’s @ 133 kN (30,000 lbf)</td>
</tr>
<tr>
<td>Fuse Wire Resistance</td>
<td>1.2 to 2.0 Ω @ 25°C</td>
</tr>
<tr>
<td>Actuation Current&lt;sup&gt;2&lt;/sup&gt;</td>
<td>4 Amps for 25 ms</td>
</tr>
<tr>
<td>No-Fire Current&lt;sup&gt;3&lt;/sup&gt; (continuity)</td>
<td>250 mA</td>
</tr>
<tr>
<td>Release Time&lt;sup&gt;4&lt;/sup&gt;</td>
<td>&lt;50 ms</td>
</tr>
<tr>
<td>Qualification Temperature Range&lt;sup&gt;5&lt;/sup&gt;</td>
<td>-135°C to +135°C</td>
</tr>
<tr>
<td>Maximum Angular Misalignment</td>
<td>6° Cone</td>
</tr>
<tr>
<td>Mass&lt;sup&gt;6&lt;/sup&gt;</td>
<td>700 g (1.54 lb)</td>
</tr>
</tbody>
</table>

Notes:

<sup>1</sup>Shock is preload dependent, contact applications engineering for shock at other preloads.
<sup>2</sup>Actuation can be achieved using a range of current, the value in the table is the value used for qualifying this device.
<sup>3</sup>No-fire current for 5 minutes or less as ambient temperature, consult NEA applications engineers for other no-fire current requirements.
<sup>4</sup>Release time is dependent on actuation current, contact applications engineering for more specific information on actuation time as a function of current.
<sup>5</sup>The values presented for qualification temperature range are not a measure of the limits of the device.
<sup>6</sup>Mass does not include harnessing and lead wires.

Model 9106B Mechanical Interface Drawing

Note: Model 9106B Release Mechanism shown. Different configurations available with alternate release rods, mounting features, and connectors. Metric configurations are also available.
Global Leader
NEA® Electronics, Inc. is a global leader in spacecraft mechanisms. Our low shock release devices are relied upon for spaceflight applications more than any other device.

Reliable
Our designs are reliable, simple, insensitive to adverse environments and backed up by years of heritage and loyal customers.

Quality Assured
NEA, a trusted supplier of mission critical components, is certified to ISO 9001:2008 and AS9100:2009 C.

Pin Pullers
NEA is the global leader in non-pyrotechnic Hold Down & Release Mechanisms (HDRM) for the spacecraft market. Our patented split spool technology that has made our HDRMs the industry standard for non-pyrotechnic release mechanisms is also available in Pin Puller configurations.

Applications
Typical applications include:
- Antennas
- Scientific instruments
- Solar arrays
- Reflectors
- Satellite, spacecraft payloads
- Booms and masts
- Stage separation
- Caging mechanisms

Principle of Operation
NEA Pin Pullers consist of a spring-loaded plunger that is restrained using the same patented split-spool and bridge wire technology used in our Hold Down & Release Mechanisms. The spool subassembly includes two spool halves which are held together by a tight winding of a restraining wire that terminates in a bridge wire connecting two electrical terminals at the electrical interface to the device. The spool assembly, by virtue of the restraining wire winding, can prevent axial motion of the plunger. When sufficient electrical current is passed through the terminals and the bridge wire, the bridge wire heats up and breaks under the applied tension load. This allows the restraining wire to unwind, separating the spool halves and releasing the spring-preloaded plunger.

The actuation method is simple and reliable and forms the basis of actuation for many of NEA's other products including: Release Mechanisms, Battery Cell Bypass Switches and Non-Pyrotechnic Valves.

Technical Advantages
NEA release device technology provides significant advantages.

Low Shock
There are three sources of shock with traditional pyrotechnic release devices; those include the pyrotechnic initiator and the resulting transfer of kinetic energy within the mechanism. The NEA approach eliminates both of these sources of shock. There is no pyrotechnic initiator required so there is no initial shock and the restraint wire release mechanism is also not a significant contributor to shock.

A third source of shock is the energy stored in the release rod itself as well as any of the other components that are in the preload path. The nature of NEA device's gentle release of preload allows this stored energy to be dissipated over the release event minimizing the stored energy contribution to shock as well.

Fast Acting
With respect to shock, the action of NEA devices is quite gentle yet the release event itself is still very fast. Since the bridge wire is extremely small the release event can be triggered in milliseconds. This capability allows multiple NEA devices to be used in parallel where simultaneous release is required, such as large solar array panels and spacecraft stage separations.
NEA Pin Pullers

Reliable
With simplicity comes reliability. The basic design of the NEA Pin Puller is very simple with a minimum of moving components. The devices are robust and not sensitive to extreme environments or contaminants. High reliability is supported both analytically and by an extensive history of successful operation in mission critical applications. NEA Pin Pullers are available in both electrically redundant and non-redundant configurations.

Temperature Insensitive
The simplicity of the NEA release device mechanism is an asset not just for reliability but also with respect to temperature sensitivity. NEA Pin Pullers are insensitive to extreme temperatures. NEA Pin Pullers are being qualified for operation at 25K. The extreme low mass of the bridge wire results in actuation performance that is insensitive to initial conditions.

Low Risk
NEA HDRMs have an extensive history of use on a broad variety of spaceflight applications and are currently the baseline release device of choice on most major spacecraft buses. This history of reliability and mission success makes NEA HDRMs our customers’ low risk option.

Compatible
NEA HDRM devices have been designed to work with existing pyro firing circuits. The flexibility of the design however also allows operation with lower firing current if required.

Key Features
- Extremely low release shock
- Redundant or non-redundant actuation circuit
- Near simultaneous release of multiple hold-down points (<10 ms)
- Extended operating temperature range
- Can be operated with pyrotechnic initiation circuitry
- Range safety friendly
- Space-rated materials
- Factory refurbishment

Custom Configurations
In addition to our line of standard Pin Pullers NEA can provide custom configurations that include: modifications to the mechanical interface, modified housing designs, changes to lead wires, revisions to load capability, additional connector housings, and materials changes. NEA can also provide Pin Pullers as part of a next higher assembly either built to our customer’s prints or designed at NEA to our customer’s specifications. Our Pin Pullers can also be integrated into our electromechanical gimbal actuators as part of a launch restraint system or range of motion limitation.

Many of our current customers rely on NEA’s in-house engineering expertise to integrate our market leading split-spool Pin Puller technology into custom assemblies to improve their competitive edge.
Model 1120 Product Data Sheet

The same Split-Spool technology that made NEA the global leader in non-pyrotechnical Hold Down & Release Mechanisms is also available in NEA’s Pin Puller mechanisms. The NEA Model 1120 Pin Puller can provide pull forces from 50 N to 90 N (11 lbf to 20 lbf).

Applications
Typical applications include:
- Antennas
- Scientific instruments
- Solar arrays
- Reflectors
- Satellite, spacecraft payloads
- Booms and masts
- Stage separation
- Caging mechanisms

Key Features
- Extremely low release shock
- Redundant or non-redundant actuation circuit
- Near simultaneous release of multiple hold-down points (<10 ms)
- Extended operating temperature range
- Can be operated with pyrotechnic initiation circuitry
- Range safety friendly
- Space-rated materials

Principle of Operation
NEA Pin Pullers consist of a spring-loaded plunger that is restrained using the same patented split-spool and bridge wire technology used in our Hold Down & Release Mechanisms. The spool subassembly includes two spool halves which are held together by a tight winding of a restraining wire that terminates in a bridge wire connecting two electrical terminals at the electrical interface to the device. The spool assembly, by virtue of the restraining wire winding, can prevent axial motion of the plunger. When sufficient electrical current is passed through the terminals and the bridge wire, the bridge wire heats up and breaks under the applied tension load. This allows the restraining wire to unwind, separating the spool halves and releasing the spring-preloaded plunger.

