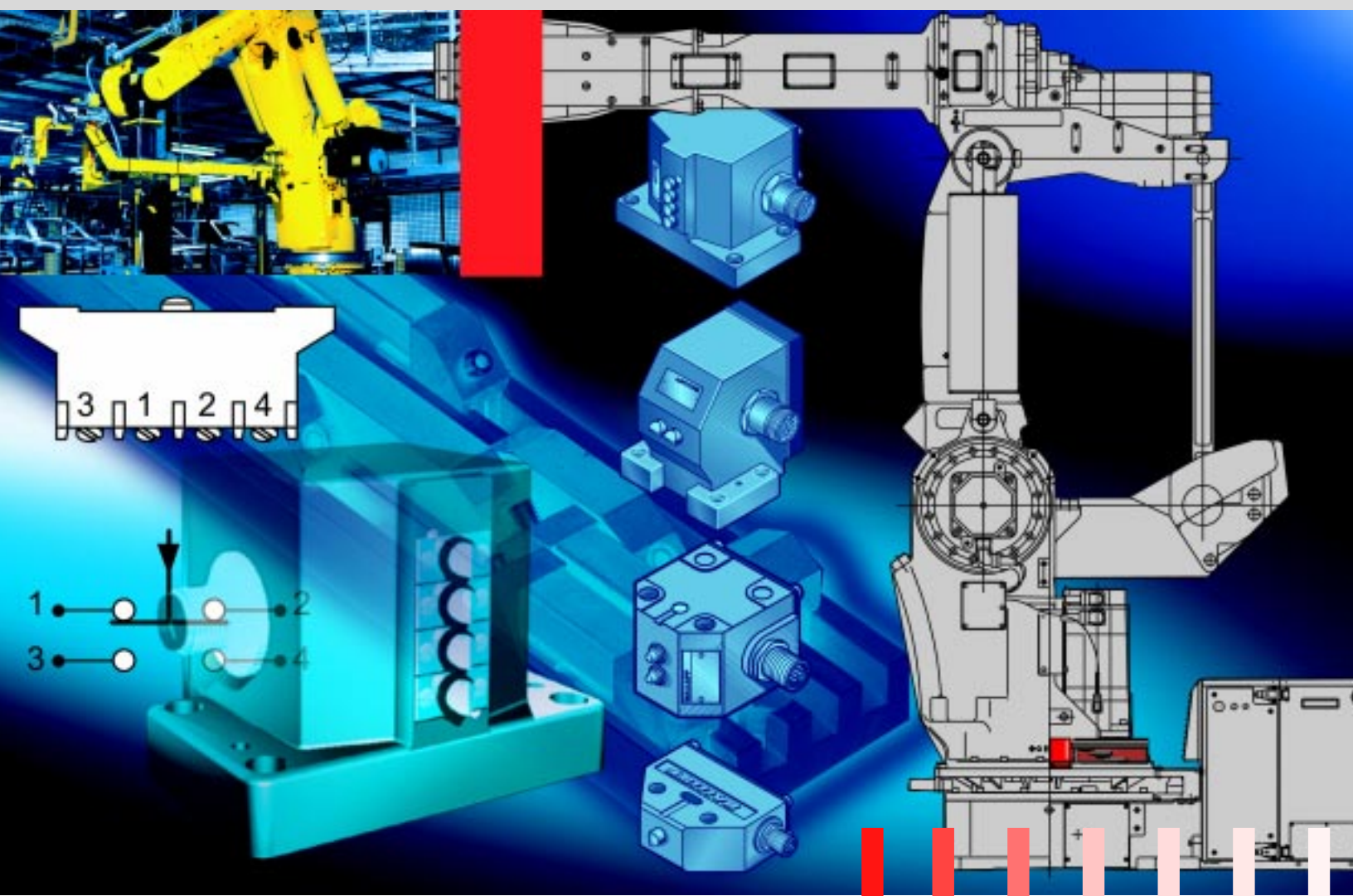
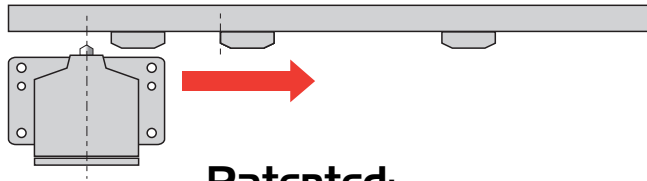


Mechanical Switches

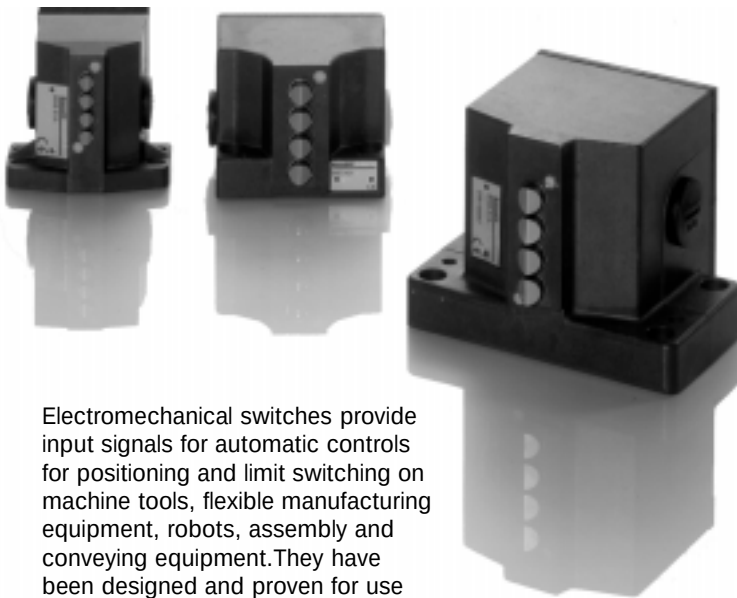
Precision Switching
With Unmatched Durability





Patented:

- Plunger guides
- Plunger mechanism
- Snap switches



Electromechanical switches provide input signals for automatic controls for positioning and limit switching on machine tools, flexible manufacturing equipment, robots, assembly and conveying equipment. They have been designed and proven for use under extreme conditions.

- ISO 9001
- DIN 43 636
- UL
- CSA
- CE



Company Overview	2-9
Product Introduction	10-11
Cam Switch Selection Guide	13
Cam Switches	14-49
Snap Switch Elements	50-51
Inductive Sensor Elements	52-53
Cables and Connectors	54-57
Accessories and Fittings	58-59
Cam Switch Installation	60
Cam Switch Dimensions	61-69
Linear Cam Trays	71-85
Mechanical Linear Trip Cams	87-94
Electronic Linear Trip Cams	95-97
Rotary Cam Drums & Trays	99-102
Mechanical Rotary Trip Cams	103-107
Electronic Rotary Trip Cams	109-111
Robot Zone Limit System	113-128

<http://www.balluff.com/BNS>

With more than 80 years of experience in the field of sensor technology, Balluff is now one of the most capable manufacturers of electronic and electromechanical sensors, linear transducers, and identification systems.

Located just south of Cincinnati, Ohio in Florence, Kentucky, Balluff's North American headquarters serves markets in the United States, Canada and Mexico. The wooded setting surrounding the two-story, 58,000 square foot facility belies its high tech mission and phenomenal growth. Two major building expansions since 1986 have been fueled by a yearly sales growth of twenty-five percent.

The most recent expansion has increased manufacturing and product design capabilities, as well as added a world-class training center. These developments support Balluff's continued growth in application-specific, technology-driven customer solutions. From simple part presence detection to tough positioning and sensing applications, Balluff is positioned as the partner of choice for North American sensing solutions.

Balluff Inc. is the North American headquarters of Neuhausen, Germany-based Balluff GmbH, a worldwide maker of sensors, transducers, ID systems and industrial automation components. The company employs over 100 at the Florence location, and more than 1000 worldwide.



Producing leading-edge sensor products requires exceptional accuracy and reliability. Testing and calibration take place throughout the manufacturing process to insure top performance.



State-of-the-art shipping operations allow same day shipping, expedited delivery on in-stock items and 24-hour on-call service!



Balluff's high level of employee satisfaction and low turnover are the backbone of efficient manufacturing and assembly processes. Great people = great products!

The Balluff advantage – 80 years of..

Innovative technology

State-of-the-art electronics

Application-specific customer solutions



Gebhard Balluff founds a mechanical repair shop in Neuhausen for bicycles, motorcycles and sewing machines.



Development of patented electromechanical limit switches. Balluff becomes an automotive and machine tool industry partner.



Production of inductive proximity switches begins.



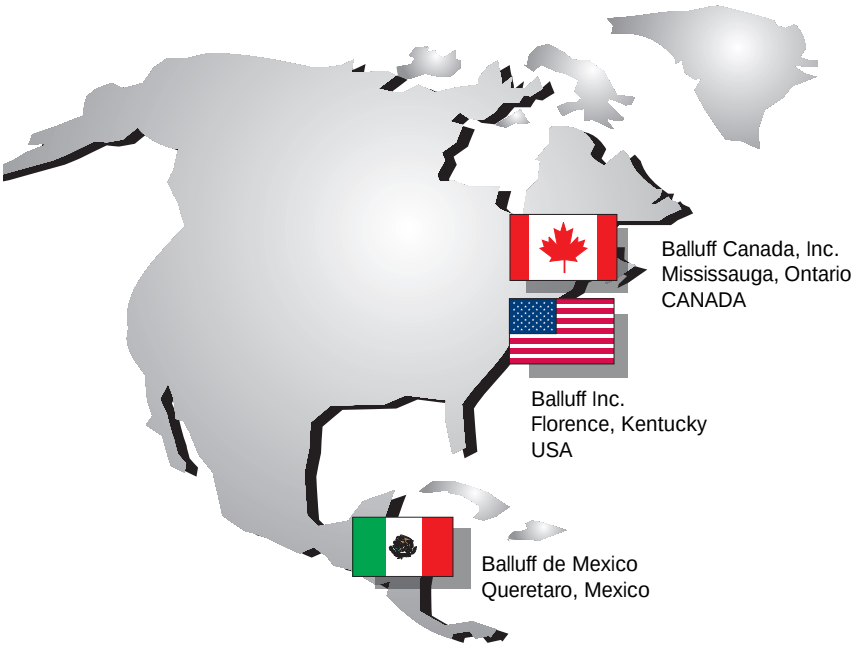
Company expansion in Neuhausen with addition of a new plant.

1921

1956

1968

1976



The North American Network
Balluff home offices in North America service a qualified sales and distribution network spanning the continent from top to bottom. Our North American operations support customers in industries ranging from machine tool to robotics, injection molding, packaging, material handling and more.

Florence, Kentucky USA
Our Florence, Kentucky location is conveniently located within the Cincinnati Tri-state area, and is just minutes from the Greater Cincinnati Northern Kentucky International Airport. Home of Balluff's North American operations, the Florence plant has recently expanded to a 2-story 58,000 square foot facility with more than 100 employees.

Mississauga, Ontario CANADA
Balluff Canada serves the Canadian marketplace with a network of experienced distributors across all provinces and territories.

Queretaro, MEXICO
Located in the thriving town of Queretaro, our new and expanding sales center is within range of some of the largest industrial operations in Mexico.



**To locate your local
Balluff distributor, visit
<http://www.balluff.com/distributors/>
or call 1-800-543-8390**



Production of optoelectronic switches begins.

1978

Production of microprocessor-controlled limit switches used with angle encoders begins.
Production of rotary encoders begins.

1979-1980



Founding of Balluff Inc. in New Jersey, USA by John Goyer, President and CEO.

1981



Addition of a second plant in Neuhausen.
Production of identification systems begins.

1984

Our Products

Our product range is engineered for tough positioning and part sensing applications in a variety of automated machinery environments. Our history designing and producing rugged limit switches for the automotive industry provides the basis for our continued research and development of tough, cutting-edge sensing technologies.

Sensors



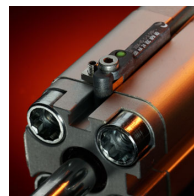
Tubular Inductives



Block-style Inductives



Capacitives



Magnetic Field Sensors



Optoelectronics



Electromechanicals



Micropulse™ Transducers

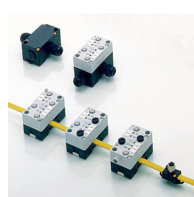


Transducer Accessories

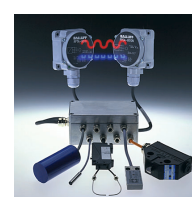
Sensor Systems



Identification Systems



AS-Interface Systems



Remote Systems

**Innovative
solutions for a
wide range of
industries and
automation
processes!**

Connectors/Accessories



Industries & Applications

Our primary customer base in the metalworking, automotive and plastics industries has provided a stable base from which our technological innovation has branched into a broad array of applications.

The rugged choice for extreme conditions.

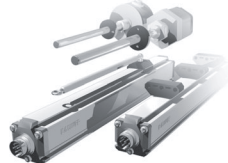
Assembly automation
Automotive: body and assembly
Bottling
Ceramics and glass
Hydraulics & pneumatics

Injection molding
Material handling
Metal cutting
Metal forming
Packaging

Paper and textiles
Plastics
Plastics and rubber
Robotics
Welding



Balluff, Inc. relocates to Florence, KY.



Production of linear transducers begins.



Main manufacturing plant opens in Vespem, Hungary.



Expansion of Florence, KY plant to 40,000 sq. feet.

1986

1987

1989

1994

Customer Service One Call Does It All. Easy. Fast. Personal.

We're dedicated to your success. Quick service, exceptional products and experienced employees are yours when you call Balluff. We are a world leader in sensor technology with a team of the best people in the industry ready to solve your automation challenges. We'll make your search for the right sensor easier, faster, and less stressful.

Give us a call. You will be instantly connected with experienced customer service, technical support and application engineers who know the industry - your industry. We know how to make your work easier, and will go out of our way to make sure you are satisfied with our products and services. WE are what separates us from the competition!



- 24 Hour on-call service
- Same-day shipping: In by 2 p.m., out same day!
- Adequate service or parts shipped free!
- Expedited delivery on in-stock items
- Fast, friendly service guaranteed
- Direct stop technical support
- Product selection & application assistance
- Direct tech support
- Cross references
- Competitive pricing
- Customized solutions – just ask!
- Experienced service and technical support

We'll get to know you. Our service is based on geography, so you'll speak with the same people every time you call. We'll get to know your order history and delivery preferences so you don't have to waste time repeating the same requests over and over!

Technical Service/Application Engineering

Finding the best sensor means first selecting the correct sensing technology. Our customer service representatives work hand-in-hand with the best application engineers and technicians in the industry.

Over time, Balluff has developed a reputation in the industry for solving the difficult applications. We live up to this reputation everyday. How do we do it?

Products and people.

No other sensor company has our broad range of products or the customer and technical experience to support it. Go ahead, give us a test. We love a challenge!



Let our experienced professionals help you choose the right sensor!

Our experienced application engineering group will help you choose the best sensor for your application regardless of the technology used. If an optical sensor is better than an inductive sensor, we'll know. We manufacture all major types of sensing technologies and understand better than anyone where to apply a particular technology.

We find the best sensor for your application and apply it correctly.



New North American President, CEO Kent Howard.



Founding of Balluff Canada.



New logistics and production center opens in Neuhausen, Germany

Founding of Balluff Mexico



18,000 square foot expansion of USA facility to enhance manufacturing and testing of inductive proximity sensors and Micropulse® magnetostrictive linear position sensors.

1998

1999

2000

2001

2002



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BALLUFF – Your partner around the world.

Product Catalogs

Balluff product documentation is divided into 4 convenient and easy to use catalogs. Each catalog provides complete technical information in an easy to read format, along with a complete list of product accessories.

All catalogs are also available online in the PDF format.

Discover how clean, efficient and focused our product catalogs are designed. Just one of the reasons Balluff is an easy company to do business with!

- Full technical information
- CAD drawings
- Wiring diagrams
- Product photos
- Application examples
- Part number ordering codes



Sensors

Object detection & measurement

Our broadest line of inductive, optical, capacitive, magnetic sensors and remote systems used in industrial automation.



ID Systems

Identification

Complete read/write identification system for hostile environments.



Linear Transducers

Linear measurement & feedback

Fastest growing line of magnetostrictive linear transducers and supporting accessories.



Mechanical Switches

Precision Switching

Positioning and limit switching for extreme automation conditions.

Balluff Online

Balluff.com is your source for keeping on top of the latest developments in sensor technology. Whether you are looking for an overview, a specific application, a part number cross, or the technical details about a particular sensor, Balluff.com is constantly expanded and up-to-date. Get on the fast track – stop by and bookmark your direct path to fast, friendly sensor information on Balluff.com!

Product Center

Since we know how confusing sensor products can be, our product center offers a multiple path selection approach. Find an automation solution your way:

- Find products by sensing technology or system
- Find by entering a Balluff part number
- Find by entering an industry part number to cross with a Balluff part
- View products for specific industry applications
- Printable datasheets, downloadable DWG files, PDF product brochures, catalogs and more!

Solutions Center

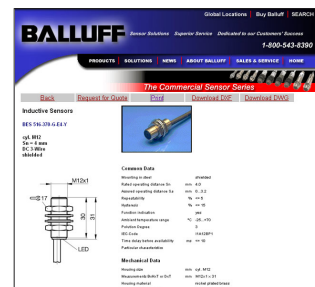
See how others in your industry have solved an automation challenge! Ask our application engineering experts for a unique Balluff solution to your particular sensing need. With over 75 years of experience, our solutions are proven!

Sales and Service Center

- Find your local Balluff distributor
- Contact Balluff directly
- Find a Balluff location worldwide
- Request literature

Technical Center

- Technotes
- FAQs
- Product manuals
- Technical reference and assistance
- Quality standards



www.balluff.com

Our Quality Standards

Reliable quality of products and services is essential for a successful and lasting relationship with our customers.

Balluff Inc.'s Mission Statement exemplifies the drive and dedication that is applied to all facets of the business 24 hours each day. Although Balluff is already recognized as the industry leader in quality and reliability, new initiatives continue to be pursued that promote even higher standards.

Highest quality of our products is the top priority objective in all areas of the business. To define and support this principle, the following eight guidelines have been developed:



- To exceed customers' expectations with quality products and services.
- The application and the market ultimately determine the quality of our products and services.
- Strive toward zero defects for products and services.
- Defect prevention takes precedence over defect elimination. The goal is not just eliminate errors but also the root causes.
- Every employee must be dedicated to continually improve quality.
- It is Management's responsibility to instill quality awareness throughout the company.
- To insure product quality all purchased parts and materials must be of the highest quality. Therefore, a team-oriented relationship between Balluff Inc. and our vendors is required, based on specific quality requirements.
- A high standard of quality increases profitability, insures competitiveness in the market, retains and creates jobs, and guarantees the continued existence of the company.

Our Mission:

Sensor Solutions Superior Service Dedication to Our Customers' Success



The quality management system of Balluff Inc. is registered by NSF-ISR to ISO 9001.



STANDARD WARRANTY

BALLUFF Inc. products are guaranteed to be free from defects in material and workmanship as follows:

Standard 2-year warranty from the date of shipment for photoelectric and flow sensors, capacitive sensors, read-write ID systems, magnetostrictive transducers (Micropulse™ AT)*, connectors and cables, electromechanical limit and rotary switches, and all products with electromechanical relays sold to the original user.

* Micropulse™ AT: 1-year warranty from date of shipment

Standard lifetime warranty for inductive sensors and magnetically operated sensors sold to the original user.

Balluff Inc. will repair or replace at our discretion, without charge, any unit, which fails because of defective workmanship or material, during this guarantee period and which is returned to BALLUFF Inc. transportation prepaid. The guarantee will not

apply if, in the judgement of BALLUFF Inc., damage or failure has resulted from accident, alteration, misuse, abuse, or operation on an incorrect power supply. The guarantee expressly does not include any other costs such as the cost of removal of the defective part, installation, labor or

consequential damages of any kind. BALLUFF Inc. assumes no responsibility for selection and installation of its products. The foregoing is in lieu of all other guarantees expressed, implied or statutory and BALLUFF Inc. neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with said products.

WARNING

These sensors are NOT approved for use in personnel safety applications. A sensor failure or malfunction can result in either an energized or de-energized output state. Never use these sensors for personnel safety. Doing so may result in serious bodily injury or death.

Only products specifically designated as safety products are designed to meet OSHA and ANSI standards for point-of-operation devices.

For safety grounding issues please refer to the technical section in the end of this catalog.

Product Overview

Engineered for your most demanding switching requirements in harsh environmental conditions, the BALLUFF Cam Switch System is the preference of automatic machinery builders around the world. The BALLUFF Cam Switch System offers a package of benefits that make it the right position control choice anywhere you need precision switching coupled with unmatched durability.

Description of System and Options

The BALLUFF Cam Switch System consists of two basic elements:

1. A rugged multiple limit switch assembly with configurable limit switch inserts
2. A set of linear or rotary cams and associated mounting tray

The multiple limit switch assembly is offered with a wide variety of options:

- Precision mechanical snap switch inserts for dry contact switching
- Positive-opening mechanical safety switch inserts for over-travel limiting
- Non-contact inductive sensor inserts in a variety of voltage ratings and logic types
- LED switch status indication
- Viton sealing membranes for aggressive solvent environments
- Chisel, roller, or ball tipped mechanical switch plungers
- Plunger wipers for improved operation in sticky or gritty locations
- Custom pre-wired and factory-tested with micro or mini style connectors
- Custom mixed assemblies combining snap, safety, and inductive elements

Applications

Industrial applications include automatic equipment requiring precise and repeatable on-off position indication in severe operating environments such as flooding with machine tool cutting and cooling fluids, shock, vibration, flying chips, dust and dirt, and temperature variation.

The BALLUFF Cam Switch System is ideal for robot dynamic safety zone control. Positive break safety switches coupled with high switching element density, rugged construction, and long life expectancy combine to produce a perfect match for a safe and reliable human-robot interface.

**Preferred by
automatic
machinery
builders
worldwide!**

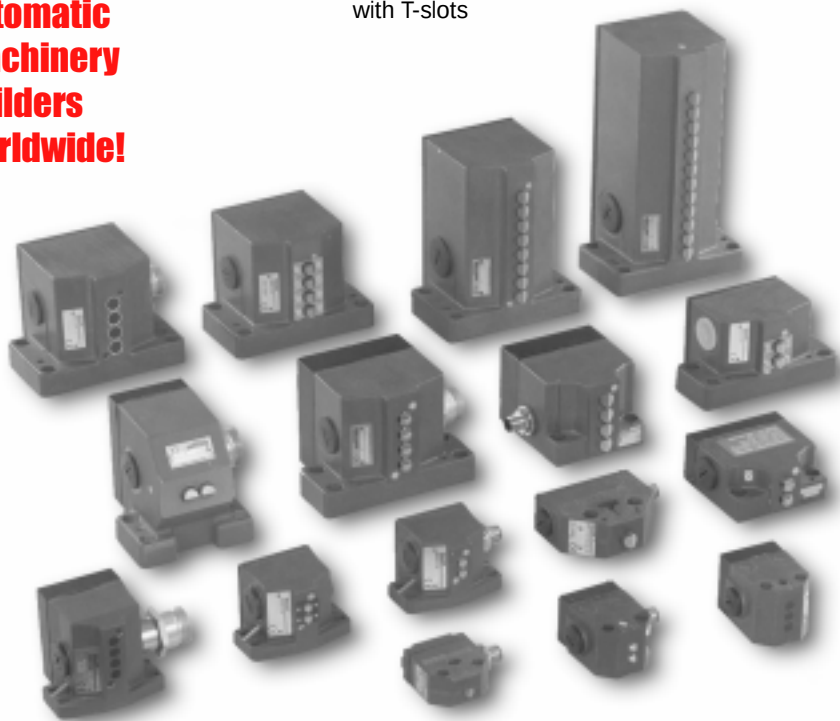
Precision switching
coupled with
unmatched
durability

The switching cams are available in several variations:

- Straight for linear applications in various lengths
- Radial for rotary applications in various radii and swept angles
- Surface-hardened solid steel for long life with mechanical switches
- Mild tubular steel for non-contact inductive switching
- U-channel for drop-in installation or T-slot for captive adjustability

The cam tray styles include:

- Straight for linear applications in various lengths, slot types, and profiles
- Machined aluminum drums for rotary applications in various diameters and slot profiles
- Extruded aluminum semi-circles in various radii with T-slots



Build It The Way You Want It

Balluff Cam Switches are highly configurable. With a wide variety of useful features, you can tailor the product to exactly match your application requirements.

Actuation and Switching Systems

You can choose from three actuation and output switching systems.

- **Mechanical/Mechanical**
a mechanical cam trips a mechanical plunger, which actuates an electro-mechanical switch element through a sealed membrane. Best for highest level of switchpoint stability and repeatability.
- **Mechanical/Electronic**
A mechanical cam trips a mechanical plunger. The metallic plunger is sensed internally by an inductive sensor and the output signal is switched electronically. Perfect for extremely low DC current switching in heavy metallic chip areas that would false trip an inductive sensor.
- **Inductive/Electronic**
Metallic cam is sensed by an inductive sensor element, which changes state electronically to activate the output signal. Non-contact operation for wear-free service in areas without metallic chips.

With Balluff cam switches, you've got options...

Plungers

For mechanically-actuated types, choose between four plunger styles.



Chisel-tipped for highly repeatable switchpoints at lower speeds over short cams



Ball-tipped for multi-directional cam approach



Roller-tipped with axle bushing for higher speeds



Roller-tipped with ball-bearing axle for maximum speed and long cams

Safety and/or Overtravel Limit Switch Elements

Balluff has two types of positive-drive NC limit switch elements available that conform to VDE 0113 standards. These NC elements are forced open by a rigid plunger, providing assurance against welded contacts. Mix safety switch elements with standard mechanical or inductive elements to provide an assured overtravel signal.

Viton

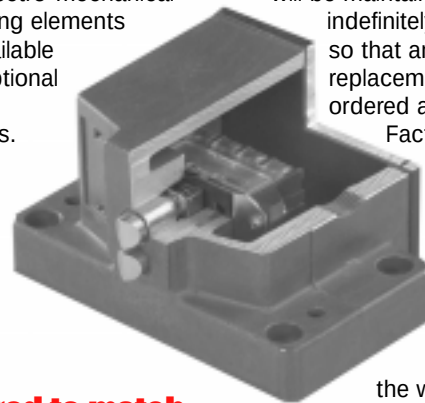
Balluff Cam Switches are built standard with Buna-N membranes and seals. In areas where solvents and coolants may attack Buna-N, specify the Viton option.

Inductive Sensor Elements

Choose from a range of voltage and logic configurations: AC, DC, PNP, NPN, NO, NC, 2-wire, 3-wire, 4-wire.

LED Function Display

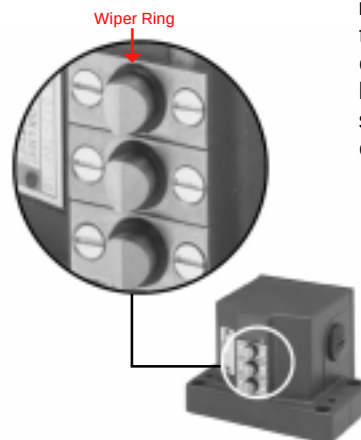
Cam switches with electronic switching elements come with output function display LEDs as standard. Cam switches with electro-mechanical switching elements are available with optional LED displays.



...Tailored to match YOUR application requirements!

Wiper/Scraper Rings

In some applications, dried coolant residue and other sticky substances can congeal on the standard plungers of mechanical switches, causing intermittent sticking. Balluff has developed optional wiper/scraper rings to scavenge such residue from the plunger to keep it clean and operational.



Factory Pre-wired Connectors

Very Popular! Factory pre-wired connectors allow rapid installation on new equipment and rapid replacement in event of failure during production. Balluff will wire the connector according to your custom specifications. Your custom configuration will receive a unique part number. All documentation will be maintained

indefinitely by Balluff, so that an exact replacement can be ordered at any time. Factory pre-wired connectors are 100% individually tested before shipment, ensuring that the wiring is correct. Just hook it up and go!

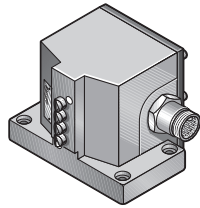


AS-i Bus - Direct Interface

With the growing implementation of bus network solutions for factory automation, Balluff has developed a series of Mechanical Cam Switches with a built-in direct AS-i interface. Simply bring the two-conductor AS-i conductor up to the switch housing and hook up with standard M12 DC Micro connector.

Series 100

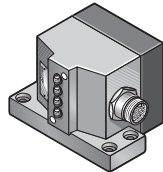
Page 14



- Full size housing
- Most popular style
- Accommodates full size switch elements
- AS-i option 16-17
- Electronic output option 18-19
- Series **602-11** inductive version 20-21

Series 62

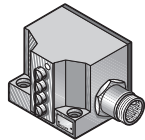
Pages 22-23



- Reduced dimension flange
- Accommodates full size switch elements
- Smaller terminal compartment than Series 100

Series 61

Page 24



- Compact housing with small terminal compartment
- Accommodates full size switch elements
- AS-i option 26-27
- Electronic output option 28-29
- Series **610-11, 612-11, 613-11** inductive version .30-31

Series F60

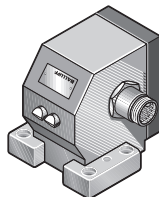
Page 32



- Compact single limit switch
- Accommodates full size switch elements
- Available with safety switch elements
- Selectable approach axis

Series 72

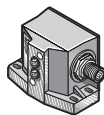
Page 34



- Perpendicular cam approach
- Compact housing with small terminal compartment
- Accommodates full size switch elements
- Electronic output option 36-37
- Series **605-11** inductive version 38-39

Series 46

Page 40



- Miniature housing with mounting flange
- Accommodates miniature switch elements
- Series **603-11** miniature version 42-43

Series 40

Page 44



- Miniature housing with minimum footprint
- Accommodates miniature switch elements
- Series **650-11** inductive version 46-47

Series 99/100

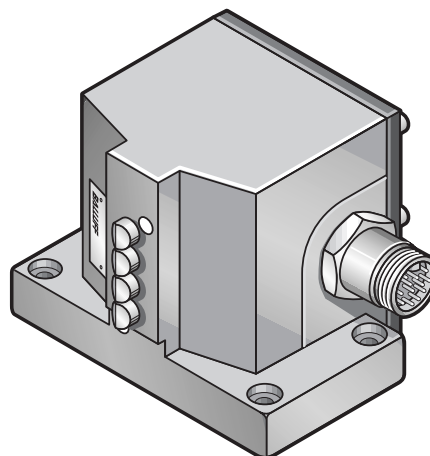
Page 48



- Miniature single limit switch
- Accommodates miniature switch elements
- Selectable approach axis

Housing Designation	
Housing Form	
Axis of Motion	
Plunger Centerline Spacing	
Operation Principle	

Series 100 Mechanical
Full Size Terminal Compartment per DIN 43.697
Parallel to Mounting Surface
12 mm
Mechanically actuated and switched



Housing material	
Housing coating	
Protection class	
Plunger material	
Plunger guide bushing material	standard
	version X512
Terminal compartment gasket material	
Plunger sealing membrane material	
Conduit plug O-ring material	
Conduit plug material	
Dimensions & Installation	
Ambient temperature	

Model	Switch Element
Contact arrangement & type	
Application	
Switch actuation force	
Switching frequency	
Plunger construction	
Approach velocity	Chisel plunger type D
Switchpoint repeatability	Type D in wiper ring housing form E
	Roller plunger type R
	Ball bearing roller plunger type L
	Ball plunger type K
Electrical characteristics	
LED function indication options	6...60V AC/DC
	90...250 V AC/DC
	24 V DC

Ordering Code

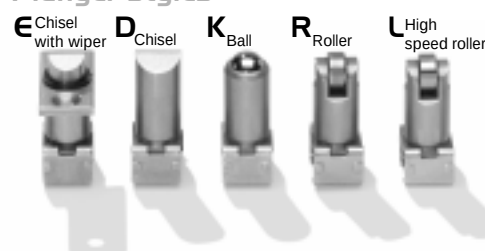
Mechanical Data

die-cast aluminum
grey anodized
IP67 (DIN 40.050); NEMA 4, 4X, 6, 6P, 11, 12, 13
stainless steel
Teflon (PTFE) & lead impregnated sintered tin & bronze over steel, self-lubricating
hardened aluminum, coolant-lubricated
Buna-N rubber (standard) Viton (version X512)
"
"
Plyamid PA 6.6 15% glass fiber reinforced
refer to installation Notes and Dimensional Information section
-5...+80°C

519 & 819		113 & 813	
BSE-20	BSE-20	BSE-61	BSE-85
NO + NC Snap Action	C-NO-NC snap action	NC creep opening	NO-NC snap action
precision	low current	VDE 0113 safety	VDE 0113 safety
15 N	15 N	15 N	15 N
300/min	200/min	300/min	50/min
telescoping overtravel	telescoping overtravel	rigid positive drive	rigid positive drive
10m/min ±0.002mm	10m/min ±0.02mm	12m/min ±0.002mm	12m/min ±0.002mm
10m/min ±0.002mm	10m/min ±0.02mm	12m/min ±0.002mm	12m/min ±0.002mm
20m/min ±0.01mm	20m/min ±0.05mm	50m/min ±0.01mm	50m/min ±0.02mm
120m/min ±0.01mm	120m/min ±0.05mm	120m/min ±0.01mm	80m/min ±0.02mm
8m/min ±0.002mm	8m/min ±0.02mm	10m/min ±0.002mm	10m/min ±0.002mm
Refer to individual Switch Element Data			
FD	-	FD	-
FE	-	FE	-
-	FC	-	FC

(see facing page)

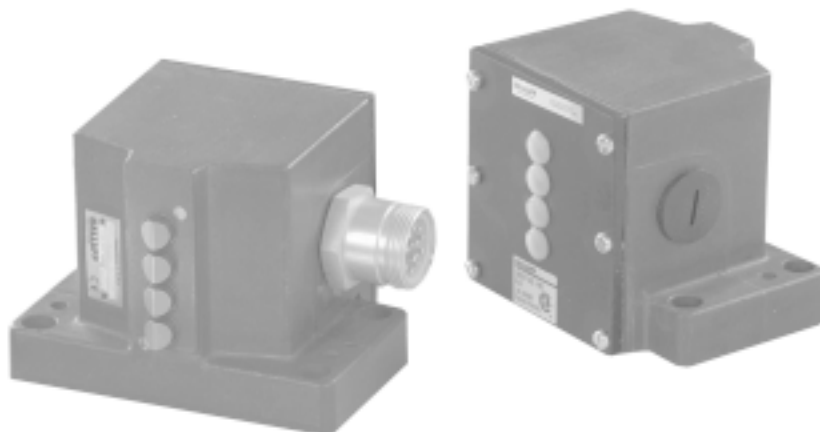
Plunger styles



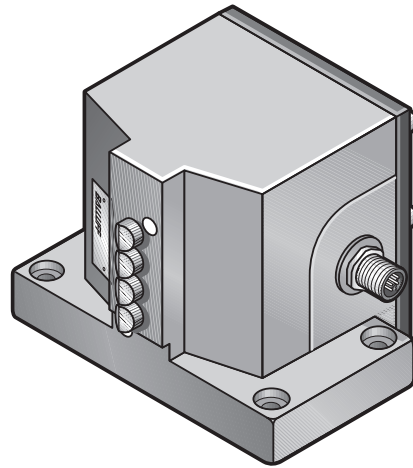
Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

Ordering Code		BNS - 813 - X512 - D04 - D12 - 100 - 20 - 02 - FD - #####									
Balluff Cam Switch	BNS										
Conduit openings	519 = Pg standard										
and VDE 0113 safety	819 = metric standard**										
	113 = Pg safety										
	813 = metric safety**										
Viton option	X512 = Viton										
	blank = Buna-N										
Housing Form	D = standard										
	E = wiper rings (chisel plunger only)										
Number of plungers	BSE-30, BSE-61, BSE-85 02...06, 08, 10, 12, 14, 16										
	BSE-82 02...04										
Plunger type	D = chisel										
	R = roller										
	L = ball bearing roller										
	K = ball tip										
Plunger spacing, mm	12										
Housing designation	100										
Switch element											
519 & 819	10 = BSE-30 only										
	3B = BSE-82 only										
113 & 813	10 = BSE-61 & BSE-30 mixed										
	12 = BSE-61 only										
	20 = BSE-85 & BSE-30 mixed										
	22 = BSE-85 only										
Number of safety elements 01...16 = No. of BSE-61 or BSE-85 starting at flange	blank = BSE-30 or BSE-82 only										
LED options	FD = 6...60 V AC/DC										
	FE = 90...250 V AC/DC										
	FC = 24 V DC										
	blank = no LED										
Custom Assembly	##### = factory suffix indicating special configuration such as custom pre-wired connector, mixed switching elements, etc.										
	blank = standard assembly										

** Consult factory for availability



Housing Designation	Series 100 Mechanical with built-in AS-i bus interface module
Housing Form	Full Size Terminal Compartment per DIN 43.697
Axis of Motion	Parallel to Mounting Surface
Plunger Centerline Spacing	12 mm
Operation Principle	Mechanically actuated and switched

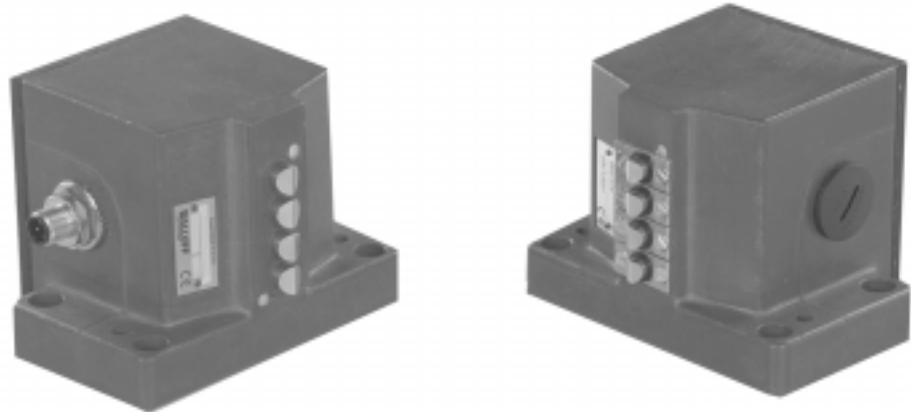


		Mechanical Data	
Housing material		die-cast aluminum	
Housing coating		grey anodized	
Protection class		IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P, 11, 12, 13	
Plunger material		stainless steel	
Plunger guide bushing material		Teflon (PTFE) & lead impregnated sintered tin & bronze over steel, self-lubricating	
Terminal compartment gasket material		Buna-N rubber	
Plunger sealing membrane material		Buna-N rubber	
Conduit plug O-ring material		Buna-N rubber	
Conduit plug material		Polyamid PA 6.6 15% glass fiber reinforced	
Dimensions & Installation		refer to Installation Notes and Dimensional Information section	
Ambient temperature		-5...+80°C	
Model		519 & 819	
Switch Element		BSE-30	
Contact arrangement & type		NO snap action	
Application		precision	
Switch actuation force		15 N	
Switching frequency		300/min	
Plunger construction		telescoping overtravel	
Approach velocity,	Chisel plunger type D	10m/min ±0.002mm	
Switchpoint repeatability	Type D in wiper ring housing form E	10m/min ±0.002mm	
	Roller plunger type R	20m/min ±0.01mm	
	Ball bearing roller plunger type L	120m/min ±0.01mm	
	Ball plunger type K	8m/min ±0.002mm	
Supply Voltage		via AS-i bus	
Current draw		50 mA	
Reverse polarity protected		yes	
Short circuit protected		yes	
Power-up ready delay		1 s	
Function indication		LED each position	
Parameters settable		no	
AS-i slave profiles		0,F	
Preset address	changeable from master or programming unit	00	
Data bit arrangement		Bit D0, Function T0	
		Bit D1, Function T1	
		Bit D2, Function T2	
		Bit D4, Function T4	
AS-i coupling accessory	order separately	BAS-K-H1S-ADT-S4	
Ordering Code		(see facing page)	

