

Intuitive **Human Interface** Components and Solutions



Grayhill Product and Solution Guide

New Products

Series 14 - Illuminated SMT Key Switch

The 14 Series surface mount key switch combines an IP67 seal and LED illumination. With an operational life of over 1 million cycles at full power, this push button will provide positive tactile feedback for the life of the assembly. This compact switch is small enough to fit on handheld devices and tough enough for use outdoors in wet or dirty environments.

see page 20



T4 Touch Panel

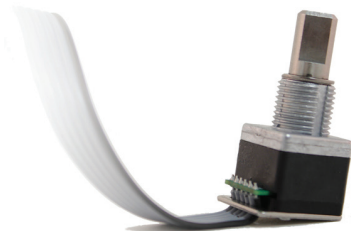
The T4 Touch Panel can quickly and accurately track up to 10 touch points at a time. The high screen sensor resolution of 4,096 x 4,096 enables many touch points in close proximity, enabling operators to control images in extreme detail. The T4 also has Fluid Rejection and Fluid Compatibility mode, facilitating use when moisture is present.

see page 5

Series 68B - Analog Paddle

The 68B analog paddle for heavy-duty industrial applications, agriculture vehicles and construction equipment gives the operator fingertip control in the harshest environments. Series 68B is a dash-panel armrest mounted paddle that features contactless hall effect sensing. The large, colored paddle travels 40-degrees from center in two directions, providing a ratiometric output with optional detent and latching positions, as well as friction lock.

see page 17



Series 68P Hall Effect Long Life Pot Substitute

The 68P has a proportional output and an operating life of over 3 million cycles, making it ideal for high reliability, long life applications in rugged environments. Redundant output versions are available to meet safety regulations.

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Why Grayhill?

Human Interface Experience

We understand haptics, ergonomics, and styling.
As importantly, we understand the evolving needs and expectations of end-product users in our target markets.

Market Focus

Our investments in research and development lead to new products and innovations in human interface for our target markets.

Products AND Solutions

We design and manufacture award winning and innovative human interface components.
They can be customized for your application or we can integrate them into a complete solution.

Time to Market

We choose to be vertically integrated in key product development activities to reduce time to market.

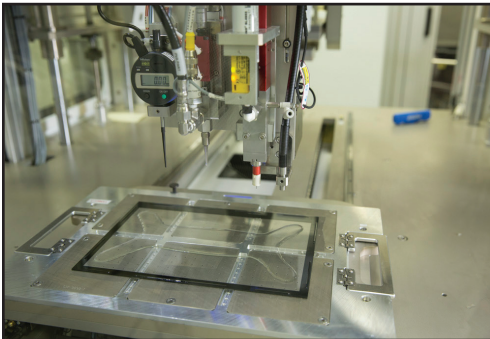
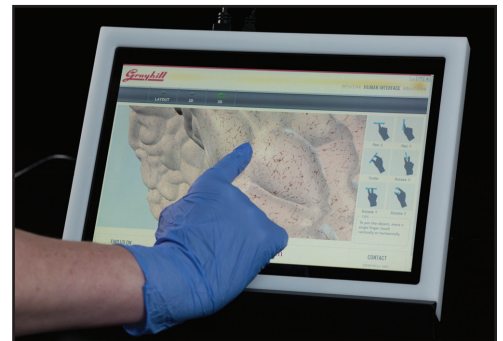
Industry Leading Touch Technology

Wide variety of products and multifaceted solutions

New generations of hundreds of industrial products are incorporating touch panels and gesture recognition devices as a way to create a new, intuitive experience to their users. As both a leader in the introduction of innovative projected capacitive (PCAP) touch products and leading designer of assemblies incorporating PCAP touch technology, Grayhill continues its reputation for high quality instinctive human interfaces. Our Instinct family of PCAP touchscreens was specifically developed for industrial applications where moisture is present and gloved hand operation is expected. For applications where it is problematic or impractical to perform gestures directly on a touchscreen, we incorporate the PCAP technology in our T1 and T2 Instinct families of remote touch sensors. Finally, we can incorporate these products into higher level assemblies to simplify your supply chain.

Touchscreens

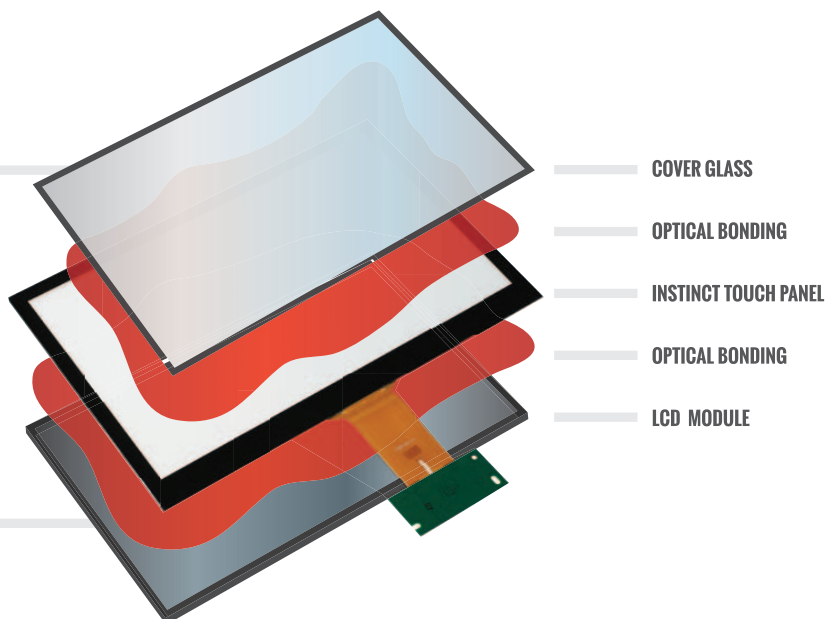
The complete PCAP solution consisting of cover glass, touch sensor, the latest Atmel touch controller, firmware, Instinct gesture recognition software, and optical bonding is designed and delivered from a single source. Our standard T4 Instinct Touchscreens offer pristine clarity, high touch durability and long term stability over temperature and UV exposure. Grayhill also offers a wide range of customization options to meet your requirements including screen dimensions, cover glass size, painting, and thickness, bonding and coatings such as anti-glare.



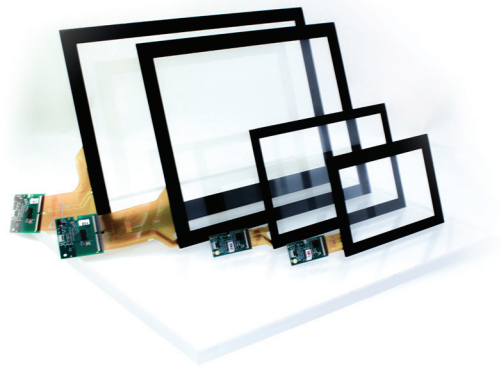
In-House Optical Bonding

For applications requiring outstanding sun light readability and/or applications requiring high front impact and/or mechanical strength, we recommend bonding the cover glass to the sensor and the sensor to the LCD display using an optically clear liquied adhesive. In doing so, air gaps are eliminated which dramatically improves contrast ratios in direct sunlight and make for a more robust assembly. Our fully automated bonding process enables us the flexibility to produce custom solutions and meet your project milestones and production fluctuations.

With a clear adhesive layer bonding the LCD, touch panel and top glass, any chance for air pockets is completely eliminated. The result is superior mechanical performance with the highest possible optical clarity, moisture resistance and solid strength for impact resistance.