The actuation method is simple and reliable and forms the basis of actuation for many of NEA’s other products including: Release Mechanisms, Battery Cell Bypass Switches and Non-Pyrotechnic Valves.
NEA Model 1120 Pin Puller

Model 1120 Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pull Force at Beginning of Stroke</td>
<td>90 N (20 lbf)</td>
</tr>
<tr>
<td>Pull Force at End of Stroke</td>
<td>50 N (11 lbf)</td>
</tr>
<tr>
<td>Fuse Wire Resistance</td>
<td>0.95 to 1.6 Ω @ 25°C</td>
</tr>
<tr>
<td>Actuation Current</td>
<td>4 Amps for 25 ms</td>
</tr>
<tr>
<td>No-Fire Current (continuity)</td>
<td>400 mA</td>
</tr>
<tr>
<td>Release Time</td>
<td>&lt;50 ms</td>
</tr>
<tr>
<td>Qualification Temperature Range</td>
<td>-60°C to +150°C</td>
</tr>
<tr>
<td>Mass</td>
<td>55 g (1.94 oz)</td>
</tr>
</tbody>
</table>

Notes:
1. Actuation can be achieved using a range of current, the value in the table is the value used for qualifying this device.
2. No-fire current for 5 minutes or less as ambient temperature, consult NEA applications engineers for other no-fire current requirements.
3. Release time is dependent on actuation current, contact applications engineering for more specific information on actuation time as a function of current.
4. The values presented for qualification temperature range are not a measure of the limits of the device.
5. Mass does not include harnessing and lead wires.

Model 1120 Mechanical Interface Drawing

NEA® Electronics, Inc. is dedicated to building mankind’s legacy in space by supporting our customers in the aerospace industry through on time delivery of innovative products that exceed expectations and assure mission success.
NEA Model 2545 Pin Puller

Model 2545 Product Data Sheet

The same Split-Spool technology that made NEA the global leader in non-pyrotechnical Hold Down & Release Mechanisms is also available in NEA’s Pin Puller mechanisms. The NEA Model 2545 Pin Puller can provide pull forces from 111 N to 200 N (25 lbf to 45 lbf).

Applications

Typical applications include:
- Antennas
- Scientific instruments
- Solar arrays
- Reflectors
- Satellite, spacecraft payloads
- Booms and masts
- Stage separation
- Caging mechanisms

Principle of Operation

NEA Pin Pullers consist of a spring-loaded plunger that is restrained using the same patented split-spool and bridge wire technology used in our Hold Down & Release Mechanisms. The spool subassembly includes two spool halves which are held together by a tight winding of a restraining wire that terminates in a bridge wire connecting two electrical terminals at the electrical interface to the device. The spool assembly, by virtue of the restraining wire winding, can prevent axial motion of the plunger. When sufficient electrical current is passed through the terminals and the bridge wire, the bridge wire heats up and breaks under the applied tension load. This allows the restraining wire to unwind, separating the spool halves and releasing the spring-preloaded plunger.

The actuation method is simple and reliable and forms the basis of actuation for many of NEA’s other products including: Release Mechanisms, Battery Cell Bypass Switches and Non-Pyrotechnic Valves.

Key Features

- Extremely low release shock
- Redundant or non-redundant actuation circuit
- Near simultaneous release of multiple hold-down points (<10 ms)
- Extended operating temperature range
- Can be operated with pyrotechnic initiation circuitry
- Range safety friendly
- Space-rated materials
- Factory refurbishment

Actuation Time

![Actuation Time Graph](image)
NEA Model 2545 Pin Puller

Model 2545 Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pull Force at Beginning of Stroke</td>
<td>200 N (45 lbf)</td>
</tr>
<tr>
<td>Pull Force at End of Stroke</td>
<td>111 N (25 lbf)</td>
</tr>
<tr>
<td>Fuse Wire Resistance</td>
<td>1.2 to 2.0 Ω @ 25°C</td>
</tr>
<tr>
<td>Actuation Current¹</td>
<td>4 Amps for 25 ms</td>
</tr>
<tr>
<td>No-Fire Current² (continuity)</td>
<td>250 mA</td>
</tr>
<tr>
<td>Release Time¹</td>
<td>&lt;50 ms</td>
</tr>
<tr>
<td>Qualification Temperature Range⁴</td>
<td>-101°C to +172°C</td>
</tr>
<tr>
<td>Mass⁵</td>
<td>182 g (0.40 lb)</td>
</tr>
</tbody>
</table>

Notes:

¹Actuation can be achieved using a range of current, the value in the table is the value used for qualifying this device.
²No-fire current for 5 minutes or less as ambient temperature, consult NEA applications engineers for other no-fire current requirements.
³Release time is dependent on actuation current, contact applications engineering for more specific information on actuation time as a function of current.
⁴The values presented for qualification temperature range are not a measure of the limits of the device.
⁵Mass does not include harnessing and lead wires.

Model 2545 Mechanical Interface Drawing
NEA Battery Cell Bypass Switches

Battery Cell Bypass Switches

NEA, the global leader in non-pyrotechnic Hold Down & Release Mechanisms (HDRM) for the spacecraft market, brings this same highly reliable technology to battery protection applications with our complete line of Battery Cell Bypass Switches. Battery Cell Bypass Switches provide critical protection to battery assemblies in the event that one battery cell suffers an anomaly.

Applications

- Satellite batteries
- Launch vehicle batteries
- Manned vehicle batteries
- Space platforms and instruments
- Scientific landers and rovers
- Deep sea
- Aircraft
- Military

Principle of Operation

NEA’s Battery Cell Bypass Switch is an electrically initiated, one-shot switch that bypasses and isolates failed battery cells. The switch consists of a spring-loaded plunger with multiple precious metal plated electrical contacts arranged in a Single-Pole, Double-Throw configuration and provides Make-Before-Break functionality as the plunger moves in the housing. The plunger is restrained using the same patented split-spool and bridge wire technology used in our Hold Down & Release Mechanisms.

Typically, switches are placed in series between battery cells and, when activated, bypass and isolate the failed cell from the battery assembly. Because of this configuration, bypass switches are always in-circuit and thus rated to carry a high continuous current for the duration of the mission. The design and construction of the bypass switch assure that there is no contact bounce during high dynamic loads seen during satellite launch. When activated, there are two features that ensure reliable system operation; ‘Make-Before-Break’ functionality assures there is no voltage dropout during switching and low switch contact resistance assures high peak current carrying capability.

Several NEA switch models come with built-in Zener diodes that are used to autonomously redirect current through the actuation fuse wire when a failed cell is detected. This autonomous operation device can save considerable cost associated with battery cell sensing and switch actuation circuitry.

Technical Advantages

NEA release device technology provides significant advantages.
NEA Battery Cell Bypass Switches

**Fast Acting**

With respect to shock, the action of NEA devices is quite gentle yet the release event itself is still very fast. Since the bridge wire is extremely small the release event can be triggered in milliseconds.

**Reliable**

With simplicity comes reliability. The basic design of the NEA Battery Cell Bypass Switches is very simple with a minimum of moving components. The devices are robust and not sensitive to extreme environments or contaminants. High reliability is supported both analytically and by an extensive history of successful operation in mission critical applications.

**Temperature Insensitive**

The simplicity of the NEA release device mechanism is an asset not just for reliability but also with respect to temperature sensitivity. NEA Split Spool technology is insensitive to extreme temperatures.

**Low Risk**

NEA Battery Cell Bypass Switches have an extensive history of use on a broad variety of spaceflight applications and are currently the baseline release device of choice on most major spacecraft buses. This history of reliability and mission success makes NEA switches our customers’ low risk option.

**Compatible**

NEA switch devices have been designed to work with existing pyro firing circuits. The flexibility of the design, however, also allows operation with lower firing current if required.

**Key Features**

- Available in non-autonomous and autonomous configurations
- Switch circuit can carry up to 400A of continuous current
- Single-Pole, Double-Throw (SPDT) Make-Before-Break power switch
- High reliability and long service life
- Low power switch resistance
- Lightweight
- Extended operating temperature range
- Can be operated with pyrotechnic initiation circuitry
- Range safety friendly
- Space-rated materials

**Custom Configurations**

In addition to our line of standard Battery Cell Bypass Switch devices, NEA can provide custom configurations that include: modifications to the mechanical interface, modified housing designs, changes to lead wires and changes to materials.
Global Leader
NEA® Electronics, Inc. is a global leader in spacecraft mechanisms. Our low shock release devices are relied upon for spaceflight applications more than any other device.

Reliable
Our designs are reliable, simple, insensitive to adverse environments and backed up by years of heritage and loyal customers.