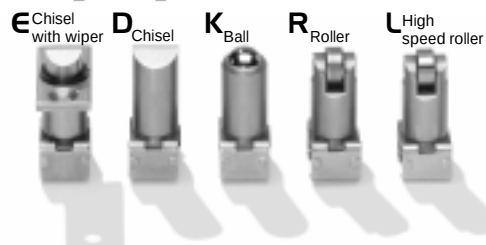
Ordering Code	BNS - 819 - E04 - D12 - 100 - 10- ALS
Balluff Cam Switch	BNS
Conduit openings	519 = Pg 819 = metric**
Housing Form	D = standard E = wiper rings (chisel plunger only)
Number of plungers	02, 03, 04
Plunger type	D = standard R = roller L = ball bearing roller K = ball tip
Plunger spacing, mm	12
Housing designation	100
Switch Element	10 = BSE-30 only
AS-i Limit Switch	ALS =M12 DC micro connector LEFT side ARS = M12DC micro connector Right Side*

*Looking at plungers, flange down

**Consult factory for availability



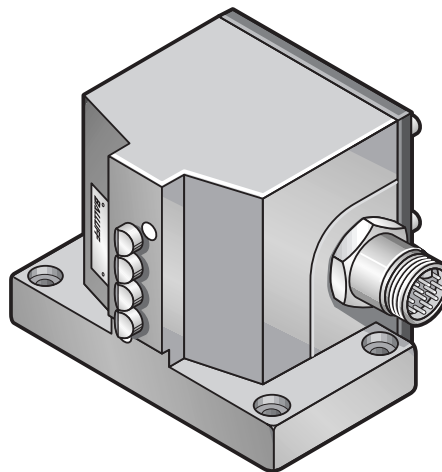
Plunger styles



Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

Housing Designation
Housing Form
Axis of Motion
Plunger Centerline Spacing
Operation Principle

Series 100 Mechanical/Electronic
Full Size Terminal Compartment per DIN 43.697
Parallel to Mounting Surface
12 mm
Mechanically actuated, electronically switched



Housing material
Housing coating
Protection class
Plunger material
Plunger guide bushing material
Terminal compartment gasket material
Plunger sealing membrane material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature

Switch Element

Contact arrangement & type
Applications - solid state switching in metal chip environment
Switch actuation force
Switching frequency
Plunger construction
Approach velocity
Chisel plunger type D
Roller plunger type R
Ball bearing roller plunger type L
Ball plunger type K

Switchpoint repeatability
Electrical characteristics
LED function indication

Ordering Code

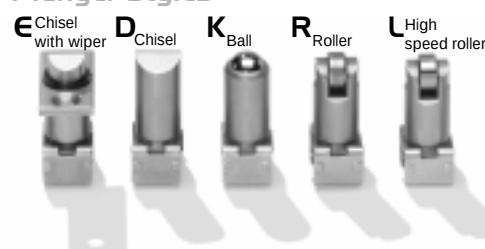
Mechanical Data

die-cast aluminum
grey anodized
IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P, 11, 12, 13
stainless steel
Teflon (PTFE) & lead impregnated sintered tin & bronze over steel, self-lubricating
Buna-N rubber
Buna-N rubber
Buna-N rubber
Plyamid PA 6.6 15% glass fiber reinforced
refer to Installation Notes and Dimensional Information section
refer to individual Sensor Element Data

BES-516-110-D(14DH)	BES-516-108-D(14DHF)	BES-516-410-J(14JJ)	BES-516-421-J (14JK)
PNP complementary	NPN complementary	2-wire NO	2-wire NC
10...30 V DC	10...30 V DC	90...250 V AC	90...250 V AC
15 N	15 N	15N	15N
300/min	300/min	300/min	300/min
telescoping overtravel	telescoping overtravel	telescoping overtravel	telescoping overtravel
10m/min	10m/min	10m/min	10m/min
20m/min	20m/min	20m/min	20m/min
120m/min	120m/min	120m/min	120m/min
8m/min	8m/min	8m/min	8m/min
	refer to individual Sensor Element Data		
	refer to individual Sensor Element Data		
included	included	included	included

(see facing page)

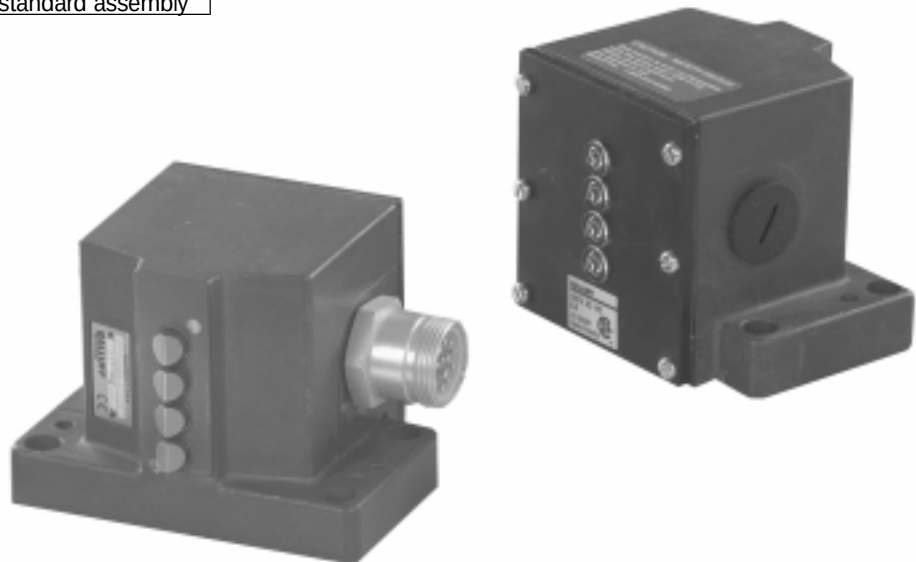
Plunger styles



Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

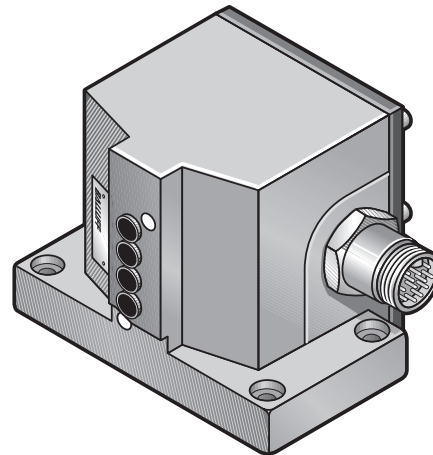
Ordering Code	BNS - 819 - D03 - R12 - 100 - 14-DH - #####
Balluff Cam Switch	BNS
Conduit openings	519 = Pg 819 = metric**
Housing Form	D = standard
Number of plungers	02...06, 08, 10, 12, 14, 16
Plunger type	D = chisel R = roller L = ball bearing roller K = ball tip
Plunger spacing, mm	12
Housing designation	100
Inductive sensor element	14-DH = BES-516-110-D 14-DF = BES-516-108-D 14-JJ = BES-516-410-J 14-DH = BES-516-421-J
Custom assembly	##### = factory suffix indicating special configuration such as custom pre-wired connector, mixed switching elements, etc. blank = standard assembly

****Consult factory for availability**



Housing Designation
Housing Form
Axis of Motion
Operation Principle

Series 602-11 Inductive (similar to Series 100)
Full Size Terminal Compartment per DIN 43.697
Parallel to Mounting Surface
Inductive sensing, electronic switching



Housing material
Housing coating
Protection class
Terminal compartment gasket material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature

Inductive Sensor Element

Contact arrangement & type
Applications - non-contact sensing, electronic switching, chip-free

Inductive Sensor Element

Contact arrangement & type
Applications - non-contact sensing, electronic switching, chip-free

Inductive Sensor Element

Contact arrangement & type
Applications - intrinsically safe
Switching frequency
Switchpoint repeatability
Electrical characteristics
LED function indication

Ordering Code**Mechanical Data**

die-cast aluminum
grey anodized
IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P
Buna-N rubber

Polyamid PA 6.6 15% glass fiber reinforced
refer to Installation Notes and Dimensional Information section
refer to individual Sensor Element Data

BES-516-110 (PA)	BES-516-108 (NA)	BES-517-410 (WS)*	BES-517-421 (WO)**
PNP complementary	NPN complementary	2-wire NO	2-wire NC
10...60 V DC	10...60 V DC	90...250 V AC	90...250 V AC
BES-517-560-H (KHG)	BES-517-561-H (NA)	BES-516-410 (EJ)*	BES-517-421 (EK)**
2-wire NO	2-wire NC	2-wire NO	2-wire NC
10...55 V DC	10...55 V DC	90...250 V AC	90...250 V AC
BES-516-314-N (NG)			
2-wire NAMUR			
7.7...9.0 V DC			

refer to individual Switch Element Data

refer to individual Switch Element Data

refer to individual Switch Element Data

included

included

included

included

(see facing page)

* WS & EJ interchangeable.

** WO & EK interchangeable.
EJ & EK are obsolete.

Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

Ordering Code		BNS - 816- B05 - WS - 12 - 602 - 11 - #####	
Balluff Cam Switch	BES-516 = Pg		
Conduit openings	BNS-816 = metric*		
Housing Form	B = standard		
Number of sensing positions	02...06, 08, 10, 12, 14, 16		
Inductive Sensor Element	PA = BES-516-110		
	NA = BES-516-108		
	WS = BES-517-410		
	WO = BES-517-421		
	KHG = BES-517-560-H		
	KHH = BES-517-561-H		
	EJ = BES-516-410***		
	EK = BES-516-421***		
	NG = BES-516-314-N**		
Sensor spacing, mm	12		
Housing designation	602-11		
Custom assembly	#### = factory suffix indicating special configurations such as custom pre-wired connector, mixed switching elements, etc.		
	blank = standard assembly		

* Consult factory for availability.

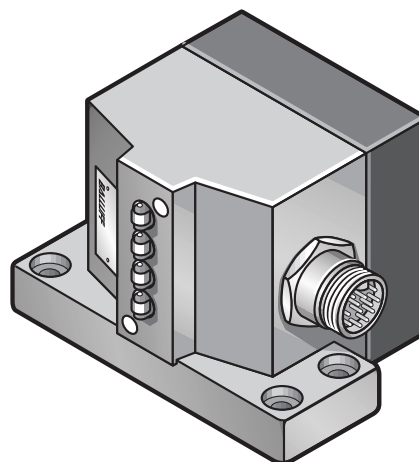
** Use with approved energy barrier switching amplifier. Refer to BES NAMUR section of Sensor Catalog for selection.

*** EJ & EK are obsolete.



Housing Designation
Housing Form
Axis of Motion
Plunger Centerline Spacing
Operation Principle

Series 62 Mechanical
Compact Terminal Compartment and Reduced Dimension Mounting Flange
Parallel to Mounting Surface
12 mm
Mechanically actuated and switched



Housing material
Housing coating
Protection class
Plunger material
Plunger guide bushing material
Terminal compartment gasket material
Plunger sealing membrane material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature

Model	
Switch Element	
Contact arrangement & type	
Application	
Switch actuation force	
Switching frequency	
Plunger construction	
Approach velocity,	Chisel plunger type D
Switchpoint repeatability	Roller plunger type R
	Ball bearing roller plunger type L
	Ball plunger type K

Electrical characteristics	
LED function indication options	6...60V AC/DC
	90...250 V AC/DC

Ordering Code

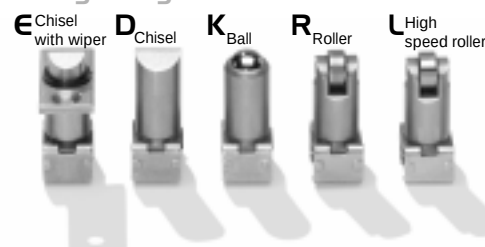
Note: LED options require taller terminal compartment cover

Mechanical Data

die-cast aluminum
grey anodized
IP 67 (DIN 40.050): NEMA 4, 4X, 6, 6P, 11, 12, 13
stainless steel
Teflon (PTFE) & lead impregnated sintered tin & bronze over steel, self-lubricating
Buna-N rubber
Buna-N rubber
Buna-N rubber
Plyamid PA 6.6 15% glass fiber reinforced
refer to Installation Notes and Dimensional Information section
-5...+80°C

519 & 819	113 & 813
BSE-30	BSE-61
NO + NC snap action	NC creep opening
precision	VDE 0113 safety
15 N	15 N
300/min	300/min
telescoping overtravel	rigid positive drive
10m/min ±0.002mm	12m/min ±0.002mm
20m/min ±0.01mm	50m/min ±0.01mm
120m/min ±0.01mm	120m/min ±0.01mm
8m/min ±0.002mm	10m/min ±0.002mm
Refer to individual switch element data	
FD	FD
FE	FE
(see facing page)	

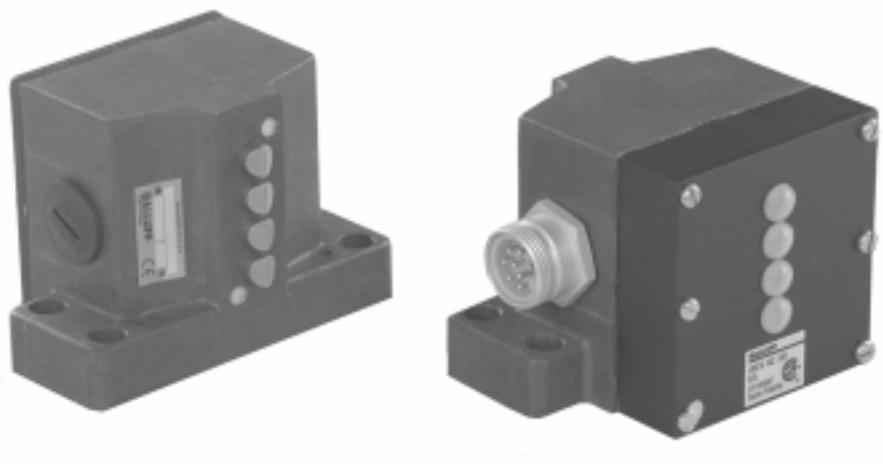
Plunger styles



Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

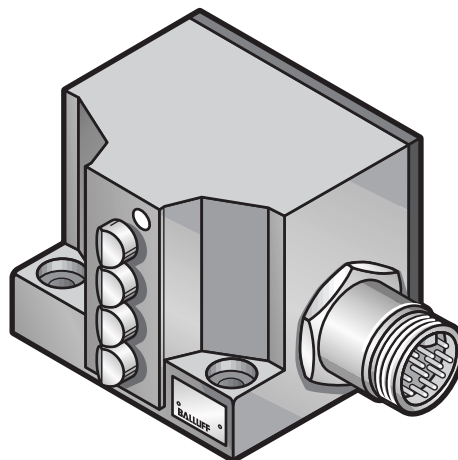
Ordering Code	BNS - 813 - D04 - L12 - 062- 12 - 04- FD - ####
Balluff Cam Switch	BNS
Conduit openings	519 = Pg standard*
and VDE 0113 safety	819 = metric standard*
	113 - Pg safety
	813 = metric safety
Housing Form	D = standard
Number of plungers	02...06, 08, 10, 12, 14, 16
Plunger type	D = chisel
	R = roller
	L = ball bearing roller
	K = ball tip
Plunger spacing, mm	12
Housing designation	062
Switch element	
519 & 819	10 = BSE-30 only
113 & 813	10 = BSE-61 & BSE-30 mixed
	12 BSE-61 only
Number of safety elements	01...16 - No. of BSE-61
starting at flange	blank = BSE 30 only
LED options	FD = 6...60 V AC/DC
	FE = 90...250 V AC/DC
	blank = no LED
Custom assembly	#### = factory suffix indicating special configuration such as custom pre-wired connector, mixed switching elements, etc.
	blank = standard assembly

*Consult factory for availability



Housing Designation
Housing Form
Axis of Motion
Plunger Centerline Spacing
Operation Principle

Series 61 Mechanical
Compact Terminal Compartment and Minimum Footprint Mounting Flange
Parallel to Mounting Surface
12 mm
Mechanically actuated and switched



Housing material
Housing coating
Protection class
Plunger material
Plunger guide bushing material
Terminal compartment gasket material
Plunger sealing membrane material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature

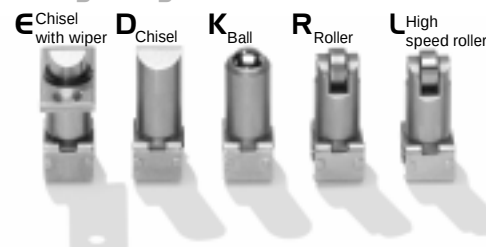
Model
Switch Element
Contact arrangement & type
Application
Switch actuation force
Switching frequency
Plunger construction
Approach velocity
Switchpoint repeatability
Electrical characteristics
LED function indication options
Ordering Code

Mechanical Data
die-cast aluminum
gray anodized
IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P, 11, 12, 13
stainless steel
Teflon (PTFE) & lead impregnated sintered tin & bronze over steel, self-lubricating
hardened aluminum, coolant lubricated
Buna-N-rubber (standard), Viton (version X512)
Polyamid PA 6.6 15% glass fiber reinforced
refer to individual Sensor Element Data
-5...+80° C

543 & 819		113 & 813	
BSE-30	BSE-82	BSE-61	BSE-85*
NO+NC snap action	C-NO-NC snap action	NC creep opening	NO-NC snap action
precision	low current	VDE 0113 safety	VDE 0113 safety
15 N	15 N	15N	15N
300/min	200/min	300/min	50/min
telescoping overtravel	telescoping overtravel	rigid positive drive	rigid positive drive
10m/min ±0.002mm	10m/min ±0.02mm	12m/min ±0.002mm	12m/min ±0.02mm
10m/min ±0.002mm	10m/min ±0.02mm	12m/min ±0.002mm	12m/min ±0.02mm
20m/min ±0.01mm	20m/min ±0.05mm	50m/min ±0.01mm	50m/min ±0.02mm
120m/min ±0.01mm	120m/min ±0.05mm	120m/min ±0.01mm	80m/min ±0.02mm
8m/min ±0.02mm	8m/min ±0.02mm	10m/min ±0.002mm	10m/min ±0.02mm
Refer to individual Switch Element Data			
FD*	-	FD*	-
FE*	-	FE*	-
-	FC	-	FC
(see facing page)			

*requires taller terminal compartment cover

Plunger styles



Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

Ordering Code	BNS - 813 - X512 - B05- L12 - 61 - A - 10 - 03 - FD-####
Balluff Cam Switch	BNS
Conduit openings	543 = Pg standard
and VDE 0113 safety	819 = metric standard**
	113 = Pg safety
	813 = metric safety**
Viton option	X512 = Viton
	blank = Buna-N
Housing Form	B = threaded side access only ¹
	B = threaded side & flange access ²
	C = threaded side & unthreaded flange access with gasket ³
	E = wiper rings threaded side access only ¹ (Chisel Plunger Only)
	E = wiper rings threaded side & flange access ² (Chisel Plunger Only)
Number of plungers	BSE-30, BSE-61, BSE-85 02...06
	BSE-82 02...04
Plunger type	D = chisel
	R = roller
	L = ball bearing roller
	K = ball tip
Plunger spacing, mm	12
Housing designation	61
Distance flange to centerline	543 & 819 02...06 plungers 12 ¹
of first plunger, mm	543 & 819 92, 03 plungers only 24 ²
	543 & 819 02 plungers only 30 ³
	113 & 813 02...06 plungers A = 12 ¹
	113 & 813 02, 03 plungers only C = 24 ²
	113 & 813 02 plungers only D = 30 ³
Switch element	
543 & 819	10 = BSE-30 only
	3B = BSE-82 only
113 & 813	10 = BSE-61 & BSE-30 mixed
	12 = BSE-61 only
	20 = BSE-85 & BSE-30 mixed*
	22 = BSE-85 only*
Number of safety elements	01...16 = No. of BSE-61 or BSE-85
starting at flange	blank = BSE-30 or BSE-82 only
LED options	FD = 6...60 V AC/DC*
	FE = 90...250 V AC/DC*
	FC = 24 V DC
	blank = no LED
Custom assembly	#### = factory suffix indicating
	special configuration such as
	custom pre-wired connector,
	mixed switching elements, etc.
	blank = standard assembly

^{1,2,3} Superscripts indicate allowable combinations of housing form.

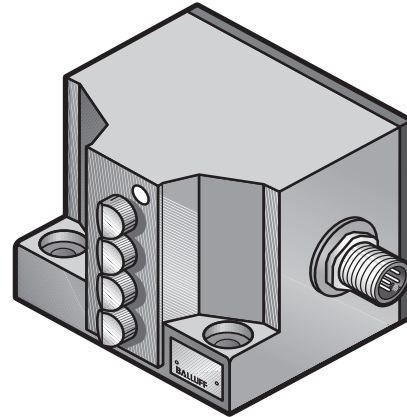
* Requires taller terminal compartment cover.

** Consult factory for availability.



Housing Designation
Housing Form
Axis of Motion
Plunger Centerline Spacing
Operation Principle

Series 61 Mechanical with built-in AS-i bus interface module
Compact Terminal Compartment and Minimum Footprint Mounting Flange
Parallel to Mounting Surface
12 mm
Mechanically actuated and switched



Housing material
Housing coating
Protection class
Plunger material
Plunger guide bushing material
Terminal compartment gasket material
Plunger sealing membrane material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature

Model
Switch Element
Contact arrangement & type
Application
Switch actuation force
Switching frequency
Plunger construction
Approach velocity, Chisel plunger type D
Switchpoint repeatability Type D in wiper ring housing form E
Roller plunger type R
Ball bearing roller plunger type L
Ball plunger type K

Supply voltage
Current draw
Reverse polarity protected
Short circuit protected
Power-up ready delay
Function indication
Parameters settable
AS-i slave profiles
Preset address changeable from master or programming unit
Data bit arrangement

AS-i coupling accessory	order separately
Ordering Code	

Mechanical Data

die-cast aluminum
gray anodized
IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P, 11, 12, 13
stainless steel
Teflon (PTFE) & lead impregnated sintered tin & bronze over steel, self-lubricating
Buna-N rubber
Buna-N rubber
Buna-N rubber
Plyamid PA 6.6 15% glass fiber reinforced
refer to Installation Notes and Dimensional Information section
-5...+80°C

519 & 819

BSE-30*

NO snap action
precision
15 N
300/min
telescoping overtravel
10m/min ±0.002mm
10m/min ±0.002mm
20m/min ±0.01mm
120m/min ±0.01mm
8m/min ±0.002mm
via AS-i bus
50 mA
yes
yes
1 s
LED each position
no
0,F
00
Bit D0, Function T0
Bit D1, Function T1
Bit D2, Function T2
Bit D4, Function T4

BAS-K-H1S-ADT-S4

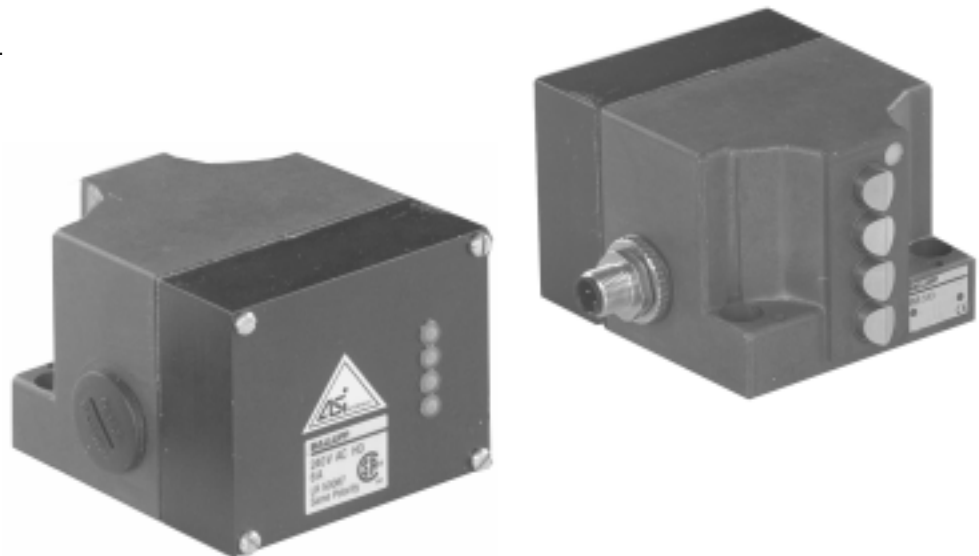
(see facing page)

*Requires taller terminal compartment cover for AS-i electronic module.

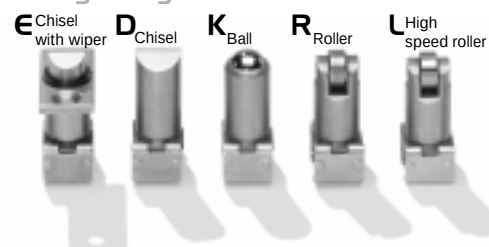
Ordering Code	BNS - 819 - B04 - D12 - 61- 12 -10 - ALS
Balluff Cam Switch	BNS
Conduit openings	543 = Pg standard 819 = metric standard*
Housing Form	B = threaded side access only E = wiper rings (chisel plunger only)
Number of plungers	02, 03, 04
Plunger type	D = standard R = roller L = ball bearing roller K = ball tip
Plunger spacing, mm	12
Housing designation	61
Distance flange to centerline of first plunger, mm	12
Switch element	10 = BSE-30 only
AS-i Limit Switch	ALS = M12 DC micro connector LEFT side ARS = M12 DC micro connector RIGHT side

* Consult factory for availability.

** Looking at plungers, flange down.



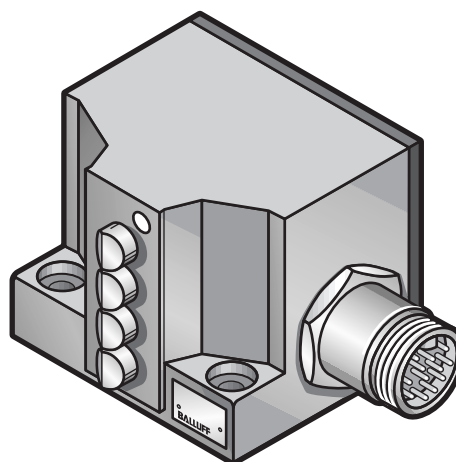
Plunger styles



Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

Housing Designation
Housing Form
Axis of Motion
Plunger Centerline Spacing
Operating Principle

Series 61 Mechanical/Electronic
Compact Terminal Compartment and Minimum Footprint Mounting Flange
Parallel to Mounting Surface
12 mm
Mechanically actuated, electronically switched



Housing material
Housing coating
Protection class
Plunger material
Plunger guide bushing material
Terminal compartment gasket material
Plunger sealing membrane material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature

Switching Element

Contact arrangement & type
Application - solid state switching in metal chip environment
Switch actuation force
Switching frequency
Plunger construction
Approach velocity
Chisel plunger type D
Roller plunger type R
Ball bearing roller plunger type L
Ball plunger type K

Switchpoint repeatability
Electrical characteristics
LED function indication

Ordering Code

Mechanical Data

die-cast aluminum
gray anodized
IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P, 11, 12, 13
stainless steel
Teflon (PTFE) & lead impregnated sintered tin & bronze over steel, self-lubricating
Buna-N rubber
Buna-N rubber
Buna-N rubber

Polyamid PA 6.6 15% glass fiber reinforced

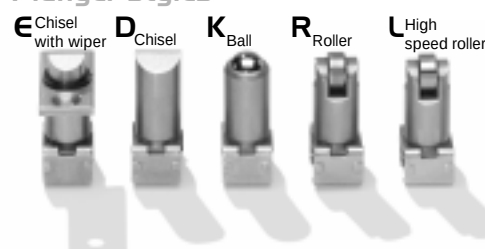
refer to Installation Notes and Dimensional Information section

refer to individual Sensor Element Data

BES-516-110-D(14DH)	BES-516-108-D(14DF)	BES-517-410-J(14JJ)	BES-517-421-J (14JK)
PNP complementary	NPN complementary	2-wire NO	2-wire NC
10...30 V DC	10...30 V DC	90...250 V AC	90...250 V AC
15 N	15 N	15N	15N
300/min	300/min	300/min	300/min
telescoping overtravel	telescoping overtravel	telescoping overtravel	telescoping overtravel
10m/min	10m/min	10m/min	10m/min
20m/min	20m/min	20m/min	20m/min
120m/min	120m/min	120m/min	120m/min
8m/min	8m/min	8m/min	8m/min
	refer to individual Switch Element Data		
	refer to individual Switch Element Data		
included	included	included	included

(see facing page)

Plunger styles



Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

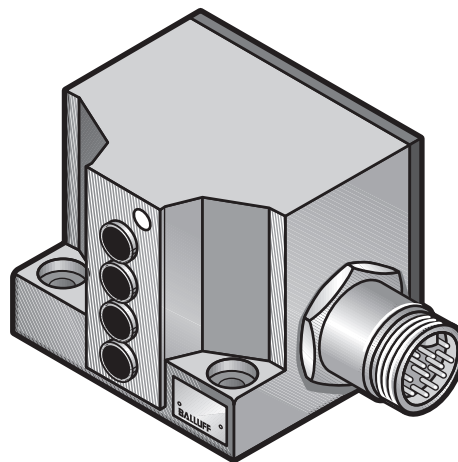
Ordering Code		BNS - 819 - B05 - D12 - 61- 12 - 14 - DH - #####									
Balluff Cam Switch	BNS										
Conduit openings	543 = Pg 819 = metric*										
Housing Form	B = standard ¹ B = threaded side & flange access ² C = threaded side & unthreaded flange access with gasket ³ E = wiper rings threaded side access only ¹ E = wiper rings threaded side & flange access ²										
Number of plungers	02...06										
Plunger type	D = chisel R = roller L = ball bearing roller K = ball tip										
Plunger spacing, mm	12										
Housing designation	61										
Distance flange to centerline of first plunger, mm	02...06 plungers 12 03 plungers only 24 02 plungers only 30										
Inductive sensor element	14-DH = BES-516-110-D 14-DF = BES-516-108-D 14-JJ = BES-516-410-J 14-JK = BES-516-421-J										
Custom assembly	#### = factory suffix indicating special configuration such as custom pre-wired connector, mixed switching elements, etc. blank = standard assembly										

^{1,2,3} Superscripts indicate allowable combinations of housing form.
* Consult factory for availability.



Housing Designation
Housing Form
Axis of Motion
Sensor Centerline Spacing
Operating Principle

Series 610-11, 612-11, 613-11 Inductive (similar to Series 61 Mechanical)
Compact Terminal Compartment and Minimum Footprint Mounting Flange
Parallel to Mounting Surface
12 mm
Inductive sensing, electronic switching



Housing material
Housing coating
Protection class
Terminal compartment gasket material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature

Inductive Sensor Element

Contact arrangement & type
Applications - non-contact sensing, electronic switching, chip-free

Inductive Sensor Element

Contact arrangement & type
Applications - non-contact sensing, electronic switching, chip-free

Inductive Sensor Element

Contact arrangement & type
Applications - intrinsically safe
Switching frequency
Switching repeatability
Electrical characteristics
LED Function indication

Ordering Code

Mechanical Data

die-cast aluminum
gray anodized
IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P, 11, 12, 13
Buna-N rubber
Buna-N rubber
Polyamid PA 6.6 15% glass fiber reinforced
refer to Installation Notes and Dimensional Information section
refer to individual Sensor Element Data

BES-516-110(PA)	BES-516-108(NA)	BES-517-410(WS)*	BES-517-421 (WO)**
PNP complementary	NPN complementary	2-wire NO	2-wire NC
10...60 V DC	10...60 V DC	90...250 V AC	90...250 V AC
BES-516-110(PA)	BES-516-108(NA)	BES-517-410(WS)*	BES-517-421 (WO)**
2-wire NO	2-wire NC	2-wire NO	2-wire NC
10...55 V DC	10...55 V DC	90...250 V AC	90...250 V AC
BES-516-110(PA)	BES-516-108(NA)	BES-517-410(WS)*	BES-517-421 (WO)**
2-wire NAMUR			
7.7...9.0 V DC			
	refer to individual Switch Element Data		
	refer to individual Switch Element Data		
	refer to individual Switch Element Data		
included	included	included	included

(see facing page)

* WS & EJ interchangeable.
** WO & EK interchangeable.
EJ & EK are obsolete.

Switch Element Data Pages 50-51
Linear Cam Trays Pages 71-85
Linear Trip Cams Pages 89-97
Rotary Cam Drums Pages 99-102
Rotary Trip Cams Pages 103-111
Connectors & Cables Pages 54-57
Accessories & Fittings Pages 58-59
Installation Guidelines Page 60
Dimensions Pages 61-69

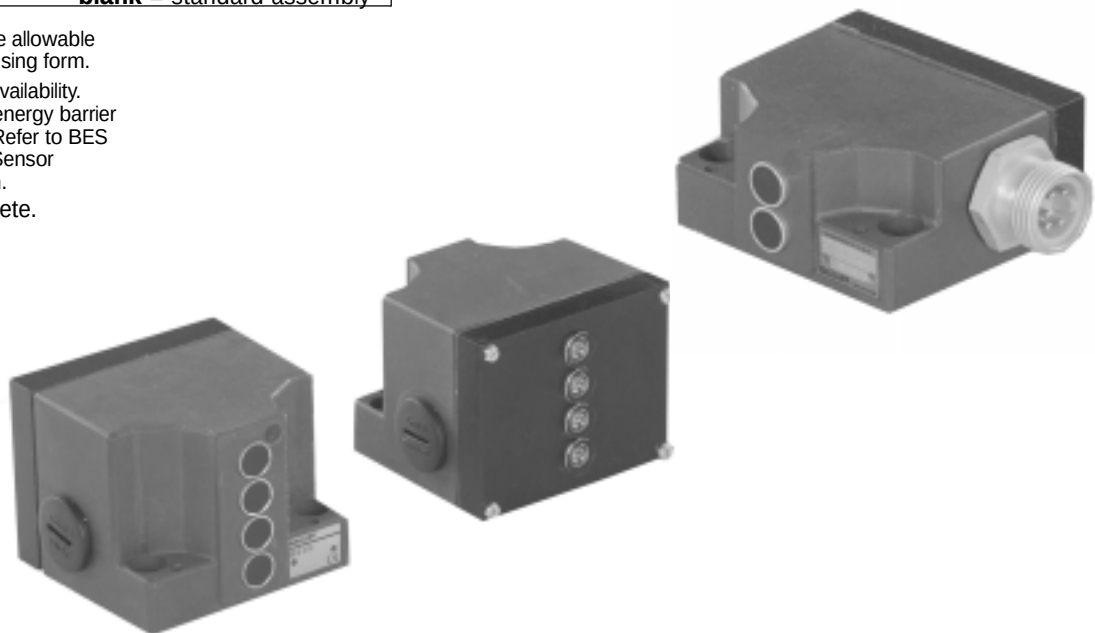
Ordering Code		BNS - 816 - B03 - PA - 12 - 612 - 11 - ####	
Balluff Cam Switch	BES-516 = Pg		
Conduit openings	BNS - 816 = metric		
Housing Form	B = threaded side access only ¹		
	B = threaded side & flange access ²		
	C = threaded side & unthreaded flange access with gasket ^{3*}		
Number of sensing positions	610-11 = 02...06 ¹		
	612-11 = 02, 03 ²		
	613 - 11 = 02, 03 ³		
Inductive sensor element	PA = BES-516-110		
	NA = BES-516-108		
	WS = BES-517-410		
	WO = BES-517-421		
	KHG = BES-517-560-H		
	KHH = BES-517-561-H		
	EJ = BES-516-410***		
	EK = BES-516-421***		
	NG = BES-516-314-N		
Sensor spacing, mm	12		
Housing designation	12mm = 610-11 ¹		Threaded side access only ¹
distance flange to centerline	24mm = 612-11 ²		threaded side & flange access ²
of first sensor, mm	30mm = 613-11 ³		threaded side & unthreaded flange access with gasket ³
Custom assembly	#### = factory suffix indicating special configuration such as custom pre-wired connector, mixed switching elements, etc.		
	blank = standard assembly		

^{1,2,3} Superscripts indicate allowable combinations of housing form.

* Consult factory for availability.

** Use with approved energy barrier switching amplifier. Refer to BES NAMUR section of Sensor Catalog for selection.

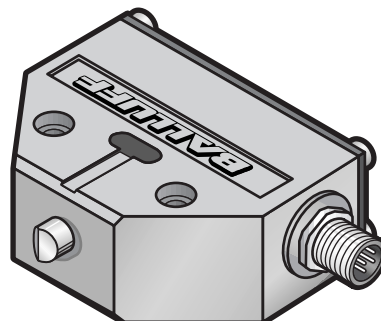
*** EJ & EK are obsolete.



Housing Designation
Housing Form
Axis of Motion
Operation Principle

Series F 60 Mechanical

Compact Terminal Compartment and Minimum Footprint Mounting Flange
Parallel or Perpendicular to Mounting Surface
Mechanically actuated and switched



Housing material
Housing coating
Protection class
Plunger material
Plunger guide bushing material standard
version X512

Terminal compartment gasket material
Plunger sealing membrane material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature

Model

Switch Element

Contact arrangement & type
Application
Switch actuation force
Switching frequency
Plunger construction
Approach velocity, Chisel plunger type D
Switchpoint repeatability Type D in wiper ring housing form E
Roller plunger type R
Ball bearing roller plunger type L
Ball plunger type K

Electrical characteristics
LED function indication options* 6...60V AC/DC
* requires taller cover 90...250 V AC/DC
24 V DC

Ordering Code

Mechanical Data

die-cast aluminum

gray anodized

IP 67 (DIN 40 050); NEMA 4, 4X, 6, 6P, 11, 12, 13

stainless steel

Teflon (PTFE) & lead impregnated sintered tin & bronze over steel, self-lubricating
hardened aluminum, coolant lubricated

Buna-N-rubber (standard), Viton (version X512)

Buna-N-rubber (standard), Viton (version X512)

Buna-N-rubber (standard), Viton (version X512)

Polyamid PA 6.6 15% glass fiber reinforced

refer to individual Sensor Element Data

-5...+80° C

519 & 819

BSE-30

NO + NC Snap Action

precision

15 N

300/min

telescoping overtravel

10m/min ±0.002mm

10m/min ±0.002mm

20m/min ±0.01mm

120m/min ±0.01mm

8m/min ±0.002mm

113 & 813

BSE-61

NC creep opening

VDE 0113 safety

15 N

300/min

rigid positive drive

12m/min ±0.002mm

12m/min ±0.002mm

50m/min ±0.01mm

120m/min ±0.01mm

10m/min ±0.002mm

BSE-85

NO-NC snap action

VDE 0113 safety

15 N

50/min

rigid positive drive

12m/min ±0.002mm

12m/min ±0.002mm

50m/min ±0.02mm

80m/min ±0.02mm

10m/min ±0.002mm

Refer to individual Switch Element Data

FD

FD

-

FE

FE

-

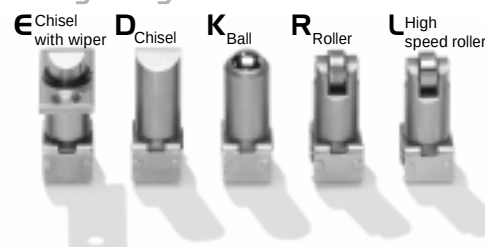
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-

FC

(see facing page)

Plunger styles



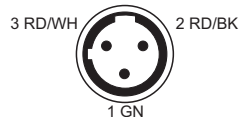
Switch Element Data Pages 50-51
Linear Cam Trays Pages 71-85
Linear Trip Cams Pages 89-97
Rotary Cam Drums Pages 99-102
Rotary Trip Cams Pages 103-111
Connectors & Cables Pages 54-57
Accessories & Fittings Pages 58-59
Installation Guidelines Page 60
Dimensions Pages 61-69

Ordering Code	BNS - 813 - X512 - FL60 - 187 - FC - S4
Balluff Cam Switch BNS	
Conduit openings 519 = Pg standard and VDE 0113 safety 819 = metric standard*	
113 = Pg safety 813 = metric safety*	
Viton option X512 = Viton blank = Buna-N	
Housing form and FD60 = standard with D chisel plunger type FR60 = standard with R roller FL60 = standard with L ball bearing roller FK60 = standard with K ball tip FE60 = wiper ring with D chisel	
Switch element 519 & 819 101 = BSE-30 and approach direction 113 & 813 183 = BSE-61 113 & 813 185 = BSE-61 113 & 813 186 = BSE-85 113 & 813 187 = BSE-85	approach direction user-configurable: depress plunger, twist 90°, release approach direction fixed: parallel to mounting surface approach direction fixed: perpendicular to mounting surface approach direction fixed: parallel to mounting surface approach direction fixed: perpendicular to mounting surface
LED options FD = 6...60 V AC/DC FE = 90...250 V AC/DC FC = 24 V DC blank = no led	
Connector option S4 = 4-pole DC micro blank = no connector	

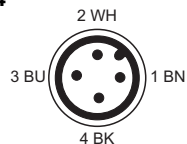
*Consult factory for availability.