Instinct Touch Technology



Series	Description	Configurations
T4	PCAP Touch Panel	4 Standard sizes <ul style="list-style-type: none"> • 5.0" • 7.0" • 10.4" • 12.1"

Features

- 10 point multi-touch
- High touch resolution (up to 4096 x 4096)
- Operates in high moisture environments
- Gloved hand operation
- USB or i2C
- Simple integration

Series	Description	Configurations
T2	Multi-Touch ControlWheel	<ul style="list-style-type: none"> • Black or White • Software Development Kit for Evaluation

Features

- Instinct Software Libraries for easy integration
- Touchpad, Virtual Rotary Encoder, 4 position Joystick all in one device
- IP 67 seal
- Gloved hand operation
- Easy to clean and disinfect



Series	Description	Configurations
T1	50mm Multi-Touch Ring Encoder	<ul style="list-style-type: none"> • Highlight ring encoder • Encoder torque and angle of throw • Optional pushbutton • Software development kit for evaluation

Features

- Instinct software libraries for easy integration
- Touchpad, optical encoder, and pushbutton all in one device
- USB compatible HID device
- IP 64 seal

Series	Description	Configurations
T101 - DEV1	T1 Instinct Software Development Kit (SDK)	<ul style="list-style-type: none"> • Quick Start User's Guide • Multi-touch device mounted on a demo panel • USB cable ready • Instinct Touch Technology Software
T201 - DEV1	T2 Instinct Software Development Kit (SDK)	

Features

- Multi-touch interface with Instinct gesture recognition software
- Performance of a robust set of commands for navigation, search, menu selection, image manipulation and many other functions
- 2D and 3D images that can be controlled and manipulated in real time
- Tools that track touchpoint data and interpret it as gestures





Solutions: Healthcare

Grayhill understands the human interface requirements of doctors, nurses and technicians in the healthcare industry. Our human factors engineers focus on the tactile and audible response that allow medical professionals to easily and confidently set device controls. Our industrial design team creates products that have sealed and washable surfaces with minimal crevices. Materials are selected for their ability to inhibit bacterial growth and withstand disinfection.

New T4 Touch Panel



Grayhill's encoders, pushbuttons, joysticks and touch panels are popular components in medical electronic devices because of our ability to offer quality tested custom configurations. Further, Grayhill specializes in the design of custom front panels that incorporate the above components, as well as custom keypads, displays, multi-touch touchscreens and touch pads.

To maximize panel space, we often create custom shaped keypads that can be quickly molded at low cost. Our engineering team can help specify the appropriate display technology and then tool a rugged and sealed housing to protect it. With decades of experience designing and manufacturing sensitive electronic devices, Grayhill can also integrate microprocessors, PCBs, cables and connectors.

Grayhill components and assemblies are ideal for any aspect of patient care and are already deployed in high volumes on defibrillators, imaging equipment, anesthesia, ventilators, patient monitors and home healthcare devices.



www.grayhill.com/healthcare

CAT Scan Operator Panel

Solutions: Military

Grayhill understands the human interface requirements of today's soldiers and pilots. We are continuously innovating to make military devices lighter and more intuitive while improving ruggedness, power consumption and readability. In the field, soldiers and pilots can be overwhelmed by external stimuli. They need to make quick decisions and operate devices quickly and with certainty. Grayhill helps them achieve this goal by tuning the interface haptics to provide the appropriate force-feedback for gloved hands.

Grayhill offers the widest range of rotary switches successfully rated to MIL-spec electrical, mechanical and environmental requirements. Our military strength rotary switches have high torque and pushbutton force, as well as push and pull-to-turn functions to avoid accidental actuation.

We have been serving this market since our founding over 70 years ago. Today, most solutions are custom designed to meet the needs of modern defense applications. Many of these applications include sealed keypads, displays and control electronics that can operate in a wide temperature range with low power consumption. COTS components, NVIS compliant backlighting and displays with thermal blast protective windows are just a few examples of common requirements.



Our front panels are field proven for dismounted soldiers, vehicle mounted and airborne applications. Specific projects include laser guidance devices, Night Vision Imaging Systems, handheld navigation units and communication systems. Grayhill understands the requirements of OEM's in the Military Market. We are ITAR (International Traffic in Arms Regulations) Compliant and AS9100 rev.C certified.

above right: handheld global positioning device
above left: secure personal radio with 77 Series sealed rotary switch
below: switch and keypad/display assembly on vehicle-mounted radio





Solutions: Off-Highway Vehicles

Grayhill understands the human interface requirements of farmers and construction workers. Because operators of off-highway vehicles spend long days in the driver's seat, engineers at Grayhill look beyond basic functionality to improve operator efficiency and comfort.

We specialize in creating user interface devices that communicate via CAN-bus (J1939 and CANopen protocol) to control on-board systems. A standard range of keypads, joystick/encoders and displays are offered as base products ready for quick, cost-effective customization. These products simplify mechanical installation into the vehicle cab and electrical integration with the vehicle's control units.

Custom Solutions

Starting with custom design services, Grayhill takes a proactive approach to help identify job specs. Our engineers look beyond basic functionality to improve operator efficiency and ergonomics. This approach yields more intuitive controls that reduce operator fatigue and increase productivity. They optimize product design to simplify installation into the vehicle cab which reduces the OEM's assembly time. Further, these custom products are programmed for easy integration with the vehicle's on-board control unit. Examples of custom developed products include dashboards, A-Post and arm-rest mounted controls.



www.grayhill.com/off-highway



Custom Armrest



Controls Console

Vehicle Interface Products

Product Selection Chart

Series	Description	Configurations	Features
3D65	6.5-inch VGA Display	Optional touchscreen	<ul style="list-style-type: none"> J1939 compliant CAN interface 5 soft keys IP67 sealed Up to 3 simultaneous video feeds
3D104	10.4-inch SVGA Display	Optional touchscreen	



3D65 and 3D104 Series Displays

Series	Description	Configurations	Features
3D50	5-inch Display	Optional touchscreen	<ul style="list-style-type: none"> Flush panel-mount module can be built into dashboards and armrest assemblies Responsive touch screen works with bare or gloved fingers even in wet/dirty environments Optically bonded display for excellent sunlight readability J1939 compliant CAN interface Application programming with VUI Builder or QT



3D50 Series Display

Series	Description	Configurations	Features
3D32	3.2-inch MicroDisplay	Optional internal heater	<ul style="list-style-type: none"> Software controlled backlight color Easy to program J1939 CANbus PGNs Replaces gauges, fault indicators, service reminders, etc. Excellent daylight readability



3D32 Series MicroDisplay

Series	Description	Configurations	Features
3J	Vehicle Display Controller	3 options for center knob - Optical Rotary Encoder - Encoder with Pushbutton - Joysticking Encoder with Pushbutton	<ul style="list-style-type: none"> 500,000 encoder cycles 1,000,000 cycles per key J1939 and CANopen versions Sealed to IP67 for outdoor use Vibration and impact resistant Operating temp: -40°C to +85°C Designed for 12/24 volt systems Custom legends and configurations



3J Series

Series	Description	Configurations	Features
3K	Keypads for Vehicles	5 standard sizes (R x C) - 20 keys (4 x 5) - 15 keys (3 x 5) - 12 keys (4 x 3) - 8 keys (4 x 2) - 8 keys (2 x 4) - 6 keys (2 x 3)	<ul style="list-style-type: none"> 1,000,000 cycles per key J1939 and CANopen versions Sealed to IP67 for outdoor use Vibration and impact resistant Operating temp: -40°C to +85°C Designed for 12/24 volt systems Custom legends and configurations 0-3 indicator LED's per key



3K Series



Rotary Switches

Grayhill is the leading manufacturer of single and multi-deck rotary switches with extremely rugged construction and virtually limitless configurations. Many of our rotary switches are MIL qualified to exacting electrical, mechanical and environmental standards. We offer many options including isolated positions, spring returns, adjustable stops, concentric shaft switches and configurable keylock switches. Contact a Grayhill representative early in your design process to discuss your application. In many cases, we can meet your requirements with a standard option or a simple modification.