Quality Assured
NEA, a trusted supplier of mission critical components, is certified to ISO 9001:2008 and AS9100:2009 C.

NEA 8020 Series
Battery Cell Bypass Switches

8020 Series Product Data Sheet

NEA, the global leader in non-pyrotechnic Hold Down & Release Mechanisms (HDRM) for the spacecraft market, brings this same highly reliable technology to battery protection applications with our complete line of Battery Cell Bypass Switches. Battery Cell Bypass Switches provide critical protection to battery assemblies in the event that one battery cell suffers an anomaly.

Principle of Operation
NEA’s Battery Cell Bypass Switch is an electrically initiated, one-shot switch that bypasses and isolates failed battery cells. The switch consists of a spring-loaded plunger with multiple precious metal plated electrical contacts arranged in a Single-Pole, Double-Throw configuration and provides Make-Before-Break functionality as the plunger moves in the housing. The plunger is restrained using the same patented split-spool and bridge wire technology used in our Hold Down & Release Mechanisms.

Typically, switches are placed in series between battery cells and, when activated, bypass and isolate the failed cell from the battery assembly. Because of this configuration, bypass switches are always in-circuit and thus rated to carry a high continuous current for the duration of the mission. The design and construction of the bypass switch assure that there is no contact bounce during high dynamic loads seen during satellite launch. When activated, there are two features that ensure reliable system operation; Make-Before-Break functionality assures there is no voltage dropout during switching and low switch contact resistance assures high peak current carrying capability.

Several NEA switch models come with built-in Zener diodes that are used to autonomously redirect current through the actuation fuse wire when a failed cell is detected. This autonomous operation device can save considerable cost associated with battery cell sensing and switch actuation circuitry.

Key Features
- Available in non-autonomous and autonomous configurations
- Switch circuit can carry up to 100A of continuous current
- Single-Pole, Double-Throw (SPDT) Make-Before-Break power switch
- High reliability and long service life
- Low power switch resistance
- Lightweight
- Extended operating temperature range
- Can be operated with pyrotechnic initiation circuitry
- Range safety friendly
- Space-rated materials

Actuation Time

![Typical Actuation Curve for NEA Battery Cell Bypass Switches](attachment:actuation_curve.png)
Mission Success

NEA® Electronics, Inc. is dedicated to building mankind’s legacy in space by supporting our customers in the aerospace industry through on time delivery of innovative products that exceed expectations and assure mission success.

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NEA® 8020 Series Battery Cell Bypass Switches

8020 Series Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>8020 Series Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Current Ratings</td>
<td>100 A</td>
</tr>
<tr>
<td>Switch Resistance</td>
<td>&lt;250 μΩ @ 100 A</td>
</tr>
<tr>
<td>Fuse Wire Resistance</td>
<td>0.95 to 1.6 Ω @ 25°C</td>
</tr>
<tr>
<td>Minimum Actuation Current&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1.2 A</td>
</tr>
<tr>
<td>Nominal Actuation Current</td>
<td>4 Amps for 25 ms</td>
</tr>
<tr>
<td>No-Fire Current&lt;sup&gt;2&lt;/sup&gt;</td>
<td>500 mA</td>
</tr>
<tr>
<td>Actuation Time&lt;sup&gt;3&lt;/sup&gt;</td>
<td>&lt;50 ms</td>
</tr>
<tr>
<td>Make Before Break Duration</td>
<td>&lt;1 ms</td>
</tr>
<tr>
<td>Qualification Temperature Range&lt;sup&gt;4&lt;/sup&gt;</td>
<td>-55°C to +85°C</td>
</tr>
<tr>
<td>Mass&lt;sup&gt;5&lt;/sup&gt;</td>
<td>62 g (2.19 oz)</td>
</tr>
</tbody>
</table>

Notes:

<sup>1</sup> Actuation can be achieved using a range of current, the value in the table is the value used for qualifying this device.

<sup>2</sup>No-fire current for 5 minutes or less as ambient temperature, consult NEA applications engineers for other no-fire current requirements.

<sup>3</sup> Actuation time is dependent on actuation current, contact applications engineering for more specific information on actuation time as a function of current.

<sup>4</sup> The values presented for qualification temperature range are not a measure of the limits of the device.

<sup>5</sup>Mass is representative and varies slightly with different specific part numbers within the series but does not include harnessing and lead wires.

Model 8023 Mechanical Interface Drawing

Note: Model 8023 Battery Cell Bypass Switch shown above as an example. Other models available with alternate mounting feet, terminal configurations and optional zener diodes for autonomous operation.

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NEA 8030 Series Battery Cell Bypass Switches

8030 Series Product Data Sheet

NEA, the global leader in non-pyrotechnic Hold Down & Release Mechanisms (HDRM) for the spacecraft market, brings this same highly reliable technology to battery protection applications with our complete line of Battery Cell Bypass Switches. Battery Cell Bypass Switches provide critical protection to battery assemblies in the event that one battery cell suffers an anomaly.

Principle of Operation

NEA’s Battery Cell Bypass Switch is an electrically initiated, one-shot switch that bypasses and isolates failed battery cells. The switch consists of a spring-loaded plunger with multiple precious metal plated electrical contacts arranged in a Single-Pole, Double-Throw configuration and provides Make-Before-Break functionality as the plunger moves in the housing. The plunger is restrained using the same patented split-spool and bridge wire technology used in our Hold Down & Release Mechanisms.

Typically, switches are placed in series between battery cells and, when activated, bypass and isolate the failed cell from the battery assembly. Because of this configuration, bypass switches are always in-circuit and thus rated to carry a high continuous current for the duration of the mission. The design and construction of the bypass switch assure that there is no contact bounce during high dynamic loads seen during satellite launch. When activated, there are two features that ensure reliable system operation; Make-Before-Break functionality assures there is no voltage dropout during switching and low switch contact resistance assures high peak current carrying capability.

Several NEA switch models come with built-in Zener diodes that are used to autonomously redirect current through the actuation fuse wire when a failed cell is detected. This autonomous operation device can save considerable cost associated with battery cell sensing and switch actuation circuitry.

Key Features

- Available in non-autonomous and autonomous configurations
- Switch circuit can carry up to 200A of continuous current
- Single-Pole, Double-Throw (SPDT) Make-Before-Break power switch
- High reliability and long service life
- Low power switch resistance
- Lightweight
- Extended operating temperature range
- Can be operated with pyrotechnic initiation circuitry
- Range safety friendly
- Space-rated materials

Actuation Time

![Typical Actuation Curve for NEA Battery Cell Bypass Switches](chart.png)
NEA 8030 Series
Battery Cell Bypass Switches

8030 Series Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Series 8030 Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Current Ratings</td>
<td>250 A</td>
</tr>
<tr>
<td>Switch Resistance</td>
<td>&lt;200 μΩ @ 250 A</td>
</tr>
<tr>
<td>Fuse Wire Resistance</td>
<td>0.95 to 1.6 Ω @ 25°C</td>
</tr>
<tr>
<td>Minimum Actuation Current¹</td>
<td>1.2 A</td>
</tr>
<tr>
<td>Nominal Actuation Current</td>
<td>4 Amps for 25 ms</td>
</tr>
<tr>
<td>No-Fire Current² (continuity)</td>
<td>500 mA</td>
</tr>
<tr>
<td>Actuation Time³</td>
<td>&lt;50 ms</td>
</tr>
<tr>
<td>Make Before Break Duration</td>
<td>&lt;1 ms</td>
</tr>
<tr>
<td>Qualification Temperature Range⁴</td>
<td>-55°C to +85°C</td>
</tr>
<tr>
<td>Mass⁵</td>
<td>130 g (4.59 oz)</td>
</tr>
</tbody>
</table>

Notes:
¹Actuation can be achieved using a range of current, the value in the table is the value used for qualifying this device.
²No-fire current for 5 minutes or less as ambient temperature, consult NEA applications engineers for other no-fire current requirements.
³Actuation time is dependent on actuation current, contact applications engineering for more specific information on actuation time as a function of current.
⁴The values presented for qualification temperature range are not a measure of the limits of the device.
⁵Mass is representative and varies slightly with different specific part numbers within the series but does not include harnessing and lead wires.