Pinouts vary - consult factory
for specific wiring diagrams.

S21

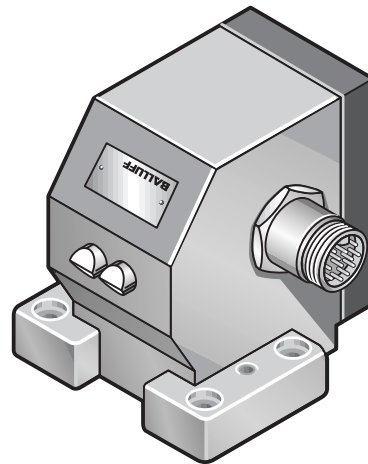


S4



Housing Designation
Housing Form
Axis of Motion
Plunger Centerline Spacing
Operating Principle

Series 72 Mechanical
Compact Terminal Compartment
Perpendicular to Mounting Surface
12mm
Mechanically actuated and switched



Housing material
Housing coating
Protection class
Plunger material
Plunger guide bushing material
Terminal compartment gasket material
Plunger sealing membrane material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature

Mechanical Data
sand-cast aluminum
gray anodized
IP 67 (DIN 40 050); NEMA 4, 4X, 6, 6P, 11, 12, 13
stainless steel
Teflon (PTFE) & lead impregnated sintered tin & bronze over steel, self-lubricating
Buna-N-rubber
Buna-N-rubber
Buna-N-rubber
Polyamid PA 6.6 15% glass fiber reinforced
refer to individual Sensor Element Data
-5...+80° C

Model
Switch Element
Contact arrangement & type
Application
Switch actuation force
Switching frequency
Plunger construction
Approach velocity, Chisel plunger type D
Switchpoint repeatability Type D in wiper ring housing form E
Roller plunger type R
Ball bearing roller plunger type L
Ball plunger type K
Electrical characteristics
LED function indication options 6...60V AC/DC
90...250 V AC/DC
24 V DC

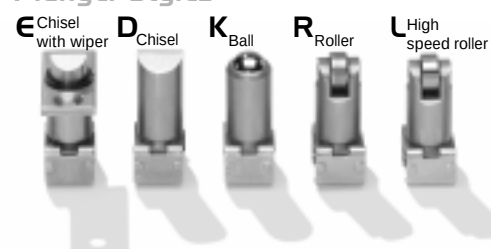
519 & 819	113 & 813	
BSE-30	BSE-61	BSE-85*
NO + NC Snap Action	NC creep opening	NO-NC snap action
precision	VDE 0113 safety	VDE 0113 safety
15 N	15 N	15 N
300/min	300/min	50/min
telescoping overtravel	rigid positive drive	rigid positive drive
10m/min ±0.002mm	12m/min ±0.002mm	12m/min ±0.002mm
10m/min ±0.002mm	12m/min ±0.002mm	12m/min ±0.002mm
20m/min ±0.01mm	50m/min ±0.01mm	50m/min ±0.02mm
120m/min ±0.01mm	120m/min ±0.01mm	80m/min ±0.02mm
8m/min ±0.002mm	10m/min ±0.002mm	10m/min ±0.002mm
Refer to individual Switch Element Data		
FD*	FD*	-
FE*	FE*	-
-	-	FC

Ordering Code

(see facing page)

*Requires taller terminal compartment cover.

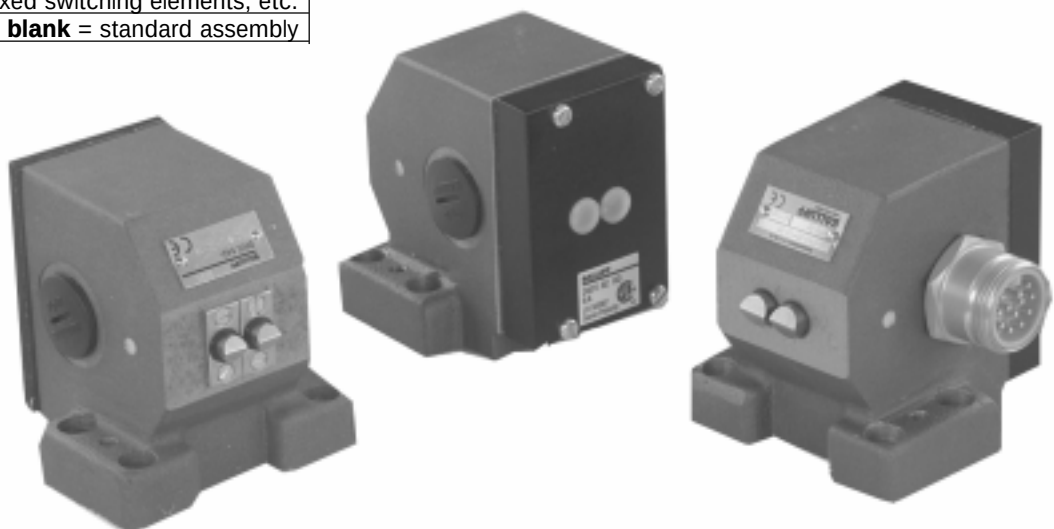
Plunger styles



Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

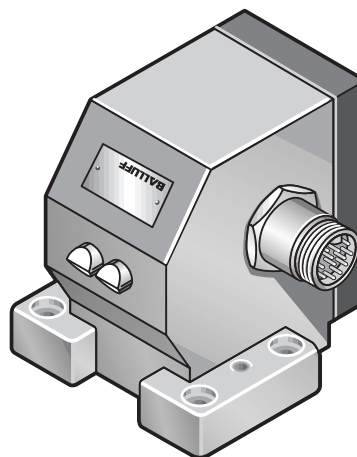
Ordering Code		BNS - 813 - B05 - R12 - 72 - 10 - 03 - FD - ####									
Balluff Cam Switch	BNS										
Conduit openings	542 = Pg standard										
and VDE 0113 safety	819 = metric standard*										
	113 = Pg safety										
	813 = metric safety*										
Housing Form	B = standard										
	E = wiper rings (chisel plunger only)										
Number of plungers	02...06, 08, 10, 13, 16										
Plunger Type	D = chisel										
	R = roller										
	L = ball bearing roller										
	K = ball tip										
Plunger spacing, mm	12										
Housing designation	72										
Switch element	10 = BSE-30 only										
542 & 819	10 = BSE 61 & BSE-30 mixed										
113 & 813	12 = BSE-61 only										
	20 = BSE 85 & BSE-30 mixed										
	22 = BSE-61 only										
Number of safety elements	01...16 = No. of BSE-61 or BSE-85										
starting at flange	blank = BSE-30 or BSE-82 only										
LED options	FD = 6...60 V AC/DC										
	FE = 90...250 V AC/DC										
	blank = no LED										
Custom assembly	#### = factory suffix indicating										
	special configuration such as										
	custom pre-wired connector,										
	mixed switching elements, etc.										
	blank = standard assembly										

*Consult factory for availability.



Housing Designation
Housing Form
Axis of Motion
Plunger Centerline Spacing
Operating Principle

Series 72 Mechanical/Electronic
Compact Terminal Compartment
Perpendicular to Mounting Surface
12 mm
Mechanically actuated, electronically switched



Housing material
Housing coating
Protection class
Plunger material
Plunger guide bushing material
Terminal compartment gasket material
Plunger sealing membrane material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature

Switching Element

Contact arrangement & type
Application - solid state switching in metal chip environment
Switch actuation force
Switching frequency
Plunger construction
Approach velocity
Chisel plunger type D
Roller plunger type R
Ball bearing roller plunger type L
Ball plunger type K

Switchpoint repeatability
Electrical characteristics
LED function indication

Ordering Code

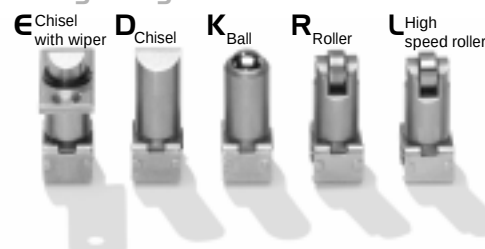
Mechanical Data

sand-cast aluminum
gray anodized
IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P, 11, 12, 13
stainless steel
Teflon (PTFE) & lead impregnated sintered tin & bronze over steel, self-lubricating
Buna-N rubber
Buna-N rubber
Buna-N rubber
Polyamid PA 6.6 15% glass fiber reinforced
refer to Installation Notes and Dimensional Information section
refer to individual Sensor Element Data

BES-516-110-D(14DH)	BES-516-108-D(14DF)	BES-517-410-J(14JJ)	BES-517-421-J (14JK)
PNP complementary	NPN complementary	2-wire NO	2-wire NC
10...30 V DC	10...30 V DC	90...250 V AC	90...250 V AC
15 N	15 N	15N	15N
300/min	300/min	300/min	300/min
telescoping overtravel	telescoping overtravel	telescoping overtravel	telescoping overtravel
10m/min	10m/min	10m/min	10m/min
20m/min	20m/min	20m/min	20m/min
120m/min	120m/min	120m/min	120m/min
8m/min	8m/min	8m/min	8m/min
	refer to individual Switch Element Data		
	refer to individual Switch Element Data		
included	included	included	included

(see facing page)

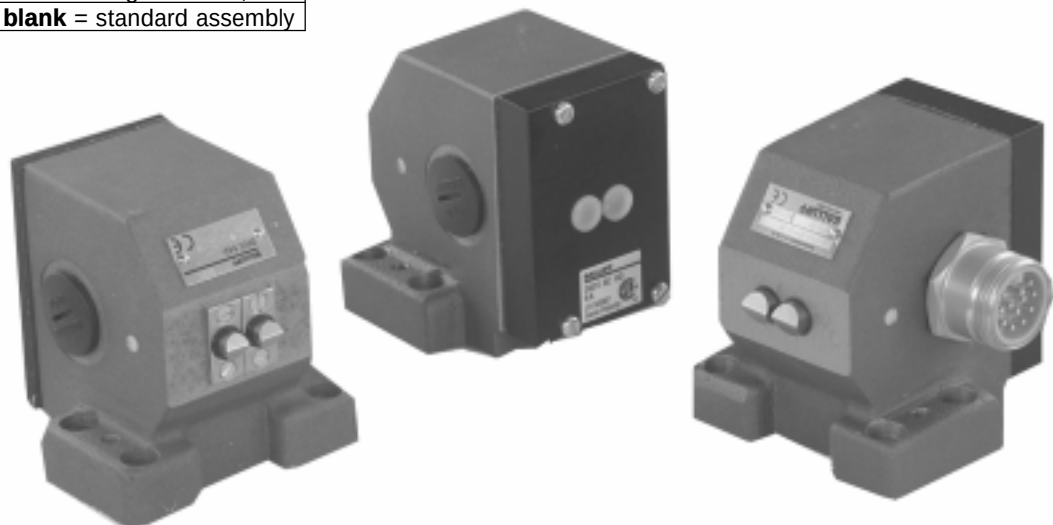
Plunger styles



Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

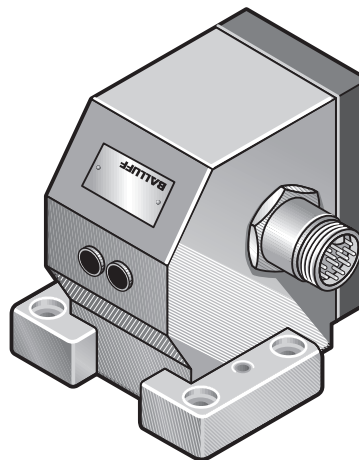
Ordering Code		BNS - 819 - B03 - R12 - 72- 14 - DH - ####									
Balluff Cam Switch	BNS										
Conduit openings	542 = Pg 819 = metric										
Housing Form	B = standard										
Number of plungers	02...06, 08, 10, 13, 16										
Plunger type	D = chisel R = roller L = ball bearing roller K = ball tip										
Plunger spacing, mm	12										
Housing designation	72										
Inductive sensor element	14-DH = BES-516-110-D 14-DF = BES-516-108-D 14-JJ = BES-516-410-J 14-JK = BES-516-421-J										
Custom Assembly	#### = factory suffix indicating special configuration such as custom pre-wired connector, mixed switching elements, etc. blank = standard assembly										

*Consult factory for availability



Housing Designation
Housing Form
Axis of Motion
Plunger Centerline Spacing
Operation Principle

Series 605-11 Inductive (similar to Series 72 Mechanical)
Full Size Terminal Compartment per DIN 43.697
Perpendicular to Mounting Surface
12 mm
Inductive sensing, electronic switching



Housing material
Housing coating
Protection class
Terminal compartment gasket material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature

Inductive Sensor Element

Contact arrangement & type
Applications - non-contact sensing, electronic switching, chip-free

Inductive Sensor Element

Contact arrangement & type
Applications - non-contact sensing, electronic switching, chip-free

Inductive Sensor Element

Contact arrangement & type
Applications - **intrinsically safe**

Switching frequency
Switchpoint repeatability
Electrical characteristics
LED function indication

Ordering Code**Mechanical Data**

die-cast aluminum
grey anodized
IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P, 11, 12, 13
Buna-N rubber
Buna-N rubber
Polyamid PA 6.6 15% glass fiber reinforced
refer to Installation Notes and Dimensional Information section

refer to individual Sensor Element Data

BES-516-110(PA)	BES-516-108(NA)	BES-517-410(WS)*	BES-517-421 (WO)**
PNP complementary	NPN complementary	2-wire NO	2-wire NC
10...60 V DC	10...60 V DC	90...250 V AC	90...250 V AC
BES-517-560-H(KHG)	BES-517-561-H(KHH)	BES-516-410(EJ)*	BES-517-421 (EK)**
2-wire NO	2-wire NC	2-wire NO	2-wire NC
10...55 V DC	10...55 V DC	90...250 V AC	90...250 V AC
BES-516-314-N(NG)			
2-wire NAMUR			
7.7...9.0 V DC			
	refer to individual Sensor Element Data		
	refer to individual Sensor Element Data		
	refer to individual Sensor Element Data		
included	included	included	included
(see facing page)			

* WS & EJ interchangeable.

** WO & EK interchangeable.
EJ & EK are obsolete.

Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

Ordering Code		BNS - 816- B03 - NA - 12 - 605 - 11 - #####					
Balluff Cam Switch	BES-516 = Pg						
Conduit openings	BNS-816 = metric						
Housing Form	B = standard						
Number of sensing positions	02...06, 08, 10, 13, 16						
Inductive sensor element	PA = BES-516-110						
	NA = BES-516-108						
	WS = BES-517-410						
	WO = BES-517-421						
	KHG = BES-517-560-H						
	KHH = BES-517-561-H						
	EJ = BES-516-410**						
	EK = BES-516-421**						
	NG = BES-516-314-N						
Sensor spacing, mm	12						
Housing designation	605-11						
Custom assembly	##### = factory suffix indicating special configuration such as customer pre-wired connector, mixed switching elements, etc.						
	blank = standard assembly						

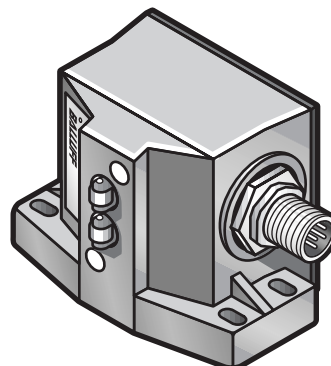
* Consult factory for availability.

** EJ & EK are obsolete.



Housing Designation
Housing Form
Axis of Motion
Plunger Centerline Spacing
Operation Principle

Series 46 Mechanical
Miniature Terminal Compartment and Reduced Dimension Mounting Flange
Parallel to Mounting Surface
8mm
Mechanically actuated and mechanically switched



Housing material
Housing coating
Protection class
Plunger material
Plunger guide bushing material
(consult factory for availability)
Terminal compartment gasket material
Plunger sealing membrane material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature

Model
Switch Element
Contact arrangement & type
Application
Switch actuation force
Switching frequency
Plunger construction
Approach velocity
Chisel plunger type D
Switchpoint repeatability
Type D in wiper ring housing form E
Roller plunger type R
Ball plunger type K

Electrical characteristics
LED function indication options (consult factory for availability)
24 V DC

Ordering Code

Mechanical Data

die-cast aluminum
grey anodized
IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P
stainless steel
Teflon (PTFE) & lead impregnated sintered tin & bronze over steel, self-lubricating
hardened aluminum, coolant-lubricated
Buna-N rubber (standard), Viton (version X512)
Buna-N rubber (standard), Viton (version X512)
Buna-N rubber (standard), Viton (version X512)
Polyamid PA 6.6 15% glass fiber reinforced
refer to Installation Notes and Dimensional Information section

-5...+80°C

519 & 819

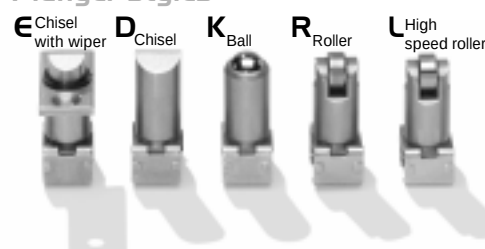
BSE-75	BSE-76	BSE-82*
C+NO+NC snap action	C+NO+NC snap action	C+NO+NC snap action
solder terminals (vibration)	side entry screw terminals	top entry screw terminals
8 N	8 N	8 N
200/min	200/min	200/min
telescoping overtravel	telescoping overtravel	telescoping overtravel
8m/min ±0.02mm	8m/min ±0.02mm	8m/min ±0.02mm
8m/min ±0.02mm	8m/min ±0.02mm	8m/min ±0.02mm
60m/min ±0.05mm	60m/min ±0.05mm	60m/min ±0.05mm
9m/min ±0.03mm	9m/min ±0.03mm	9m/min ±0.03mm

Refer to individual Switch Element Data

FC	FC*	-
(see facing page)		

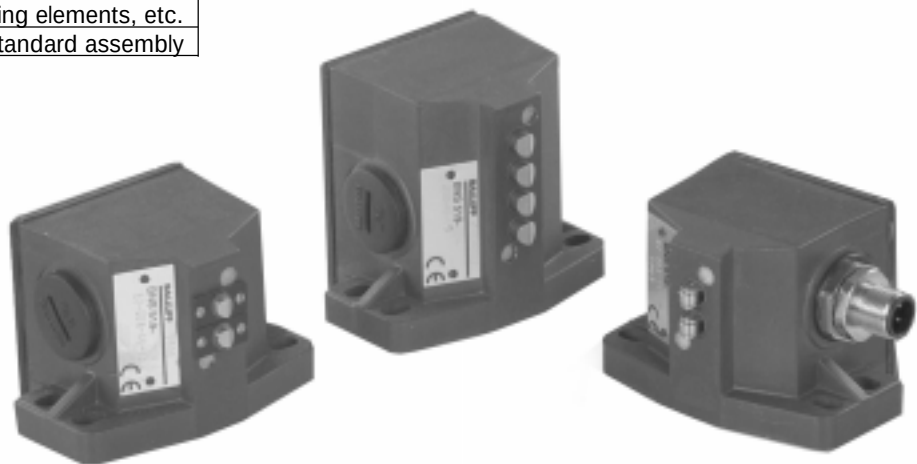
*Requires taller terminal compartment cover.

Plunger styles



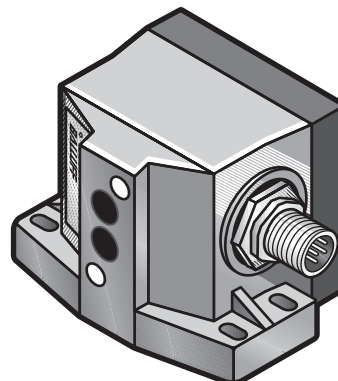
Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

Ordering Code		BNS - 819 - X512 - B04 - R08 - 46 - 13 - FC - #####									
Balluff Cam Switch	BNS										
Conduit openings	519 = Pg standard 819 = metric standard										
Viton option	X512 = Viton blank = Buna-N										
Housing Form	B = standard E = wiper rings (chisel plunger only)										
Number of plungers	BSE-75 & BSE-76 02...06, 08, 10, 12 BSE-82 02...04										
Plunger type	D = chisel R = roller K = ball tip										
Plunger spacing, mm	08										
Housing designation	46										
Switch element	12 = BSE-75 13 = BSE-76 3B = BSE-82										
	BSE-75 & BSE-76 only FC = 24 V										
LED options	DC blank = no LED										
Custom assembly	##### = factory suffix indicating special configuration such as custom pre-wired connector, mixed switching elements, etc. blank = standard assembly										



Housing Designation
Housing Form
Axis of Motion
Plunger Centerline Spacing
Operation Principle

Series 603-11 Inductive (similar to Series 46 Mechanical)
Miniature Terminal Compartment and Reduced Dimension Mounting Flange
Parallel to Mounting Surface
8 mm
Inductive sensing, electronic switching



Housing material
Housing coating
Protection class
Terminal compartment gasket material
Plunger sealing membrane material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature
Inductive Sensor Element
Contact arrangement & type
Applications - non-contact sensing, electronic switching, chip-free
Switching frequency
Switchpoint repeatability
Electrical characteristics
LED function indication
Ordering Code

Mechanical Data	
die-cast aluminum	
grey anodized	
IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P	
Buna-N rubber standard	
Buna-N rubber standard	
Buna-N rubber standard	
Polyamid PA 6.6 15% glass fiber reinforced	
refer to Installation Notes and Dimensional Information section	
-5...+80°C	
BES-517-312-Y (TOB)	BES-517-312-Y (TOB)
PNP NO	NPN NO
10...30 V DC	10...30 V DC
refer to individual Sensor Element Data	
refer to individual Sensor Element Data	
refer to individual Sensor Element Data	
included	included
(see facing page)	

Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-III
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69



Housing Designation

Housing Form

Axis of Motion

Plunger Centerline Spacing

Operation Principle

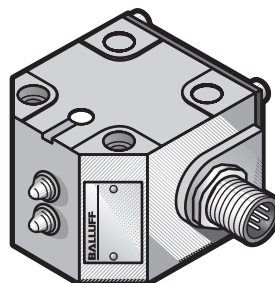
Series 40 Mechanical

Miniature Terminal Compartment and Minimum Footprint Mounting Flange

Parallel to Mounting Surface

8 mm

Mechanically actuated and switched



Housing material

Housing coating

Protection class

Plunger material

Plunger guide bushing material standard
(consult factory for availability) version X512

Terminal compartment gasket material

Plunger sealing membrane material

Conduit plug O-ring material

Conduit plug material

Dimensions & Installation

Ambient temperature

Model

Switch Element

Contact arrangement & type

Application

Switch actuation force

Switching frequency

Plunger construction

Approach velocity, Chisel plunger type D

Switchpoint repeatability Type D in wiper ring housing form E

Roller plunger type R

Ball plunger type K

Electrical characteristics

LED function indication options (consult factory for availability) 24 V DC

Ordering Code

Mechanical Data

die-cast aluminum

grey anodized

IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P

stainless steel

Teflon (PTFE) & lead impregnated sintered tin & bronze over steel, self-lubricating

hardened aluminum, coolant-lubricated

Buna-N rubber (standard), Viton (version X512)

-

-

Polyamid PA 6.6 15% glass fiber reinforced

refer to Installation Notes and Dimensional Information section

-5...+80°C

519 & 819

BSE-75

BSE-75

C+NO+NC snap action

C+NO+NC snap action

solder terminals (vibration)

side entry screw terminals

8 N

8 N

200/min

200/min

telescoping overtravel

telescoping overtravel

8m/min ±0.02mm

8m/min ±0.02mm

8m/min ±0.02mm

8m/min ±0.02mm

60m/min ±0.05mm

60m/min ±0.05mm

9m/min ±0.03mm

9m/min ±0.03mm

Refer to individual Switch Element Data

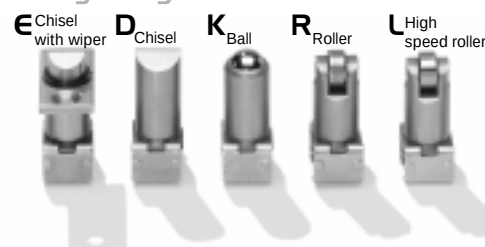
FC*

FC*

(see facing page)

*Requires taller terminal compartment cover.

Plunger styles



Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

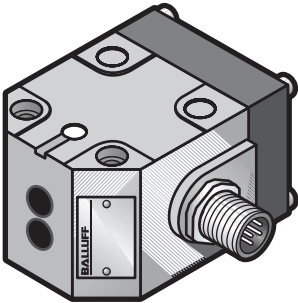
Ordering Code		BNS - 819 - X512 - B04 - R08- 40 - 13 - FC - #####									
Balluff Cam Switch	BNS										
Conduit openings	519 = Pg standard 819 = metric standard										
Viton option	X512 = Viton blank = Buna-N										
Housing Form	B = standard E = wiper rings (chisel plunger only)										
Number of plungers	02...06										
Plunger type	D = chisel R = roller K = ball tip										
Plunger spacing, mm	08										
Housing designation	40										
Switch element	12 = BSE-75 13 = BSE-76										
LED options	FC = 24 V DC** blank = no LED										
Custom assembly	##### = factory suffix indicating special configuration such as custom pre-wired connector, mixed switching elements, etc. blank = standard assembly										

**Available 2-position only.



Housing Designation
Housing Form
Axis of Motion
Plunger Centerline Spacing
Operation Principle

Series 650-11 Inductive (similar to Series 40 Mechanical)
Minature Terminal Compartment and Minimum Footprint Mounting Flange
Parallel to Mounting Surface
8 mm
Inductive sensing, electronic switching



Housing material
Housing coating
Protection class
Terminal compartment gasket material
Plunger sealing membrane material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature
Inductive Sensor Element
Contact arrangement & type
Applications - non-contact sensing, electronic switching, chip-free
Switching frequency
Switchpoint repeatability
Electrical characteristics
LED function indication options
Ordering Code

Mechanical Data	
die-cast aluminum	
grey anodized	
IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P	
Buna-N rubber standard	
Buna-N rubber standard	
Buna-N rubber standard	
Polyamid PA 6.6 15% glass fiber reinforced	
refer to Installation Notes and Dimensional Information section	
refer to individual Sensor Element Data	
BES-517-312-Y (TOB)	BES-517-311-Y (TNB)
PNP NO	NPN NO
10...30 V DC	10...30 V DC
refer to individual Sensor Element Data	
refer to individual Sensor Element Data	
refer to individual Sensor Element Data	
included	included
(see facing page)	

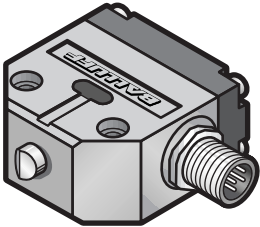
Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-III
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

Ordering Code		BNS - 816- B03 - TOB - 08 - 650 - 11 - #####						
Balluff Cam Switch	BES-516 = Pg							
Conduit openings	BNS-816 = metric							
Housing Form	B = standard							
Number of sensing positions	02...06, 08, 10, 12							
Inductive sensor element	TOB = BES-517-312-Y							
	TNB = BES-517-311-Y							
Sensor spacing, mm	08							
Housing designation	650-11							
Custom assembly	#### = factory suffix indicating special configuration such as custom pre-wired connector, mixed switching elements, etc.							
	blank = standard assembly							



Housing Designation
Housing Form
Axis of Motion
Operation Principle

Series 99 and Series 100 Mechanical
Miniature Terminal Compartment and Minimum Footprint Mounting Flange
Parallel or Perpendicular to Mounting Surface
Mechanically actuated and switched



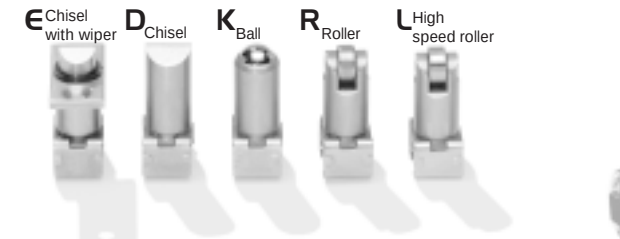
Housing material
Housing coating
Protection class
Plunger material
Plunger guide bushing material
standard version X512
Terminal compartment gasket material
Plunger sealing membrane material
Conduit plug O-ring material
Conduit plug material
Dimensions & Installation
Ambient temperature
Model
Switch Element
Contact arrangement & type
Application
Switch actuation force
Switching frequency
Plunger construction
Approach velocity, Chisel plunger type D
Switchpoint repeatability Type D in wiper ring housing form E
Roller plunger type R
Ball plunger type K
Electrical characteristics

Mechanical Data	
die-cast aluminum	
grey anodized	
IP 67 (DIN 40.050); NEMA 4, 4X, 6, 6P	
stainless steel	
Teflon (PTFE) & lead impregnated sintered tin & bronze over steel, self-lubricating	
hardened aluminum, coolant-lubricated	
Buna-N rubber (standard), Viton (version X512)	
"	
"	
Polyamid PA 6.6 15% glass fiber reinforced	
refer to Installation Notes and Dimensional Information section	
-5...+80°C	
519 & 819	
BSE-73	BSE-74*
C+NO+NC snap action	C+NO+NC snap action
solder terminals (vibration)	side entry screw terminals
8 N	8 N
200/min	200/min
telescoping overtravel	telescoping overtravel
8m/min ± 0.02 mm	8m/min ± 0.02 mm
8m/min ± 0.02 mm	8m/min ± 0.02 mm
60m/min ± 0.05 mm	60m/min ± 0.05 mm
9m/min ± 0.03 mm	9m/min ± 0.03 mm
Refer to individual Switch Element Data	

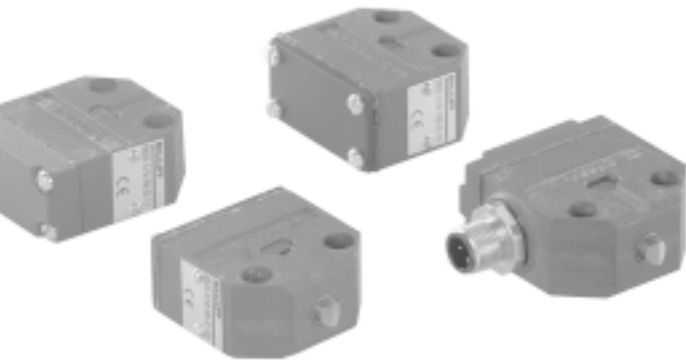
Ordering Code

(see facing page)
*Requires taller terminal compartment cover.

Plunger styles



Switch Element Data	Pages 50-51
Linear Cam Trays	Pages 71-85
Linear Trip Cams	Pages 89-97
Rotary Cam Drums	Pages 99-102
Rotary Trip Cams	Pages 103-111
Connectors & Cables	Pages 54-57
Accessories & Fittings	Pages 58-59
Installation Guidelines	Page 60
Dimensions	Pages 61-69

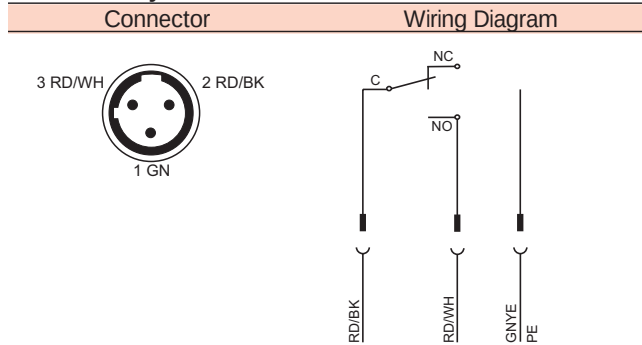


Ordering Code	BNS - 819- X512 - 100 - E13 - FC - S4
Balluff Cam Switch BNS	
Conduit openings 519 = Pg 819 = metric*	
Viton option X512 = Viton blank = Buna-N	
Housing Designation & Form 519-099 = Pg 07 conduit 519-100 = Pg 09 conduit 819-099 = M12 conduit 819-100 = M16 conduit	Outside dimensions +2mm greater than 099 version
Plunger type D = chisel** R = roller** ED = chisel plunger with wiper ring** K = ball tip**	
Switch element 12 = BSE-73 13 = BSE-74	
Connector option S4 = 4-pole DC micro S21 = 2-pole AC micro (100 only) S80 = 4-pole AC micro (100 only) blank = no connector	

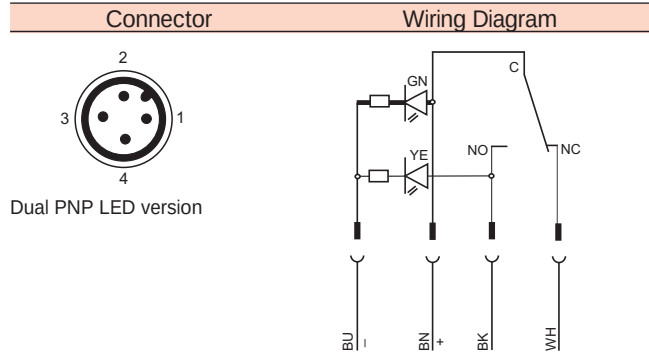
* Consult factory for availability.

** Approach direction user-configurable,
depress plunger, twist 90°, release.

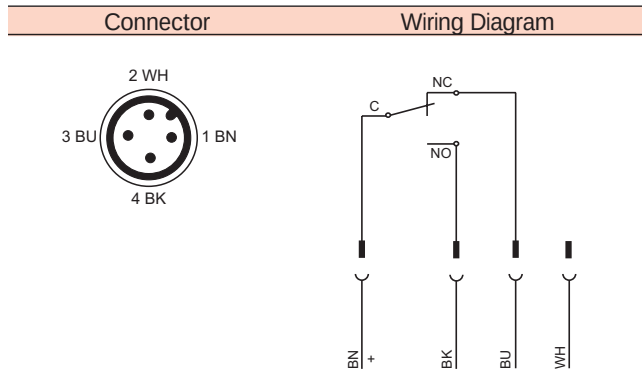
S21 100 only



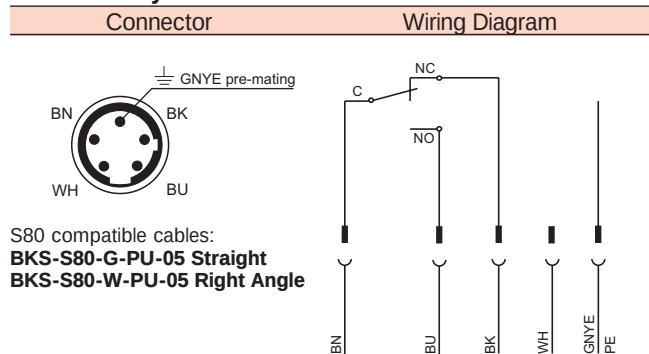
BNS-519-X499-100-R-11



S4 099 &100



S80 100 only



S80 compatible cables:
BKS-S80-G-PU-05 Straight
BKS-S80-W-PU-05 Right Angle

Series

Switch Type

BSE-30

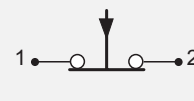
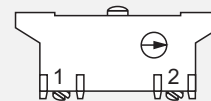
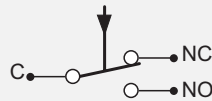
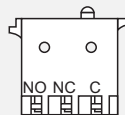
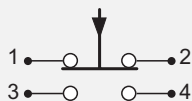
Snap Switch

BSE-82

Snap Switch

BSE-61

Safety creep switch VDE 0113



Ordering Code

BSE-30

BSE-82

BSE-61

Construction

Housing material

Housing cover material

Contact material

Contact system

Switch system

Contact arrangement

Contact isolation

Connection means

duroplastic

thermoplastic

gold plated fine silver

double break

snap action mechanism

NO + NC

thermal and galvanic

screw terminals with self-lifting clamps

thermoplastic PA

thermoplastic PA

gold crosspoint

single break

snap action mechanism

C + NO + NC

spring not current-carrying

screw terminals with self-lifting clamps

duroplastic

thermoplastic

fine silver

double break

creep opening

positive drive NC to VDE 0113

thermal and galvanic

screw terminals with self-lifting clamps

Mechanical data

Actuation force at plunger

Switch-back force at plunger

Bounce time at 10mm/min cam velocity

Switch changeover time

Switching frequency

Ambient temperature range

4.8 N

1.3 N

1.5 ms

10 ms

300/min

-30...+90°C

1.55 N

0.75 N

2 ms

10 ms

3.3 Hz

-20...+85°C

12 N

2.5 N

1.5 ms

depends on cam velocity

200/min

-30...+90°C

Electrical data

Insulation class

Nominal voltage rating

Constant current rating

Minimum load current @ 24 V DC

Contact resistance when new

Current rating, AC inductive loads, 250 V AC, 40...60 Hz

Group C VDE 0110

240 V AC

6 A

20 mA

40 mΩ

6 A (cos Θ = 1)

2 A (cos Θ = 0.8)

1 A (cos Θ = 0.4)

0.5 A

4 A

Group C VDE 0110

4...30 V DC

5 A

10 mA

240 mΩ

5 A (cos Θ = 1)

2 A (cos Θ = 0.8)

-

0.5 A

5 A

Group C VDE 0110

250 V AC

6 A, depends on velocity, frequency

20 mA

-

-

-

-

-

-

Life Expectancy (standard conditions)

Mechanical, operations at 1.6 cycles/sec (VDE 0660 E3)

Electrical

> 50 million

depends on load, velocity, frequency

> 10 million

depends on load, velocity, frequency

> 50 million

depends on load, velocity, frequency

Approvals

UL, cUL

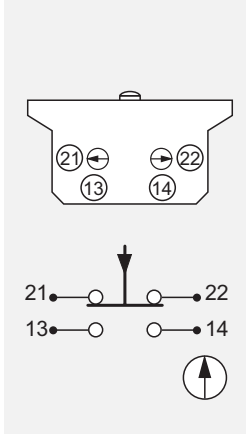
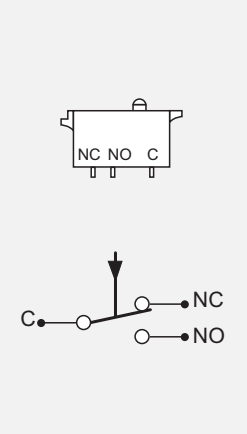
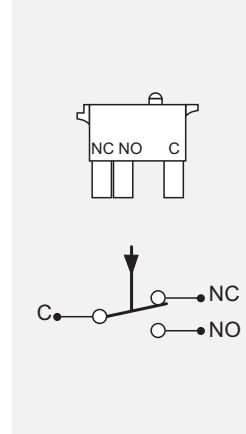
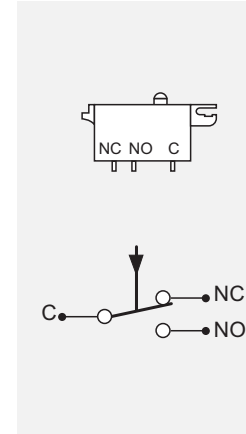
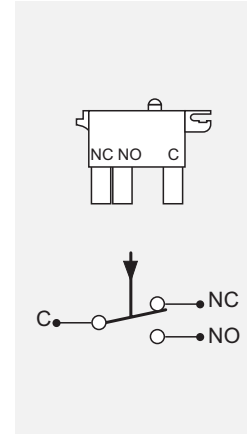
E66808

SUVA No. 542/1983 (single)

SUVA No. 789/1983 (multiple)

in conjunction with rigid plunger

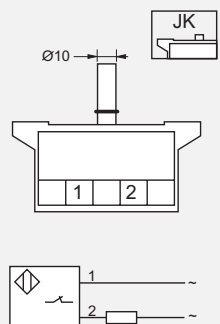
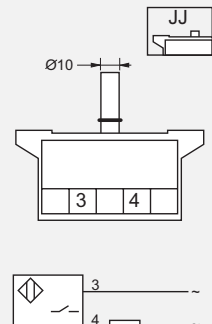
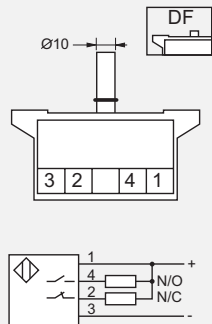
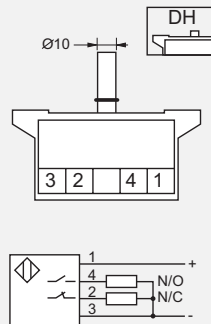
= Positive opening contact for safety applications.