Product Selection Chart - Single Deck

Series	Features	Poles	Angles of Throw (Degrees)	Rating (Max)	Switch Diameter inches [mm]	Behind Panel Depth inches [mm]	Termination Options
19	UL Recognized, High Current	1	30	15A	2.000 [50,80]	0.950 [24,13]	Solder Lug, Faston
24	Long Operational Life at 1 Amp	1	36	1A	1.000 [25,40]	0.580 [14,73]	PC Mount, Solder Lug
50	MIL-Qual Available Process Seal Available	1-2	36, 45, 60, 90	200mA	0.500 [12,70]	0.698 [17,72]	PC Mount, Solder Lug
51	Same as Above, Up to 16 Positions	1-4	22.5, 30	200mA	0.562 [14,27]	0.698 [17,72]	PC Mount, Solder Lug
56	Compact Format	1, 2, 4	30, 36	200mA	0.500 [12,70]	0.355 [9,02]	PC Mount, Solder Lug
75	Minimal Diameter, Flush or Knob Shaft	1-2	36	200mA	0.300 [7,62]	0.550 [13,97]	PC Mount
77	Minimal Depth Behind Panel	1-2	36	200mA	0.500 [12,70]	0.180 [4,57]	PC Mount



Typical applications include:

- Two-way radio frequency selection
- Industrial controls, test and measurement tools
- Security systems with keylock controls
- Military radios, transmitters and receivers
- Ground and airborne vehicle controls

Customization can include:

- Fixed stop, adjustable stop or continuous rotation
- Multiple termination and cabling options
- Custom detents (clicks) and tactile feel
- Special operations such as pull-to-turn
- Modified shaft lengths and flats

Product Selection Chart - Multi-Deck

Series	Features	Decks	Poles	Angles of Throw (Degrees)	Rating (Max)	Switch Diameter inches [mm]	Behind Panel Depth inches [mm]	Termination Options
08	MIL-S-3786/13	1-12	1-2	36	250mA	0.687 [17,45]	.960 [24,38] to 4.158 [105,61]	PC Mount, Solder Lug
09	MIL-S-3786/13	1-12	1-6	30, 45, 60, 90	250mA	0.750 [19,05]	.960 [24,38] to 4.158 [105,61]	PC Mount, Solder Lug
42, 44	MIL-S-3786/4, SR04-1	1-12	1-6	30, 36, 45, 60, 90	1A	1.000 [25,40] to 1.162 [29,51]	1.025 [26,04] to 5.081 [129,06]	PC Mount, Solder Lug
43, 54	MIL-S-3786/4, SR04-2	1-3	1-2	30, 36	1A	1.000 [25,40] to 1.162 [29,51]	1.818 [46,18] to 3.451 [87,66]	Solder Lug
53 57 59	Smallest Switch with this many positions	1-12	1-12 1-8 1-10	15 22.5 18	250mA 250mA 250mA	1.281 [32,54] 1.125 [28,58] 1.125 [28,58]	0.916 [23,27] to 4.829 [122,66]	Solder Lug Solder Lug Solder Lug
71	MIL-S-3786/39	1-12	1-6	30, 36	250mA	0.500 [12,70] to 0.750 [19,05]	0.761 [19,33] to 3.439 [87,35]	PC Mount, Solder Lug

Keylocks

Series	Features	Decks	Poles	Angles of Throw (Degrees)	Rating (Max)	Switch Diameter inches [mm]	Behind Panel Depth inches [mm]	Termination Options
44L	8-Pin Round Key	1-6	1-4	45	5A	1.170 [29,72]	1.556 [29,52] to 3.536 [89,81]	Solder Lug
58	In-Panel Key Recoding	1	1-2	36, 45, 60, 90	200mA	0.900 [22,86]	1.957 [49,71]	PC Mount, Solder Lug
71J,L	5-Plates, 1-Sided Key	1-12	1-6	30, 36	250mA	0.900 [22,86]	1.811 [46,00] to 5.119 [130,02]	Solder Lug



08/09

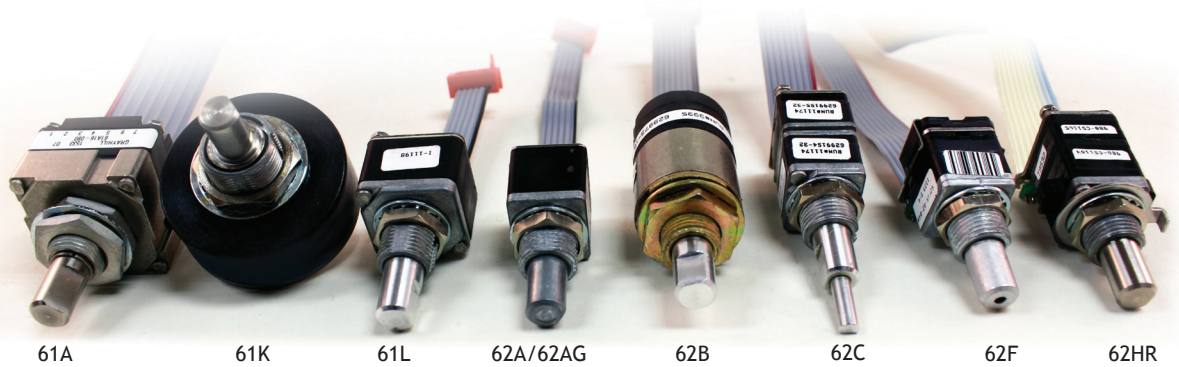
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42/43/44/45

Optical Encoders

Grayhill specializes in human interface optical encoders that provide excellent tactile feedback to the user. The greatest advantage of optical encoders is their non-contact switching technology which results in an exceptionally high operational life. Although the end-product may vary, typical applications measure speed, distance and/or rotational angle.



Product Selection Chart

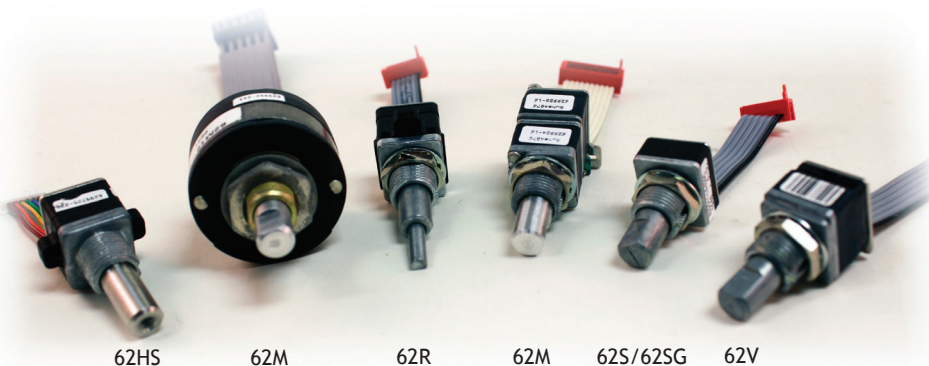
Series	Features	Life Ratings (cycles)	Resolution	Body Size inches [mm]	Behind Panel Depth inches [mm]	Integrated Pushbutton
61A	Absolute Coding	1,000,000	8, 16, 24, 32 PPR	0.875 [22,22] sq.	0.525 [13,33]	No
61K	4-Pin Termination, High Resolution	10,000,000	25, 32, 50, 64, 100, 128, 256 CPR	1.250 [31,75] dia.	0.500 [12,70]	No
61R	5-Pin Termination, Polarized Connection	10,000,000	25, 32, 50, 64, 100, 128, 256 CPR	1.250 [31,75] dia.	0.500 [12,70]	No
61L	One quadrature cycle per detent	1,000,000	24 CPR	0.650 [16,51] sq.	0.590 [14,99]	Yes, optional
62A	Small Package	1,000,000	12 16, 20, 24, 32 PPR	0.500 x 0.540 [12,70 x 13,72]	0.525 [13,34]	Yes, optional
62AG	Price Competitive 62A	1,000,000	16, 20, 24, 32 PPR	0.500 x 0.580 [12,70 x 14,73]	0.532 [13,51]	Yes, optional
62B	Push & Pull to Select	1,000,000	16, 32 PPR	0.687 [17,45] dia.	1.080 [27,43]	Yes, push and pull
62C	Concentric Shaft	1,000,000	12, 16, 20, 24, 32 PPR	0.500 x 0.580 [12,70 x 14,73]	0.933 [23,69]	Yes, optional
62D	High Torque (3.5in-oz)	1,000,000	12 16, 20, 24, 32 PPR	0.500 x 0.580 [12,70 x 14,73]	0.525 [13,34]	Yes, optional
62F	Knob Illumination	1,000,000	16, 20, 24, 32 PPR	0.500 x 0.540 [12,70 x 13,72]	0.657 [16,68]	Yes, optional
62H	High Torque, Concentric Shaft	1,000,000	8, 12, 16 PPR	0.740 x 0.750 [18,80 x 19,05]	0.878 [22,30]	Yes, optional
62HN	High Torque Non-Turn Concentric Shaft	1,000,000	8, 12, 16 PPR	0.740 x 0.750 [18,80 x 19,05]	0.785 [19,94]	Yes, optional
62HR	High Torque, Redundant Output	1,000,000	8, 12 16 PPR	0.740 x 0.750 [18,80 x 19,05]	0.845 [21,46]	Yes, optional