Model 8036 Mechanical Interface Drawing

Note: Model 8036 Battery Cell Bypass Switch shown above as an example. Other models available with alternate mounting feet, terminal configurations and optional zener diodes for autonomous operation.

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Global Leader
NEA® Electronics, Inc. is a global leader in spacecraft mechanisms. Our low shock release devices are relied upon for spaceflight applications more than any other device.

Reliable
Our designs are reliable, simple, insensitive to adverse environments and backed up by years of heritage and loyal customers.

Quality Assured
NEA, a trusted supplier of mission critical components, is certified to ISO 9001:2008 and AS9100:2009 C

NEA 8040 Series
Battery Cell Bypass Switches

8040 Series Product Data Sheet

NEA, the global leader in non-pyrotechnic Hold Down & Release Mechanisms (HDRM) for the spacecraft market, brings this same highly reliable technology to battery protection applications with our complete line of Battery Cell Bypass Switches. Battery Cell Bypass Switches provide critical protection to battery assemblies in the event that one battery cell suffers an anomaly.

Principle of Operation
NEA’s Battery Cell Bypass Switch is an electrically initiated, one-shot switch that bypasses and isolates failed battery cells. The switch consists of a spring-loaded plunger with multiple precious metal plated electrical contacts arranged in a Single-Pole, Double-Throw configuration and provides Make-Before-Break functionality as the plunger moves in the housing. The plunger is restrained using the same patented split-spool and bridge wire technology used in our Hold Down & Release Mechanisms.

Typically, switches are placed in series between battery cells and, when activated, bypass and isolate the failed cell from the battery assembly. Because of this configuration, bypass switches are always in-circuit and thus rated to carry a high continuous current for the duration of the mission. The design and construction of the bypass switch assure that there is no contact bounce during high dynamic loads seen during satellite launch. When activated, there are two features that ensure reliable system operation; Make-Before-Break functionality assures there is no voltage dropout during switching and low switch contact resistance assures high peak current carrying capability.

Several NEA switch models come with built-in Zener diodes that are used to autonomously redirect current through the actuation fuse wire when a failed cell is detected. This autonomous operation device can save considerable cost associated with battery cell sensing and switch actuation circuitry.

Key Features
- Available in non-autonomous and autonomous configurations
- Switch circuit can carry up to 400A of continuous current
- Single-Pole, Double-Throw (SPDT) Make-Before-Break power switch
- High reliability and long service life
- Low power switch resistance
- Lightweight
- Extended operating temperature range
- Can be operated with pyrotechnic initiation circuitry
- Range safety friendly
- Space-rated materials
- Factory refurbishment

Actuation Time

Typical Actuation Curve for NEA Battery Cell Bypass Switches
(neutral conditions)
Mission Success
NEA® Electronics, Inc. is dedicated to building mankind’s legacy in space by supporting our customers in the aerospace industry through on time delivery of innovative products that exceed expectations and assure mission success.

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NEA® 8040 Series
Battery Cell Bypass Switches

8040 Series Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Series 8040 Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Current Ratings</td>
<td>400 A</td>
</tr>
<tr>
<td>Switch Resistance</td>
<td>&lt;150 μΩ @ 400 A</td>
</tr>
<tr>
<td>Fuse Wire Resistance</td>
<td>0.95 to 1.6 Ω @ 25°C</td>
</tr>
<tr>
<td>Minimum Actuation Current¹</td>
<td>1.2 A</td>
</tr>
<tr>
<td>Nominal Actuation Current</td>
<td>4 Amps for 25 ms</td>
</tr>
<tr>
<td>No-Fire Current² (continuity)</td>
<td>500 mA</td>
</tr>
<tr>
<td>Actuation Time³</td>
<td>&lt;50 ms</td>
</tr>
<tr>
<td>Make Before Break Duration</td>
<td>&lt;1 ms</td>
</tr>
<tr>
<td>Qualification Temperature Range⁴</td>
<td>-55°C to +85°C</td>
</tr>
<tr>
<td>Mass⁵</td>
<td>250 g (8.8 oz)</td>
</tr>
</tbody>
</table>

Notes:
¹Actuation can be achieved using a range of current, the value in the table is the value used for qualifying this device.
²No-fire current for 5 minutes or less as ambient temperature, consult NEA applications engineers for other no-fire current requirements.
³Actuation time is dependent on actuation current, contact applications engineering for more specific information on actuation time as a function of current.
⁴The values presented for qualification temperature range are not a measure of the limits of the device.
⁵Mass is representative and varies slightly with different specific part numbers within the series but does not include harnessing and lead wires.

Model 8043 Mechanical Interface Drawing

Note: Model 8043 Battery Cell Bypass Switch shown above as an example. Other models available with alternate mounting feet, terminal configurations and optional zener diodes for autonomous operation.

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Mission Success
NEA® Electronics, Inc. is dedicated to building mankind’s legacy in space by supporting our customers in the aerospace industry through on time delivery of innovative products that exceed expectations and assure mission success.
Non-Pyrotechnic Valves

NEA’s highly reliable Hold Down & Release Mechanisms technology has been adapted for use in Non-Pyrotechnic Valves. The electrically redundant valves offer low shock and positive isolation with both liquid and gas lines. They are available in both normally closed and normally open configurations.

Applications

The Non-Pyrotechnic Valves are most suited to one-shot applications that are inaccessible and require maximum reliability such as:

- Spacecraft fuel lines
- Nuclear coolant valves
- Tamper proof hydraulic valves for security applications

Principle of Operation

NEA Non-Pyrotechnic Valves consist of a spring-loaded plunger that is restrained using the same patented split-spool and bridge wire technology used in our Hold Down & Release Mechanisms. The spool subassembly includes two spool halves which are held together by a tight winding of a restraining wire that terminates in a bridge wire connecting two electrical terminals at the electrical interface to the device. The spool assembly, by virtue of the restraining wire winding, can prevent axial motion of the plunger. When sufficient electrical current is passed through the terminals and the bridge wire, the bridge wire heats up and breaks under the applied tension load. This allows the restraining wire to unwind, separating the spool halves and releasing the spring-preloaded plunger, which is directly connected to a ball and cone valve mechanism. Actuation can either separate the ball from the cone or engage the ball in the cone depending on the configuration selected.

The actuation method is simple and reliable and forms the basis of actuation for many of NEA’s other products including: Battery Cell Bypass Switches and Pin Pullers.

Technical Advantages

NEA release device technology provides significant advantages.

Low Shock

There are three sources of shock with traditional pyrotechnic release devices; those include the pyrotechnic initiator and the resulting transfer of kinetic energy within the mechanism. The NEA approach eliminates both of these sources of shock. There is no pyrotechnic initiator required so there is no initial shock and the restraint wire release mechanism is also not a significant contributor to shock.

A third source of shock is the energy stored in the release rod itself as well as any of the other components that are in the preload path. The nature of NEA device’s gentle release of preload allows this stored energy to be dissipated over the release event minimizing the stored energy contribution to shock as well.

Fast Acting

With respect to shock, the action of NEA devices is quite gentle yet the release event itself is still very fast. Since the bridge wire is extremely small the release event can be triggered in milliseconds.
NEA Non-Pyrotechnic Valves

Reliable
With simplicity comes reliability. The basic design of the NEA Non-Pyrotechnic Valve is very simple with a minimum of moving components. The devices are robust and not sensitive to extreme environments or contaminants.

Compatible
NEA Non-Pyrotechnic Valves have been designed to work with existing pyro firing circuits. The flexibility of the design, however, also allows operation with lower firing current if required.

Custom Configurations
In addition to our line of standard Non-Pyrotechnic Valves, NEA can provide custom configurations that include: modifications to the mechanical interface, modified housing designs, changes to lead wires, revisions to pressure capability, additional connector housings, and materials changes. NEA can also provide Non-Pyrotechnic Valves as part of a next higher assembly either built to our customer’s prints or designed at NEA to our customer’s specifications.

Many of our current customers rely on NEA’s in-house engineering expertise to integrate our market leading split-spool Non-Pyrotechnic Valve technology into custom assemblies to improve their competitive edge.