BSE-85 Safety snap switch VDE 0113	BSE-73 Snap Switch	BSE-74 Snap Switch	BSE-75 Snap Switch	BSE-76 Snap Switch
				
BSE-85	BSE-73	BSE-74	BSE-75	BSE-76
fiberglass-reinforced thermoplastic thermoplastic PA fine silver double break snap action mechanism NO + positive drive NC to IEC 60947-5-1 thermal and galvanic screw terminals with self-lifting clamps	thermoplastic thermoplastic gold plated silver single break snap action mechanism C + NO + NC spring not current-carrying solder terminals	thermoplastic thermoplastic gold plated silver single break snap action mechanism C + NO + NC spring not current-carrying screw terminals with self-lifting clamps	thermoplastic thermoplastic gold plated silver single break snap action mechanism C + NO + NC spring not current-carrying solder terminals	thermoplastic thermoplastic gold plated silver single break snap action mechanism C + NO + NC spring not current-carrying screw terminals with self-lifting clamps
18 N 0.8 N 3 ms 1.5 ms, min. velocity 1mm/min 3000/hour -30...+85°C	1.45N 0.50 N 2 ms 10 ms 200/min -20...+85°C	1.45N 0.50 N 2 ms 10 ms 200/min -20...+85°C	1.45N 0.50 N 2 ms 10 ms 200/min -20...+85°C	1.45N 0.50 N 2 ms 10 ms 200/min -20...+85°C
Group C VDE 0110 250 V AC 10 A 20 mA 40 mΩ 10 A (cos Θ = 1) 25 A (cos Θ = 0.7) - 2.5 A 4 A	Group C VDE 0110 250 V AC, 4...30 V DC 5 A, 100 mA 10 mA 240 mΩ - 2 A (cos Θ = 0.8, 200 V AC) - - 5 A (L/R = 10 ms)	Group C VDE 0110 250 V AC, 4...30 V DC 5 A, 100 mA 10 mA 240 mΩ - 2 A (cos Θ = 0.8, 200 V AC) - - 5 A (L/R = 10 ms)	Group C VDE 0110 250 V AC, 4...30 V DC 5 A, 100 mA 10 mA 240 mΩ - 2 A (cos Θ = 0.8, 200 V AC) - - 5 A (L/R = 10 ms)	Group C VDE 0110 250 V AC, 4...30 V DC 5 A, 100 mA 10 mA 240 mΩ - 2 A (cos Θ = 0.8, 200 V AC) - - 5 A (L/R = 10 ms)
> 5 million depends on load, velocity, frequency	> 10 million depends on load, velocity, frequency	> 10 million depends on load, velocity, frequency	> 10 million depends on load, velocity, frequency	> 10 million depends on load, velocity, frequency

 = Positive opening contact for safety applications.

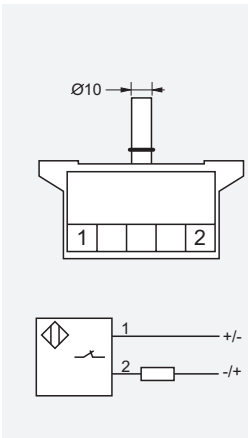


Series	BES-516-110 (PA)	BES-516-108 (NA)	BES-517-410(WS), BES-516-410 (EJ)	BES-517-421(WO), BES-516-421 (EK)
Sensor Type	Inductive proximity	Inductive proximity	Inductive proximity	Inductive proximity
Mounting	Flush (shielded)	Flush (shielded)	Flush (shielded)	Flush (shielded)



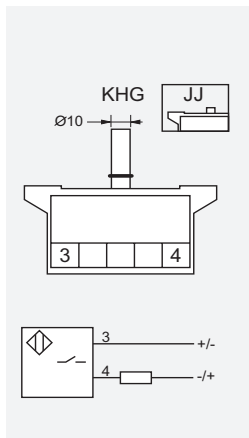
Ordering Code	BES-516-110 (PA) BES-516-110-D (14DH)	BES-516-108 (NA) BES-516-108-D (14DF)	BES-517-410(WS) BES-516-410 (EJ) BES-516-410-J (14JJ)	BES-517-421(WO) BES-516-421 (EK) BES-516-421-J (14JK)
Construction				
Housing material	Polyamide PA 6.6/PBTR	Polyamide PA 6.6/PBTR	Polyamide PA 12	Polyamide PA 12
Connection means	screw terminals	screw terminals	screw terminals	screw terminals
Ambient temperature range	-25...+70°C	-25...+70°C	-25...+70°C	-25...+70°C
Sensing data				
Nominal sensing range	2.0 mm	2.0 mm	2.0 mm	2.0 mm
Effective operating distance	0...1.6 mm	0...1.6 mm	0...1.6 mm	0...1.6 mm
Switching hysteresis	15%	15%	15%	15%
Electrical data				
Logic	DC PNP current sourcing	DC NPN current sinking	AC	AC
Output function	4-wire complementary (NO+NC)	4-wire complementary (NO+NC)	2-wire NO	2-wire NC
Supply voltage	10...60 V DC	10...60 V DC	90...250 V AC, 45...65 Hz	90...250 V AC, 45...65 Hz
Supply voltage ripple	15%	15%	-	-
Load current capacity	200 mA	200 mA	20...100mA, 1.0 A inrush	20...100mA, 1.0 A inrush
Switching frequency, max	3 kHz	3 kHz	15 Hz	15 Hz
Voltage drop	-	-	-	-
Short circuit protected	yes	yes	no	no
LED function display	yes	yes	yes	yes
Approvals	UL, cUL E117437	UL, cUL E117437	UL, cUL E117437	UL, cUL E117437

BES-517-560-H (KHG)
Inductive proximity
Flush (shielded)



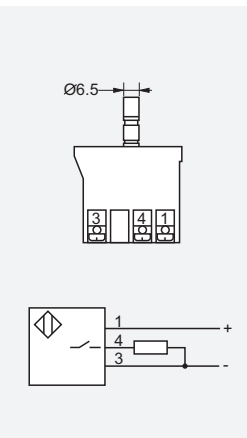
BES-517-560-H (KHG)

BES-517-561-H (KHH)
Inductive proximity
Flush (shielded)



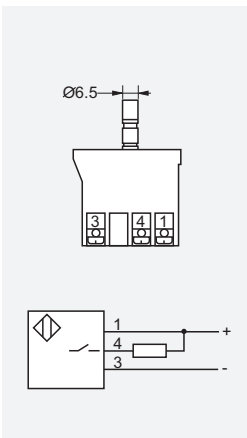
BES-517-561-H (KHH)

BES-517-312-Y (TOB)
Inductive proximity
Flush (shielded)



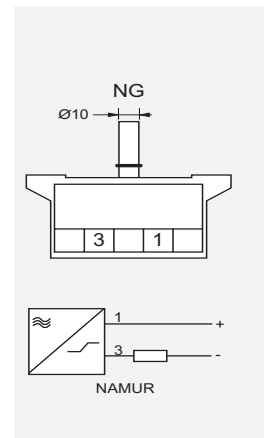
BES-517-312-Y (TOB)

BES-517-311-Y (TNB)
Inductive proximity
Flush (shielded)



BES-517-311-Y (TNB)

BES-516-314-N (NG)
Inductive proximity, NAMUR
Flush (shielded)



BES-516-314-N (NG)

Polyamide PA 12
screw terminals
-25...+70°C

2.0 mm
0...1.6 mm
20%

DC
2-wire NO
10...55 V DC
15 %
5...100 mA
3 kHz
7 V
yes
yes

UL,cUL
E117437

Polyamide PA 12
screw terminals
-25...+70°C

2.0 mm
0...1.6 mm
20%

DC
2-wire NC
10...55 V DC
15 %
5...100 mA
3 kHz
7 V
yes
yes

Polyamide PA 6.6/PBTR
screw terminals
-25...+70°C

1.1 mm
0...0.9 mm
15%

DC PNP current sourcing
3-wire NO
10...30 V DC
15 %
130 mA
500 Hz
-
yes
yes

UL,cUL
E117437

Polyamide PA 6.6/PBTR
screw terminals
-25...+70°C

1.1 mm
0...0.9 mm
15%

DC NPN current sinking
3-wire NO
10...30 V DC
15 %
130 mA
500 Hz
-
yes
yes

UL,cUL
E117437

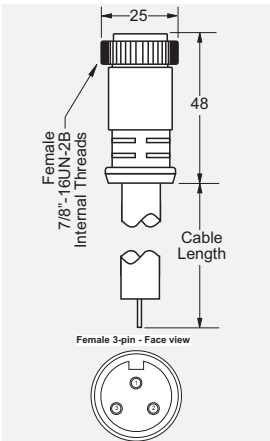
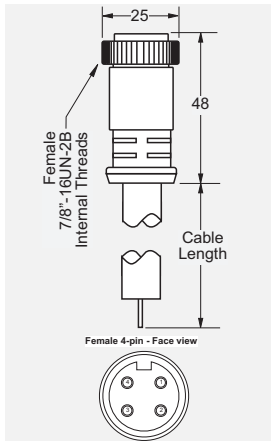
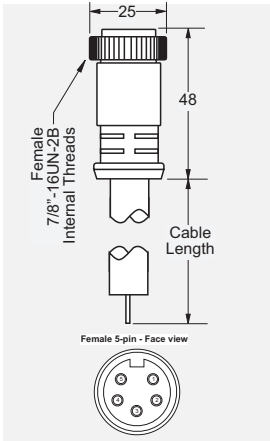
Polyamide PA 12
screw terminals
-25...+70°C

2.0 mm
0...1.6 mm
20%

DC
2-wire NC
10...55 V DC
15 %
5...100 mA
3 kHz
7 V
yes
yes

UL,cUL
E117437
FM 4V9A4.AX

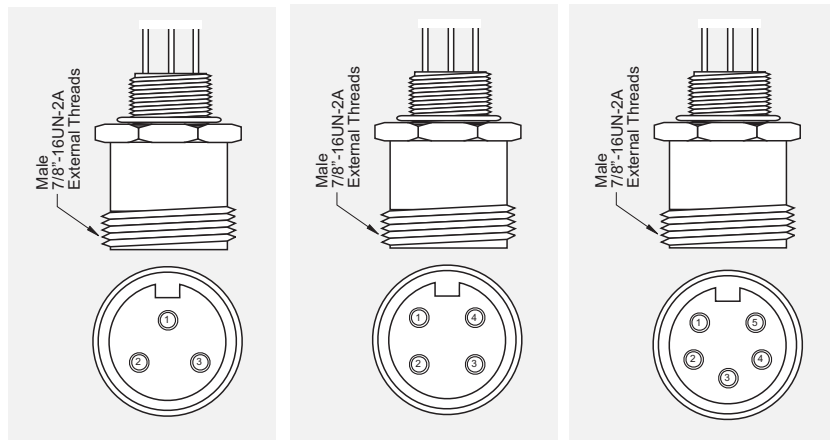
Use with approved energy barrier
switching amplifier.
Refer to Sensor Catalog, BES NAMUR section

Connector Type	Circular Mini	Circular Mini	Circular Mini
Description	Female Cable	Female Cable	Female Cable
Coupling Threads	7/8"-16 UN-2A	7/8"-16 UN-2A	7/8"-16 UN-2A
Poles	3	4	5
			

Ordering Code			
PVC	C05 AE1 00 VY 150F	C05 AE4 00 VY 150F	CA05 AE18 VY 200F
TPE			
PUR			

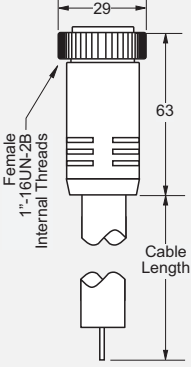
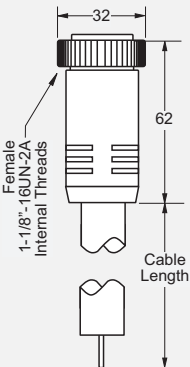
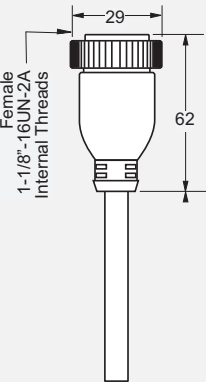
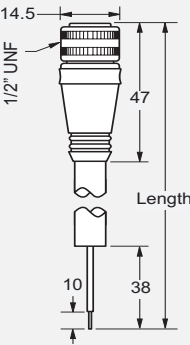
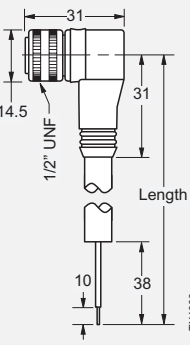
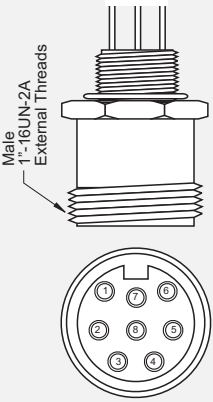
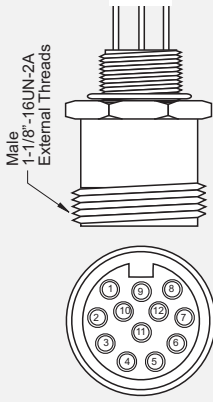
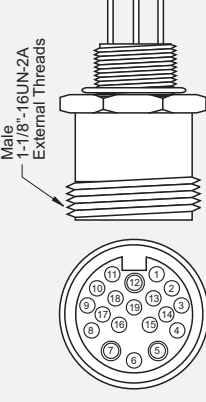
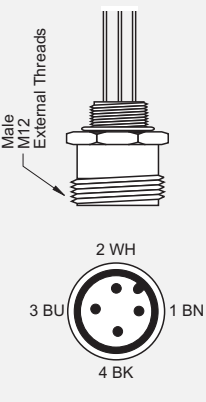
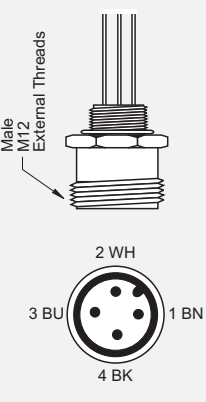
Specifications			
Length	15 feet	15 feet	20 feet
No. of conductors x gauge	(3) x 18 AWG	(4) x 16 AWG	(5) x 18 AWG
Voltage rating	300 V	600 V	300 V

Connector Type	Circular Mini	Circular Mini	Circular Mini
Description	Male Receptacle	Male Receptacle	Male Receptacle
Coupling Threads	7/8"-16 UN-2A	7/8"-16 UN-2A	7/8"-16 UN-2A
Poles	3	4	5

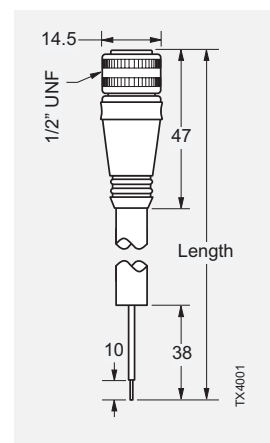
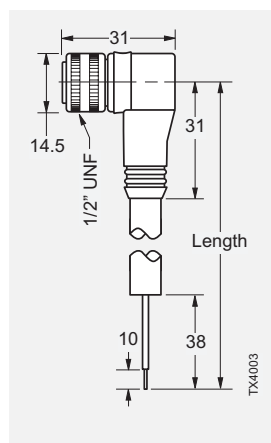
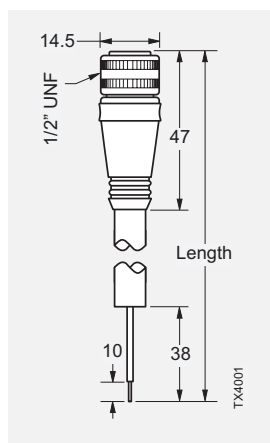


Ordering Code			
Mounting threads Pg 13.5	Z/03-PIN-MALE-RECP-PG-13.5	Z/04-PIN-MALE-RECP-PG-13.5	Z/05-PIN-MALE-RECP-PG-13.5
Mounting threads Pg 16			
Mounting threads Pg 09			
Mounting threads 1/2" NPT			

Specifications			
Lead Length	12"	12"	12"
No. of conductors x gauge	(3) x 18 AWG	(4) x 18 AWG	(5) x 18 AWG
Voltage rating	600 V	600 V	300 V

Circular Mini Female Cable 1"-16 UN-2A 8	Circular Mini Female Cable 1-1/8"-16 UN-2A 12	Circular Mini Female Cable 1-1/8"-16 UN-2A 19	Circular Micro Female Cable Straight M12 DC Single Key 4	Circular Micro Female Cable Right Angle M12 DC Single Key 4
				
CB08 AE18 VY 200F	CC12 AE18 VY 200F	CC19 AE22 VY 050M CC19 AE22 PB 050M	C04 AEL 00 VY 050M C04 AEL 00 TY 050M	C04 BEL 00VY 050M C04 BEL 00TY 050M
20 feet (8) x 18 AWG 300 V	20 feet (12) x 18 AWG 300 V	5 meters (3) x 18 (16) x 22 AWG 300 V	5 meters (4) x 22 AWG 300 V	5 meters (4) x 22 AWG 300 V
Circular Mini Male Receptacle 1"-16 UN-2A 8	Circular Mini Male Receptacle 1"-1/8"-16 UN-2A 12	Circular Mini Male Receptacle 1-1/8"-16 UN-2A 19	Circular Micro Male Receptacle M12 DC Single Key 4	Circular Micro Male Receptacle M12 DC Single Key 4
				
Z/08-PIN-MALE-RECP-PG-13.5 Z/08-PIN-MALE-RECP-PG-16	Z/12-PIN-MALE-RECP-PG-13.5 Z/12-PIN-MALE-RECP-PG-16	Z/19-PIN-MALE-RECP-PG-16.5	BKS-Z/RSF-4-S4-RECEPTACLE	BKS-Z/RSF-4-S4-RECEPTACLE
12" (8) x 18 AWG 300 V	12" (8) x 18 AWG 300 V	12" (3) x 18, (16) x 22 AWG 300 V	12" (4) x 22 AWG 300 V	12" (4) x 22 AWG 300 V

Connector Type	Circular Micro	Circular Micro	Circular Micro
Description	Female Cable Straight	Female Cable Right Angle	Female Cable Straight
Coupling Threads	1/2"-UNF AC Dual Key	1/2"-UNF AC Dual Key	1/2"-UNF AC Dual Key
Poles	3	3	4

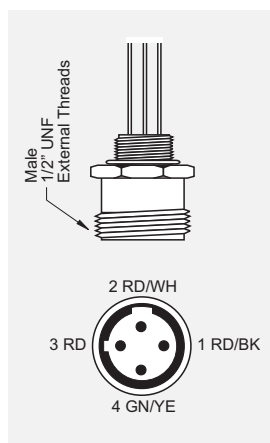
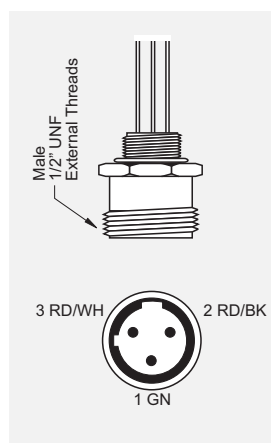
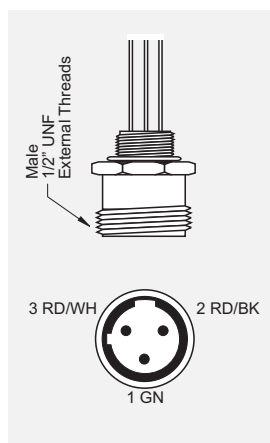


Ordering Code			
PVC	C21 AE3 00 VY 150F	C21 BE3 00 VY 150F	C21 AE4 00 VY 150F
TPE	C21 AE3 00 TY 150F	C21 BE3 00 TY 150F	C21 AE4 00 TY 150F
PUR			

Specifications

Length	15 feet	15 feet	15 feet
No. of conductors x gauge	(3) x 22	(3) x 22	(4) x 22
Voltage rating	300 V	300 V	300 V

Connector Type	Circular Micro	Circular Micro	Circular Micro
Description	Male Receptacle	Male Receptacle	Male Receptacle
Coupling Threads	1/2"-UNF AC Dual Key	1/2"-UNF AC Dual Key	1/2"-UNF AC Dual Key
Poles	3	3	4

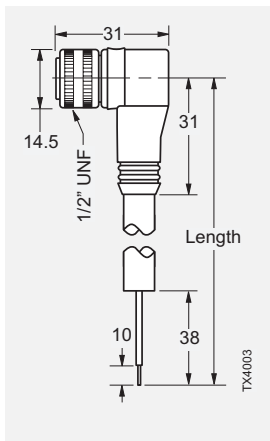


Ordering Code			
Mounting threads Pg 13.5			
Mounting threads Pg 16			
Mounting threads Pg 09	R-21-CA3-006M	R-21-CA3-006M	
Mounting threads 1/2" NPT			Z/04-PIN-MICRO-AC-RECP-1/2"NPT

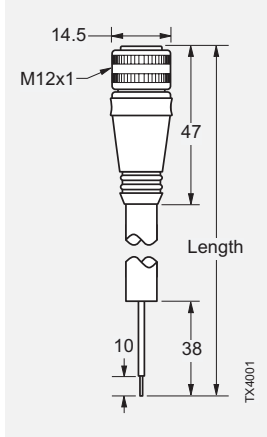
Specifications

Lead Length	12"	12"	12"
No. of conductors x gauge	(3) x 22	(3) x 22	(4) x 22
Voltage rating	300 V	300 V	300 V

Circular Micro
Female Cable Right Angle
1/2"-UNF AC Dual Key
4



Circular Micro
Female Cable Straight
M12 DC Single Key
8



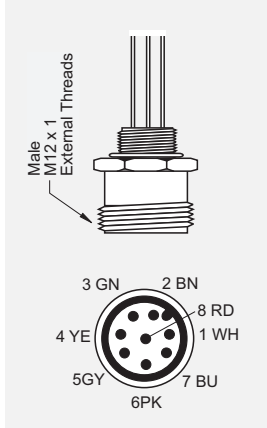
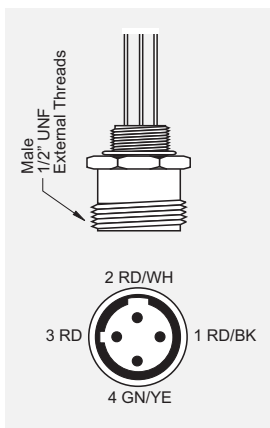
C21 BE4 00 VY 150F
C21 BE4 00 TY 150F

C04-AET-00-PB-050M

15 feet
(4) x 22
300 V

5 meters
(8) x 24
30 V AC, 36 V DC

Circular Micro
Male Receptacle
1/2"-UNF AC Dual Key
4



Z/04-PIN-MICRO-AC-RECP-1/2"NPT

R04-CA8-003M

12"
(4) x 22
300 V

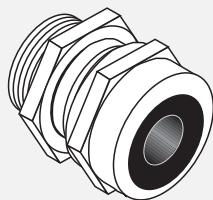
12"
(8) x 24
30 V AC, 36 V DC

Accessory Type
Description

Cord Seal
Pg Threaded

Cap, Sealing
Pg Threaded

Reducer
Pg to Pg



Ordering Code

PG-07-CORD-SEAL (Ø2...8mm)
PG-09-CORD-SEAL (Ø3...10mm)
PG-11-CORD-SEAL (Ø5...13mm)
PG-13.5-CORD-SEAL (Ø7...15mm)
PG-16-CORD-SEAL (Ø8...17mm)
PG-21-CORD-SEAL (Ø18...30mm)

PG-07-M*
Z/THREADED-CAP-PG-09
Z/THREADED-CAP-PG-11
Z/THREADED-CAP-PG-13.5
Z/THREADED-CAP-PG-16
Z/THREADED-CAP-PG-21

PG-11-M-TO-PG-09-F
PG-13.5-M-TO-PG-09-F
PG-13.5-M-TO-PG-11-F
PG-16-M-TO-PG-11-F
PG-16-M-TO-PG-13.5-F
PG-21-M-TO-PG-16-F

Materials

Buna-N seal
Nickel-plated brass

Plastic
* Nickel-plated brass

Nickel-plated brass

Application Notes

Order matching O-Ring separately

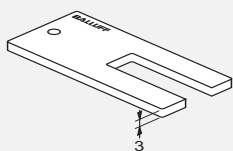
O-ring included

Order matching O-Ring separately

Accessory Type
Description

Set-Up Gauge
BSE-30 and BSE-61

Set-Up Gauge
BSE-85



Ordering Code

Z/BNL-GAUGE-100-3MM

BNL-Z/GAUGE-X508

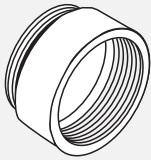
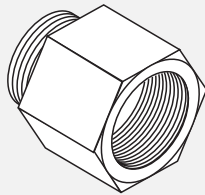
Application Notes

Used to gauge distance between
switch face and cam surface.

Used to gauge distance between
switch face and cam surface.

Instructions etched on gauge.

Instructions etched on gauge.
Paper instruction included.

Accessory Type Description	Increaser Pg to Pg	O-Ring Pg	Adapter Pg to NPT
			
Ordering Code	PG-07-M-TO-PG-09-F PG-09-M-TO-PG-11-F PG-09-M-TO-PG-13.5-F PG-11-M-TO-PG-13.5-F	PG-07-O-RING PG-09-O-RING PG-11-O-RING PG-13.5-O-RING PG-16-O-RING PG-21-O-RING	PG-07-M-TO-1/2"F PG-09-M-TO-1/2"F PG-11-M-TO-1/2"F PG-13.5-M-TO-1/2"F PG-16-M-TO-1/2"F PG-21-M-TO-1/2"F
Materials	Nickel-plated brass	Buna-N rubber	Nickel-plated brass
Application Notes	Order matching O-Ring separately		Use pipe compound on NPT thread

Installation Sheets - Ordering Code

Description	Part Number	Notes
Installation Sheet for BNS 100,72,62,61,F60	BNS-Z/INSTALL-SHEET-I98001	Included with switch
Installation Sheet for BNS 46,40,100/99	BNS-Z/INSTALL-SHEET-I98002	Included with switch
Installation Sheet for BSE-30	BNS-Z/INSTALL-SHEET-I98004	Included w/spare part kit
Installation Sheet for BSE-61	BNS-Z/INSTALL-SHEET-I98005	Included w/spare part kit
Installation Sheet for BSE-85	BNS-Z/INSTALL-SHEET-I98006	Included w/spare part kit

A Note About Pre-Travel Adjustment of Balluff Cam Switches

The pre-travel adjustment of Balluff cam switches has been carefully set by the Balluff factory. Do not tamper with the pre-travel adjustment screw for the following reasons:

1. If the pre-travel is increased beyond factory specifications, the switch will fail to reliably function.
2. If the pre-travel is reduced below factory specifications, excessive overtravel will lead to premature switch failure due to return spring fatigue.

Excessive overtravel will also cause premature failure of the sealing membrane, allowing fluid leaks into the housing.

Field Replacement of Snap Switches in Existing Limit Switch Installations

When replacing snap switches in the field, every effort should be made to insure proper pre-travel adjustment according to the following:

BNS 100, 72, 61, 62, F60 and Mixed Multiples

Switch Type	Pre-Travel Specification	Notes
BSE-30	2.0 mm $\pm$ 0.1 mm	
BSE-61	1.0 mm $\pm$ 0.1 mm	Forced opening at 2.3 mm depression
BSE-85	1.5 mm $\pm$ 0.1 mm	Forced opening at 3.3 mm depression
BSE-82	2.0 mm $\pm$ 0.25 mm	

BNS 40, 46 Multiples and 99/100 Singles

Switch Type	Pre-Travel Specification
BSE-69	0.5 mm $\pm$ 0.25 mm
BSE-70	0.5 mm $\pm$ 0.25 mm
BSE-71	0.5 mm $\pm$ 0.25 mm
BSE-72	0.5 mm $\pm$ 0.25 mm
BSE-73	0.5 mm $\pm$ 0.25 mm
BSE-74	0.5 mm $\pm$ 0.25 mm
BSE-75	0.5 mm $\pm$ 0.25 mm
BSE-76	0.5 mm $\pm$ 0.25 mm
BSE-77	0.5 mm $\pm$ 0.25 mm
BSE-82	0.5 mm $\pm$ 0.25 mm

Switch Housing Sealing Guidelines

Always be sure to adequately seal all threaded openings!

It is very important for the installer to ensure that all threaded openings are properly sealed by fully compressing the O-ring on PG- or metric-type fittings

and by applying Teflon pipe tape to any tapered NPT-type conduit junctions. Be sure to use fittings and cord seals that are rated for IP 67 to maintain the IP 67 enclosure rating of Balluff limit switches. Balluff recommends using high

quality metal-to-rubber cord seals such as those manufactured by Schlemmer (available through Balluff). Avoid plastic fittings - experience has shown that these invariably leak.

Balluff Pre-Wired Cam Switches

For pre-wired Balluff cam switches, there is no reason to open the housing cover. Simply attach the correct mating cordset and firmly tighten.

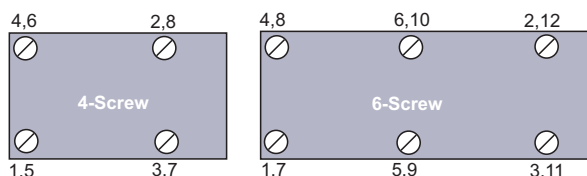
Properly Re-install Cam Switch Housing Cover

(Non-pre-wired cam switches only)
After wiring of the cam switch is complete, care should be taken to equally tighten all housing cover screws to ensure a good gasket seal between the cover and the housing. First carefully snug all cover

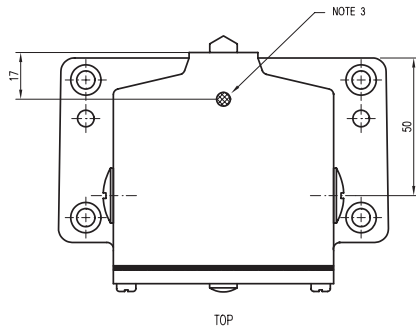
screws, then use a criss-crossing pattern to complete the tightening sequence. The objective is to avoid over-tightening any one screw with respect to the others, which could cause the opposite side of the cover to lift slightly, allowing fluid leaks into the housing.

Housing Cover Tightening Sequence

Apply sufficient torque to compress (but not displace) gasket.

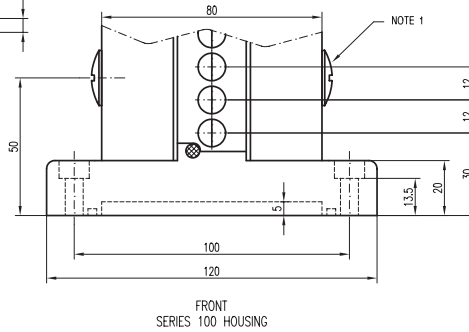
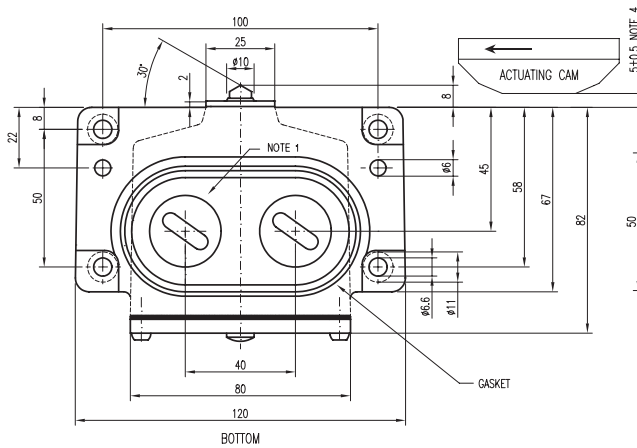


Series 100

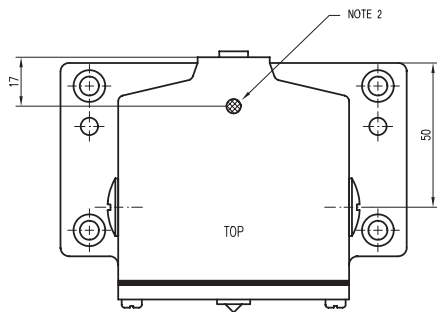


1. CONDUIT OPENINGS
2...5 PLUNGERS, SIDE & FLANGE = Pg 16 OR M25
6 OR MORE PLUNGERS, SIDE = Pg 21 OR M25; FLANGE = Pg 16 OR M25
2. SAFETY SWITCHES MARKED BY RED DOTS EITHER SIDE OF PLUNGER
3. HOUSINGS WITH 12 OR MORE PLUNGERS HAVE BREATHER HOLE ON END OF HOUSING
4. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SWITCH MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SWITCHES MAY BE DAMAGED BY OVERTRAVEL.

No. of plungers	2	3	4	5	6	8	10	12	14	16
Housing Height (mm)	70	80	90	105	120	140	170	200	240	240

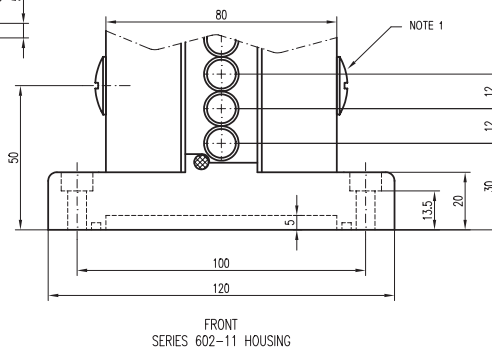
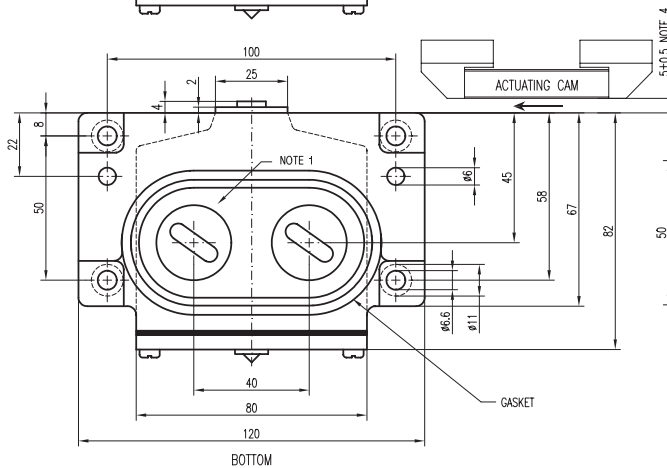


Series 602-II

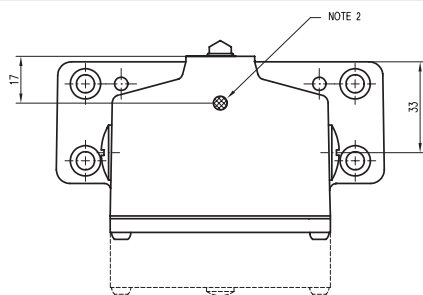


1. CONDUIT OPENINGS
2...5 SENSORS, SIDE & FLANGE = Pg 16 OR M25;
6 OR MORE SENSORS, SIDE = Pg 21 OR M25; FLANGE = Pg 16 OR M25
2. HOUSINGS WITH 10 OR MORE SENSORS HAVE BREATHER HOLE ON END OF HOUSING
3. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SENSOR MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SENSORS MAY BE DAMAGED BY CONTACT

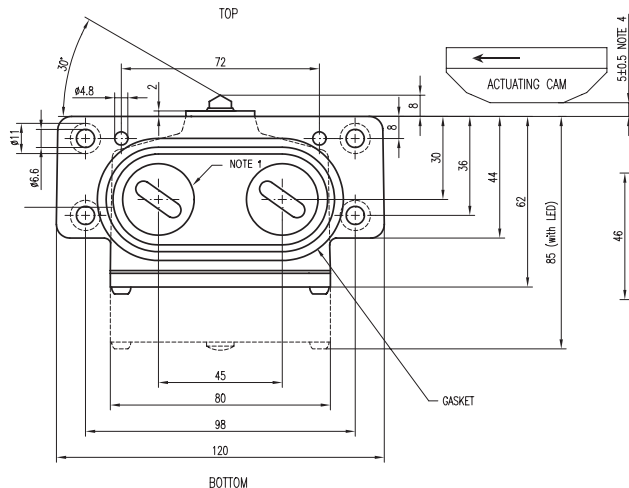
No. of sensors	2	3	4	5	6	8	10	12	14	16
Housing Height (mm)	70	80	90	105	120	140	170	200	240	240



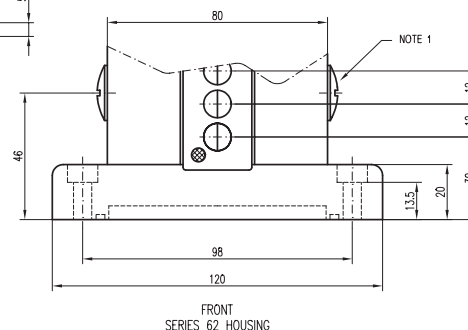
Series 62



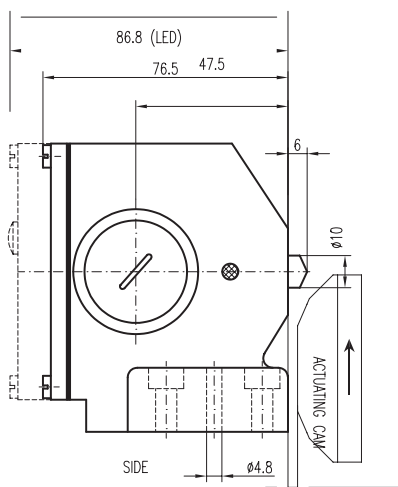
1. CONDUIT OPENINGS
2...5 PLUNGERS, SIDE & FLANGE = Pg 16 OR M25
6 OR MORE PLUNGERS, SIDE = Pg 21 OR M25; FLANGE = Pg 16 OR M25
2. SAFETY SWITCHES MARKED BY RED DOTS EITHER SIDE OF PLUNGER
3. HOUSINGS WITH 12 OR MORE PLUNGERS HAVE BREATHER HOLE ON END OF HOUSING
4. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SWITCH MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SWITCHES MAY BE DAMAGED BY OVERTRAVEL



No. of plungers	2	3	4	5	6	8	10	12	14	16
Housing Height (mm)	70	80	90	105	120	140	170	200	240	240

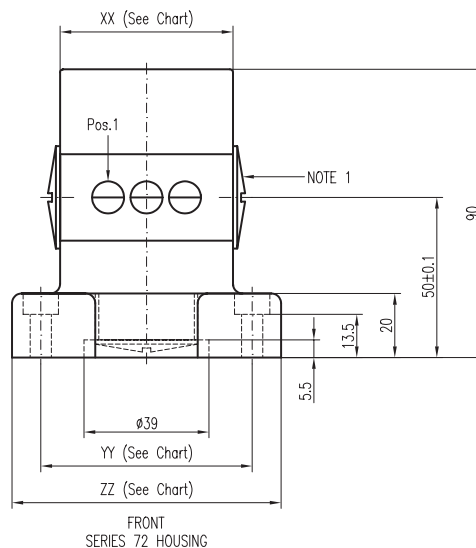
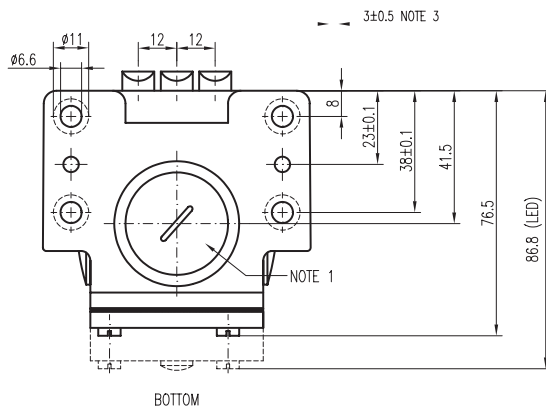


Series 62

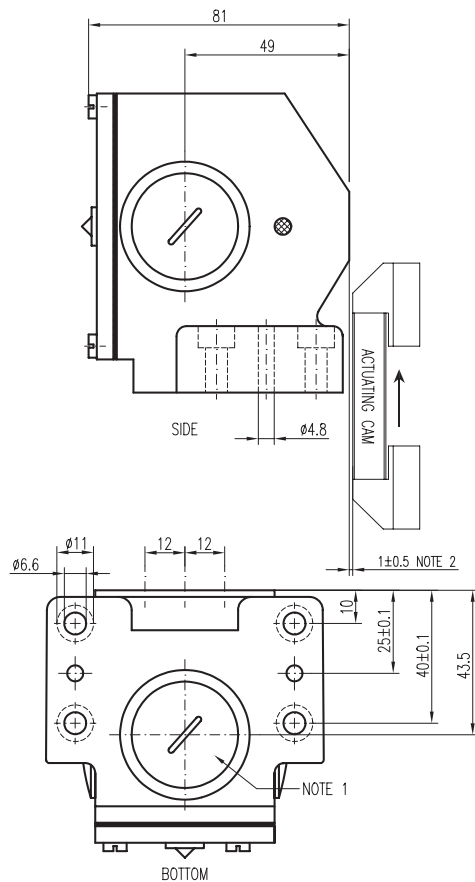


1. CONDUIT OPENINGS
2 PLUNGERS, SIDE & FLANGE = Pg 16 OR M25
3 OR MORE PLUNGERS, SIDE & FLANGE = Pg 21 OR M25
2. SAFETY SWITCHES MARKED BY RED DOTS EITHER SIDE OF PLUNGER
3. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SWITCH MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SWITCHES MAY BE DAMAGED BY OVERTRAVEL

No. of plungers	3	4	5	6	8	10	13	16
XX	54	68	84	100	132	148	180	212
YY	66	82	98	114	146	162	194	226
ZZ	84	100	116	132	164	180	212	244

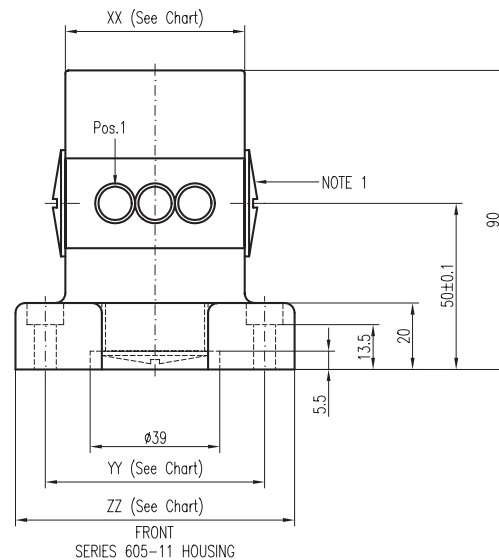


Series 605-II



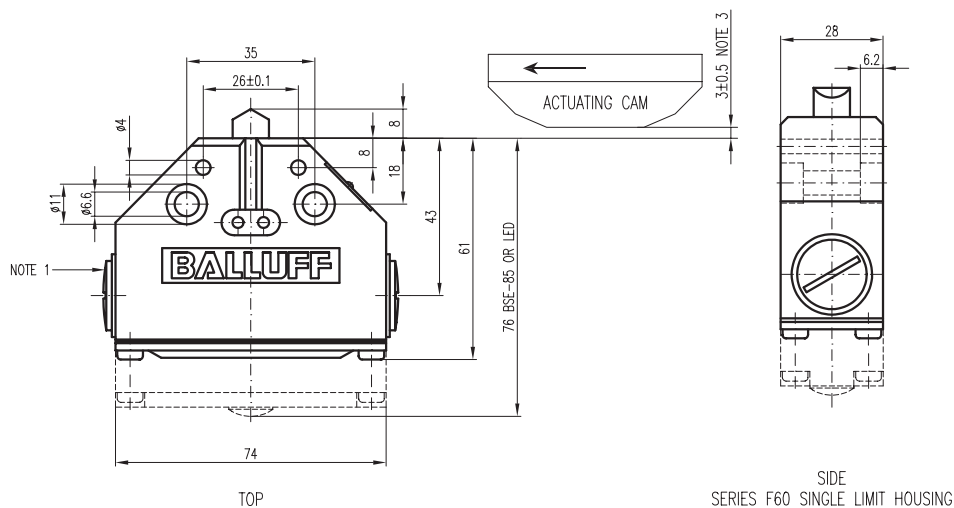
1. CONDUIT OPENINGS
- 2 PLUNGERS, SIDE & FLANGE = Pg 16 OR M25
- 3 OR MORE PLUNGERS, SIDE & FLANGE = Pg 21 OR M25
2. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SENSOR MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SENSORS MAY BE DAMAGED BY OVERTRAVEL.