www.grayhill.com/opticalencoders

Typical applications include:

- Medical electronics, including patient monitors, ventilators and imagers
- Communication systems, including two-way radios and software defined radios
- Navigation devices for ground vehicles and avionic systems
- Precision test and measuring equipment
- Sound mixing and editing consoles
- Automotive climate control and entertainment systems



Customization can include:

- Custom detents (clicks) and tactile feel
- Modified shaft lengths and flats
- Multiple termination and cabling options
- Custom electronics for unique outputs
- Special packaging such as custom mounts



Product Selection Chart (continued)

Series	Features	Life Ratings (cycles)	Resolution	Body Size inches [mm]	Behind Panel Depth inches [mm]	Integrated Pushbutton
62HS	High Torque, Minimal Behind Panel	1,000,000	8, 12, 16 PPR	0.650 x 0.750 [16,50 x 19,05]	0.530 [13,46]	Yes, optional
62M	Magnetic Detent	3,000,000	24 PPR	1.100 [27,94] dia.	0.725 [18,42]	Yes, optional
62N	Low Torque Non-Turn Concentric Shaft	1,000,000	12, 16, 24, 32 PPR	0.500 x 0.540 [12,70 x 13,72]	0.670 [17,02]	Yes
62NG	No-Turn Pushbutton Shaft	1,000,000	16, 20, 24 PPR	0.580 x 0.550 [14,73 x 12,70]	0.532 [13,51]	Yes
62R	Redundant Output	1,000,000	12, 16, 24 PPR	0.500 x 0.540 [12,70 x 13,72]	0.933 [23,69]	Yes, optional
62S	Minimal Depth Behind Panel	1,000,000	8, 12, 16, 20, 24, 32 PPR	0.500 x 0.540 [12,70 x 13,72]	0.290 [7,37]	Yes, optional
62SG	Minimal Depth Behind Panel	1,000,000	16, 24, 32 PPR	0.500 x 0.580 [12,70 x 14,73]	0.292 [7,42]	Yes, optional
62SR	Sealed Encoder and Cable Assembly	1,000,000	12, 16, 20, 24 PPR	1.000 x 0.870 [25,40 x 22,10]	0.550 [13,97]	Yes, optional
62T	Thumbwheel	1,000,000	16 PPR	0.780 x 1.758 [19,81 x 44,65]	0.650 [16,51]	Yes, optional
62V	3.3Vdc Input	1,000,000	12 16, 20, 24, 32 PPR	0.500 x 0.540 [12,70 x 13,72]	0.525 [13,34]	Yes, optional

Mechanical Encoders

Grayhill mechanical encoders combine the feel of our rotary switches with a digital output. They provide an economical way of obtaining Octal, Binary Coded Decimal, Hexadecimal and Gray code output from a rotary switch. Standard products include offerings with concentric shafts, isolated positions and adjustable stops.

Customization can include:

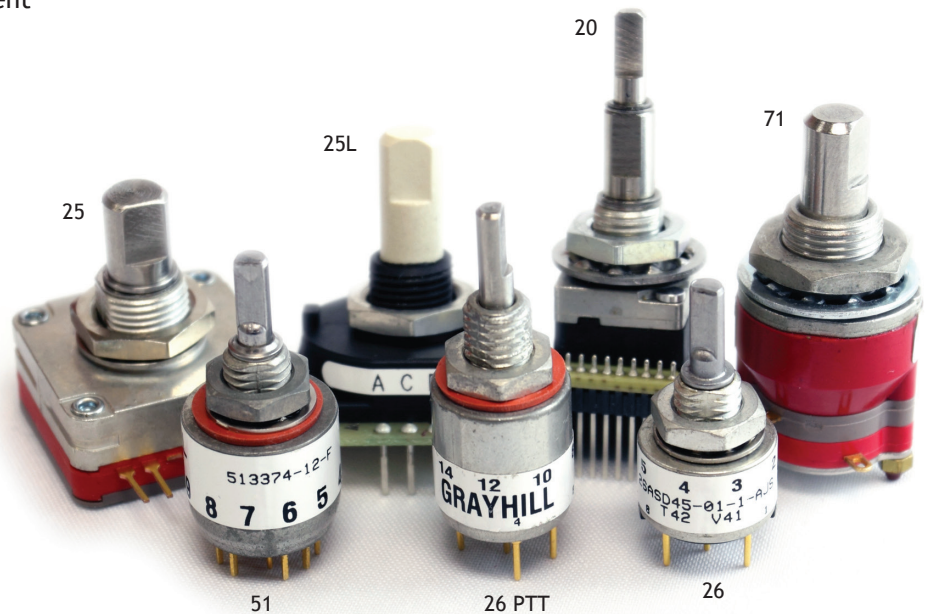
- Custom detents (clicks) and tactile feel
- Output codes
- Modified shaft lengths and flats
- Multiple termination and cabling options
- Integration into a custom front panel assembly

Product Selection Chart

Series	Features	Life Ratings (Cycles)	Angles of Throw (Degrees)	Output Code	Body Size inches [mm]	Behind Panel Depth inches [mm]
20	Concentric Shafts	25,000	22, 30, 36, 45	Binary, Gray, Quadrature	0.500 [12,70] sq.	0.659 [16,74]
25	Multi-Deck	50,000	10, 11.25, 12, 15, 18, 22.5, 30, 45, 60, 90	Binary, Gray, Quadrature	0.865 [21,97] sq.	0.450 to 1.050 [11,43 to 26,67]
25L	Price Competitive	100,000	10, 11.25, 15, 18, 22.5, 30, 45	Hexadecimal, Gray, Quadrature	0.865, [21,97] sq.	0.343 [8,71]
26	Small Size	25,000	22.5, 45	Quad, Octal, BCD, Hex, Gray	0.500 [12,70] dia.	0.332 [8,43]
26 PTT	Pull-to-turn (isolated positions)	25,000	22.5	Binary, Gray	0.500 [12,70] dia.	0.600 [15,24]
51	PC Mount, Adjustable Stops	25,000	30	Binary or Binary Complement	0.562 [14,27] dia.	0.537 [13,64]
71	Solder Lugs	25,000	36	Binary	0.687 [17,45] dia.	0.761 [19,33]

Typical applications include:

- Automotive GPS and radios
- Medical equipment
- Audio/visual recording/mixing equipment
- Avionics
- Transportation equipment
- Fitness equipment
- Test and measurement equipment
- Agricultural equipment
- Construction equipment
- Oscilloscopes
- Pulse/signal generators



Joysticks

NavCoders™ are a unique human interface device for navigating through on-screen software.