Key Features
- Electrically Redundant
- Low Shock
- Positive Isolation
- Available in normally closed or open configurations
- Operating pressure between 0 to 31 MPa
- Burst Pressure >63 MPa
- Metal-sealed and hermetically-sealed valves are available
- Post actuation contamination: <15 items and <25 microns
- Predictable Actuation Times
- Contamination free actuation
- Hermetically sealed before and after actuation
- Material selections compatible with flow material, gas or liquid
NEA Model NPV9000 Non-Pyrotechnic Valve

Model NPV9000 Product Data Sheet

NEA’s highly reliable Hold Down & Release Mechanisms technology has been adapted for use in Non-Pyrotechnic Valves. The electrically redundant valves offer low shock and positive isolation with both liquid and gas lines. They are available in both normally closed and normally open configurations.

Applications

The Non-Pyrotechnic Valves are most suited to one shot applications that are inaccessible and require maximum reliability such as:

- Spacecraft fuel lines
- Nuclear coolant valves
- Tamper proof hydraulic valves for security applications

Principle of Operation

NEA Non-Pyrotechnic Valves consist of a spring-loaded plunger that is restrained using the same patented split-spool and bridge wire technology used in our Hold Down & Release Mechanisms. The spool subassembly includes two spool halves which are held together by a tight winding of a restraining wire that terminates in a bridge wire connecting two electrical terminals at the electrical interface to the device. The spool assembly, by virtue of the restraining wire winding, can prevent axial motion of the plunger. When sufficient electrical current is passed through the terminals and the bridge wire, the bridge wire heats up and breaks under the applied tension load. This allows the restraining wire to unwind, separating the spool halves and releasing the spring-preloaded plunger, which is directly connected to a ball and cone valve mechanism. Actuation can either separate the ball from the cone or engage the ball in the cone depending on the configuration selected.

The actuation method is simple and reliable and forms the basis of actuation for many of NEA’s other products including; Battery Cell Bypass Switches and Pin Pullers.

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- Material selections compatible with flow material, gas or liquid
Mission Success
NEA® Electronics, Inc. is dedicated to building mankind’s legacy in space by supporting our customers in the aerospace industry through on time delivery of innovative products that exceed expectations and assure mission success.

NEA® Model NPV9000
Non-Pyro Technic Valve

Model NPV9000 Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burst Pressure (5 minutes)</td>
<td>63.4 MPa (9,200 psi)</td>
</tr>
<tr>
<td>Maximum Operational Pressure</td>
<td>31 MPa (4,500 psi)</td>
</tr>
<tr>
<td>Minimum Operational Pressure</td>
<td>0 MPa (0 psi)</td>
</tr>
<tr>
<td>Minimum Actuation Current(^1)</td>
<td>2 A</td>
</tr>
<tr>
<td>Actuation Time(^2)</td>
<td>30 ms</td>
</tr>
<tr>
<td>Cold Temperature Limit</td>
<td>-257°C (16 K)</td>
</tr>
<tr>
<td>Hot Temperature Limit</td>
<td>+160°C</td>
</tr>
<tr>
<td>Mass(^3)</td>
<td>496.5 g (17.5 oz)</td>
</tr>
</tbody>
</table>

Notes:

\(^1\) Actuation can be achieved using a range of current, the value in the table is the value used for qualifying this device.

\(^2\) Actuation time is dependent on actuation current, contact applications engineering for more specific information on actuation time as a function of current.

\(^3\) Mass does not include harnessing and lead wires.

Model NPV9000 Mechanical Interface Drawing
Connectors & Disconnects

NEA provides a highly customizable line of electrical In-Flight Disconnects (IFDs) for satellites, spacecraft, rocket stage and umbilical separation. The connectors are highly customizable and can be provided with MIL standard inserts. The connectors can be provided with Zero Separation Force (ZSF) features that can be tuned to specific positive, zero or negative separation forces. Dead Face (DF) connectors are also available that provide electrical isolation prior to separation. The DF connectors are designed to work with NEA’s ZSF connectors.

Applications

- Typical applications include:
  - Satellite, spacecraft and payloads
  - Stage separation
  - Umbilical disconnects
  - Panel disconnect assemblies
  - Harsh environments

Principle of Operation

NEA’s electrical In-Flight Disconnects utilize industry standard MIL-DTL-38999 inserts and MIL-C-39029 pin and socket contacts that are housed in a custom shell that provides the zero separation force and dead face functionality.

NEA ZSF connectors feature a set of stainless steel kickoff springs that are custom configured to meet the specific force profile required. Each mated connector pair is factory calibrated to compensate for connector pin engagement and other retention forces, assuring precise and smooth separation.

NEA DF connectors have an internal shuttle that disconnects and isolates electrical signals prior to physical separation at the separation plane, assuring upstream integrity of electrical interfaces, even during harsh environmental conditions after separation. DF connectors are designed to work in conjunction with NEA’s ZSF connectors at the separation interface to provide a complete solution to stage separation.

Technical Advantages

NEA In-Flight Disconnect technology provides significant advantages.

Customization

NEA IFDs are built around industry standard connector inserts that allow NEA to offer a large range of possible configurations. Since NEA designs and manufactures the connector shell, we can tailor the features, separation forces and interface to specific requirements. The ability to interface ZSF connectors with DF connectors provides additional possibilities to satisfy critical application requirements.
NEA Connectors & Disconnects

**Low Risk**

NEA’s flight heritage of In-Flight-Disconnect technology assures customers are taking the low risk approach.

**Short Lead Time**

NEA In-Flight Disconnects are a highly customizable flight proven solution that can be provided in a relatively short lead time.

**Performance**

NEA Zero Separation Force connectors can be precisely tuned to minimize their influence on payload trajectory. NEA Dead Face connectors are designed to disconnect their conduction paths prior to complete separation assuring critical electronics are protected from harsh environments that might be encountered in application such as ocean splashdown and recovery.

**Key Features**

- Zero, positive, or negative separation force
- Mounts from rear of panel or bracket
- Tolerates wide range of linear and angular misalignment permitting blind engagement
- Standard MIL-DTL-38999 inserts
- Full range of keying configurations
- Service Class H
- Utilizes MIL-C-39029 pin and socket contacts
- AS85049 compatible backshell
- Backshell hardware available
- Complete harness and disconnect assemblies available
- ZSF100 series mates with our Model DF200 and 201 dead face connectors
- Absolute electrical isolation prior to separation at the separation plane
Model ZSF and IFD Product Data Sheet

NEA’s ZSF and IFD connectors are reliable in-flight electrical disconnects for satellite and spacecraft separation, missile staging, and umbilical separation. Connector pairs are designed to provide precision zero, positive or negative separation force, eliminating the need for lanyard pull actuation.

Applications
Typical applications include:
- Satellite, spacecraft and payloads
- Stage separation
- Umbilical disconnects
- Panel disconnect assemblies

Principle of Operation
NEA’s Zero Separation Force (ZSF) and In-Flight Disconnects (IFD) electrical interconnects incorporate standard MIL-DTL-38999 inserts and MIL-C-39029 pin and socket contacts.

Each mated connector pair is factory calibrated to compensate for connector pin engagement and other retention forces, assuring precise and smooth separation. ZSF and IFD connectors feature a floating shell, eliminating jamming during mating and separation. Blind engagement of the plug and receptacle pairs is possible, since the connectors allow for linear and angular misalignment. Connectors can be mounted from the rear of the panel or bracket, allowing for ease of installation. All of the in-flight disconnects are backshell ready, and if required, can be provided with the overall system.

NEA Electronics has the capability to pair our connectors with our non-explosive Hold Down & Release Mechanisms (HDRM) and other hardware such as brackets, alignment pins, springs, and harnessing to provide low-shock, high reliability stage and umbilical disconnect assemblies.

Key Features
- Zero, positive, or negative separation force
- Mounts from rear of panel or bracket
- Tolerates wide range of linear and angular misalignment permitting blind engagement
- Standard MIL-DTL-38999 inserts
- Full range of keying configurations
- Service Class H
- Utilizes MIL-C-39029 pin and socket contacts
- AS85049 compatible backshell
- Backshell hardware available
- Complete harness and disconnect assemblies available
- ZSF100 series mates with our Model DF200 and 201 dead face connectors
Mission Success
NEA® Electronics, Inc. is dedicated to building mankind’s legacy in space by supporting our customers in the aerospace industry through on time delivery of innovative products that exceed expectations and assure mission success.