No. of sensors	3	4	5	6	8	10	13	16
XX	54	68	84	100	132	148	180	212
YY	66	82	98	114	146	162	194	226
ZZ	84	100	116	132	164	180	212	244

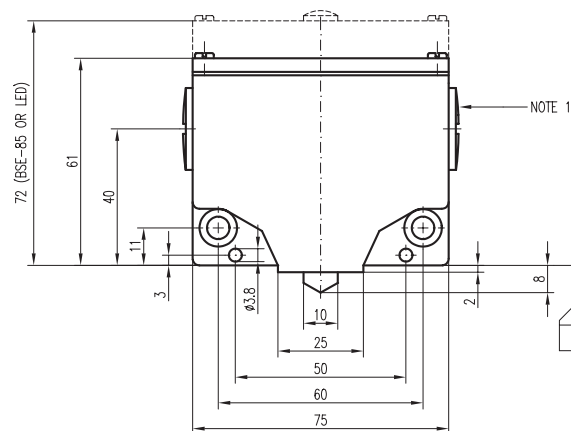


Series F60 - Single

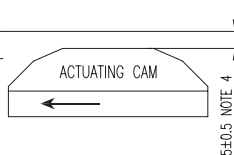
1. CONDUIT OPENINGS Pg 9 OR M16
2. SAFETY SWITCHES MARKED BY RED DOTS EITHER SIDE OF PLUNGER
3. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SWITCH MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SWITCHES MAY BE DAMAGED BY OVERTRAVEL.



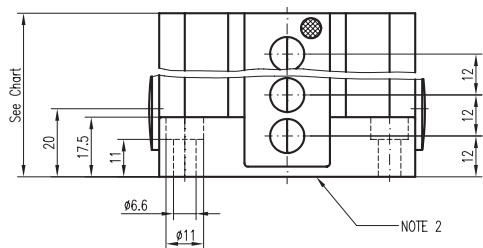
Series 61



1. CONDUIT OPENINGS Pg 13.5 OR M20
2. SAFETY SWITCHES MARKED BY RED DOTS EITHER SIDE OF PLUNGER
3. BREATHER HOLE ON BOTTOM OF HOUSING
4. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SWITCH MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SWITCHES MAY BE DAMAGED BY OVERTRAVEL.

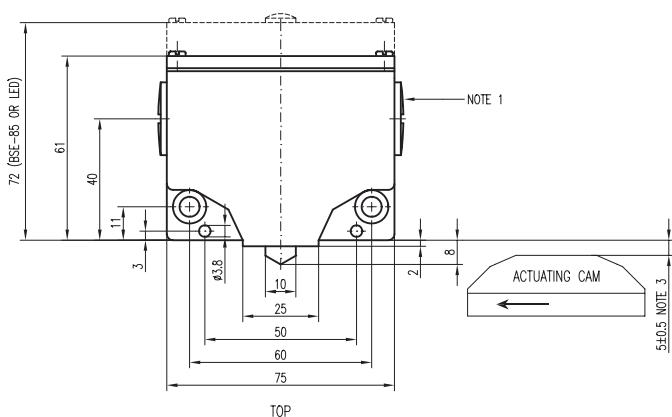


No. of plungers	2	3	4	5	6
Housing Height (mm)	36	48	60	72	84

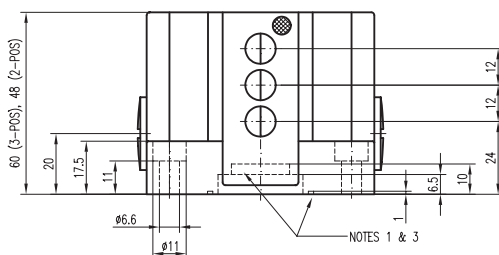
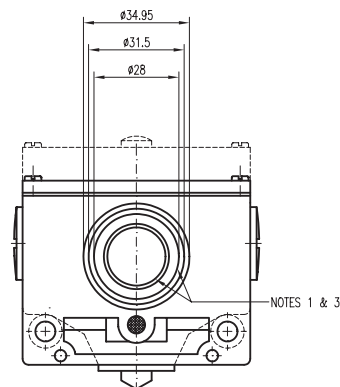


SERIES 61 HOUSING B WITH 12mm (A) FIRST PLUNGER LOCATION

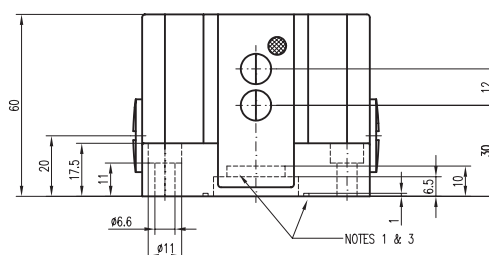
Series 61



1. CONDUIT OPENINGS Pg 13.5 OR M20
2. SAFETY SWITCHES MARKED BY RED DOTS EITHER SIDE OF PLUNGER
3. GASKET AROUND BOTTOM THREADED CONDUIT OPENING
4. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SWITCH MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SWITCHES MAY BE DAMAGED BY OVERTRAVEL.

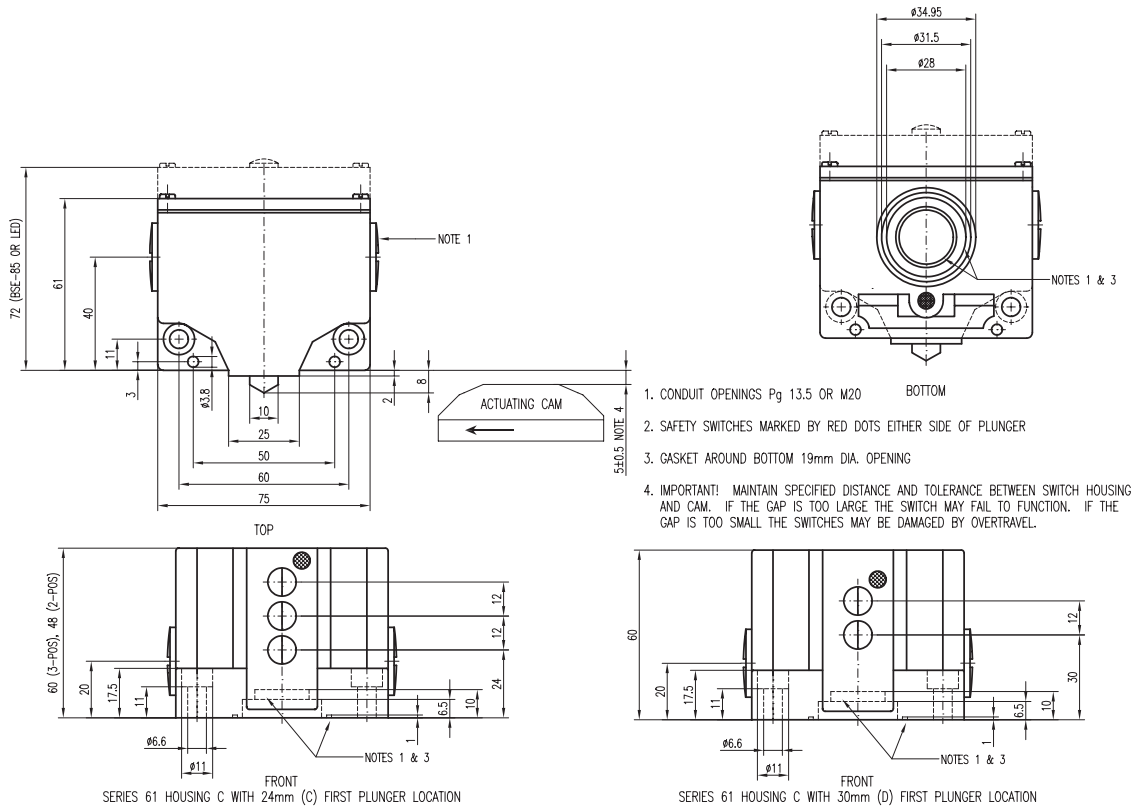


SERIES 61 HOUSING B WITH 24mm (C) FIRST PLUNGER LOCATION

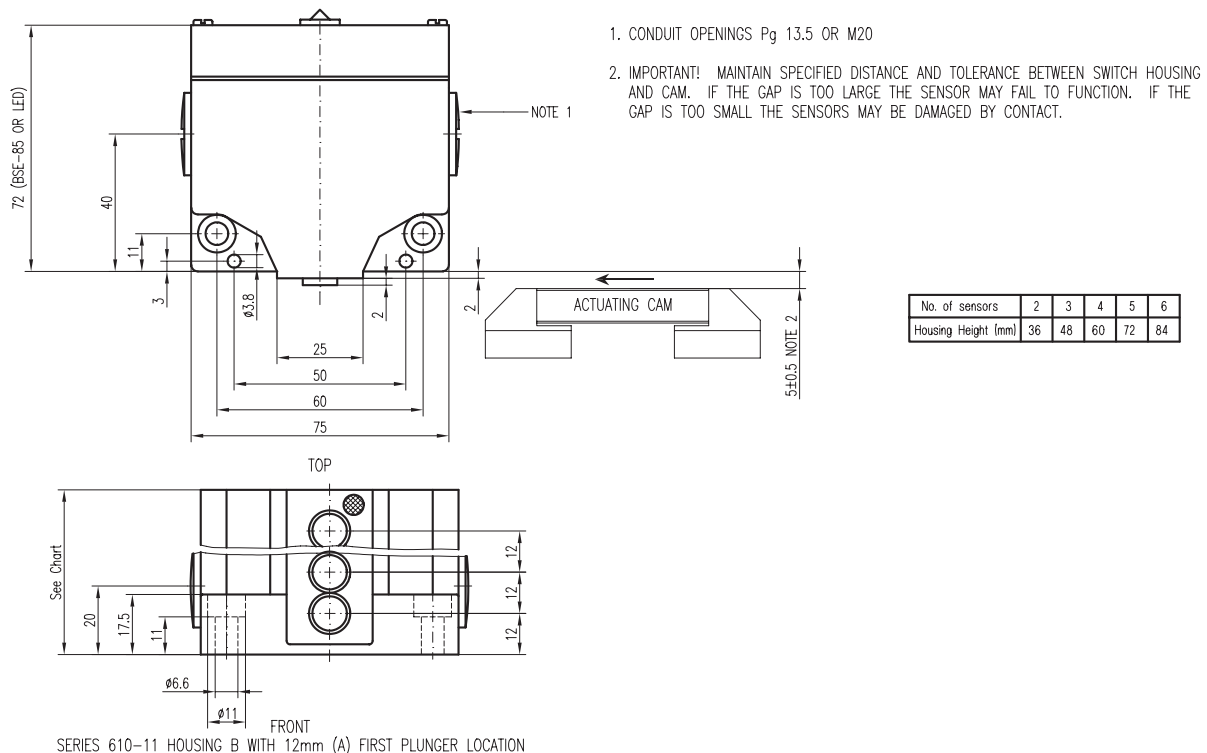


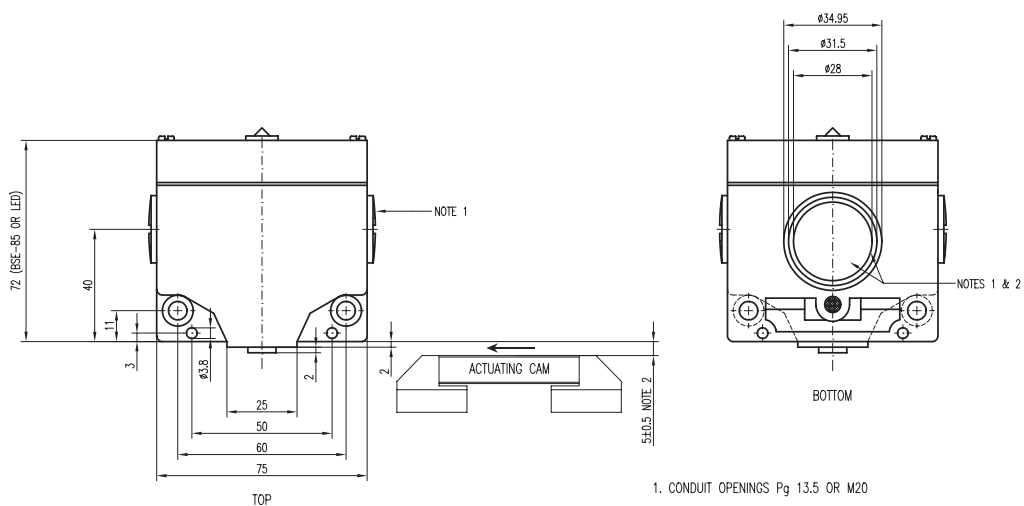
SERIES 61 HOUSING B WITH 30mm (D) FIRST PLUNGER LOCATION

Series 61

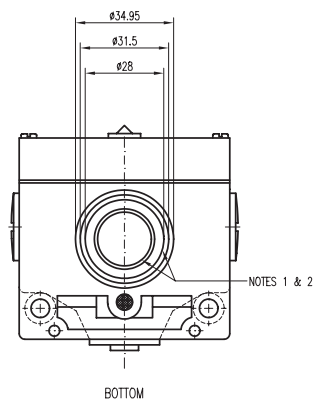
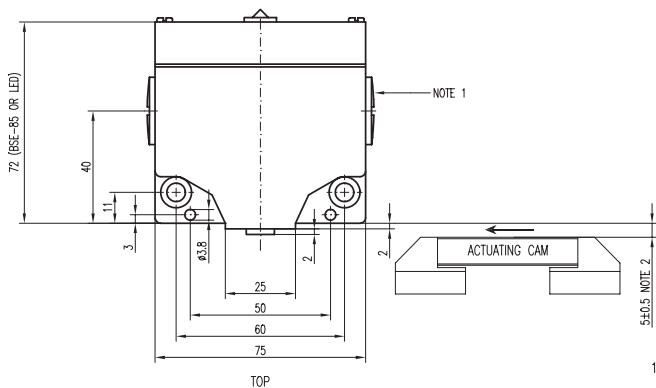
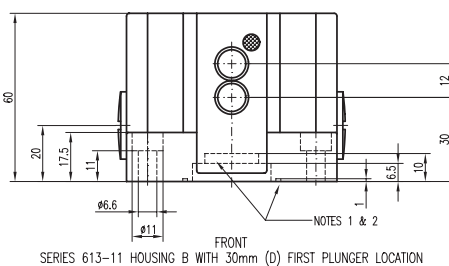
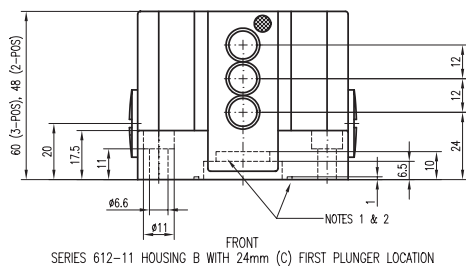


Series 610-II

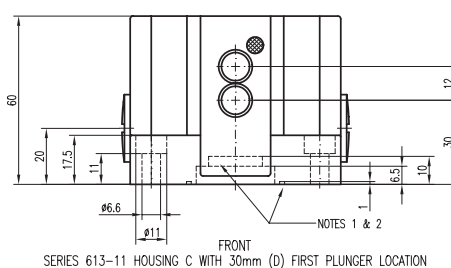
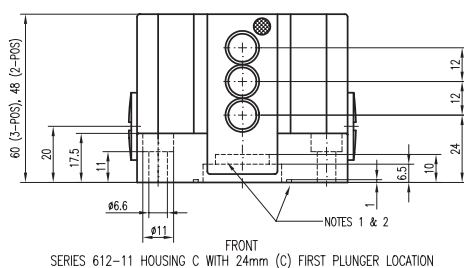




1. CONDUIT OPENINGS Pg 13.5 OR M20
2. GASKET AROUND BOTTOM THREADED CONDUIT OPENING
3. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SENSOR MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SENSORS MAY BE DAMAGED BY CONTACT.

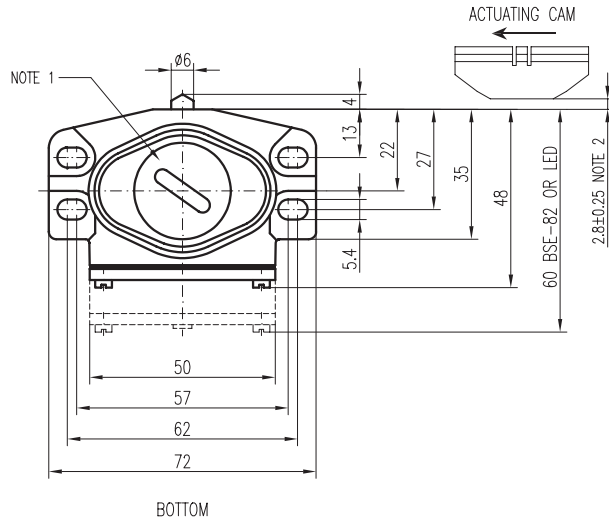


1. CONDUIT OPENINGS Pg 13.5 OR M20
2. GASKET AROUND BOTTOM 19mm DIA. OPENING
3. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SENSOR MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SENSORS MAY BE DAMAGED BY CONTACT.

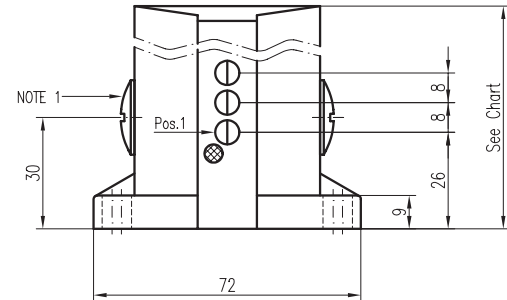


Series 46

1. CONDUIT OPENINGS
SIDE = Pg 11 OR M16
FLANGE = Pg 16 OR M25
2. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SWITCH MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SWITCHES MAY BE DAMAGED BY OVERTRAVEL.



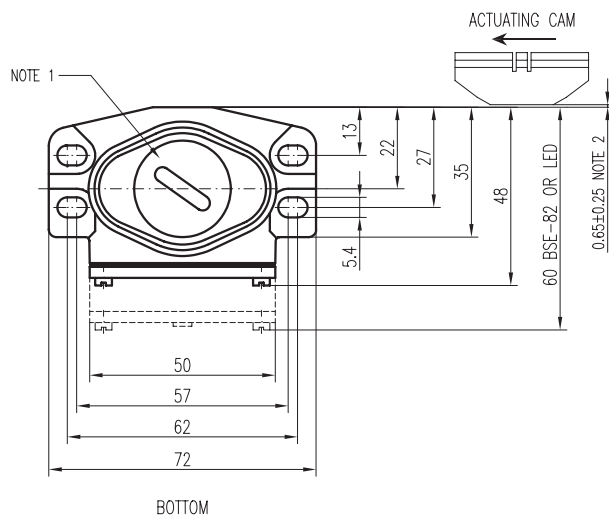
No. of Plungers	2	3	4	5	6	8	10	12
Housing Height (mm)	49	59	64	72	80	96	112	129



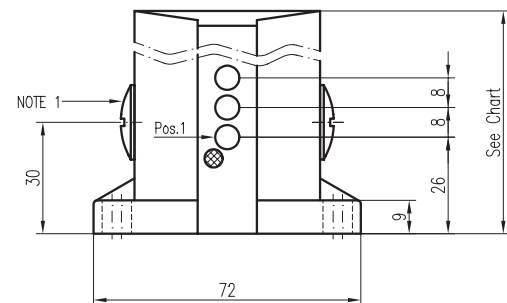
FRONT
SERIES 46 HOUSING

Series 603-II

1. CONDUIT OPENINGS
SIDE = Pg 11 OR M16
FLANGE = Pg 16 OR M25
2. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SENSOR MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SENSORS MAY BE DAMAGED BY CONTACT.

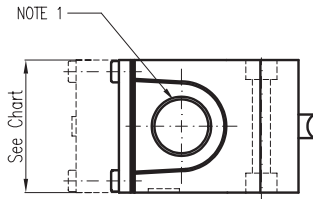


No. of Sensors	2	3	4	5	6	8	10	12
Housing Height (mm)	49	59	64	72	80	96	112	129



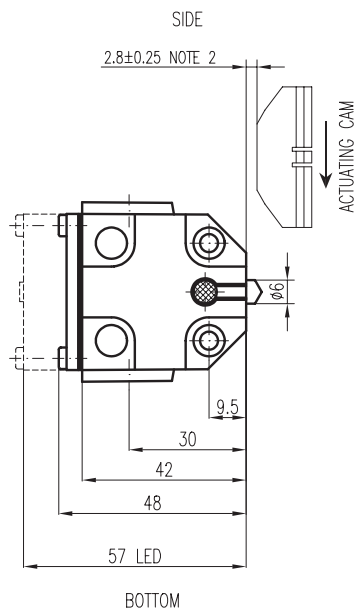
FRONT
SERIES 603-II HOUSING

Series 40

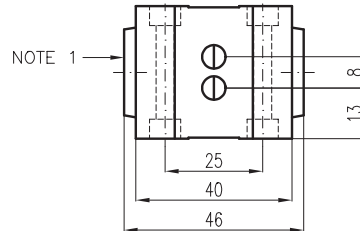


1. CONDUIT OPENINGS
SIDE = Pg 09 OR M16

2. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SWITCH MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SWITCHES MAY BE DAMAGED BY OVERTRAVEL.



No. of plungers	2	3	4	5	6
Housing Height (mm)	34	42	50	58	66

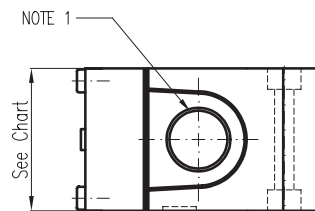
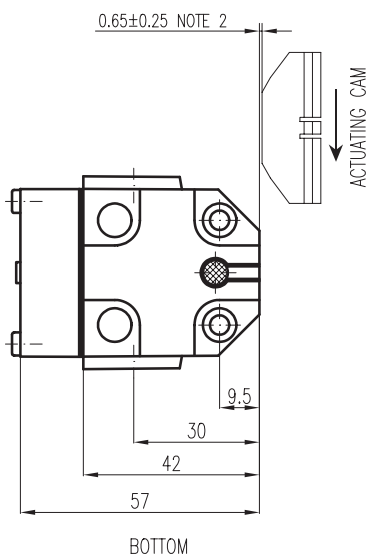


FRONT
SERIES 40 HOUSING

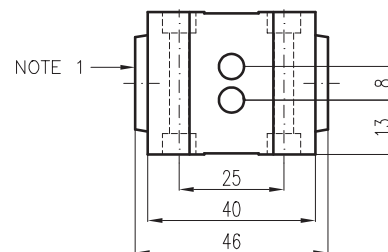
Series 650-II

1. CONDUIT OPENINGS
SIDE = Pg 09 OR M16

2. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SENSOR MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SENSORS MAY BE DAMAGED BY CONTACT.



No. of sensors	2	3	4	5	6
Housing Height (mm)	34	42	50	58	66

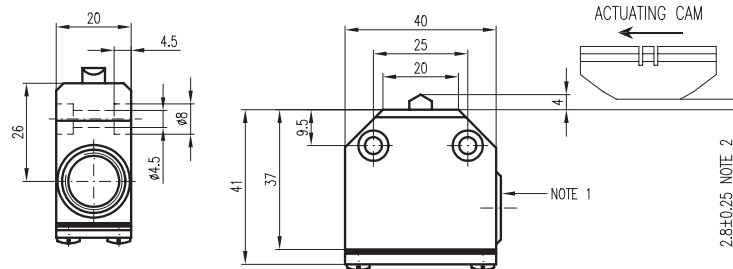


FRONT
SERIES 650-II HOUSING

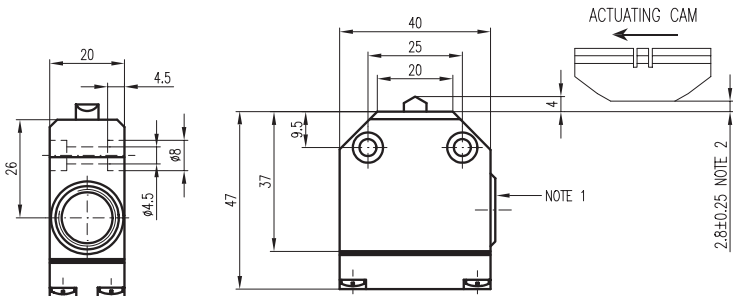
Series 099-Single

1. CONDUIT OPENINGS Pg 7 OR M12

2. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SWITCH MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SWITCHES MAY BE DAMAGED BY OVERTRAVEL.



SERIES 99 SINGLE LIMIT WITH SOLDER TERMINALS

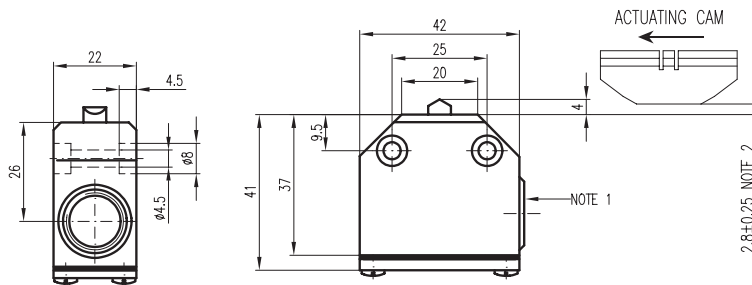


SERIES 99 SINGLE LIMIT WITH SCREW TERMINALS

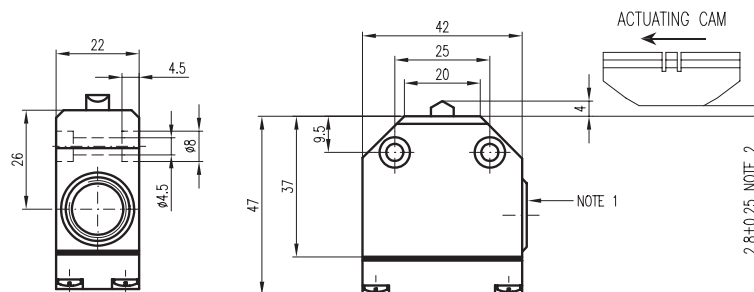
Series 100-Single

1. CONDUIT OPENINGS Pg 9 OR M16

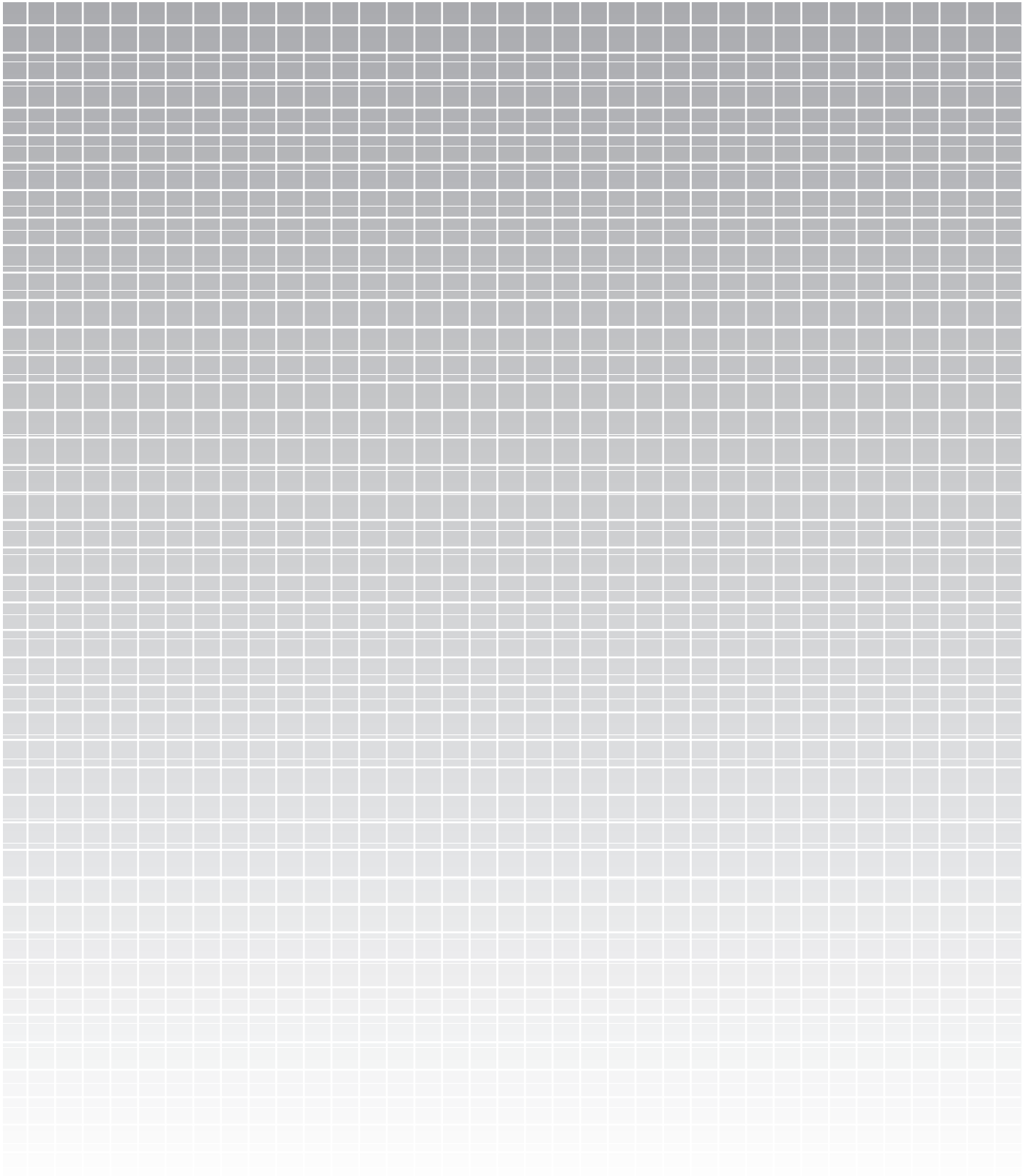
2. IMPORTANT! MAINTAIN SPECIFIED DISTANCE AND TOLERANCE BETWEEN SWITCH HOUSING AND CAM. IF THE GAP IS TOO LARGE THE SWITCH MAY FAIL TO FUNCTION. IF THE GAP IS TOO SMALL THE SWITCHES MAY BE DAMAGED BY OVERTRAVEL.



SERIES 100 SINGLE LIMIT WITH SOLDER TERMINALS



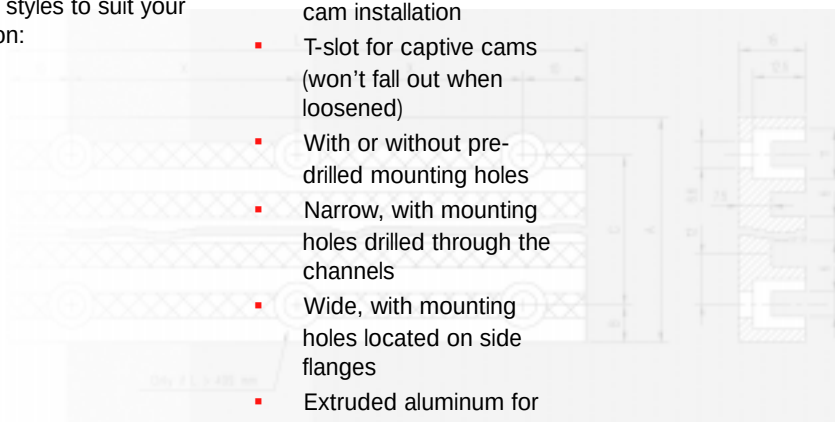
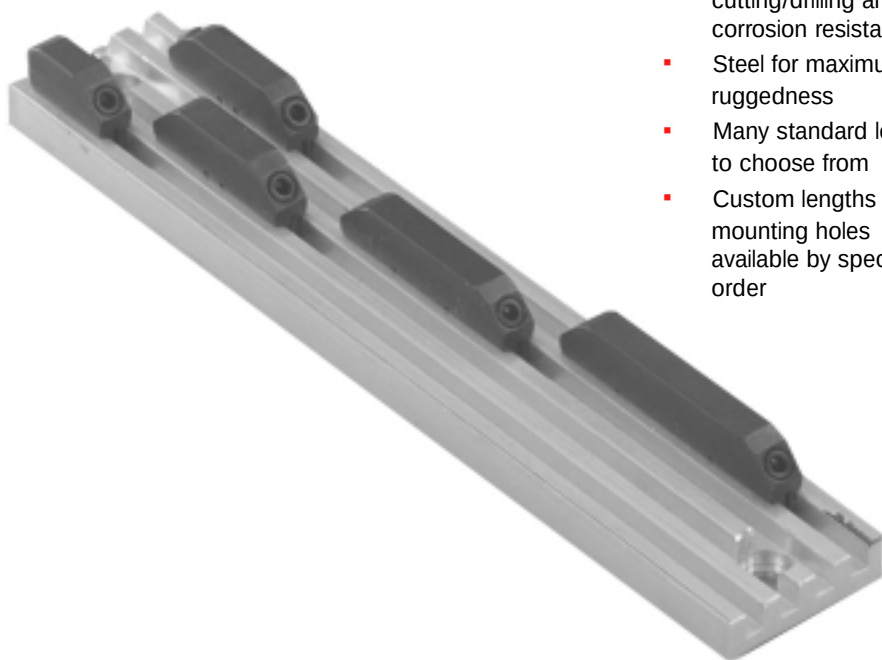
SERIES 100 SINGLE LIMIT WITH SCREW TERMINALS



Linear cam trays are straight metal channels used to hold linear trip cams for mechanical and electronic limit switches. The trip cams are held in the U-channels by friction wedges and by T-nuts in the T-slot channels. The cam is adjusted in the channel to set the exact switchpoint, then locked in place with a hex socket set screw.