- 4-way or 8-way directional control to navigate through menu options
- Center pushbutton for selecting menu options
- Rotational control for scrolling through many options or adjusting an intensity setting such as volume



Joystick Encoders

Series	Features	Life Rating (cycles)	Resolution	Body Size inches [mm]	Behind Panel Depth inches [mm]
60A	2, 4 or 8 Direction Joystick, Rotary Encoder and Pushbutton on Single Shaft	Joystick: 500,000 Rotary: 1,000,000 Push: 1,000,000	20 PPR	1.000 [25,40] dia.	0.598 [15,19]
60AD	Same as 60A plus three levels of joystick/pushbutton force and rotary torque	Joystick: 500,000 Rotary: 1,000,000 Push: 1,000,000	20 PPR	1.000 [25,40] dia.	0.950 [24,13]
60AR	Rugged, 4 or 8 Direction Joystick, Rotary Encoder and Pushbutton, Sealed to IP67	Joystick: 500,000 Rotary: 1,000,000 Push: 1,000,000	20 PPR	1.000 [25,40] dia.	0.950 [24,13]
60C	4 Direction Joystick plus Rotary Encoder and Pushbutton on Concentric Shafts	Joystick: 500,000 Rotary: 500,000 Push: 500,000	16 PPR	1.000 [25,400] sq.	0.661 [16,79]

Joysticks

Series	Features	Life Rating (cycles)	Electrical Characteristics	Circuitry	Termination	Behind Panel Depth inches [mm]
04A	Four Directions	500,000	250mA at 115Vac	4PST: NO	PC Mount	0.150 [3,81]
04J	Rugged & Sealed, Four Directions with Center Pushbutton	100,000	2A resistive at 115 Vac	5PST: NO	Solder Lug PC Mount	0.659 [16,73]
67A	Compact, Hall Effect Sensing Technology	1,000,000	Supply: 3.3V Active: 3mA Sleep: 0.1 mA	I ² C Code	Connector or Pins	0.727 [18,47]
67B	Hall Effect Sensing Momentary Rotation	1,000,000	Supply: 3.3V Active: 3mA Sleep: 0.1 mA	I ² C Code	Connector or Pins	0.629 [15,98]



www.grayhill.com/joysticks

Hall Effect Switches

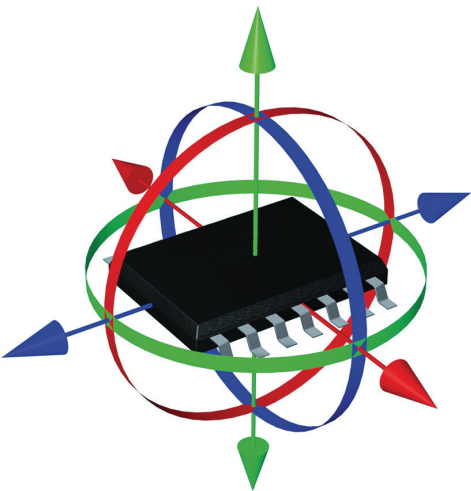
Hall-effect technology provides contactless operation, facilitating a long operational life. The Hall-effect sensor magnetically detects the position of another moving part such as the shaft in a joystick or encoder. This relational position can be output from the device in a variety of formats, including I2C, open collector or push-pull output. Hall-effect technology has the advantage of working in low voltage applications and often features a sleep mode to conserve power. Grayhill is introducing this technology across several switch types, including joysticks, paddle/rockers and rotaries.

Typical applications include:

- Work vehicle controls, including material handling equipment
- Medical electronics, including bed and table positioning
- Audio/video equipment, including professional editing
- Robotic and industrial automation controllers
- Automotive GPS, climate control, and entertainment

Customization can include:

- Various housing and mounting options
- Multiple termination and cabling options
- Custom electronics and output



Joysticks

These compact joysticks can provide precise cursor control where other pointing devices are impractical, such as on test and measurement equipment or medical electronics. Other applications include CNC positioning, industrial / robotic control and work vehicles / aerial platforms.

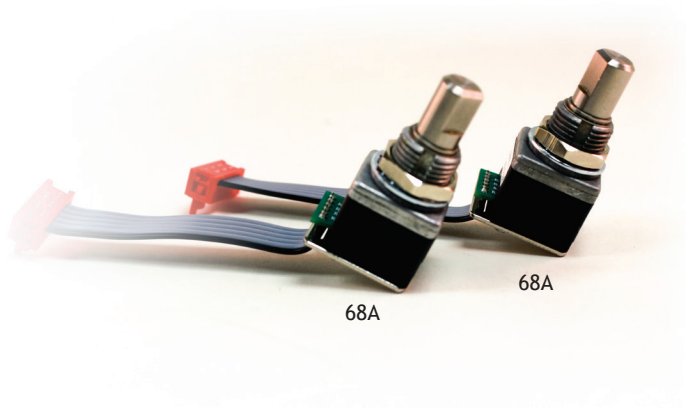
Series	Description/Features	Life Rating (cycles)	Range of Movement	Body Size inches [mm]	Behind Panel Depth inches [mm]	Output
67A	Joystick Small Package	1,000,000	Shaft travel 20° in any direction	1.300 [33,02] sq	0.727 [18, 47]	I²C Proportional
67B	Joystick with Momentary Rotation & Pushbutton	1M for rotary, pushbutton and joystick	Shaft travel 20° in any direction	1.250 [31,75] dia	.629 [15,98]	I²C Proportional joystick I²C Rotation Mechanical pushbutton
67C	Joystick with 360° Rotation & Pushbutton	1M for rotary and pushbutton, 2M for joystick	4 sensors, 8 directions	1.000 ± .015 dia	.588 ± .015	Proportional joystick Quadrature Encoder Mechanical pushbutton



Rotary

These rotary switches share the same sensor technology: Hall effect. But their outputs differ substantially. The 68A provides digital quadrature output, similar to other Grayhill encoders. The 68P provides a proportional analog output, similar to a potentiometer. Both benefit from non-contact Hall effect technology.

Series	Description/Features	Life Rating (cycles)	Resolution	Body Size inches [mm]	Behind Panel Depth inches [mm]	Output
68A	Rotary, Optional Redundancy	1,000,000 for rotary & pushbutton	16 PPR	.500 [12, 7] sq	.562 ± .015 [14,26 ± 0,38]	Quadrature rotary mechanical pushbutton
68P	Rotary, Optional Redundancy	1M for rotary, pushbutton and joystick	0.5V - 4.5V every 360°	.500 [12, 7] sq	.503 ± .015 [12,78 ± 0,38]	Proportional



Paddle/Rocker

Series	Description/Features	Life Rating (cycles)	Range of Movement	Body Size inches [mm]	Behind Panel Depth inches [mm]	Output
68B	Friction Lock, Detent Option	200,000	Paddle travel 40° both ways Latching angle 36° Detent angle 26°	1.062	.273 ± .005	Proportional



68B Featured with Red, Yellow, and Green Outline Colors

Keypads

Grayhill offers a full line of customizable keypads. Standard configurations include sealed rubber keypads, vandal-resistant metallic construction, and low-profile or full travel actuation keypads. Switching technologies include conductive rubber and metal dome contacts. Outputs include matrix output and single pole / common bus. All keypads have options for custom legends and many feature backlit keys. Often, a keypad technology is specified for integration into a custom front panel assembly. In these cases, the keypad technology can be deployed in a custom shape to meet the unique requirements of the application.