**NEA Model ZSF and IFD Zero Separation Force Connector**

**Model ZSF and IFD Configurations**

<table>
<thead>
<tr>
<th>Connector Model</th>
<th>Style</th>
<th>Shell Size</th>
<th>Insert Arrangement</th>
<th>Mates With</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZSF100P</td>
<td>Plug</td>
<td>17</td>
<td>8</td>
<td>DF200SS2</td>
</tr>
<tr>
<td>ZSF100</td>
<td>Plug</td>
<td>21</td>
<td>11, 16, 35, 41</td>
<td>ZSF200</td>
</tr>
<tr>
<td>IFD100</td>
<td>Plug</td>
<td>19</td>
<td>35</td>
<td>IFD200</td>
</tr>
<tr>
<td>ZSF200</td>
<td>Receptacle</td>
<td>21</td>
<td>11, 16, 35, 41</td>
<td>ZSF100</td>
</tr>
<tr>
<td>ZSF202S</td>
<td>Receptacle</td>
<td>25</td>
<td>62</td>
<td>ZSF100P</td>
</tr>
<tr>
<td>IFD200</td>
<td>Receptacle</td>
<td>19</td>
<td>35</td>
<td>IFD100</td>
</tr>
</tbody>
</table>

**Model ZSF and IFD Technical Specifications**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separation Force</td>
<td>0 N (0 lbf) (or adjustable to customer spec)</td>
</tr>
<tr>
<td>Engagement Force</td>
<td>90 N (20 lbf)</td>
</tr>
<tr>
<td>Linear Misalignment</td>
<td>0.76mm (0.03 in) min</td>
</tr>
<tr>
<td>Maximum Angular Misalignment</td>
<td>20° cone</td>
</tr>
<tr>
<td>Qualification Temperature Range</td>
<td>-55°C to +200°C</td>
</tr>
<tr>
<td>Mass</td>
<td>117 g (0.29 lb)</td>
</tr>
</tbody>
</table>

**Model ZSF and IFD Mechanical Interface**

NEA Zero Separation Force connector and In-Flight Disconnect mechanical interfaces are compliant with MIL-DTL-38999.
NEA's Dead Face (DF) connectors are reliable in-flight electrical disconnects for satellite and spacecraft separation, missile staging, and umbilical separation. In addition to providing precision separation force, DF connectors provide electrical isolation prior to physical separation.

Applications
- Typical applications include:
  - Satellite, spacecraft and payloads
  - Stage separation
  - Umbilical disconnects
  - Panel disconnect assemblies
  - Harsh environments

Principle of Operation
NEA's DF electrical interconnects incorporate standard MIL-DTL-38999 inserts and MIL-C-39029 pin and socket contacts. DF connectors have an internal shuttle that disconnects and isolates electrical signals prior to physical separation at the separation plane, assuring upstream integrity of electrical interfaces, even during harsh environmental conditions after separation.

DF connectors are designed to work in conjunction with NEA's ZSF100P connectors at the separation interface. Each mated connector pair is factory calibrated to compensate for connector pin engagement and other retention forces, assuring precise and smooth separation. DF connectors feature a floating shell, eliminating jamming during mating and separation. Blind engagement of the plug and receptacle pairs is possible, since the connectors allow for linear and angular misalignment. Connectors can be mounted from the rear of the panel or bracket, allowing for ease of installation. The back side of the DF connector mates with a MIL-C-38999 Series III plug.

Key Features
- Absolute electrical isolation prior to separation at the separation plane
- Zero, positive, or negative separation force
- Mounts from rear of panel or bracket
- Tolerates wide range of linear and angular misalignment permitting blind engagement
- MIL-DTL-38999 insert configurations
- Full range of keying configurations
- Service Class H
- Utilizes MIL-C-39029 pin and socket contacts
- Complete harness and disconnect assemblies available
- DF200 and 201 series mates with our Model ZSF100 connectors
NEA Model DF
Dead Face Connector

Model DF Dead Face Connector Configurations

<table>
<thead>
<tr>
<th>Connector Model</th>
<th>Style</th>
<th>Shell Size¹</th>
<th>Insert Arrangement¹</th>
<th>Mates With</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF200SS</td>
<td>Receptacle</td>
<td>17</td>
<td>8</td>
<td>ZSF100P²</td>
</tr>
<tr>
<td>DF200SS, 201SS</td>
<td>Receptacle</td>
<td>25</td>
<td>7, 29, 24, 61, 90</td>
<td>ZSF100P²</td>
</tr>
</tbody>
</table>

Notes:
1Existing shell sizes and insert arrangements shown. Other MIL-DTL-38999 shell size and insert arrangements available.
2See data sheet for NEA Model ZSF100 connectors

Model DF Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separation Force</td>
<td>0 N (0 lbf) (or adjustable to customer spec)</td>
</tr>
<tr>
<td>Engagement Force</td>
<td>90 N (20 lbf)</td>
</tr>
<tr>
<td>Linear Misalignment</td>
<td>0.76mm (0.03 in) min</td>
</tr>
<tr>
<td>Maximum Angular Misalignment</td>
<td>5° cone (half cone)</td>
</tr>
<tr>
<td>Qualification Temperature Range¹</td>
<td>-55°C to +200°C at 10-4 Torr</td>
</tr>
<tr>
<td>Short Duration Firewall</td>
<td>1,343°C</td>
</tr>
<tr>
<td>Shock²</td>
<td>14,200 G peak</td>
</tr>
<tr>
<td>Random Vibration²</td>
<td>17 Grms, 180 sec per axis</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>100MΩ min at 1500 VDC</td>
</tr>
<tr>
<td>Dielectric Withstanding Voltage</td>
<td>2mA max leakage at 1000 VAC</td>
</tr>
<tr>
<td>Shell to Shell Conductivity</td>
<td>10MΩ drop at 1A</td>
</tr>
<tr>
<td>Mass³</td>
<td>380 g (0.84 lb)</td>
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</table>

Notes:
1The values presented for qualification temperature range are not a measure of the limits of the device.
2Shock and random vibration testing performed in the mated and unmated configurations.
3Representative of DF200SS, 25-24 insert arrangement with electrical contacts. Contact NEA Electronics for other configurations.

Model DF Mechanical Interface

NEA Dead Face connector mechanical interfaces are compliant with MIL-DTL-38999.

NEA® Electronics, Inc., 14370 White Sage Road, Moorpark, California 93021, USA | neaelectronics.com
Gimbals and Pointing Mechanisms

Introducing a modern range of actuators specifically designed for precision spacecraft pointing applications. NEA’s engineering team has assembled the technical requirements of prime contractors around the world and built a family of actuators that meets and in many cases far exceeds their combined requirements.

Applications

- Antenna Gimbals
- Thruster Gimbals
- Solar Array Drives
- Laser Communications
- Robotics

Procurement Advantage

NEA’s customer-centric philosophy has been to create a modern high performance actuator designed for ease of manufacture so critical cost and schedule targets can be met. The design was developed in concert with major spacecraft prime contractors who aided in the development through sharing of technical requirements as well as programmatic cost and schedule goals.

NEA’s program team has focused on these key programmatic objectives in the development of this family of products:

- Design to Cost
- Reduced Lead Time
- Minimize Risk

Design to Cost

NEA has used modern design and manufacturing methods to streamline the manufacturing process, reduce touch labor and, through careful design optimization, has reduced product costs.

Reduced Lead Time

NEA has also invested in full environmental test capability in-house at our Moorpark, California facility so all environmental testing can be performed under NEA schedule control.

Minimized Risk

Reduced cost and lead times translate directly into reduced program risk. Additionally, all of the components selected for the actuator design are direct derivatives of flight proven heritage components. Thorough analysis will be shared with customer engineers for verification of performance margins.
NEA Gimbals and Pointing Mechanisms

Engineering Advantage

NEA’s electromechanical engineering team has over 45 years of experience in the spacecraft actuator field and understand the concerns of engineers that specify these devices. To simplify the engineering specification and procurement process NEA has focused on the following areas:

- Documentation
- Scalable Modular Design
- Analysis
- Qualification
- Heritage

Scalable Modular Design

NEA engineers have taken a “no compromise” approach to the development of our spacecraft actuator line of devices. Our devices are conceived, developed, analyzed and tested to be the best in class.