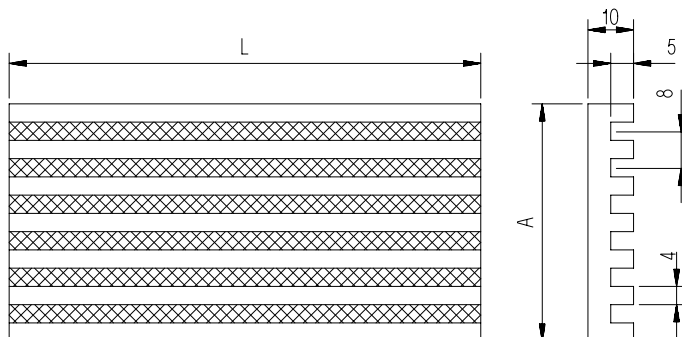
Cam trays are available in a variety of styles to suit your application:

- U-channel for drop in cam installation
- T-slot for captive cams (won't fall out when loosened)
- With or without pre-drilled mounting holes
- Narrow, with mounting holes drilled through the channels
- Wide, with mounting holes located on side flanges
- Extruded aluminum for economy and ease of cutting/drilling and corrosion resistance
- Steel for maximum ruggedness
- Many standard lengths to choose from
- Custom lengths and mounting holes available by special order



Centerline Spacing, Channel to Channel
Material and Construction
Cam Tray Designation
Cam Tray Form
Use with Switch Housings
Use with Cams
Mounting

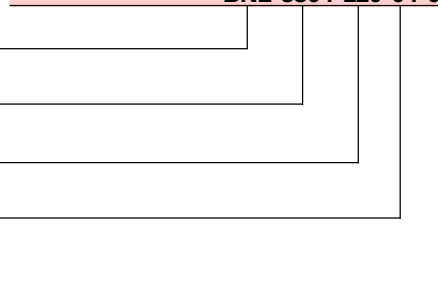
12 mm
Extruded Aluminum U-Channel, Without Side Flanges
BNL-5304-120
Form A per DIN 69 628
Series 100, 602-11, 62, 61, 610-11, 72, 605-11 Multiple: F 60 Single 6mm Mounting Slot, BNN-520-UA, BNN-520-UB, BNN-UA, BNN-UB, BEN-516-14 Flangeless, Supplied without Mounting Holes



Number of Channels
1
2
3
4
6
8
10
Ordering Code

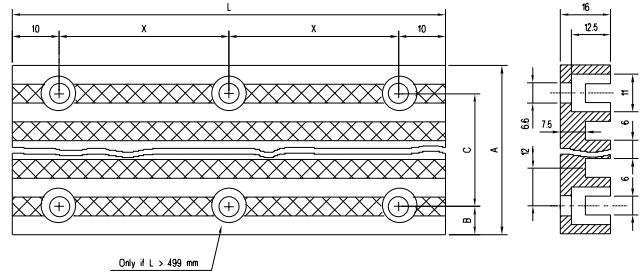
Width (A) mm
17
29
41.5
53
77
101
125
BNL-5304-120-04-0500

Balluff Cam Switch	BNL
Type Designation	5304
Channel centerline spacing	12mm = 120
Number of channels	01...05, 6, 8, 10
Length (L) mm	100, 200, 500, 1000, 1500, 2000, 2500 or special length on request



Centerline Spacing, Channel to Channel
Material and Construction
Cam Tray Designation
Cam Tray Form
Use with Switch Housings
Use with Cams
Mounting

12 mm
Extruded Aluminum U-Channel, Without Side Flange
BNL-5307-120
Form A per DIN 69 628
Series 100, 602-11, 62, 61, 610-11, 72, 605-11 Multiple: F 60 Single 6mm Mounting Slot, BNN-520-UA, BNN-520-UB, BNN-UA, BNN-UB, BEN-516-14
Flangeless, Supplied with Mounting Holes



Number of Channels
1
2
3
4
6
8
10

Length (L) Range mm	Mounting Holes
0-499	1,2,3, & 4 channels (2), one row of two (4), two rows of two
500-1599	(3), one row of three (6), two rows of three
1600-2500	(4), one row of four (8), two rows of four

Ordering Code

Width (A) mm	Hole Offset (B)mm	Hole Centerline (C)mm
17	8.5	-
29	14.4	-
41.5	20.8	-
53	26.5	-
77	8.5	60
101	8.5	84
125	8.5	108

Hole Spacing (X) mm
(L-20mm)
(L-20mm)/2
(L-20mm)/3

BNL-5307-120-04-0500

Balluff Cam Switch	BNL
Type Designation	5307
Channel centerline spacing	12mm = 120
Number of channels	01...05, 6, 8, 10
Length (L) mm	100, 200, 500, 1000, 1500, 2000, 2500 or special length on request

Centerline Spacing, Channel to Channel

Material and Construction

Cam Tray Designation

Cam Tray Form

Use with Switch Housings

Use with Cams

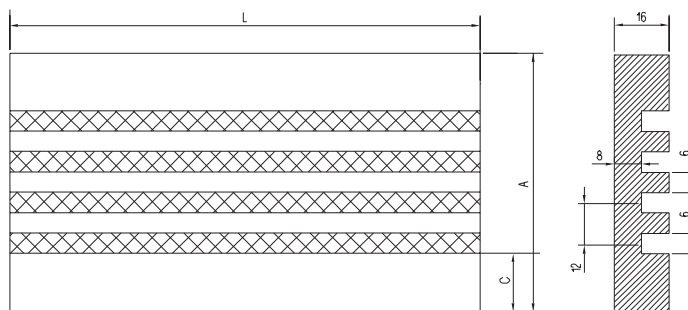
Mounting

12 mm

Extruded **Aluminum** U-Channel, With Side Flanges

BNL-5304-120-S

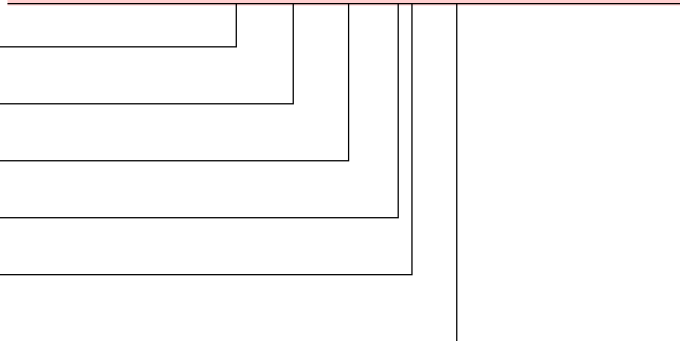
Series 100, 602-11, 62, 61, 610-11, 72, 605-11 Multiple: F 60 Single
6mm Mounting Slot, BNN-520-UA, BNN-520-UB, BNN-UA, BNN-UB, BEN-516-14
Side Flanges, Supplied without Mounting Holes



Number of Channels
2
3
4
5
6
8
10
12
14
16
Ordering Code

Width (A) mm
50
62
74
86
98
122
146
170
194
218
BNL-5304-120-S04-0500

Balluff Linear Cam Tray	BNL
Type Designation	5304
Channel centerline spacing	12mm = 120
Aluminum with side flanges	S
Number of channels	02...06, 8, 10, 12, 14, 16
Length (L) mm	100, 200, 500, 1000, 1500, 2000, 2500 or special length on request



Centerline Spacing, Channel to Channel

Material and Construction

Cam Tray Designation

Cam Tray Form

Use with Switch Housings

Use with Cams

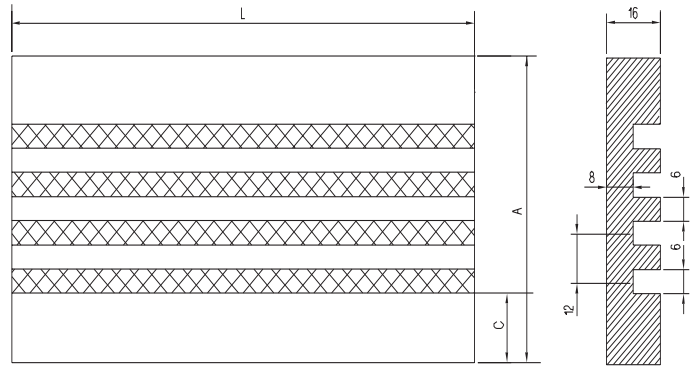
Mounting

12 mm

Extruded **Aluminum** U-Channel, With Side Flanges

BNL-5307-120-S

Series 100, 602-11, 62, 61, 610-11, 72, 605-11 Multiple: F 60 Single
6mm Mounting Slot, BNN-520-UA, BNN-520-UB, BNN-UA, BNN-UB, BEN-516-14
Side Flanges, Supplied With Mounting Holes



Number of Channels	
2	
3	
4	
5	
6	
8	
10	
12	
14	
16	
Length (L) Range mm	Mounting Holes
0-499	(4), two rows of two
500-1599	(6), two rows of three
1600-2500	(8), two rows of four
Ordering Code	

Width (A) mm	Hole Centerline (B) mm	Flange Width (C) mm
50	34	16
62	46	16
74	58	16
86	70	16
98	82	16
122	106	16
146	130	16
170	154	16
194	178	16
218	202	16
Hole Spacing (X) mm		
(L-20mm)		
(L-20mm)/2		
(L-20mm)/3		
BNL-5307-120-S04-0500		

Balluff Linear Cam Tray	BNL
Type Designation	5307
Channel centerline spacing	12mm = 120
Aluminum with side flanges	S
Number of channels	02...06, 8, 10, 12, 14, 16
Length (L) mm	100, 200, 500, 1000, 1500, 2000, 2500 or special length on request

Centerline Spacing, Channel to Channel

Material and Construction

Cam Tray Designation

Cam Tray Form

Use with Switch Housings

Use with Cams

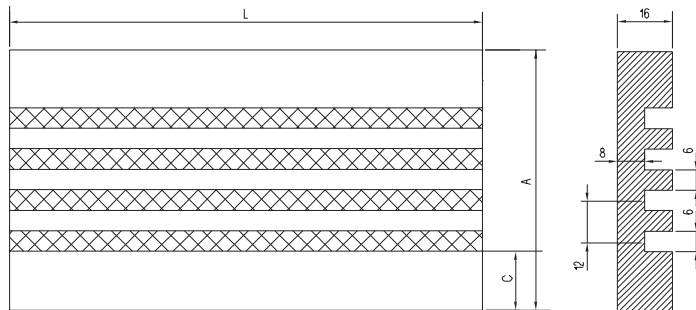
Mounting

12 mm

Machined **Steel** U-Channel, With Side Flanges

BNL-5306-120

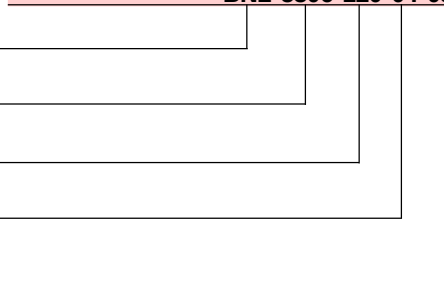
Series 100, 602-11, 62, 61, 610-11, 72, 605-11 Multiple: F 60 Single
6mm Mounting Slot, BNN-520-UA, BNN-520-UB, BNN-UA, BNN-UB, BEN-516-14
Side Flanges, Supplied without Mounting Holes



Number of Channels
2
3
4
5
6
8
10
12
14
16
Ordering Code

Width (A) mm	Flange Width (C) mm
52	17
63	16.5
76	17
87	16.5
100	17
124	17
148	17
172	17
196	17
218	16
BNL-5306-120-04-0500	

Balluff Linear Cam Tray	BNL
Type Designation	5306
Channel centerline spacing	12mm = 120
Number of channels	02...06, 8, 10, 12, 14, 16
Length (L) mm	100, 200, 500, 1000, 1200 or special length on request in increments of 100mm



Centerline Spacing, Channel to Channel

Material and Construction

Cam Tray Designation

Cam Tray Form

Use with Switch Housings

Use with Cams

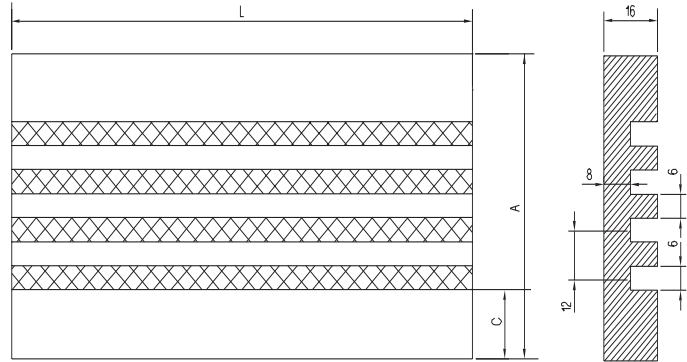
Mounting

12 mm

Machined **Steel** U-Channel, With Side Flanges

BNL-5308-120

Series 100, 602-11, 62, 61, 610-11, 72, 605-11 Multiple: F 60 Single
6mm Mounting Slot, BNN-520-UA, BNN-520-UB, BNN-UA, BNN-UB, BEN-516-14
Side Flanges, Supplied With Mounting Holes



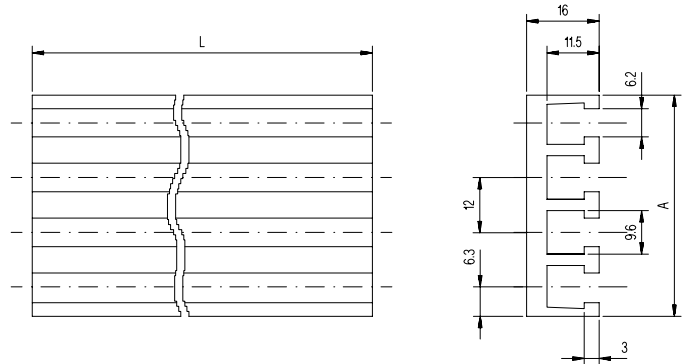
Number of Channels	
2	
3	
4	
5	
6	
8	
10	
12	
14	
16	
Length (L) Range mm	Mounting Holes
0-499	(4), two rows of two
500-1200	(6), two rows of three
Ordering Code	

Width (A) mm	Hole Centerline (B) mm	Flange Width (C) mm
50	34	16
62	46	16
74	58	16
86	70	16
98	82	16
122	106	16
146	130	16
170	154	16
194	178	16
218	202	16
Hole Spacing (X) mm		
(L-20mm)		
(L-20mm)/2		
BNL-5308-120-04-0500		

Balluff Linear Cam Tray	BNL
Type Designation	5308
Channel centerline spacing	12mm = 120
Number of channels	02...06, 8, 10, 12, 14, 16
Length (L) mm	100, 200, 500, 1000, 1200 or special length on request in increments of 100mm

Centerline Spacing, Channel to Channel
Material and Construction
Cam Tray Designation
Cam Tray Form
Use with Switch Housings
Use with Cams
Mounting

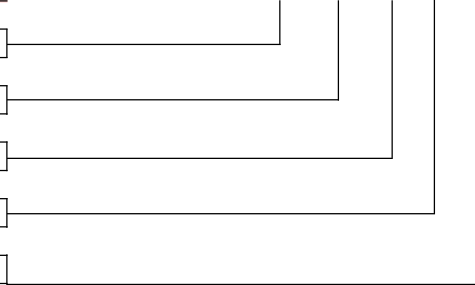
12 mm
Extruded Aluminum T-Slot, Without Side Flange
BNL-5310-120
Form B per DIN 69 638
Series 100, 602-11, 62, 61, 610-11, 72, 605-11 Multiple: F 60 Single
6mm Mounting Slot, BNN-520-TA, BNN-520-TB, BNN-TA, BNN-TB, BEN-516-13
Flangeless, Supplied Without Mounting Holes



Number of Channels
4
6
Ordering Code

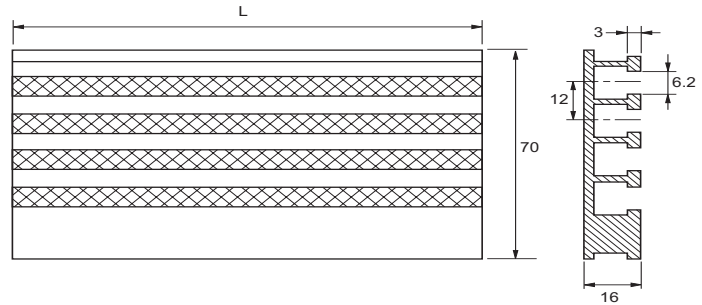
Width (A) mm
48.6
72.6
BNL-5310-120-04-0500

Balluff Linear Cam Tray	BNL
Type Designation	5310
Channel centerline spacing	12mm = 120
Number of channels	04, 06
Length (L) mm	100, 200, 500, 1000, 1500, 2000, 2500 or special length on request



Centerline Spacing, Channel to Channel
Material and Construction
Cam Tray Designation
Cam Tray Form
Use with Switch Housings
Use with Cams
Mounting

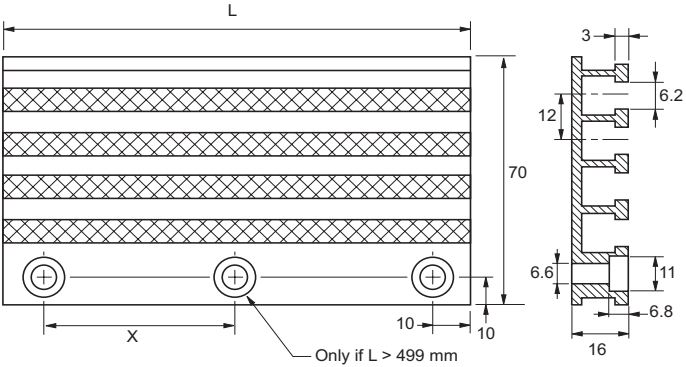
12 mm
Extruded Aluminum T-Slot, With Side Flange
BNL-5310-120-S
Series 100, 602-11, 62, 61, 610-11, 72, 605-11 Multiple: F 60 Single
6mm Mounting Slot, BNN-520-TA, BNN-520-TB, BEN-516-13
Side Flange, Supplied Without Mounting Holes



Ordering Code		BNL-5310-120-S04-0500	
Balluff Linear Cam Tray	BNL		
Type Designation	5310		
Channel centerline spacing	12mm = 120		
Aluminum with side flanges	S		
Number of channels	04		
Length (L) mm	100, 200, 500, 1000, 1500, 2000, 2500 or special length on request		

Centerline Spacing, Channel to Channel
Material and Construction
Cam Tray Designation
Cam Tray Form
Use with Switch Housings
Use with Cams
Mounting

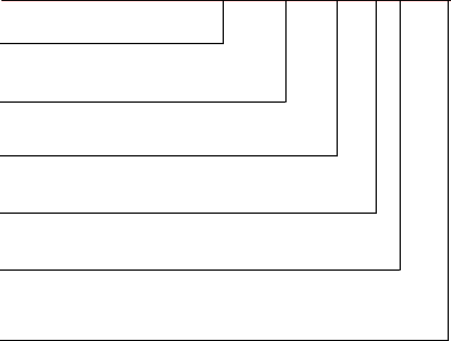
12 mm
Extruded Aluminum T-Slot, With Side Flange
BNL-5311-120-S
Series 100, 602-11, 62, 61, 610-11, 72, 605-11 Multiple: F 60 Single
6mm Mounting Slot, BNN-520-TA, BNN-520-TB
Side Flange, Supplied With Mounting Holes



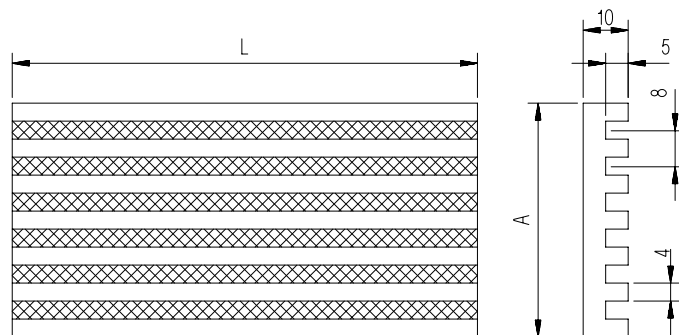
Length (L) Range mm	Mounting Holes
0-499	(2), one row of two
500-1599	(3), one row of three
1600-2500	(4), one row of four
Ordering Code	

Hole Spacing (X) mm
(L-20mm)
(L-20mm)/2
(L-20mm)/3
BNL-5311-120-S04-0500

Balluff Linear Cam Tray	BNL
Type Designation	5311
Channel centerline spacing	12mm = 120
Aluminum with side flanges	S
Number of channels	04
Length (L) mm	100, 200, 500, 1000, 1500, 2000, 2500 or special length on request



Centerline Spacing, Channel to Channel	8mm
Material and Construction	Extruded Aluminum U-channel, without side flanges
Cam Tray Designation	BNL-5304-080
Cam Tray Form	Form A per DIN 69 638
Use with Switch Housings	Series 46, 603-11, 40, 650-11 Multiple; 99,100 Single
Use with Cams	4mm Mounting Slot, BNN-520-081-S
Mounting	Flangeless, Supplied Without Mounting Holes

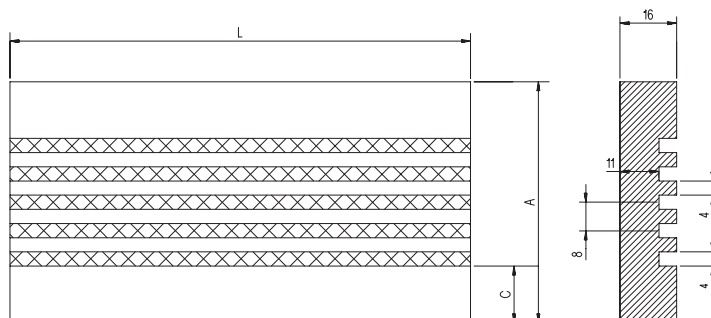


Number of Channels	Width (A) mm
2	20
3	28
4	36
5	44
6	52
8	68
10	84
Ordering Code	BNL-5304-080-04-0500

Balluff Linear Cam Tray	BNL
Type Designation	5304
Channel centerline spacing	8mm = 080
Number of channels	02...06, 08, 10
Length (L) mm	100, 200, 500, 1000, 1500, 2000, 2500 or special length on request

Centerline Spacing, Channel to Channel
Material and Construction
Cam Tray Designation
Cam Tray Form
Use with Switch Housings
Use with Cams
Mounting

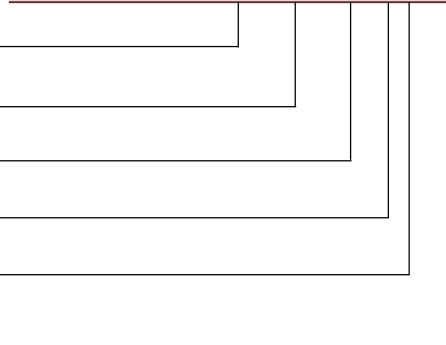
8 mm
Extruded Aluminum U-Channel, With Side Flanges
BNL-5304-080-S
Series 46, 603-11, 40, 650-11 Multiple: 99, 100 Single
4mm Mounting Slot, BNN-520-081-S
Side Flanges, Supplied Without Mounting Holes



Number of Channels
2
3
4
5
6
8
10
12
Ordering Code

Width (A) mm	Flange Width (C) mm
44	16
52	16
60	16
68	16
76	17
92	17
108	17
124	17
BNL-5304-080-S04-0500	

Balluff Linear Cam Tray	BNL
Type Designation	5304
Channel centerline spacing	8mm = 080
Aluminum side with flanges	S
Number of channels	02...06, 08, 10, 12
Length (L) mm	100, 200, 500, 1000, 1500, 2000, 2500 or special length on request



Centerline Spacing, Channel to Channel

Material and Construction

Cam Tray Designation

Cam Tray Form

Use with Switch Housings

Use with Cams

Mounting

8mm

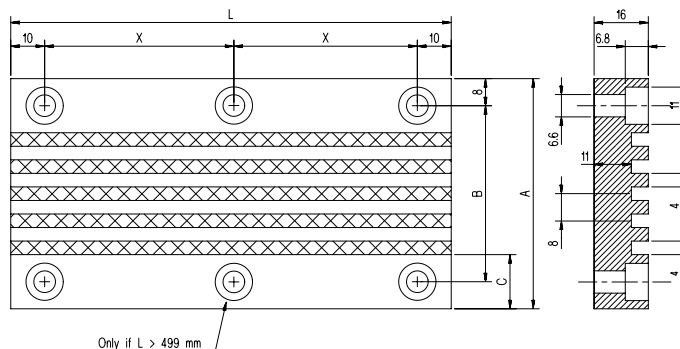
Extruded **Aluminum** U-Channel, With Side Flanges

BNL-5307-080-S

Series 46, 603-11, 40, 650-11 Multiple; 99,100 Single

4mm Mounting Slot, BNN-520-081-S

Side Flanges, Supplied With Mounting Holes



Number of Channels
2
3
4
5
6
8
10
12

Width (A) mm	Hole Centerline (B) mm	Flange Width (C) mm
44	28	44
52	36	52
60	44	60
68	52	68
76	60	76
92	76	92
108	92	108
124	108	124

Length (L) Range mm	Mounting Holes
0-499	(4), two rows of two
500-1599	(6), two rows of three
1600-2500	(8), two rows of four

Hole Spacing (X) mm
(L-20mm)
(L-20mm)/2
(L-20mm)/3

Ordering Code

BNL-5307-080-S04-0500

Balluff Linear Cam Tray	BNL
Type Designation	5307
Channel centerline spacing	8mm = 080
Aluminum with side flanges	S
Number of channels	02...06, 08, 10
Length (L) mm	100, 200, 500, 1000, 1500, 2000, 2500 or special length on request

Centerline Spacing, Channel to Channel

Material and Construction

Cam Tray Designation

Cam Tray Form

Use with Switch Housings

Use with Cams

Mounting

8 mm

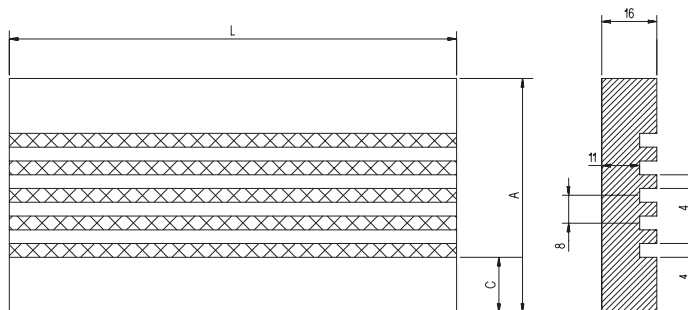
Machined **Steel** U-Channel, With Side Flanges

BNL-5306-080

Series 46, 603-11, 40, 650-11 Multiple: 99, 100 Single

4mm Mounting Slot, BNN-520-081-S

Side Flanges, Supplied Without Mounting Holes



Number of Channels
2
3
4
5
6
8
10
12
14
16

Width (A) mm	Flange Width (C) mm
46	17
52	16
63	17.5
68	16
76	16
96	18
108	16
124	16
140	16
159	17.5

Ordering Code

BNL-5306-080-04-0500

Balluff Linear Cam Tray **BNL**

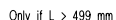
Type Designation **5306**

Channel centerline spacing 8mm = **080**

Number of channels **02...06, 08, 10**

Length (L) mm **100, 200, 500, 1000, 1500, 2000, 2500**
or special length on request

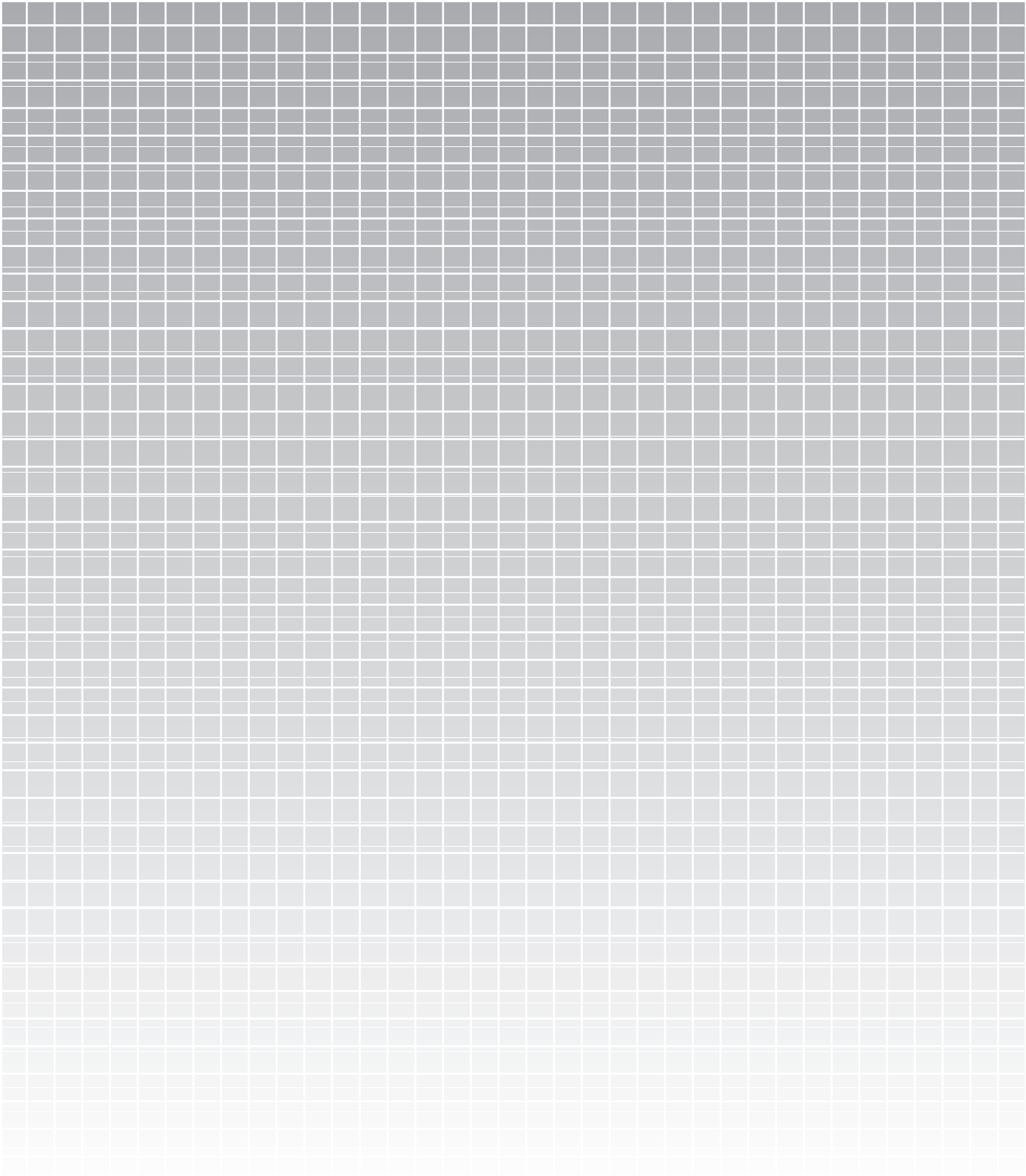
8mm
Machined Steel U-Channel, With Side Flanges
BNL-5308-080
Series 46, 603-11, 40, 650-11 Multiple; 99,100 Single
4mm Mounting Slot, BNN-520-081-S
Side Flanges, Supplied With Mounting Holes



Width (A) mm	Hole Centerline (B) mm	Flange Width (C) mm
46	30	17
52	36	16
63	47	17.5
68	52	16
76	60	16
92	80	18
108	92	16
124	108	16
140	124	16
159	143	17.5

Hole Spacing (X) mm
(L-20mm)
(L-20mm)/2

BNL-5308-080-04-0500



Linear Trip Cams for Mechanical Switches

Linear trip cams are straight metal ramps for actuating mechanical limit switches. Mounted in a linear cam tray and positioned to actuate the limit switch at the desired switchpoint, the trip cams are made from specially hardened, coated steel for long service life.

The cams are held in the U-channels by friction wedges and by T-nuts in the T-slot channels. The cam is adjusted in the channel to set the exact switchpoint, then locked in place with a hex socket set screw.

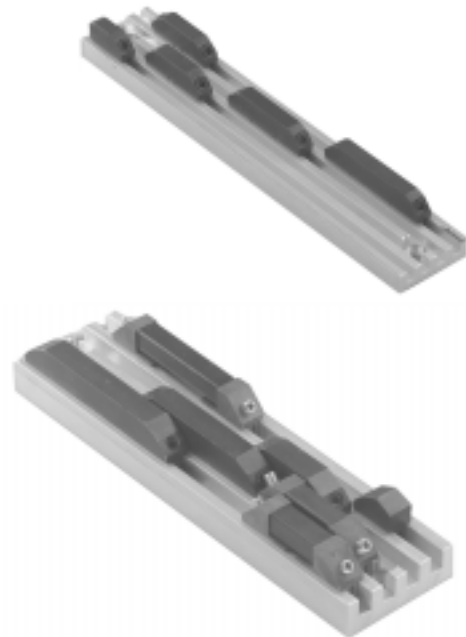
Linear trip cams are available in several different styles:

- U-channel mount for drop-in cam installation
- T-slot mount for captive cams (won't fall out when loosened)
- Single piece with single set screw for very short lengths
- Single piece with two set screws for intermediate lengths
- Modular U- or T-slot: two end ramps with set screws and an intermediate running cam for longer lengths
- Modular T-slot system for constructing cams of infinite length

Linear Trip Cams for Safety Limit Switches

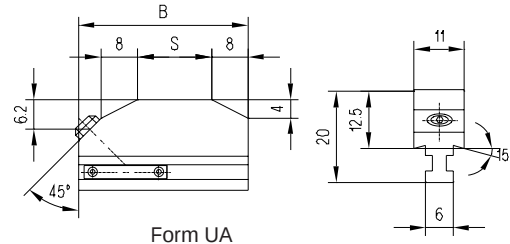
Linear trip cams **BNN-520-TA**, **BNN-520-TB**, **BNN-TA**, **BNN-TB**, **BNN-UA** and **BNN-UB** are suitable for actuating positive-drive safety limit switches when permanently affixed to the cam tray on at least one end with a self-threading screw **Z/SCREW-M4-X-20-ST-BE-DIN-7513**.

The self-threading screw can be ordered separately and takes the place of the U-channel friction wedge or T-nut, which is discarded prior to installation. The installer simply drills a **3.5mm hole (No. 28 tap drill)**, in alignment with the cam, into the cam tray and drives in the self-threading screw. Be sure to allow sufficient clearance behind the cam tray for the screw to penetrate through the cam tray.

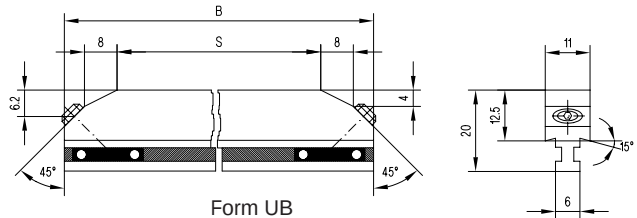


For Plunger Centerline Spacing
Type of Actuation
Mounting
Cam Designation
Cam Form
Material
For Slot Width
Use with Cam Trays

12 mm
Mechanical
U-channel
BNN-520-UA, BNN-520-UB
DIN 69 639
Hardened, Coated Steel
6mm
BNL-5304-120, -5307-120, -5304-120-S, -5307-120-S, -5306-120, -5308-120



Form UA



Form UB

Ordering Code

Balluff Mechanical Cam	BNN-520
Type of mounting channel	U-channel = U
Form	single set screw = A twin set screws = B

Actuated length (S) mm	Form A
	0, 04, 10, 16

	Form B
	0025, 0040, 0050, 0063, 0100, 0120, 0130, 0140, 0150, 0160, 0180, 0190, 0200, 0225, 0250, 0300, 0400, 0450, 0480, 0500, 0600, 0650, 0800, 1000, 1040, 1100, 1300

Application Notes

Overall length (B) mm
Form A, add 21mm to actuated length
Form B, add 26mm to actuated length

Positive-drive safety switches Intended for actuation of precision snap switches only.

Use types **BNN-520-TA, BNN-520-TB.**

BNN-TA, BNN-TB, BNN-UA or BNN-UB

for safety applications in conjunction with self-threading screws.

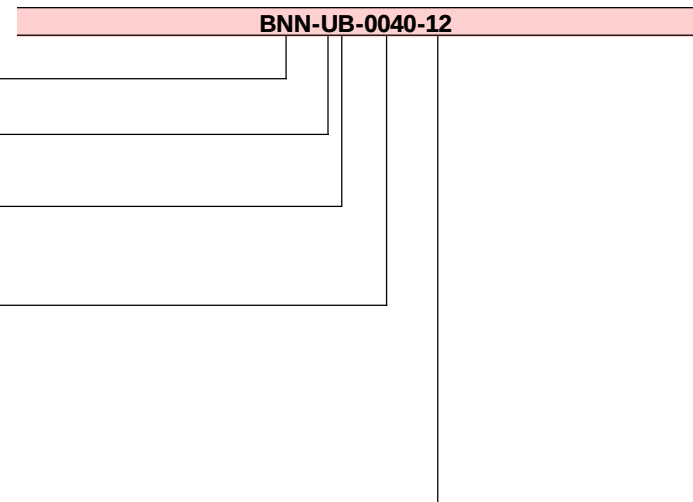
Z/SCREW-M4-X-20-ST-BE-DIN-7513

Spare Parts

Set Screw	BNN-Z/SET-SCREW-701533
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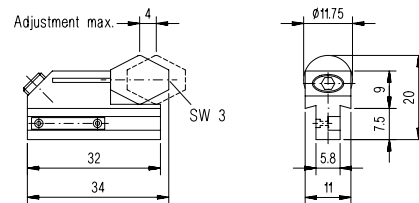
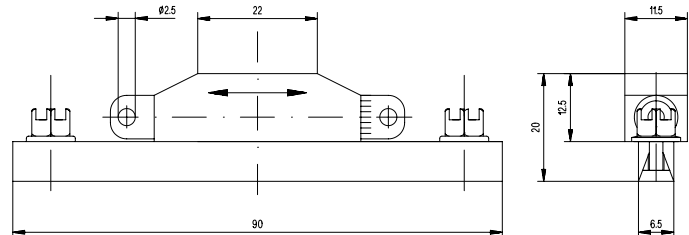
BNN-520-UB-0050

12mm
Mechanical
U-Channel
BNN-UA, BNN-UB
Hardened, Coated Steel
6mm
BNL-5304-120, -5307-120, -5304-120-S, -5307-120-S, -5306-120, -5308-120



For Plunger Centerline Spacing
Type of Actuation
Mounting
Cam Designation
Cam Form
Material
For Slot Width
Use with Cam Trays

12 mm
Mechanical, Precision Adjustment
U-channel
BNN-520-X-041, BNN-520-120-V
Hardened, Coated Steel
6mm
BNL-5304-120, -5307-120, -5304-120-S, -5307-120-S, -5306-120, -5308-120



Ordering Code	
Balluff Mechanical Cam	BNN-520
Type	Special = X
Designation	041

BNN-520-X-041	
----------------------	--

Application Notes	
For U-channel cam trays	

Intended for actuation of precision snap switches only. Do not use for positive-drive safety switches.	
--	--

Actuated length (S) mm	22
------------------------	----

adjusted by means of a $\varnothing$ 2.5 mm pin inserted into rotating micrometer heads on each end. Max. adjustment $\pm$ 5.5 mm, 11 mm total scale with 25 graduations, 1 grad = 0.02mm	
Adjustment pin not included	

Ordering Code	
Balluff Mechanical Cam	BNN-520
Channel Spacing	12 mm = 120
Designation	V

BNN-520-120-V	
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Application Notes	
For U-channel cam trays	

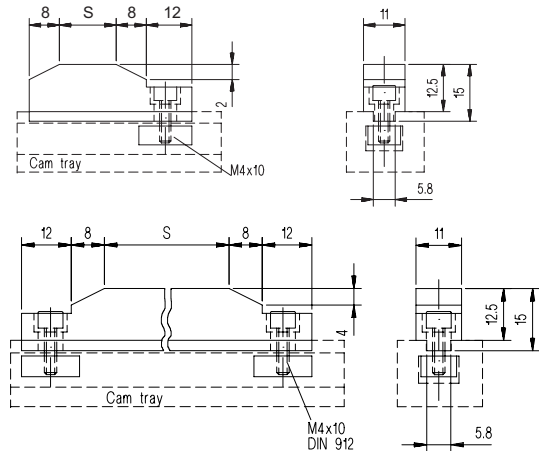
Intended for actuation of precision snap switches only. Do not use for positive-drive safety switches.	
--	--

Actuated length (S) mm	0 (chisel cam)
------------------------	----------------

Adjusted with hex wrench	
Max. adjustment $\pm$ 2.0 mm, 4.0 mm total	

For Plunger Centerline Spacing
Type of Actuation
Mounting
Cam Designation
Cam Form
Material
For Slot Width
Use with Cam Trays

12mm
Mechanical
T-Slot
BNN-520-TA, BNN-520-TB
DIN 69 639
Hardened, Coated Steel
6mm
BNL-5308-120, -5310-120, -5310-120-S



Ordering Code	
Balluff Mechanical Cam	BNN-520
Type of mounting channel	T-slot = T
Form	single set screw = A twin set screws = B
Actuated length (S) mm	Form A 0, 04, 10, 16
	Form B 025, 040, 050, 063, 080, 100 150, 200, 250, 300, 500

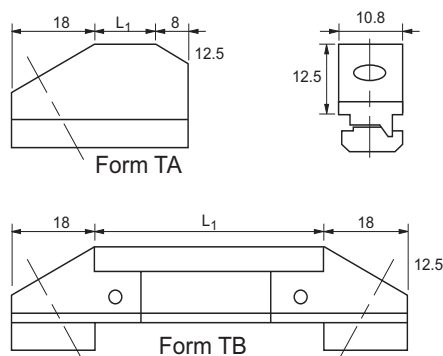
Application Notes	
Overall length (B) mm	Form A, add 28mm to actuated length Form B, add 40mm to actuated length
Positive-drive safety switches	For safety applications, use in conjunction with self-threading screw Z/SCREW-M4-X-20-ST-BE-DIN-7513

Spare Parts	
Set screw, black	Z/SCREW-M4X10-BLACK
Set screw, silver	Z/SCREW-M4X10-SILVER
T-nut	BNN-Z/NUT-T-SLOT-CAMS

BNN-520-TB-50

For Plunger Centerline Spacing
Type of Actuation
Mounting
Cam Designation
Cam Form
Material
For Slot Width
Use with Cam Trays

12 mm
Mechanical
T-slot
BNN-TA, BNN-TB
Hardened, Coated Steel
6mm
BNL-5308-120, -5310-120, -5310-120-S



Ordering Code	
Balluff Mechanical Cam	BNN
Type of mounting channel	T-slot = T
Form	single set screw = A twin set screws = B
Actuated length (L ₁) mm	Form A 0001, 0004, 0010, 0016
	Form B 0025, 0040, 0063, 0080, 0100
	0140, 0224, 0375, 0500, 0650, 0800, 1000

Plunger centerline spacing	12mm = 12
Application Notes	
Overall length (B) mm	Form A, add 26mm to actuated length Form B, add 36mm to actuated length
Cam height above cam tray, mm	12.5

Positive-drive safety switches

For safety applications, use in conjunction with self-threading screw

Z/SCREW-M4-X-20-ST-BE-DIN-7513

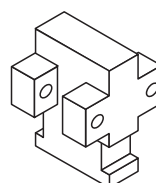
Spare Parts

End ramp for T-slot Form B	BNN-MTE-012
includes end ramp, friction block, screw, & spring	
Mounting shoe for T-slot	BNN-MTE-012-02
includes T-nut, screw, & spring	
Cam segment Form B	BNN-ZN-xxxx-12
without end ramps	where xxxx =
	0025, 0040, 0063, 0080, 0100, 0140
	0224, 0375, 0500, 0650, 0800, 1000

[illegible]

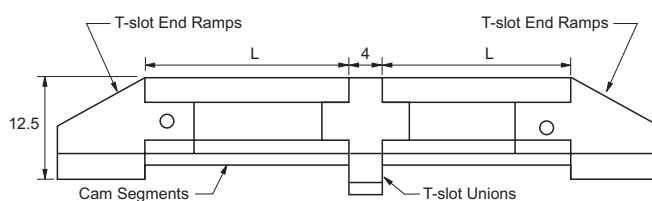
For Plunger Centerline Spacing
Type of Actuation
Mounting
Cam Designation
Cam Form
Material
For Slot Width
Use with Cam Trays

12mm
Mechanical
T-Slot
BNN-ZN
Modular system for cams of infinite length
Hardened, Coated Steel
6mm
BNL-5308-120, -5310-120, -5310-120-S



L = 1000mm Max.