Product Selection Chart

Image	Series	Features	Life Rating (cycles per key)	Array	Standard Output	Sealed	Backlit
	82	Lightable Modules that Stack in any Configuration, Insertable Legend Sheets	1,000,000	Single Button, 1x2, 1x3, 2x3	SPST, 2PST, 3PST, 4PST	N	Y
	83	Excellent Tactile Feedback from Snap-Dome Contacts, 0.5" [12,7mm] Centers	3,000,000	3x4, 4x4	Matrix or Common Bus	N	N
	84	Excellent Tactile Feedback from Snap-Dome Contacts, 0.75" [19,05mm] Centers	3,000,000	3x4, 4x4	Matrix or Common Bus	N	N
	84BL	Backlit, Sealed, Permanent Legends	3,000,000	3x4, 4x4	Matrix	Y	Y
	84R	Rugged Construction, Dome or Rubber Contacts	3,000,000	3x4, 4x4	Matrix or Common Bus	Y	N
	84S	Sealed Silicone Rubber, Snap Dome Contacts	3,000,000	Single Button, 3x4, 4x4	Matrix or Common Bus	Y	N

Typical applications include:

- Transportation equipment
- Healthcare equipment
- Fitness equipment
- Avionics
- ATMs and kiosks
- Security systems
- Industrial controls



www.grayhill.com/keypads

Image	Series	Features	Life Rating (cycles per key)	Array	Standard Output	Sealed	Backlit
	84S	Sealed Silicone Rubber, Snap Dome Contacts	3,000,000	Single Button, 3x4, 4x4	Matrix or Common Bus	Y	N
	86	Flange Mounted, 0.5" [12,7mm] Centers	3,000,000	3x4, 4x4, 5x4	Matrix or Common Bus	N	N
	87	Modules Stack in any Configuration	3,000,000	1, 2, 3, 4, 5, 6, 3x4, 4x4	Matrix or Common Bus	N	N
	88	Flange Mounted, Splash Resistant, Low Profile Domes	3,000,000	3x4, 4x4, 5x4	Matrix or Common Bus	N	N
	96	Conductive Rubber Contacts	1,000,000	3x4, 4x4	Matrix	N	Y
							
							

Customization can include:

- Legends
- Bezel color
- Multiple termination & cabling options
- Custom electronics
- Membrane, dome, or carbon pill switching
- Construction - plastic, silicone rubber, metal, etc.

Pushbuttons

Grayhill's pushbutton switches have been proven as a rugged solution for countless applications. Our pushbuttons employ a variety of contact mechanisms, circuitry, mounting and termination options. With such a wide variety available, it's easy to find one that meets your requirements. But if you require customization, we can offer custom actuation force and travel distance, or custom termination and cabling options.

Snap Action

Series	Features	Life Rating (cycles)	Electrical Rating	Circuitry	Termination	Behind Panel Depth inches [mm]
7, 2000	Audible Click, Fast Make-and-Break	25,000	10 Amps at 115 Vac	SPST: NO & NC SPDT: BBM	Faston, Solder Lug	0.796 [20,22]

Wiping Contact Switches

Series	Features	Life Rating (cycles)	Electrical Rating	Circuitry	Termination	Behind Panel Depth inches [mm]
10, 4000	Momentary Contact, UL-3A Version Available	Up to 100,000	1 Amp at 115 Vac for long life version	SPST: NO & NC	Solder Lug	0.688 [16,97]
23	Momentary Contact, Short travel: 2,41mm	100,000	250mA at 115 Vac	SPST	Solder Lug	0.476 [12,09]
46	High Reliability, Available Sealed	Up to 250,000	250mA at 115 Vac	SPDT: BBM & MBB DPDT: BBM & MBB	Solder Lug or Sealed Wires	0.770 to 1.140 [19,56 to 29,00]
46	Decorator Line with Attractive Front Bezel	250,000	250mA at 115 Vac	SPDT: BBM & MBB DPDT: BBM & MBB	Solder Lug	0.992 to 1.448 [25,20 to 36,78]

SMT Key Switches

Series	Features	Life Rating (cycles)	Electrical Rating	Circuitry	Termination	LED Colors
14	Sealed & Illuminated	1,000,000	1 mA at 30 VDC	SPST, DPST	SMT	Red Orange Yellow/Amber Green Blue White



www.grayhill.com/pushbuttons

Customization can include:

- Custom caps and legends
- Custom detents (clicks) and tactile feel
- Multiple termination and cabling options
- Custom electronics
- Integration into a Grayhill custom front panel assembly

Typical applications include:

- Security systems
- Industrial manufacturing equipment
- Casino gaming
- Audio/video equipment
- Avionics
- Fitness equipment
- Test and measurement equipment

Butt Contact Switches

Series	Features	Life Rating (cycles)	Electrical Rating	Circuitry	Termination	Behind Panel Depth inches [mm]
30	Reliable Panel Mount, UL-5A Version Available	Up to 1,000,000	1 Amp at 115 Vac for long life version	SPST: NO & NC	Solder Lug	0.315 to 0.455 [8,00 to 11,56]
30	Snap-in or Threaded Panel Mount Versions	500,000	150mA at 24Vdc	SPST: NO	Solder Lug	0.540 to 0.480 [13,72 to 12,20]
30	Decorator Line with Attractive Front Bezel	Up to 1,000,000	1 Amp at 115 Vac for long life version	SPST: NO & NC	Solder Lug	0.710 to 1.204 [18,03 to 30,58]
32	Stackable PCB Mount Switches with LED	100,000	150mA at 28 Vdc	SPST: NO & NC SPDT: BBM	Surface Mount	N/A
38B	Miniature, PCB Mount, Sealed Plunger Option	80,000	0.4VA at 20 Vac or Vdc	SPST: NO SPDT: NO/NC	Surface Mount	N/A
39	Miniature 2 Circuit Switch, Horizontal Mount	500,000	250mA at 115 Vac	SPST: NO & NC SPDT: BBM	Surface Mount	N/A
39	Long Life 0.25-inch Switch	1,000,000	150mA at 28 Vdc	SPST: NO	Surface Mount	N/A
39	Adjustable Location Settings, Plunger Seal	Up to 500,000	500mA at 115 Vac for long life version	SPST: NO & NC	Solder Lug	0.517 to 0.707 [13,14 to 17,96]
39	Minimal Behind Panel, Available Sealed	Up to 1,000,000	500mA at 115 Vac for long life version	SPST: NO & NC	Solder Lug	0.215 to 0.429 [5,47 to 10,90]