NEA has conceived the P3® precision pointing mechanism as the first in a range of devices all using a common design philosophy. The design has been planned up front to be scalable allowing NEA’s considerable investments in analytical models, test equipment and even documentation to be shared over the entire product line.

The standardized designs also offer flexibility through a careful modular approach. Two different transmission modules and two different motor modules can be combined to create four possible actuator configurations. The standard telemetry module provides redundant course and fine potentiometers, however, other telemetry modules are available. The actuator modules can be combined with gimbal brackets to create a complete multi-axis pointing platform.

Analytical Correlation

NEA’s electromechanical actuator engineering team has developed a set of standardized analytical models to cover all aspects of the pointing mechanism performance. NEA understands and appreciates that our customer’s engineers are required to verify margins and analysis methods. This is why our analysis tools are world class and our methods and results are well documented for review by our customer counterparts.

Heritage

NEA pointing mechanisms are based on an optimization of heritage components that all have a history of successful use in long life spaceflight applications.

Design Features

Some of the key design features of NEA’s pointing mechanisms include:

- Very fine step angles
- High stiffness output bearings
- Advanced motor technology
- Integral thermal monitoring and control

Very Fine Step Angles

Many applications that are concerned with torque disturbance or need higher pointing precision often are driven to microstepping. Microstepping can provide very fine step angles, however, it requires 100% duty cycle at all times to maintain rotor position resulting in high power usage and potential thermal dissipation problems.

NEA pointing mechanisms are available with either a 0.0075° output step angle and or a ~0.0024° for very fine positioning and low torque disturbance without the need for microstepping.
High Stiffness Output Bearings

NEA’s pointing mechanisms offer high stiffness and load capacity in the output bearing arrangement relative to other similar devices on the market. This ability is achieved all while maintaining a mean Hertzian contact stress of less than 2,310 MPa (335 ksi) for quiet running bearings.

Advanced Motor Technology

NEA analyzes and designs all of our motors in-house using advanced state-of-the-art three-dimensional magnetic finite element analysis. Our analytical models accurately predict end unit performance and provide the underlying foundation for our torque margins and dynamic simulation models. In-house motor testing is performed at the motor component level on every motor we build, with the results being compared against the analysis to verify the model and also allow capture of out of family performance.

Our precise models allow for performance optimization, weight reduction and in some cases the elimination of rare earth materials that drive cost. The motor configurations used in our pointing mechanisms use far fewer components than most motors used on competitive products resulting in increased reliability, reduced manufacturing time, lower cost and better step accuracy. The additional capabilities our motors provide allow us to offer superior performance in a smaller envelope.

Integral Thermal Monitoring and Control

NEA pointing mechanisms include redundant heaters and thermistors embedded in the structure. The components are mounted to a structural web that is in close proximity to the input bearings. The close proximity of the thermal control system allows for efficient heating of the components that are most likely to cause degraded torque performance at low temperatures due to lubricant viscosity changes.

This eliminates the need for external active thermal control, reduces power consumption and protects the thermal control components from damage due to mishandling of the actuator during integration.

Optional Components

NEA Pointing Mechanisms can also be integrated with several optional components to provide a complete gimbal or solar array drive assembly.

Adjustable End of Travel Stops

In limited travel applications NEA attaches hard stops to the features already provided on the actuator mounting flange to limit travel to the desired angles. Hard stops can be customized to provide very precise end of travel angles is required.

Another option is the integration of cam stops that allow the actuator to be stowed for launch beyond the normal travel angle. Once the actuator is deployed into the travel range it is prevented from returning to the stow angle and limited by the passive cam stop to the operational travel range.

Twist Capsules

In limited rotation applications where a service loop will not work NEA can provide a custom twist capsule assembly that can carry both power and signals over the rotating joint. Twist capsules can be built to rotate over 360° of travel and can carry up to several hundred transmission lines. Twist capsules feature flexible circuits that roll within an aluminum housing and have connectors on each side of the rotating interface. Twist capsules of this design have a history of successful use in long life space applications.

Slip Rings

In continuous rotation applications that require power and signals be carried over the rotating interface NEA can integrate our pointing mechanisms with slip ring modules.

Rotary Coaxial Joints

For antenna pointing applications that require coax be carried over the rotating interface NEA can provide an optional rotary coaxial joint should a service loop not be acceptable for the application.
NEA® Electronics, Inc. is dedicated to building mankind’s legacy in space by supporting our customers in the aerospace industry through on time delivery of innovative products that exceed expectations and assure mission success.

**Gimbal Brackets**

NEA can integrate two or more standard pointing mechanism actuators with brackets to create a multi-axis gimbal that is compliant with customer supplied gimbal specification stiffness and mechanical interface requirements.

**Telemetry Options**

The baseline pointing mechanism features a modular primary and course axis redundant potentiometers that provide voltage telemetry over the entire 360° of travel. For some applications, changes to the telemetry angle may be desired. This can be accommodated through the use of a custom potentiometer element within the potentiometer module.

Other applications may require the use of an optical encoder or resolver. These options can also be provided easily due to the modular nature of the device.
NEA Model P3⁵ Pointing Mechanism / Actuator

Model P3⁵ Pointing Mechanism Product Data Sheet

NEA’s P3⁵ Pointing Mechanism is designed to fit the mechanical interface requirements of a large number of existing and future applications while providing superior performance.

Advantages

- Very fine step size option ~0.0024°
- Four Flexible Standard Configurations
- Integrated active thermal control

Two Step Angle Options

NEA pointing mechanisms are available with either a 0.0075° output step angle and or a ~0.0024° for very fine positioning and low torque disturbance without the need for microstepping. Eliminating the need for microstepping reduces power consumption.

Four Configurations

The NEA P3⁵ Actuator is available in four different configurations that support both normal and fine step angles as well as 3-phase and 4-phase winding configurations.

Integrated Active Thermal Control

Integrated redundant heaters and thermistors located in close proximity to the input bearings conserve power and support extended temperature range operation.

Global Leader

NEA® Electronics, Inc. is a global leader in spacecraft mechanisms. Our low shock release devices are relied upon for spaceflight applications more than any other device.

Reliable

Our designs are reliable, simple, insensitive to adverse environments and backed up by years of heritage and loyal customers.

Quality Assured

NEA, a trusted supplier of mission critical components, is certified to ISO 9001:2008 and AS9100:2009 C.

eaelectronics.com

Cleared for Open Publication by the Office of Security Review, Department of Defense 04/24/2014 14-S-1253
Model P3^5 Actuator Technical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
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<th>P3^5</th>
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<th>P3^L</th>
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<td>Unpowered Holding Torque (min)</td>
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</tr>
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<td>Powered Holding Torque (min)</td>
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<td>Maximum Speed^3</td>
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<td>Non-operational Temperature Range</td>
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<td>Operational Temperature Range</td>
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Notes:
^1 Angle Approximate
^2 Dependent on duty cycle
^3 For no-load operation
^4 Operational temperature range is dependent on the load and inertia applied as torque margins change with temperature

Series P3^5 Actuator Mechanical Interface Drawing

NEA Model P3^5 Pointing Mechanism / Actuator
Model G3⁵ Gimbal Product Data Sheet

NEA’s G3⁵ Gimbal is designed to fit the mechanical interface requirements of a large number of existing and future applications while providing superior performance.

Advantages

- Very fine step size option ~0.0024°
- Four Flexible Standard Configurations
- Integrated active thermal control

Two Step Angle Options

NEA pointing mechanisms are available with either a 0.0075° output step angle and or a ~0.0024° for very fine positioning and low torque disturbance without the need for microstepping. Eliminating the need for microstepping reduces power consumption.

Four Configurations

The NEA G3⁵ Gimbal is available in four different configurations that support both normal and fine step angles as well as 3-phase and 4-phase winding configurations.

Integrated Active Thermal Control

Integrated redundant heaters and thermistors located in close proximity to the input bearings conserve power and support extended temperature range operation.

Design Features

Additional design features include:

- Modular Telemetry Options
- Electrically Redundant
- Custom Adjustable Stops and Travel Ranges
- Multi-pass Labyrinth Seals at Dynamic Interfaces
- Optional Twist Capsules & Rotary Coaxial Joints

Global Leader

NEA® Electronics, Inc. is a global leader in spacecraft mechanisms. Our low shock release devices are relied upon for spaceflight applications more than any other device.