T-slot Unions



Ordering Code		Cam Segments	T-Slot Unions	T-Slot End Ramps
		BNN-ZN-1000-12	BNN-HNT	BNN-MTE-012
Balluff Mechanical Cam	BNN			
Designation	intermediate cam segment = ZN			
Actuated length (L) mm	0010, 0016, 0025,			
	0040, 0063, 0080, 0092, 0100, 0110,			
	0140, 0224, 0250, 0350, 0375, 0500, 0650,			
	0792, 0800, 0960, 0984,			
	1000			
	order any combination and quantity			
Plunger centerline spacing	12mm = 12			
Balluff Mechanical Cam	BNN			
T-Slot union (length of cam surface = 4 mm)	HNT			
	order quantity = No. of cam segments - (1)			
Balluff Mechanical Cam	BNN			
End ramp (length = 18 mm)	MTE			
	order quantity = (2) per cam assembly			
Plunger centerline spacing	12mm = 012			

Application Notes	
Cam height above cam tray, mm	12.5
Cams must be terminated with an end ramp on both ends.	
Positive-drive safety switches	For safety applications, use in conjunction with self-threading screw.
Z/SCREW-M4-X-20-ST-BE-DIN-7513	

Spare Parts	
Mounting shoe for T-slot end ramp, includes T-nut, screw, & spring	BNN-MTE-012-02

For Plunger Centerline Spacing

Type of Actuation

Mounting

Cam Designation

Cam Form

Material

For Slot Width

Use with Cam Trays

8 mm

Mechanical and Inductive Electronic

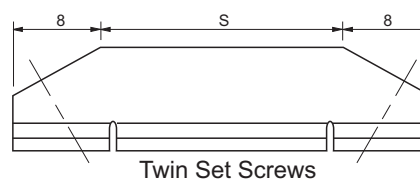
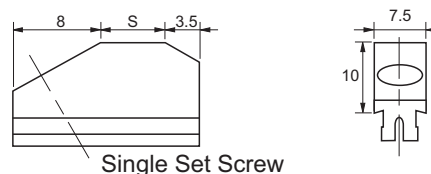
U-channel

BNN-520-081-S

Hardened, Coated Steel

4mm

BNL-5304-080, -5304-080-S, -5307-080-S, -5306-080, -5308-080



Ordering Code

BNN-520-081-S-025

Balluff Mechanical Cam

BNN-520

Series

U-channel = **081-S**

Actuated length (S) mm

Single set screw

0, 006.5, 010

Twin set screws

020, 025, 030, 040, 048, 060,

080, 100, 045, 200, 250, 440

Application Notes

Overall length (B) mm Single set screw,
add 11.5 mm to actuated length

Twin set screw, add 16 mm to actuated length

Spare Parts

Set screw

BNN-Z/SET-SCREW-701533

Electronic Linear Trip Cams for Inductive Sensors

Electronic linear trip cams for non-contact inductive sensors are made from straight, rectangular mild steel tubing held in place at both ends by sturdy plastic clamping retainers. Mounted in a linear cam tray and positioned to actuate the inductive sensor at the desired switchpoint, the mild steel trip cams are easily cut to any desired length and reassembled to the clamping retainers.

The electronic trip cams are held in the U-channels by friction wedges and by T-nuts in the T-slot channels. The cam is adjusted in the channel to set the exact switchpoint, then locked in place with a hex socket set screw.

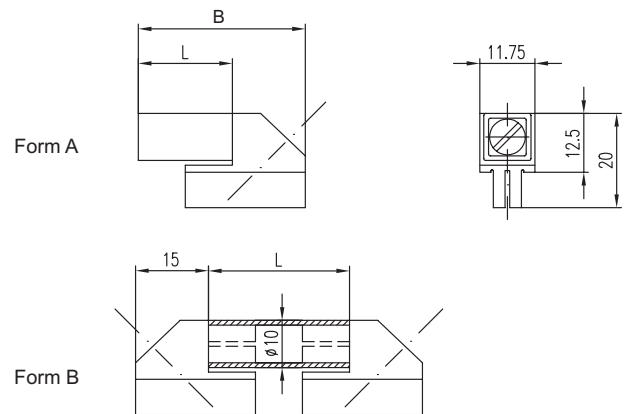
Linear trip cams are available in two basic styles:

- U-channel mount for drop-in cam installation
- T-slot mount for captive cams (won't fall out when loosened)

Application Note

These cams are intended for non-contact operation of inductive sensors only. Misapplication for use as trip cams for mechanical limit switches will result in extremely rapid wear and failure.

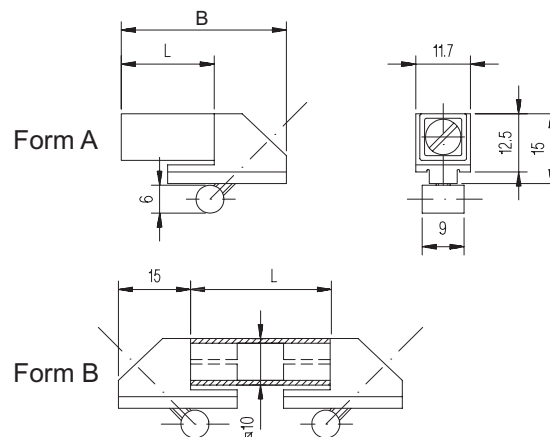
For Plunger Centerline Spacing	12mm
Type of Actuation	Inductive Electronic, Non-contact
Mounting	U-Channel
Cam Designation	BEN-516-14
Cam Form	
Material	Mild Steel Tubing, Plastic Clamping Retainers
For Slot Width	6mm
Use with Cam Trays	BNL-5304-120, -5307-120, -5304-120-S, -5307-120-S, -5306-120, -5308-120



Ordering Code	BEN-516-14-050
Balluff Mechanical Cam	
BEN-516	
Type of mounting channel	
U-channel = 14	
Actuated length (L) mm:	
Form A, single set screw	
other lengths on request: 010, 016, 020	
Form B, twin set screws	
022, 024, 025, 030, 040, 050, 051, 063	
075, 076, 077, 080, 100, 110, 115, 120	
140, 150, 152, 160, 165, 170, 180, 190	
200, 220, 240, 250, 262, 270, 280, 282	
300, 304, 305, 330, 360, 370, 400, 429	
430, 435, 450, 470, 475, 483, 495, 500	
552, 570, 594, 600, 610, 650, 660, 700	
710, 750, 800, 900, 1000	
Application Notes	
Overall length (B) mm	
Single set screw, add 15 mm to actuated length	
Twin set screw, add 30 mm to actuated length	
For non-contact electronic inductive sensors only - not for mechanical applications	
Spare Parts	
Set screw	BEN-Z/SET-SCREW-M5
Clamping retainer (end piece)	BEN-516-14-00

For Plunger Centerline Spacing
Type of Actuation
Mounting
Cam Designation
Cam Form
Material
For Slot Width
Use with Cam Trays

12 mm
Inductive Electronic, Non-contact
T-slot
BEN-516-13
Mild Steel Tubing, Plastic Clamping Retainers
6 mm
BNL-5308-120, -5310-120, -5310-120-S



Ordering Code	
Balluff Electronic Cam	BEN-516
Type of mounting channel	T-slot = 13
Actuated length (L) mm	Form B, single set screw
other lengths on request	010, 020
	Form B, twin set screws
	025, 027, 030, 050, 075, 100, 200, 300, 325
	500, 600, 700, 800, 900, 1000

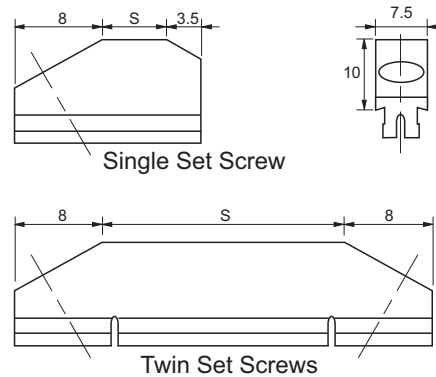
BEN-516-13-050	
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Application Notes	
Overall length (B) mm	Single set screw, add 15 mm to actuated length
	Twin set screw, add 30 mm to actuated length
For non-contact electronic inductive sensors only - not for mechanical applications.	

Spare Parts	
Clamping retainer (end piece)	BEN-516-13-00

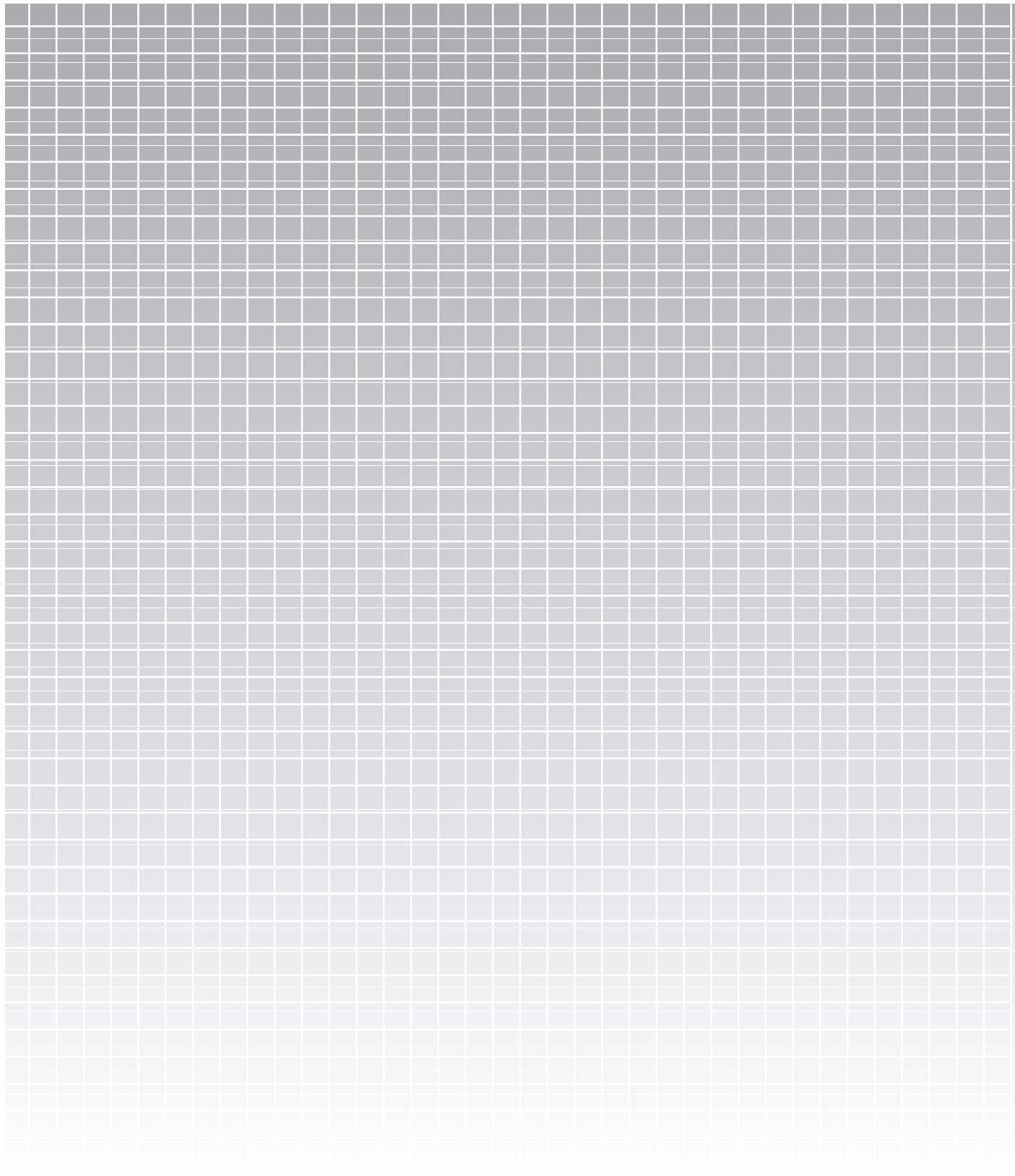
For Plunger Centerline Spacing
Type of Actuation
Mounting
Cam Designation
Cam Form
Material
For Slot Width
Use with Cam Trays

8 mm
Mechanical and Inductive Electronic
U-channel
BNN-520-081-S
Hardened, Coated Steel
4mm
BNL-5304-080, -5304-080-S, -5307-080-S, -5306-080, -5308-080



Ordering Code	
Balluff Mechanical Cam	BNN-520
Series	U-channel = 081-S
Actuated length (S) mm	Single set screw 0, 006.5, 010
	Twin set screws 020, 025, 030, 040, 048, 060, 080, 100, 045, 200, 250, 440
Application Notes	
Overall length (B) mm	Single set screw, add 11.5 mm to actuated length Twin set screw, add 16 mm to actuated length
Spare Parts	
Set screw	BNN-Z/SET-SCREW-701533

BNN-520-081-S-025	



Rotary Cam Drums and Trays

Rotary cam drums are machined from solid aluminum into a round profile. Rotary cam trays are made from extruded aluminum rolled into a semi-circle. A rotary drum provides 360 degrees for cam mounting, while the rotary cam trays provide 180 degrees. Two rotary cam trays can be used together to provide 360 degrees for cam mounting.

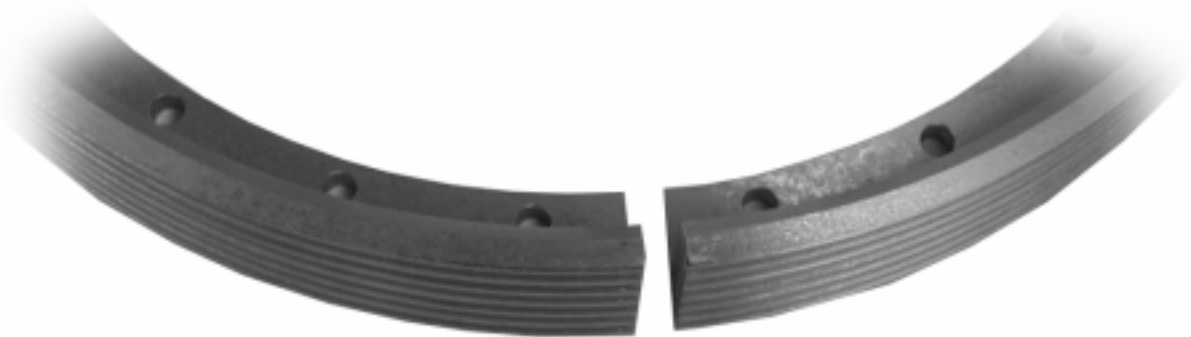
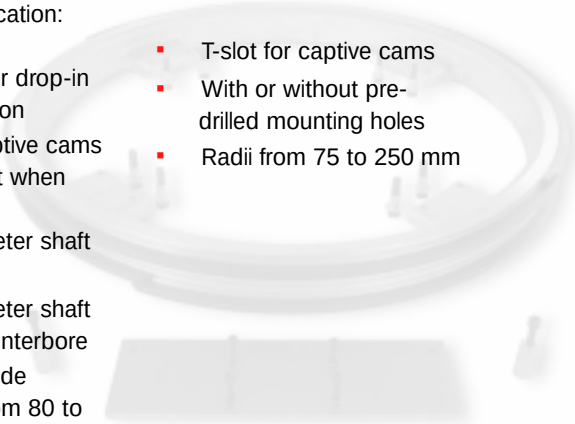
The trip cams are held in the U-channels by friction wedges and by T-nuts in the T-slot channels. The cam is adjusted in the channel to set the exact switchpoint, then locked in place with a hex socket set screw.

Rotary cam drums are available in a variety of styles to suit your application:

- U-channel for drop-in cam installation
- T-slot for captive cams (won't fall out when loosened)
- 20mm diameter shaft hole
- 20mm diameter shaft hole and counterbore
- Various outside diameters from 80 to 320 mm

Rotary cam trays carry the following options:

- T-slot for captive cams
- With or without pre-drilled mounting holes
- Radii from 75 to 250 mm



Centerline Spacing, Channel to Channel

Material and Construction

Cam Drum Designation

Cam Drum Form

Use with Switch Housings

Use with Cams

Mounting

12mm

Machined Aluminum Drum, U-Channel

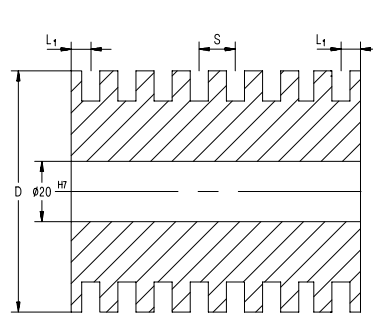
BNL-URN

Circular

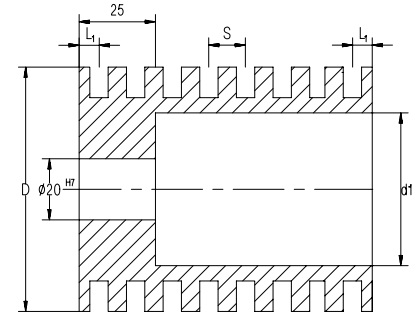
Series 100, 602-11, 62, 61, 610-11, 72, 605-11 Multiple; F 60 Single

BNN-UR

20mm dia. smoothbore for round shaft, unkeyed



Style A



Style B

Number of Channels	Drum Diameter and Style											
	80		100		150		200		250		320	
	A	B	A	B	A	B	A	B	A	B	A	B
1	•		•		•		•		•		•	
2	•		•		•		•		•		•	
3	•		•		•	•	•		•		•	
4	•		•		•	•	•		•	•	•	
5	•		•		•	•	•		•	•	•	
6	•		•		•	•	•		•	•	•	
7	•		•		•	•	•		•	•	•	
8	•		•		•	•	•		•	•	•	
9	•		•		•	•	•		•	•	•	
10	•		•		•	•	•		•	•	•	
12	•		•		•	•	•		•	•	•	
	•		•		•	•	•		•	•	•	
Ordering Code	BNL-URN-1203-150-B											
Balluff Rotary Cam Drum	BNL											
Type of channel	U-channel = URN											
Channel centerline spacing	12mm = 12											
Number of channels	01...16											
Drum diameter D, mm	80, 100, 150, 250, 320											
Drum style	Style A = A											
	Style B = B											

Application Notes

Drums are specified by diameter, cams are specified by radius.

For example, drum diameter = 200mm,

cam radius = 100mm.

Length L_1 mm 7

Inside diameter d_1 mm

For drum diameter

80 mm NA

100 mm NA

150 mm 120

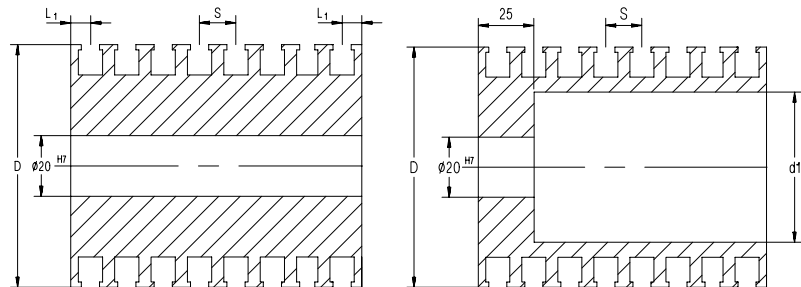
200 mm 170

250 mm 220

320 mm 290

Centerline Spacing, Channel to Channel
Material and Construction
Cam Drum Designation
Cam Drum Form
Use with Switch Housings
Use with Cams
Mounting

12mm
Machined Aluminum Drum, T-slot
BNL-TRN
Circular
Series 100, 602-11, 62, 61, 610-11, 72, 605-11 Multiple; F 60 Single
BNN-TR, BEN-IR
20mm dia. smoothbore for round shaft, unkeyed



Style A

Style B

Number of Channels	Drum Diameter and Style											
	80		100		150		200		250		320	
	A	B	A	B	A	B	A	B	A	B	A	B
1	•		•		•		•		•			•
2	•		•		•		•		•			•
3	•		•		•	•	•		•			•
4	•		•			•		•		•		•
5	•		•			•		•		•		•
6	•		•			•		•		•		•
7	•		•			•		•		•		•
8	•		•			•		•		•		•
9	•		•			•		•		•		•
10	•		•			•		•		•		•
12	•		•			•		•		•		•
	•		•			•		•		•		•
Ordering Code	BNL-TRN-1203-150-B											
Balluff Rotary Cam Drum	BNL											
Type of channel	U-channel = TRN											
Channel centerline spacing	12mm = 12											
Number of channels	01...16											
Drum diameter D, mm	80, 100, 150, 250, 320											
Drum style	Style A = A											
	Style B = B											

Application Notes

Drums are specified by diameter, cams are specified by radius.
For example, drum diameter = 200mm,
cam radius = 100mm.

Length L_1 mm 7

Inside diameter d_1 mm	
For drum diameter	
80 mm	NA
100 mm	NA
150 mm	120
200 mm	170
250 mm	220
320 mm	290

Centerline Spacing, Channel to Channel

Material and Construction

Cam Tray Designation

Cam Tray Form

Use with Switch Housings

Use with Cams

Mounting

12 mm

Extruded Aluminum T-slot, Semicircle

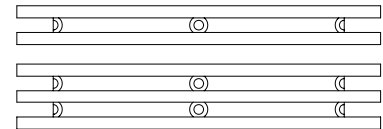
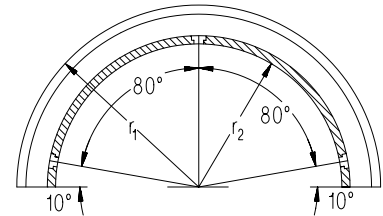
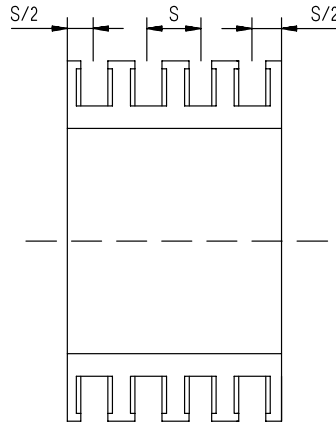
BNL-LAH

Radius

Series 100, 602-11, 62, 61, 610-11 Multiple; F 60 Single

BNN-TR, BEN-IR

Supplied With or Without Mounting Holes



Ordering Code

BNL-LAH-1206-250-B

Balluff Linear Cam Tray

BNL

Type Designation

T-slot = LAH

Channel centerline spacing, S

12 mm = 120

Number of channels, N

01, 02, 04, 06, 08

Outside radius, r1 mm

75, 100, 125, 160, 250

or special radius* on request

Mounting hole option

Without mounting holes = Blank

With mounting holes = B

Application Notes

Rotary cam trays are specified by radius, cams are specified by radius.

For example, cam tray radius = 250 mm, cam radius = 250 mm

*requires special radius cams

Coverage per piece

180° (semi-circle)

Width, mm

For cam tray channels

1 24

2 36

4 60

6 84

8 108

Mounting hole locations

10°, 90°, 170°

Number of mounting holes 1 channel = one row of three

02, 04, 06, 08 channel = two rows of three

Radius tolerance, mm

For cam tray nominal radii

r¹

r²

75 mm 75 ± 2 59 ± 2

100 mm 100 ± 2 84 ± 2

125 mm 125 ± 2 109 ± 2

160 mm 160 ± 3 144 ± 3

250 mm 150 ± 3 234 ± 3

Accessories

Mounting screws, M4 x 101 Z/SCREW-BUTTON-HEAD-M4-X-10

order quantity required

Mechanical Rotary Trip Cams

Rotary trip cams are curved metal ramps for actuating mechanical limit switches. Mounted in a rotary cam drum or tray and positioned to actuate the limit switch at the desired switchpoint, the trip cams are made from specially hardened, coated steel for long service life.

The cams are held in the U-channels by friction wedges and by T-nuts in the T-slot channels. The cam is adjusted in the channel to set the exact switchpoint, then locked in place with a hex socket set screw.

Rotary trip cams are available in various styles:

- U-channel mount for drop-in cam installation
- T-slot mount for captive cams (won't fall out when loosened)
- Two piece with single set screw for small angles
- Three piece with two set screws for larger angles



Rotary trip cams for safety limit switches

Rotary trip cams BNN-UR and BNN-TR are suitable for actuating the positive-drive safety limit switches when permanently affixed to the cam tray on at least one end with a self-threading screw Z/SCREW-M4-X-20-ST-BE-DIN-7513.

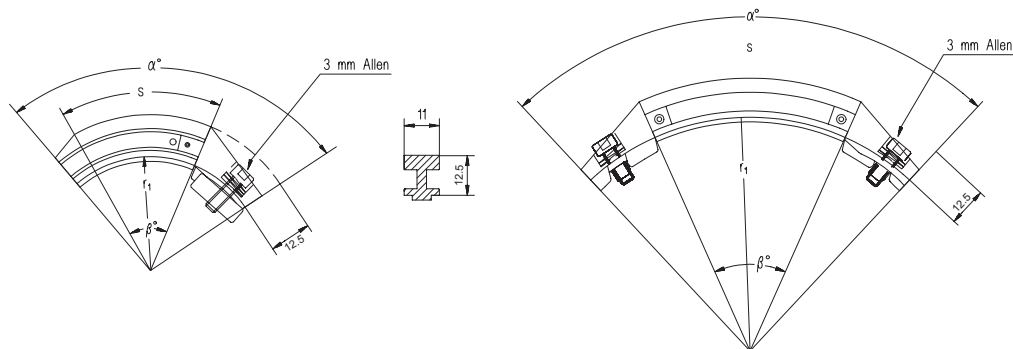
The self-threading screw can be ordered separately and takes the place of the U-channel friction wedge or

T-nut, which is discarded prior to installation. The installer simply drills a 3.5mm hole (No. 28 tap drill), in alignment with the cam, into the cam tray and drives in the self-threading screw. Be sure to allow sufficient clearance behind the cam tray for the screw to penetrate through the cam tray.



For Plunger Centerline Spacing
Type of Actuation
Mounting
Cam Designation
Cam Form
Material
For Slot Width
Use with Rotary Cam Drums and Rotary Cam Trays

12 mm
Mechanical
U-channel
BNN-UR
Radius
Hardened, Coated Steel
6 mm
BNL-URN



Nominal Radius

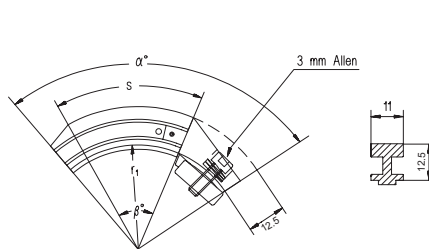
Ordering Code				
Rotary Cam	U-Channel	Swept Angle	Radius r ¹	Cam Spacing
Cam		β (°)	(mm)	(mm)
BNN	-UR	-004	-040	-12
BNN	-UR	-010	-040	-12
BNN	-UR	-015	-040	-12
BNN	-UR	-030	-040	-12
BNN	-UR	-045	-040	-12
BNN	-UR	-060	-040	-12
BNN	-UR	-075	-040	-12
BNN	-UR	-090	-040	-12
BNN	-UR	-004	-050	-12
BNN	-UR	-009	-050	-12
BNN	-UR	-015	-050	-12
BNN	-UR	-030	-050	-12
BNN	-UR	-045	-050	-12
BNN	-UR	-060	-050	-12
BNN	-UR	-075	-050	-12
BNN	-UR	-090	-050	-12
BNN	-UR	-003	-075	-12
BNN	-UR	-007	-075	-12
BNN	-UR	-015	-075	-12
BNN	-UR	-030	-075	-12
BNN	-UR	-045	-075	-12
BNN	-UR	-060	-075	-12
BNN	-UR	-075	-075	-12
BNN	-UR	-090	-075	-12
BNN	-UR	-003	-100	-12
BNN	-UR	-005	-100	-12
BNN	-UR	-010	-100	-12
BNN	-UR	-015	-100	-12
BNN	-UR	-030	-100	-12
BNN	-UR	-045	-100	-12
BNN	-UR	-060	-100	-12
BNN	-UR	-075	-100	-12
BNN	-UR	-090	-100	-12
BNN	-UR	-105	-100	-12
BNN	-UR	-120	-100	-12

Other Information		
Arc Length	Total Angle	Style
(mm)	α(°)	
4	46	1
10	52	1
14	57	1
28	72	1
41	87	1
55	116	2
69	131	2
83	156	2
4	37	1
10	42	1
16	49	1
33	63	1
49	78	1
65	104	2
82	119	2
98	134	2
4	26	1
10	30	1
23	38	1
46	60	2
69	75	2
92	90	2
114	105	2
137	120	2
4	19	1
10	22	1
20	27	1
29	37	2
56	56	2
88	67	2
118	82	2
147	97	2
177	112	2
206	127	2
236	144	2

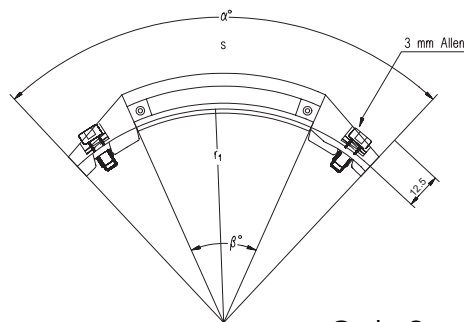
Nominal Radius	Ordering Code					Other Information		
	Rotary Cam	U-Channel	Swept Angle	Radius r ¹	Cam Spacing	Arc Length	Total Angle	Style
	Cam		β (°)	(mm)	(mm)	(mm)	α (°)	
125 mm	BNN	-UR	-002	-125	-12	4	16	1
	BNN	-UR	-004	-125	-12	10	18	1
	BNN	-UR	-009	-125	-12	20	23	1
	BNN	-UR	-015	-125	-12	36	33	2
	BNN	-UR	-030	-125	-12	72	48	2
	BNN	-UR	-045	-125	-12	108	63	2
	BNN	-UR	-060	-125	-12	144	78	2
	BNN	-UR	-075	-125	-12	180	93	2
	BNN	-UR	-090	-125	-12	216	108	2
	BNN	-UR	-105	-125	-12	252	123	2
	BNN	-UR	-120	-125	-12	288	138	2
160 mm	BNN	-UR	-001	-160	-12	4	12	1
	BNN	-UR	-003	-160	-12	10	14	1
	BNN	-UR	-007	-160	-12	20	18	1
	BNN	-UR	-015	-160	-12	45	29	2
	BNN	-UR	-030	-160	-12	90	44	2
	BNN	-UR	-045	-160	-12	135	59	2
	BNN	-UR	-060	-160	-12	181	74	2
	BNN	-UR	-075	-160	-12	226	89	2
	BNN	-UR	-090	-160	-12	271	104	2
	BNN	-UR	-105	-160	-12	316	119	2
	BNN	-UR	-120	-160	-12	361	134	2
250 mm	BNN	-UR	-001	-250	-12	4	9	1
	BNN	-UR	-002	-250	-12	10	10	1
	BNN	-UR	-004	-250	-12	20	12	1
	BNN	-UR	-015	-250	-12	69	25	2
	BNN	-UR	-030	-250	-12	137	40	2
	BNN	-UR	-045	-250	-12	206	55	2
	BNN	-UR	-060	-250	-12	275	70	2
	BNN	-UR	-075	-250	-12	343	85	2
	BNN	-UR	-90	-250	-12	412	100	2
	BNN	-UR	-105	-250	-12	481	115	2
	BNN	-UR	-120	-250	-12	549	130	2
Application Notes		Spare Parts						
Cam height, mm	12.5	End ramp for U-channel, includes ramp & mounting shoe assembly						
Special radii and swept angles available on request		radii 40...50 mm						
		radii 75...124 mm						
		radii 125...249 mm						
		radii 250 mm & up						
Positive-drive safety switches		Friction block for U-channel,						
Z/SCREW-M4-X-20-ST-BE-DIN-7513		no spring or screw included						
		BNN-URE-040-12						
		BNN-URE-075-12						
		BNN-URE-125-12						
		BNN-URE-250-12						
		BNN-URENU-1202						

For Plunger Centerline Spacing
Type of Actuation
Mounting
Cam Designation
Cam Form
Material
For Slot Width
Use with Rotary Cam Drums and Rotary Cam Trays

12 mm
Mechanical
T-slot
BNN-TR
Radius
Hardened, Coated Steel
6 mm
BNL-TRN, BNL-LAH



Style 1



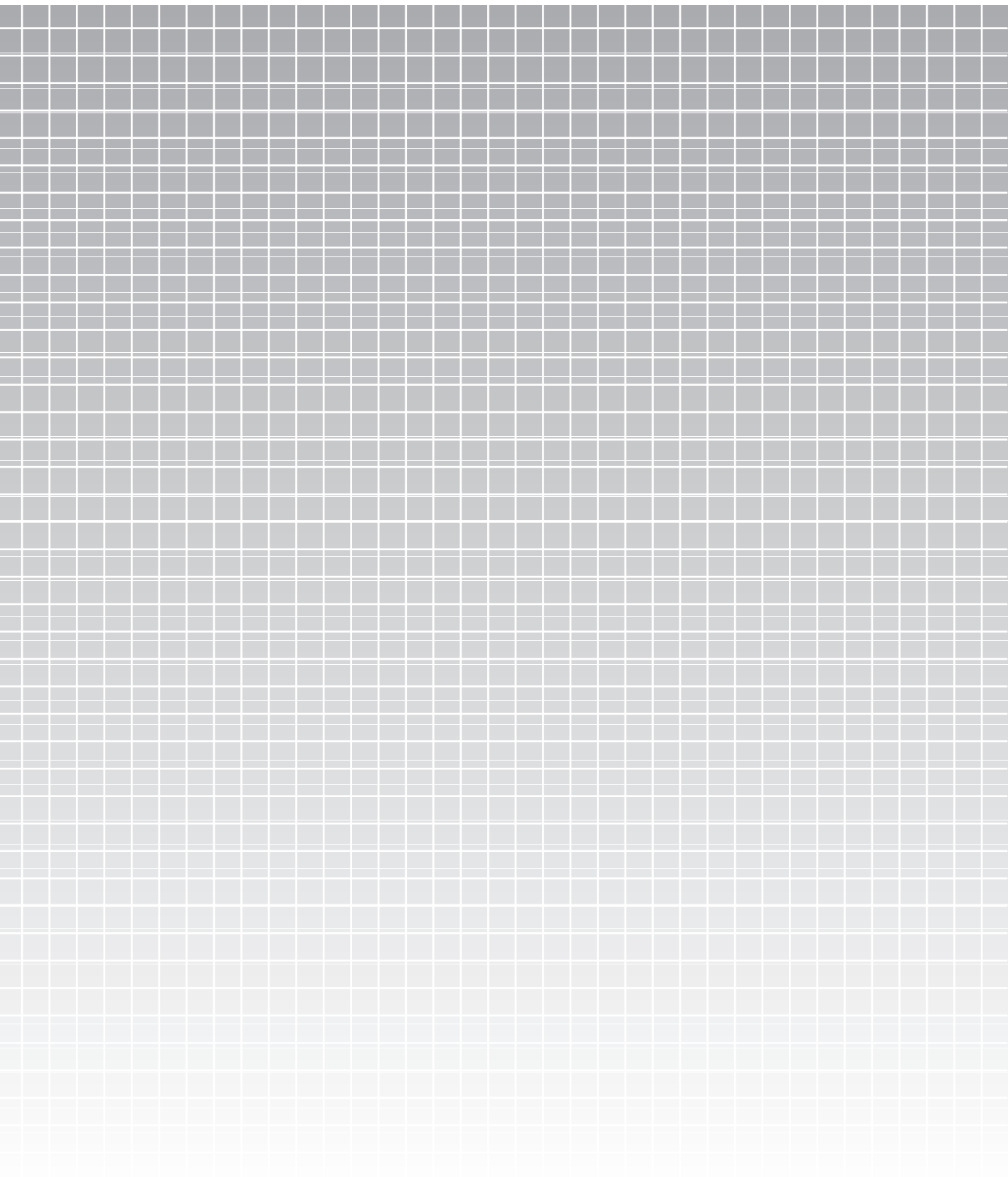
Style 2

Nominal Radius

Ordering Code				
Rotary Cam	U-Channel	Swept Angle	Radius r ¹	Cam Spacing
Cam		β (°)	(mm)	(mm)
BNN	-TR	-004	-040	-12
BNN	-TR	-010	-040	-12
BNN	-TR	-015	-040	-12
BNN	-TR	-030	-040	-12
BNN	-TR	-045	-040	-12
BNN	-TR	-060	-040	-12
BNN	-TR	-075	-040	-12
BNN	-TR	-090	-040	-12
BNN	-TR	-004	-050	-12
BNN	-TR	-009	-050	-12
BNN	-TR	-015	-050	-12
BNN	-TR	-030	-050	-12
BNN	-TR	-045	-050	-12
BNN	-TR	-060	-050	-12
BNN	-TR	-075	-050	-12
BNN	-TR	-090	-050	-12
BNN	-TR	-003	-075	-12
BNN	-TR	-007	-075	-12
BNN	-TR	-015	-075	-12
BNN	-TR	-030	-075	-12
BNN	-TR	-045	-075	-12
BNN	-TR	-060	-075	-12
BNN	-TR	-075	-075	-12
BNN	-TR	-090	-075	-12
BNN	-TR	-003	-100	-12
BNN	-TR	-005	-100	-12
BNN	-TR	-010	-100	-12
BNN	-TR	-015	-100	-12
BNN	-TR	-030	-100	-12
BNN	-TR	-045	-100	-12
BNN	-TR	-060	-100	-12
BNN	-TR	-075	-100	-12
BNN	-TR	-090	-100	-12
BNN	-TR	-105	-100	-12
BNN	-TR	-120	-100	-12

Other Information		
Arc Length	Total Angle	Style
(mm)	α (°)	
4	46	1
10	52	1
14	57	1
28	72	1
41	87	1
55	116	2
69	131	2
83	156	2
4	37	1
10	42	1
16	49	1
33	63	1
49	78	1
65	104	2
82	119	2
98	134	2
4	26	1
10	30	1
23	38	1
46	60	2
69	75	2
92	90	2
114	105	2
137	120	2
4	19	1
10	22	1
20	27	1
29	37	2
56	56	2
88	67	2
118	82	2
147	97	2
177	112	2
206	127	2
236	144	2

Nominal Radius	Ordering Code					Other Information		
	Rotary Cam	U-Channel	Swept Angle	Radius r ¹	Cam Spacing	Arc Length	Total Angle	Style
	Cam		β (°)	(mm)	(mm)	(mm)	α (°)	
125 mm	BNN	-TR	-002	-125	-12	4	16	1
	BNN	-TR	-004	-125	-12	10	18	1
	BNN	-TR	-009	-125	-12	20	23	1
	BNN	-TR	-015	-125	-12	36	33	2
	BNN	-TR	-030	-125	-12	72	48	2
	BNN	-TR	-045	-125	-12	108	63	2
	BNN	-TR	-060	-125	-12	144	78	2
	BNN	-TR	-075	-125	-12	180	93	2
	BNN	-TR	-090	-125	-12	216	108	2
	BNN	-TR	-105	-125	-12	252	123	2
	BNN	-TR	-120	-125	-12	288	138	2
160 mm	BNN	-TR	-001	-160	-12	4	12	1
	BNN	-TR	-003	-160	-12	10	14	1
	BNN	-TR	-007	-160	-12	20	18	1
	BNN	-TR	-015	-160	-12	45	29	2
	BNN	-TR	-030	-160	-12	90	44	2
	BNN	-TR	-045	-160	-12	135	59	2
	BNN	-TR	-060	-160	-12	181	74	2
	BNN	-TR	-075	-160	-12	226	89	2
	BNN	-TR	-090	-160	-12	271	104	2
	BNN	-TR	-105	-160	-12	316	119	2
	BNN	-TR	-120	-160	-12	361	134	2
250 mm	BNN	-TR	-001	-250	-12	4	9	1
	BNN	-TR	-002	-250	-12	10	10	1
	BNN	-TR	-004	-250	-12	20	12	1
	BNN	-TR	-015	-250	-12	69	25	2
	BNN	-TR	-030	-250	-12	137	40	2
	BNN	-TR	-045	-250	-12	206	55	2
	BNN	-TR	-060	-250	-12	275	70	2
	BNN	-TR	-075	-250	-12	343	85	2
	BNN	-TR	-90	-250	-12	412	100	2
	BNN	-TR	-105	-250	-12	481	115	2
	BNN	-TR	-120	-250	-12	549	130	2
Application Notes		Spare Parts						
Cam height, mm 12.5		End ramp for U-channel, includes ramp & mounting shoe assembly						
Special radii and swept angles available on request		radii 40...50 mm						
		radii 75...124 mm			BNN-TRE-040-12			
		radii 125...249 mm			BNN-TRE-075-12			
		radii 250 mm & up			BNN-TRE-125-12			
Positive-drive safety switches					BNN-TRE-250-12			
Z/SCREW-M4-X-20-ST-BE-DIN-7513		Friction block for U-channel, no spring or screw included			BNN-TRENU-1202			



Electronic Rotary Trip Cams for Inductive Sensors

Electronic rotary trip cams for non-contact inductive sensors are made from curved mild steel held in place at one or both ends by sturdy metal T-nuts. Mounted in a rotary cam drum or tray and positioned to actuate the inductive sensor at the desired switchpoint, the mild steel trip cams are available in many standard angles to suit a variety of applications.