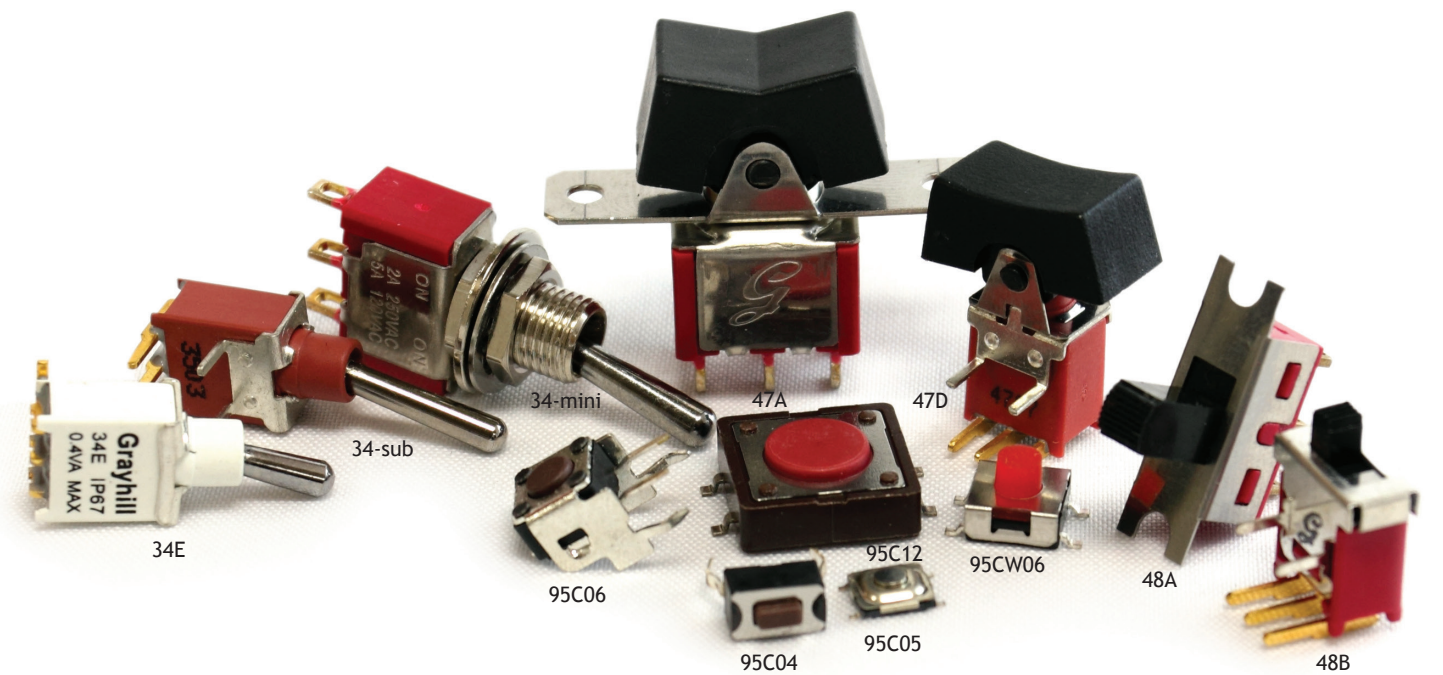


Tact, Toggle Rocker & Slide Switches

Grayhill Tact Switches are momentary pushbuttons designed for cost-effective user interface switching. They are mounted to a printed circuit board and typically actuated by a decorative keycap. The ultraminiature and lightweight structure of these tact switches make them suitable for high density mounting. Grayhill’s Toggle, Rocker, and Slide Switches are available in industry standard designs to allow for easy integration.

Tactile Switches

Series	Features	Life Rating (cycles)	Operating Force (grams)	Height inches [mm]	Termination
95C04	6mm x 3.5mm	50,000	160, 320	0.169 to 0.197 [4,30 to 5,00]	SMT, Thru-Hole
95C05	5mm Square	50,000	160	0.059 [1,49]	SMT
95C06	6mm Square, Non-Washable	Up to 500,000	100, 160, 260, 320, 520	0.169 to 0.512 [4,29 to 13,00]	SMT, Thru Hole, Right Angle
95C12	12mm Square	Up to 500,000	160, 260	0.169 to 0.335 [4,29 to 8,51]	SMT, Thru-Hole
95CW06	6mm Square, Washable	Up to 500,000	160, 180, 260, 360, 520	0.091 to 0.205 [2,30 to 5,20]	SMT, Thru-Hole, Right Angle, J-Lead



Common Features

- Excellent tactile feedback
- Insert molded terminals on tacts prevents flux buildup during soldering
- Choice of actuators, forces and heights
- Choice of bushings and terminations

Typical applications include:

- Telecommunications
- Industrial products
- Laboratory equipment
- Back-office equipment
- Handsets
- Industrial reset switches

Toggle Switches

Series	Features	Contact Rating (maximum)	Life Rating (cycles)	Circuitry Options	Termination
34A	Miniature 12,7mm Length	Up to 5A at 125 VAC	40,000	SPDT, DPDT, 3PDT, 4PDT	Solder Lug, PC Mount, Wire Wrap
34B	Miniature, Sealed per IP67	Up to 5A at 125 VAC	30,000	SPDT, DPDT, 3PDT	Solder Lug, PC Mount
34C	Sub-Miniature 8,13mm Length	Up to 3A at 125 VAC	30,000	SPDT, DPDT	Solder Lug, PC Mount
34D	Sub-Miniature, Sealed per IP67	Up to 3A at 125 VAC	30,000	SPDT, DPDT	PC Mount
34E	Sealed Surface Mount per IP67	0.4 VA at 20VAC or DC	30,000	SPDT	Surface Mount

Rocker Switches

Series	Features	Contact Rating (maximum)	Life Rating (cycles)	Circuitry Options	Termination
47A	Miniature 12,7mm Length	Up to 5A at 125 VAC	50,000	SPDT, DPDT, 3PDT, 4PDT	Solder Lug, PC Mount
47B	Miniature, Sealed per IP67	Up to 5A at 125 VAC	30,000	SPDT, DPDT, 3PDT	Solder Lug, PC Mount
47C	Sub-Miniature 8,13mm Length	Up to 3A at 125 VAC	30,000	SPDT, DPDT	Solder Lug, PC Mount
47D	Sub-Miniature, Sealed per IP67	Up to 3A at 125 VAC	50,000	SPDT, DPDT	PC Mount

Slide Switches

Series	Features	Contact Rating (maximum)	Life Rating (cycles)	Circuitry Options	Termination
48A	Miniature 12,7mm Length	Up to 5A at 125 VAC	30,000	SPDT, DPDT	Solder Lug, PC Mount
48B	Sub-Miniature 8,13mm Length	Up to 3A at 125 VAC	30,000	SPDT	PC Mount

DIP Switches

Grayhill is the world leader in DIP switch technology. Consistent high contact pressure is achieved with a spring and ball contact system on select series. Other features include a standard base seal, optional top-tape seal, and can also come in tape and reel packaging. Our DIP switches can be customized for your specific application.

Customization can include:

- Custom printing
- Special packaging
- New designs and form-factors

Surface Mount

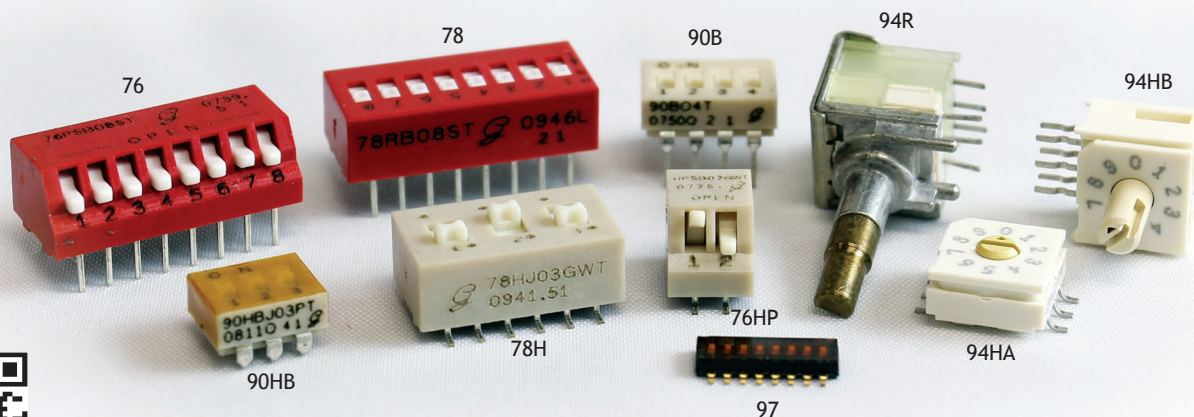
Series	Features	Positions	Actuation Type	Circuitry	Life Rating (cycles)
76HP	PIANO_DIP	2, 4, 6, 8, 10	Side Actuated Toggle	SPST	2,000
78H	Standard DIP Package	1 - 5	Top Actuated Slide	SPST, DPST	2,000
90HB	Low Profile	2 - 10	Top Actuated, Recessed Slide	SPST	2,000
94H	Rotary	8, 10, 16	Top or Side Actuated	Octal, BCD & Hexadecimal	2,000
97	Half-Pitch	2, 4, 6, 8, 10	Top Actuated, Recessed Slide	SPST	1,000