Reliable

Our designs are reliable, simple, insensitive to adverse environments and backed up by years of heritage and loyal customers.

Quality Assured

NEA, a trusted supplier of mission critical components, is certified to ISO 9001:2008 and AS9100:2009 C.
NEA Model G3^5 Gimbal

Model G3^5 Gimbal Technical Specifications
Refer to the P3^5 Pointing Mechanism Actuator data sheet for technical specifications per axis. Combined gimbal technical specifications are dependent upon customer interface requirements. Please contact NEA applications engineers for specific gimbal requirements.

Series G3^5 Gimbal Mechanical Interface Drawing
Refer to P3^5 Pointing Mechanism Actuator data sheet for mechanical interface data. Specific gimbal geometries are dependent on customer specific requirements. Please contact NEA applications engineers for specific gimbal applications and interface requirements.

Mission Success
NEA® Electronics, Inc. is dedicated to building mankind’s legacy in space by supporting our customers in the aerospace industry through on time delivery of innovative products that exceed expectations and assure mission success.
Solar Array Drive Actuators

NEA has the capability to provide a range of Solar Array Drive Actuators for a broad range of applications.

NEA can provide Solar Array Drives that are based off of our Gimbal and Pointing Mechanisms architecture by adding optional components such as slip ring assemblies and twist capsules.

For lower cost applications that are less technically demanding NEA can provide a lower cost Solar Array Drive Actuator that features a twist capsule for limited array inertias.

For applications that require more power transfer capability that can be provided with our pointing mechanisms NEA can provide a dedicated Solar Array Drive Actuator optimized for power transmission with an integral slip ring assembly.

Engineering Philosophy

Due to the mission critical nature of the application NEA makes no compromises in the design of our Solar Array Drive Actuators. Every actuator features:

- Designs that are well supported and verifiable through analysis
- Bearings sized to operate below a mean Hertzian contact stress of 2,310 MPa (335 ksi) under all load conditions
- Multi-pass labyrinth seals
- Advanced Motor Technology
- All components derived from flight proven heritage technology
- Fine step angles that preclude the use of power inefficient microstepping drivers
- Integrated active thermal control

Available Configurations

NEA recognizes that one standard scalable product may not be the best fit for all Solar Array Drive applications. This is why NEA has chosen to develop three different approaches to provide an optimized approach to each application.

S3\(^3\) Solar Array Drive Actuator

The modular nature of our P35 series of actuators allows them to be coupled with either a slip ring module or a twist capsule module for use as an S3\(^3\) Solar Array Drive Actuator. The telemetry module is replaced by one of the power transfer module options, which shares the same mechanical interface, and the telemetry module is reattached on the end of the assembly.

The S3\(^3\) Solar Array Drive Actuator offers nearly all the performance and procurement benefits of the P3\(^3\) Pointing Mechanism however due to the custom nature of each application the power transfer assembly must be optimized for each application. The output torque performance of the S3\(^3\) Solar Array Drive Actuator will be slightly less than the P3\(^3\) due to the associated drag of the power transfer assembly. This reduction is also application dependent as it is a function of the number of power and signal transfers required.

Low Cost Solar Array Drive Actuator

For applications that have smaller solar arrays and do not require continuous rotation NEA offers a smaller cost effective solution that features a small off-axis actuator driving through a low backlash spur gear. The SADA is configured to drive either one array or both arrays. A twist capsule provides signal and power transfer while telemetry is provided by a potentiometer. The can be provided in electrically redundant configurations if required at additional cost.
NEA Solar Array Drive Actuators

Custom Solar Array Drive Actuator

For applications that require continuous rotation and have a large number of power and signal transfers a custom designed Solar Array Drive Actuator can be provided.

The nature of a custom Solar Array Drive actuator is that it can be configured and optimized for the specific requirements of the application. It should be noted however that the custom nature of the design allows for design flexibility at the expense of possibly increased cost and schedule.

Advanced Motor Technology

NEA analyzes and designs all of our motors in-house using advanced state-of-the-art three-dimensional magnetic finite element analysis. Our analytical models accurately predict end unit performance and provide the underlying foundation for our torque margins and dynamic simulation models. In-house motor testing is performed at the motor component level on every motor we build with the results being compared against the analysis to verify the model and also allow capture of out of family performance.

Our precise models allow for performance optimization, weight reduction and in some cases the elimination of rare earth materials that drive cost. The motor configurations used in our pointing mechanisms use far fewer components than most motors used on competitive products resulting in increased reliability, reduced manufacturing time, lower cost and better step accuracy. The additional capabilities our motors provide allow us to offer superior performance in a smaller envelope.

Optional Components

NEA Solar Array Drive Actuators can be provided with optional components just like NEA’s Gimbals and Pointing Mechanisms.

Telemetry Options

The baseline pointing mechanism features a modular primary and course axis redundant potentiometers that provide voltage telemetry over the entire 360° of travel. For some applications changes to the telemetry angle may be desired. This can be accommodated through the use of a custom potentiometer element within the potentiometer module.

Other applications may require the use of an optical encoder or resolver. These options can also be provided easily due to the modular nature of the device.
NEA Deployment Actuators

Deployment Actuators

NEA can provide Deployment Actuators for use in deployment applications or any application that requires efficient generation of mechanical power. NEA Deployment Actuators consist of an efficient brushless DC motor often coupled to a high torque planetary gearbox.

Applications
- Solar Array Deployments
- Antenna Deployments
- Cover Systems Deployments
- Rover Wheels
- Sampling and Drill Motors

Engineering

NEA designs and analyzes all aspects of our Deployment Actuators in-house allowing complete control over the end item performance.

Advanced Motor Technology

NEA analyzes and designs all of our motors in-house using advanced state-of-the-art three-dimensional magnetic finite element analysis. Our analytical models accurately predict end unit performance and provide the underlying foundation for our torque margins and dynamic simulation models. In-house motor testing is performed at the motor component level on every motor we build with the results being compared against the analysis to verify the model and also allow capture of out of family performance.

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Our standard brushless DC motors are commutated with Hall effect sensor technology however other commutation technology can be provided as an option.

Advanced Gearbox Technology

The same philosophy that drives NEA to have complete control of motor analysis is also applied to our gearboxes. NEA performs all gearbox analysis in-house per AGMA standards. Our models correlate very well with tested performance and our analysis methods and results are readily shared with our customer’s engineering team to allow independent verification of margins.

NEA’s planetary gearboxes are optimized for spaceflight applications and are engineered by a team that has unparalleled experience in the design of planetary gearboxes for demanding spaceflight applications.

Gearboxes are available in all stainless configurations as well as combinations of stainless steel and maraging steel for high torque applications.

Custom Sized Output Bearings

NEA can size the output bearings of our Deployment Actuators to meet customer interface load requirements. All combined loading is verified with COBRA Ball Bearing analysis software to assure reliable performance with stresses within bearing allowable.
NEA® Electronics, Inc. is dedicated to building mankind’s legacy in space by supporting our customers in the aerospace industry through on time delivery of innovative products that exceed expectations and assure mission success.

NEA® Deployment Actuators

Design Features
Typical design features of NEA Deployment Motors include:

- Efficient 3-phase brushless DC motor
- Electrically redundant and non-redundant
- High torque per unit mass planetary gearbox
- Design can be optimized for specific torque and/or detent requirements
- Mechanical interface compliant with customer requirements
- Output bearings can be sized to customer specified external load requirements
- Winding resistance can be tailored to meet customer electrical interface requirements

Optional Features
NEA can provide the following optional features as part of our Deployment Actuators:

- Wye and Delta Windings
- Physically Separate Redundant Windings
- Magnetic Detents
- Power-Off Brakes
- Clutches
- Dust Seals

Mission Success
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Our designs are reliable, simple, insensitive to adverse environments and backed up by years of heritage and loyal customers.

Quality Assured
NEA, a trusted supplier of mission critical components, is certified to ISO 9001:2008 and AS9100:2009 C

Contact NEA

We welcome your enquiries from around the world and look forward to hearing from you.

For more information on NEA Electronics and our unique technology and products, please contact us:

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