Thru-Hole

Series	Features	Positions	Actuation Type	Circuitry	Life Rating (cycles)
76	Sealed Base, Spring & Ball, Top Tape Seal Option	2 - 10, 12	Raised/Recessed, Top/Side, Rocker/Toggle/PIANO	SPST, SPDT, DPDT	2,000
78	Sealed Base, Spring & Ball, Top Tape Seal Option	2 - 10, 12	Raised/Recessed, Top, Slide/Rocker	SPST, 2PST, 3PST, 4PST, SPDT, DPDT	2,000
78C	Right Angle	2 - 10, 12	Raised Slide	SPST	2,000
90B	Machine Insertable MIDIP	2 - 10	Top Actuated, Recessed Slide	SPST	2,000

Rotary





Series	Features	Positions	Actuation Type	Circuitry	Life Rating (cycles)
94H	Sealed with Coded Output	8, 10, 16	Flush or Extended, Top or Side	Octal, BCD & Hexadecimal	2,000
94R	Coded Output with Shaft	8, 10, 16	Side Actuated Shaft	Octal, BCD & Hexadecimal	2,000



I/O Modules and Racks

Grayhill offers I/O modules in the industry standard sizes of mini, standard and G5. Grayhill also offers its unique Open-Line style I/O module that offers two input/output points per snap-in module. This not only saves space but also offers quick and tool-free assembly and modification. Grayhill's I/O Racks are available in industry standard size as well as a miniature footprint size to save panel space.

Modules

Series	Features	Types	Logic Voltage Rating	Unique Options	Agency Approval
70	Industry Standard pin out 	AC In	3-6, 8-18, 15-30	120 or 220 Vac	UL, CSA, TUV
		AC Out	2.5-10, 10-18, 15-30	120 or 220 Vac, heavy inductive load	
		DC In	3.5-6, 3-6, 8-18, 15-30	Polar and non-polar, fast	
		DC Out	2.5-9, 2.5-10, 10-18, 15-30	Electromechanical relay, low leakage	
70M	Saves 35% space 	AC In	3-6, 8-18, 15-30	120 or 220 Vac	UL, CSA, TUV
		AC Out	2.5-10, 10-18, 15-30	120 or 220 Vac, heavy inductive load	
		DC In	3.5-6, 3-6, 8-18, 15-30	Polar and non-polar, fast	
		DC Out	2.5-9, 2.5-10, 10-18, 15-30	Electromechanical relay, low leakage	
70G	Fused outputs, integral LED 	AC In	4.5-6, 10-18, 17-30	120 or 220 Vac	UL, CSA, TUV
		AC Out	4-6, 8-20, 18-32	120 or 220 Vac, heavy inductive load, manual override	
		DC In	4.5-6, 10-18, 17-30	Polar and non-polar, fast, dry contact	
		DC Out	4-6, 10-20, 18-32	Electromechanical relay, low leakage, manual override	
70L	Two channel fused outputs, integral LED, mix digital and analog 	AC In	4.5-28	120 or 220 Vac	UL, CSA
		AC Out	4.5-28	120 or 220 Vac, heavy inductive load	
		DC In	4.5-28	Polar and non-polar, fast	
		DC Out	4.5-28	Electromechanical relay	
		Analog In	4.5-5.5, 4.75-5.25	0-20mA, 4-20mA, 0-5 Vdc, 0-10 Vdc, 5 Vdc	
		Analog Out	4.5-5.5, 4.75-5.25	4-20mA, TC, RTD, multiple voltage range	

Racks

Series	Features	Channels	Agency Approvals
70	Industry standard foot print	4, 8, 16, or 24 Channel	UL, CSA
70M	Miniature foot print	4, 8, 16, or 24 Channel	UL, CSA
70G	Fuses and LEDs on modules	4, 8, 16, 24 or 32 Channel	UL, CSA
70L	Highest Density	4, 8, 16, or 24 Channel	UL, CSA

Custom Solution Examples

Touchscreen Control for Blood Diagnostic Test Equipment

Grayhill was the only supplier able to offer a complete solution. Grayhill's touch control solution included a customer screened cover glass, a 7" active multi-touch PCAP touch sensor along with a separate backlit PCAP power button. The cover glass, touch sensor and colored 7.0" LCD are optically bonded together at Grayhill's LaGrange Illinois facility, providing superior daylight view ability. Grayhill's touch sensors work with gloves and water providing an ideal solution to tough requirements.

Grayhill Expertise:

- Projective Capacitive Multi-Touch Touchscreen works with gloves and water
- Optical Bonding Capability (Cover glass-Touchscreen-Display)
- Cover glass with custom screened artwork
- Special backlit PCAP power button integration into touch panel



Push-To-Talk & Volume Keypad For Secure Personal Radios

Grayhill developed an innovative custom molding and two-piece design, making a sealed keypad that is highly reliable, functional and intuitive. Special snap-action dome technology provides the correct feel, even through gloves. Before shipment, each unit is 100-percent verified for electrical functionality and seal tested to meet a 66-foot immersion requirement.

Grayhill Expertise:

- Advanced product quality planning project management
- Circuit board layout, design and manufacturing
- Complex molding
- Industrial design engineering
- Military application specification knowledge
- Metal forming and specialized coating
- Sealed assemblies — potting, seals and design

Jog Dial & Pushbutton to Interface with On-Screen Software

Grayhill developed a customized module that includes an optical encoder for cycling through display screens and push-buttons to select options quickly. Using an encoder meant that fewer push-buttons were required. Custom-molded to fit within an armrest, the module allows an operator to interact with the display without having to reach forward. The module sends and receives data to and from the display over the excavator's existing controller area network.

Grayhill Expertise:

- Ergonomic industrial design
- Controller-area network interface programming
- Plastic mold tool design and fabrication
- In-house qualification, including life testing
- Knowledge of construction vehicle conditions and requirements



Resources

Product Information

This brochure should be used as a quick reference for selecting a general product series. Detailed information such as datasheets, product specifications and drawings can be found online at www.grayhill.com.

For Accessories, go to: www.grayhill.com/accessories

Distribution Network

Grayhill products are available worldwide through regional and international distributors, local sales representatives and directly from Grayhill. For details, visit www.grayhill.com/where-to-buy

About Grayhill

Founded in 1943 as a rotary switch manufacturer, Grayhill has transformed into a world-class developer of custom human interface assemblies. This change has led to a deep understanding of unique operator preferences, technology trends and environmental requirements. Beyond product development, Grayhill has expanded vertically to offer in-house design services, fast prototyping, product analysis, qualification and certification. At the same time, we have developed a robust supply chain and total quality system that delivers superior value.

ISO certificates, AS9100 certificates, Lab accreditation and RoHS information is available at www.grayhill.com/quality

For the latest news and product releases, go to: www.grayhill.com/news

Contact Us

Customer service representatives are available
Monday - Friday, 8am - 5pm CST
by phone at (708) 354-1040
and email at info@grayhill.com

Please contact us with any
questions or comments.

We look forward to hearing from you.

Core Purpose

To be instrumental to our customers' success by delivering intuitive human interface solutions that make life simpler, safer and more efficient.