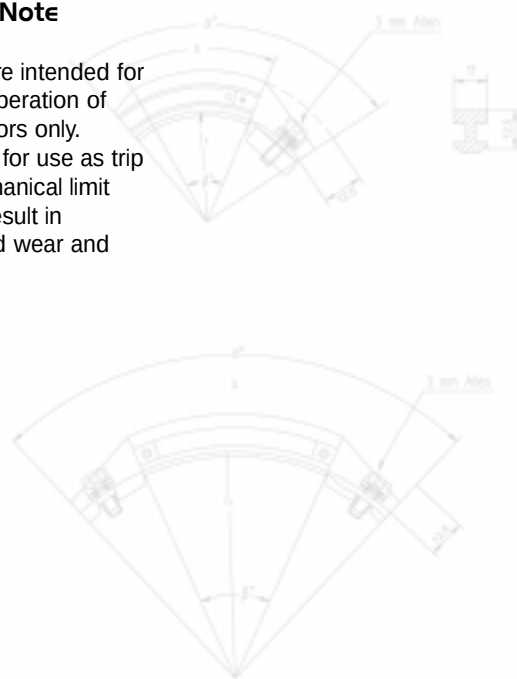
The cam is adjusted in the channel to set the exact switchpoint, the locked in place with a hex socket set screw.

Linear trip cams are available in two basic styles:

- U-channel mount for drop-in cam installation
- T-slot mount for captive cams (won't fall out when loosened)
- Two piece with single set screw for smaller angles
- Three piece with two set screws for larger angles

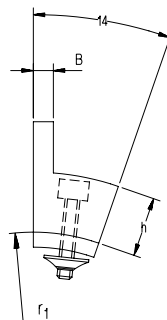
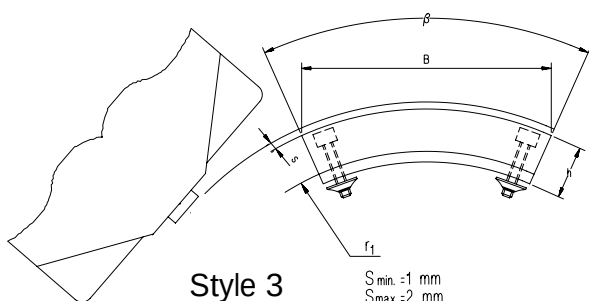
Application Note

These cams are intended for non-contact operation of inductive sensors only. Misapplication for use as trip cams for mechanical limit switches will result in extremely rapid wear and failure.

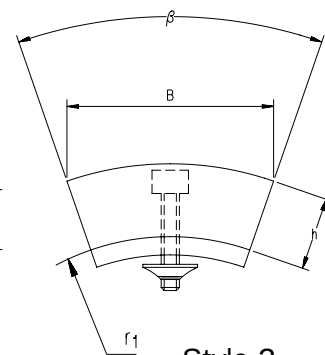
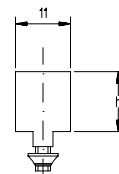


For Plunger Centerline Spacing
Type of Actuation
Mounting
Cam Designation
Cam Form
Material
For Slot Width
Use with Rotary Cam Drums and Rotary Cam Trays

12 mm
Inductive Electronic, Non-contact
T-slot
BNN-IR
Radius
Mild Solid Steel, Oxide Coated
6 mm
BNL-TRN, BNL-LAH

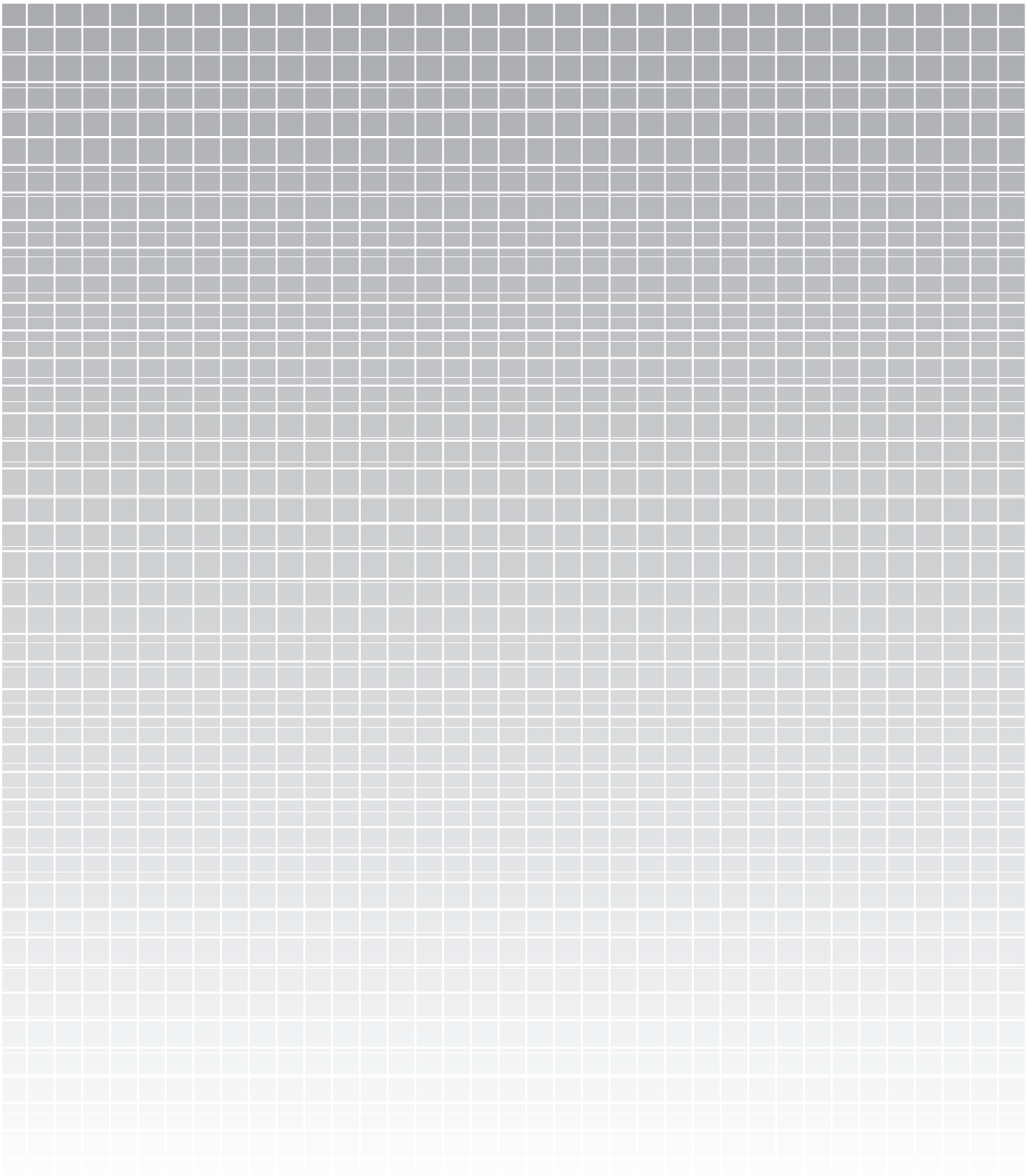


Style 1

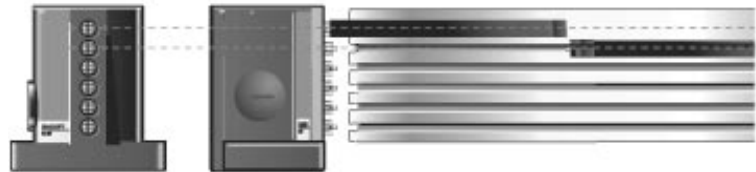


Nominal Radius	Ordering Code					Other Information	
	Rotary Cam	U-Channel	Swept Angle	Radius r^1	Cam Spacing	Arc Length	Style
	Cam		β (°)	(mm)	(mm)	(mm)	
40 mm	BEN	-IR	-004	-040	-12	4	1
	BEN	-IR	-010	-040	-12	10	2
	BEN	-IR	-015	-040	-12	14	2
	BEN	-IR	-030	-040	-12	28	2
	BEN	-IR	-045	-040	-12	41	3
	BEN	-IR	-060	-040	-12	55	3
	BEN	-IR	-075	-040	-12	69	3
	BEN	-IR	-090	-040	-12	83	3
50 mm	BEN	-IR	-004	-050	-12	4	1
	BEN	-IR	-009	-050	-12	10	2
	BEN	-IR	-015	-050	-12	16	2
	BEN	-IR	-030	-050	-12	33	2
	BEN	-IR	-045	-050	-12	49	3
	BEN	-IR	-060	-050	-12	65	3
	BEN	-IR	-075	-050	-12	82	3
	BEN	-IR	-090	-050	-12	98	3
75 mm	BEN	-IR	-003	-075	-12	4	1
	BEN	-IR	-007	-075	-12	10	2
	BEN	-IR	-015	-075	-12	23	2
	BEN	-IR	-030	-075	-12	46	2
	BEN	-IR	-045	-075	-12	69	3
	BEN	-IR	-060	-075	-12	92	3
	BEN	-IR	-075	-075	-12	114	3
	BEN	-IR	-090	-075	-12	137	3
100 mm	BEN	-IR	-003	-100	-12	4	1
	BEN	-IR	-005	-100	-12	10	2
	BEN	-IR	-010	-100	-12	20	2
	BEN	-IR	-015	-100	-12	29	2
	BEN	-IR	-030	-100	-12	56	2
	BEN	-IR	-045	-100	-12	88	3
	BEN	-IR	-060	-100	-12	118	3
	BEN	-IR	-075	-100	-12	147	3
	BEN	-IR	-090	-100	-12	177	3
	BEN	-IR	-105	-100	-12	206	3
	BEN	-IR	-120	-100	-12	236	3

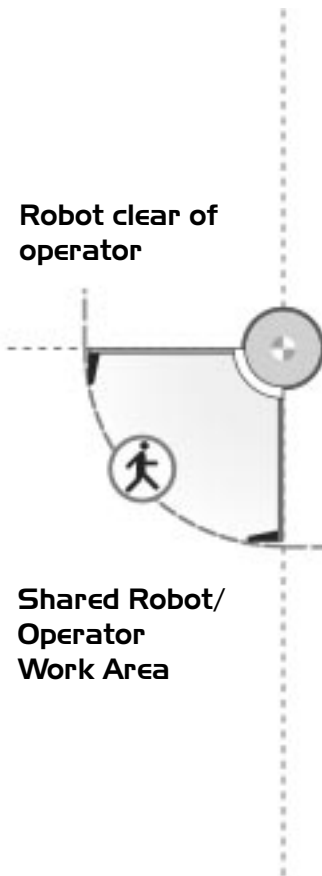
Nominal Radius	Ordering Code					Other Information	
	Rotary Cam	U-Channel	Swept Angle	Radius r ¹	Cam Spacing	Arc Length	Style
	Cam		β (°)	(mm)	(mm)	(mm)	
125 mm	BEN	-IR	-002	-125	-12	4	1
	BEN	-IR	-004	-125	-12	10	2
	BEN	-IR	-009	-125	-12	20	2
	BEN	-IR	-015	-125	-12	36	2
	BEN	-IR	-030	-125	-12	72	3
	BEN	-IR	-045	-125	-12	108	3
	BEN	-IR	-060	-125	-12	144	3
	BEN	-IR	-075	-125	-12	180	3
	BEN	-IR	-090	-125	-12	216	3
	BEN	-IR	-105	-125	-12	252	3
	BEN	-IR	-120	-125	-12	288	3
160 mm	BEN	-IR	-001	-160	-12	4	1
	BEN	-IR	-003	-160	-12	10	2
	BEN	-IR	-007	-160	-12	20	2
	BEN	-IR	-015	-160	-12	45	2
	BEN	-IR	-030	-160	-12	90	2
	BEN	-IR	-045	-160	-12	135	3
	BEN	-IR	-060	-160	-12	181	3
	BEN	-IR	-075	-160	-12	226	3
	BEN	-IR	-090	-160	-12	271	3
	BEN	-IR	-105	-160	-12	316	3
	BEN	-IR	-120	-160	-12	361	3
250 mm	BEN	-IR	-001	-250	-12	4	2
	BEN	-IR	-002	-250	-12	10	2
	BEN	-IR	-004	-250	-12	20	3
	BEN	-IR	-015	-250	-12	69	3
	BEN	-IR	-030	-250	-12	137	3
	BEN	-IR	-045	-250	-12	206	3
	BEN	-IR	-060	-250	-12	275	3
	BEN	-IR	-075	-250	-12	343	3
	BEN	-IR	-90	-250	-12	412	3
	BEN	-IR	-105	-250	-12	481	3
	BEN	-IR	-120	-250	-12	549	3
Application Notes		Spare Parts					
Cam height, mm 12.5		T-nut friction block, BEN-Z/IR-M4-T-NUT					
Special radii and swept angles available on request		no screw included					
For non-contact electronic inductive sensors only - not for mechanical applications							



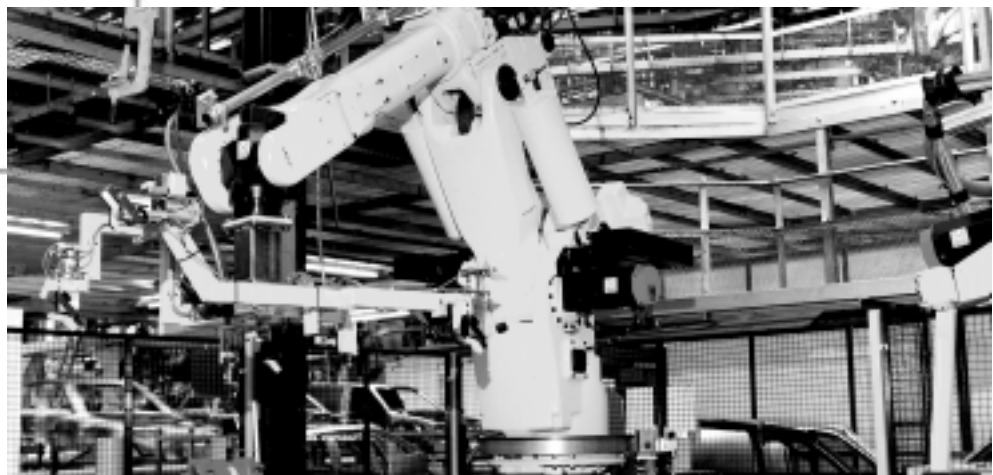
Robot Zone Limit System for Safety with Flexibility



Robot clear of
operator



Shared Robot/
Operator
Work Area



Safety with Flexibility

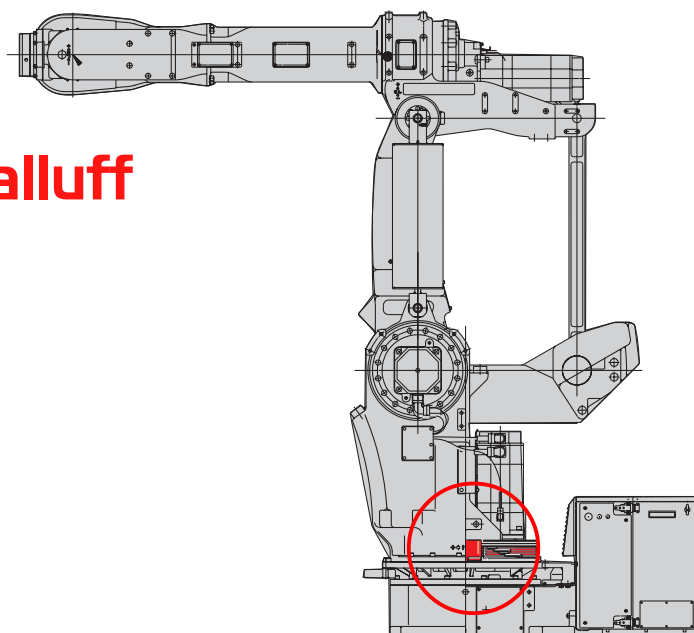
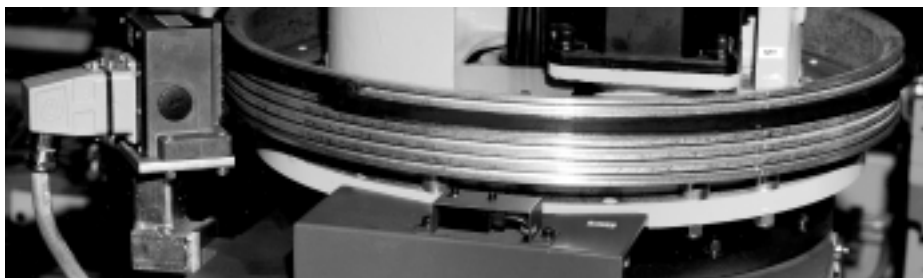
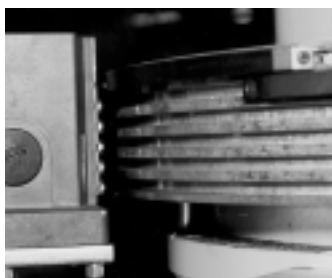
Function

Dynamic envelope restriction gives the robot cell designer the freedom to allow coordination between robots and humans within the same physical space. This flexibility can help improve workflow and reduce floor space requirements while maintaining the highest degree of personnel safety. The key is diverse complementary redundant operation.

The Zone Limit System provides a control-reliable means to interlock light curtains and safety mats with the angular position of the robot. While the robot is clear of the operator area, the cell controller mutes the output of safety sensors, allowing workers to access part of the robot cell without stopping the robot. When the robot enters the operator zone, the light curtains and safety mats are re-enabled. If a worker is present in the operator area, robot servo power is interrupted until the person leaves the area. If no worker is present in the operator area, the robot is free to move about and perform tasks in that area until someone re-enters the controlled space.

Allows robots and humans to share a work area where the human has priority over the robot.

Rugged system mutes personnel sensing devices while robot remains clear of operator area, cuts power if robot moves into spaces occupied by people.

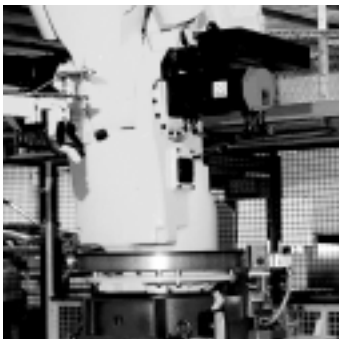


Safety – made by Balluff

Balluff cam switches with rigid plungers and safety switch elements per VDE 0113 are ideal components for constructing safety apparatus for man and machine.

Features

- Monitors up to three independent work zones with a six-channel cam system
- Robot work zones configurable from 15° to 345° in 7.5° increments
- Implements dynamic restricted envelope per ANSI/RIA R15.06-1999
- Addresses need for Category 4 control reliability
- Safety limit switches designed to VDE 0113
- Limit switch housing sealed to IP67
- Conforms to General Motors' Global Common Technical Specification for Production Robots RS-1, Section 3.10.3 "Zone Limit Switches/Dynamic Limiting Devices"



Design

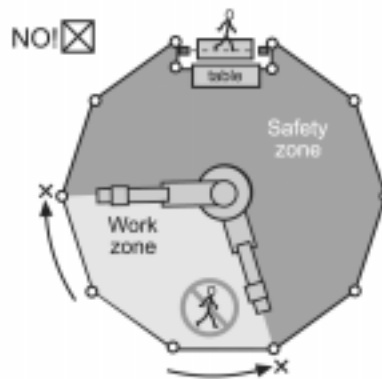
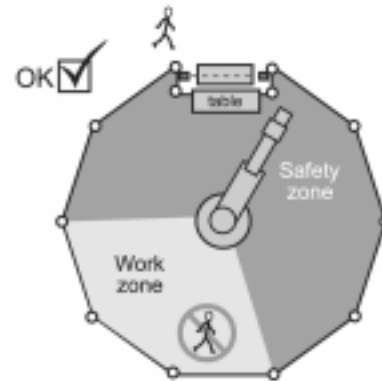
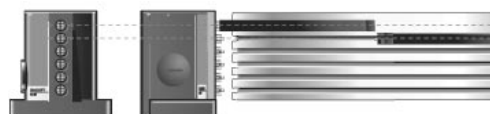
The system is composed of a heavy-duty mechanical cam switch assembly that mounts to the stationary base of the robot, a rugged circular cam tray that attaches to the robot's rotating flange, and hardened circular cams that mount on the cam tray at rotation boundary locations.

Each zone is monitored by a pair of switches tripped by a pair of complementary cams covering the full 360° of the robot's range of motion. A single point fault in any part of the system will not compromise the safety function:

- Missing cam(s)
- One cam overlapping the other
- Open/short circuit
- Welded contact
- Stuck plunger
- Switch disconnected

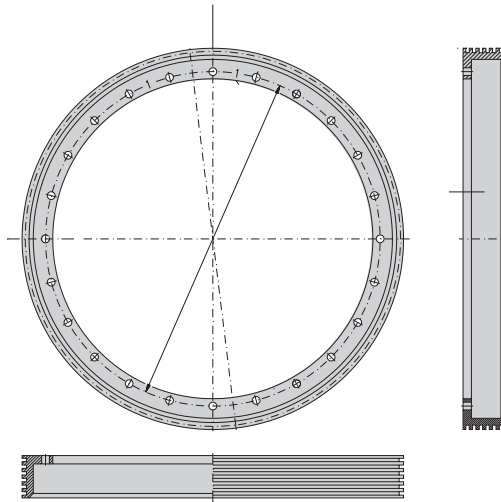
The maintenance-free mechanical cam switch assembly is a double-changeover switching system made up of six limit switches actuated by solid stainless steel plungers with high-speed ball-bearing rollers. Positive-break, force-guided contacts to VDE 0113 are rated for five million operations. The switch assembly has an anodized aluminum housing sealed to IP67 and can tolerate temperatures ranging from -5 to 80°C. Connector options range from rectangular Harting to circular Brad Harrison styles.

Precision-machined, nitrite-hardened cams are designed for long-wearing durability.



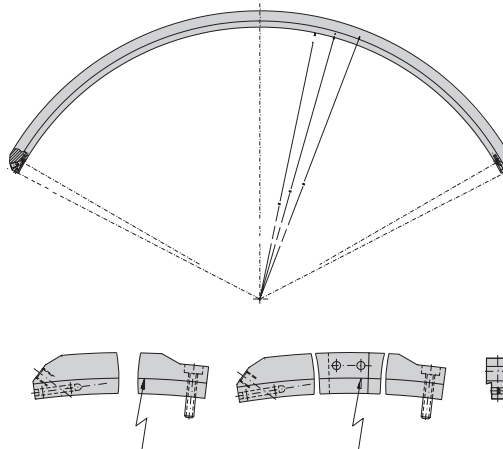
Circular Cam Tray

- 2 semi-circles each 180°
- 2, 4, or 6 channels for 1, 2, or 3 zone control



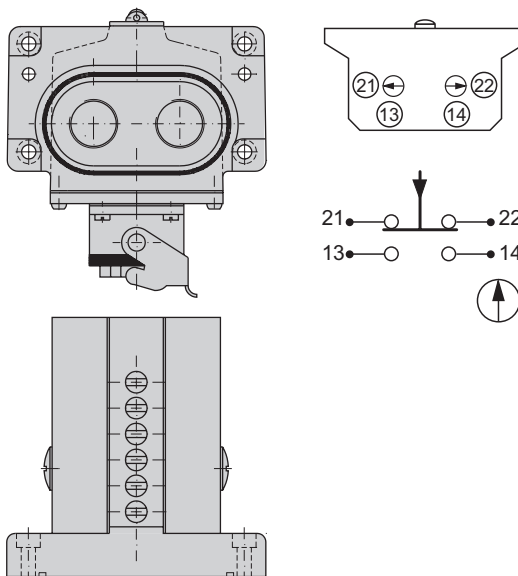
Circular Cams

- The cam length corresponds to the size of the operator area.
- Made of hardened material for longest life



Cam Switches

- Per DIN 43697
- Safety switch inserts per EN 947-5-1, VDE 0113, VDE 0660
- Patented plunger guide and plunger mechanism
- UL, CSA approval



Sheet Metal Destacking Area

This sheet metal destacking area requires three independently configurable safety zones.

During normal operation, the robot picks up new sheet stock from Material Station A and places it on the conveyor for transport into the stamping operation. When all of the raw material has been removed from Stack A, the robot program transfers the pickup over to Stack B.

At this time, a forklift operator opens the safety gate in front of Stack A, removes the empty pallet, and puts a new pallet of material in place.

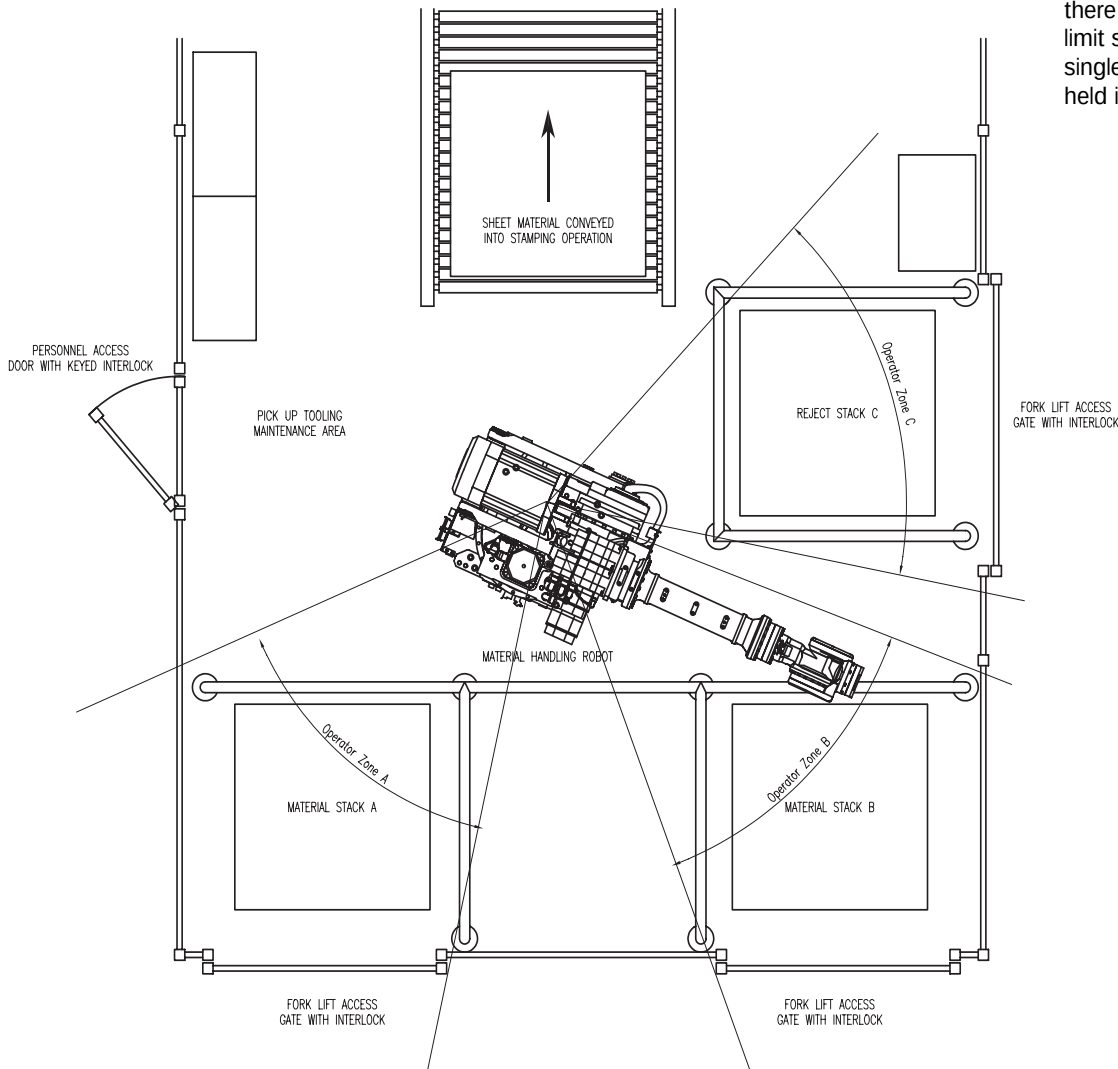
Without a zone limit system, the robot would be stopped the moment the safety gate was raised. The zone limit system, by positively monitoring the robot position, allows the safety gate switch to be muted when the robot is clear of the operator. The operator is able to enter the robot cell at Stack A without stopping the robot from working at Stack B. However, should Stack B become depleted while Stack A is being replenished, the robot will halt and will not enter Stack A until the safety gate is closed.

Rejected material is collected at Stack C. When the safety gate is opened to remove a full pallet, the robot can continue operations from Stack A to the conveyor, but will be blocked from moving across Stack C while the safety gate is open.

The door for maintenance personnel is never muted. Whenever a maintenance person opens the door with a keyed interlock, all motion in the robot cell stops. Typically, the robot would be parked in the maintenance area for service to its end effector tooling.

This application represents a three-zone system. Each zone is diverse complementary redundant and independently configurable. The zone limit system generates a separate, control-reliable 'Clear of Operator' signal when it is outside of each respective operator area. Each 'Clear of Operator' signal is sent to an approved safety relay or cell controller that monitors the interaction of the zone limit system with the light curtains, gate switches, and the robot.

Balluff accomplishes control reliability with two limit switches and a set of two complementary cams per zone. In this application, there would be a total of six limit switches contained in a single housing and six cams held in a single cam tray.



Two-Station Robotic Arc Welding Cell

A common application is the two-station robotic arc welding cell. A human operator moves between Station A and Station B, removing finished parts and replacing them with parts to be welded.

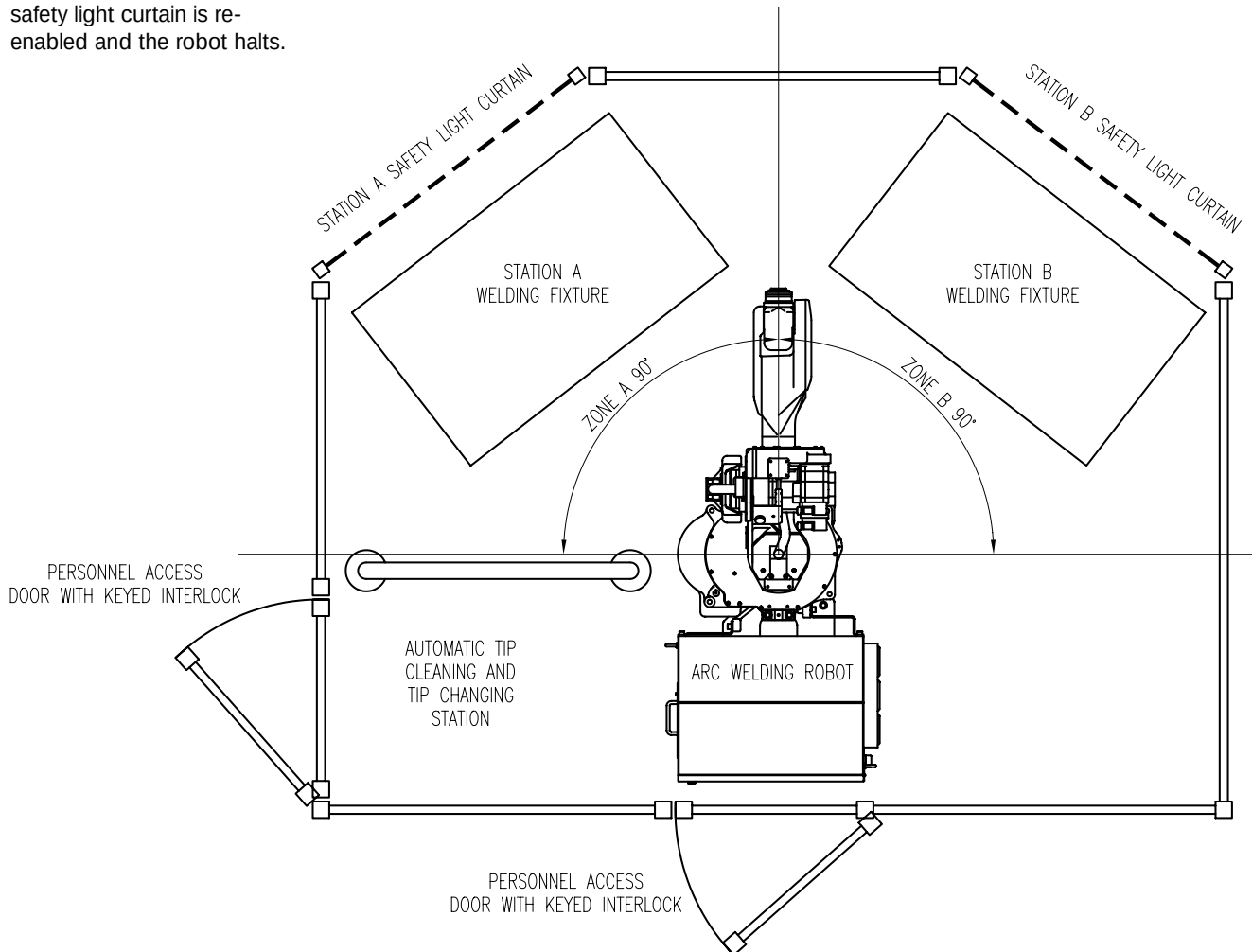
The robot follows the work of the human operator, applying welds to materials held in the fixturing. While the human operator is working at Station A, the beam of the safety light curtain is broken, but the robot is allowed to continue working at Station B. If the robot attempts to move toward Station A while the operator is still present, the safety light curtain is re-enabled and the robot halts.

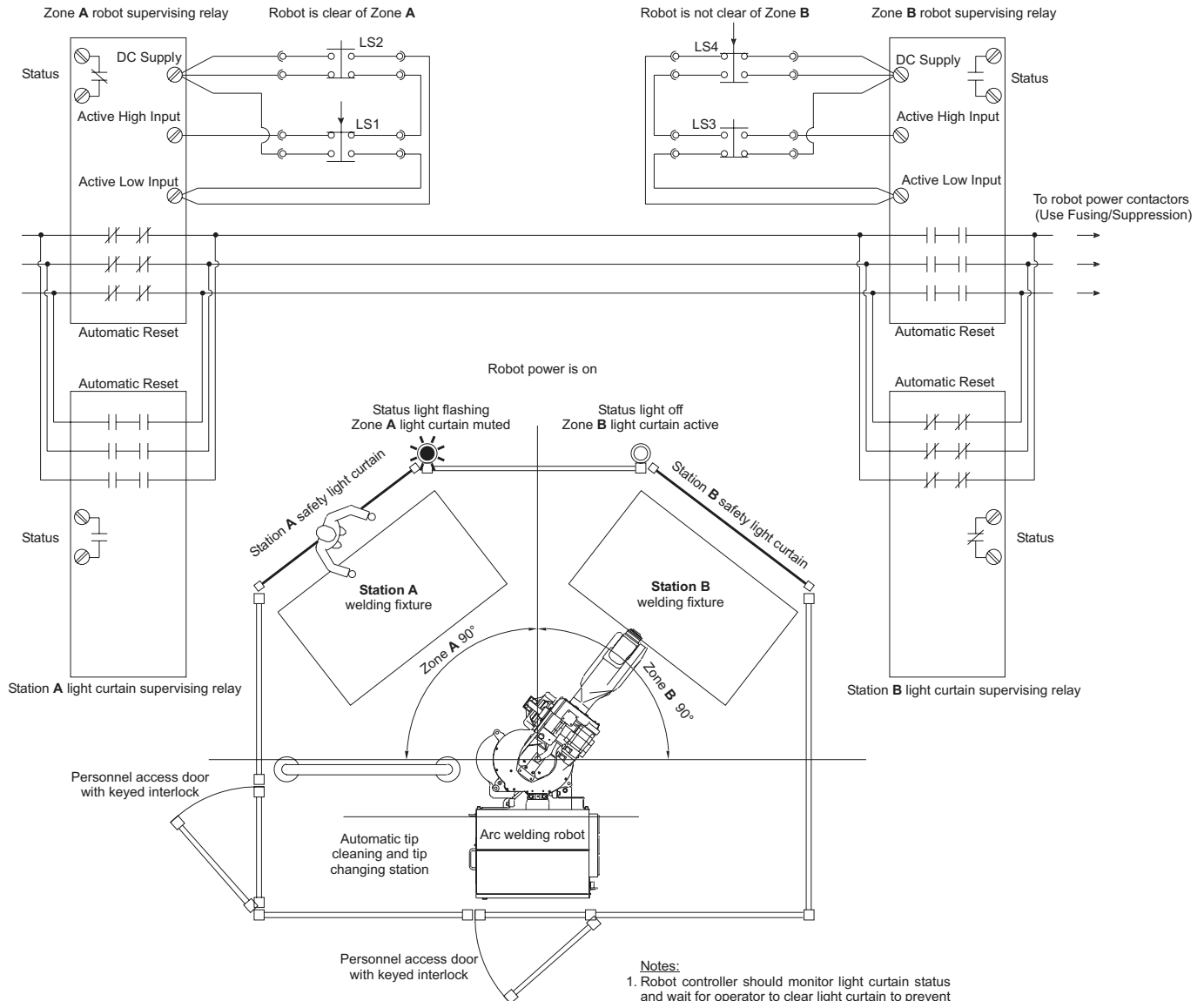
While the robot is clear of both Stations A and B, the outputs of the safety light curtains are muted. This allows the robot to perform its automated tip cleaning and tip changing tasks at the rear of the cell. If the robot attempts to move into either operator zone while an operator is present, the safety light curtains are re-enabled and the robot halts.

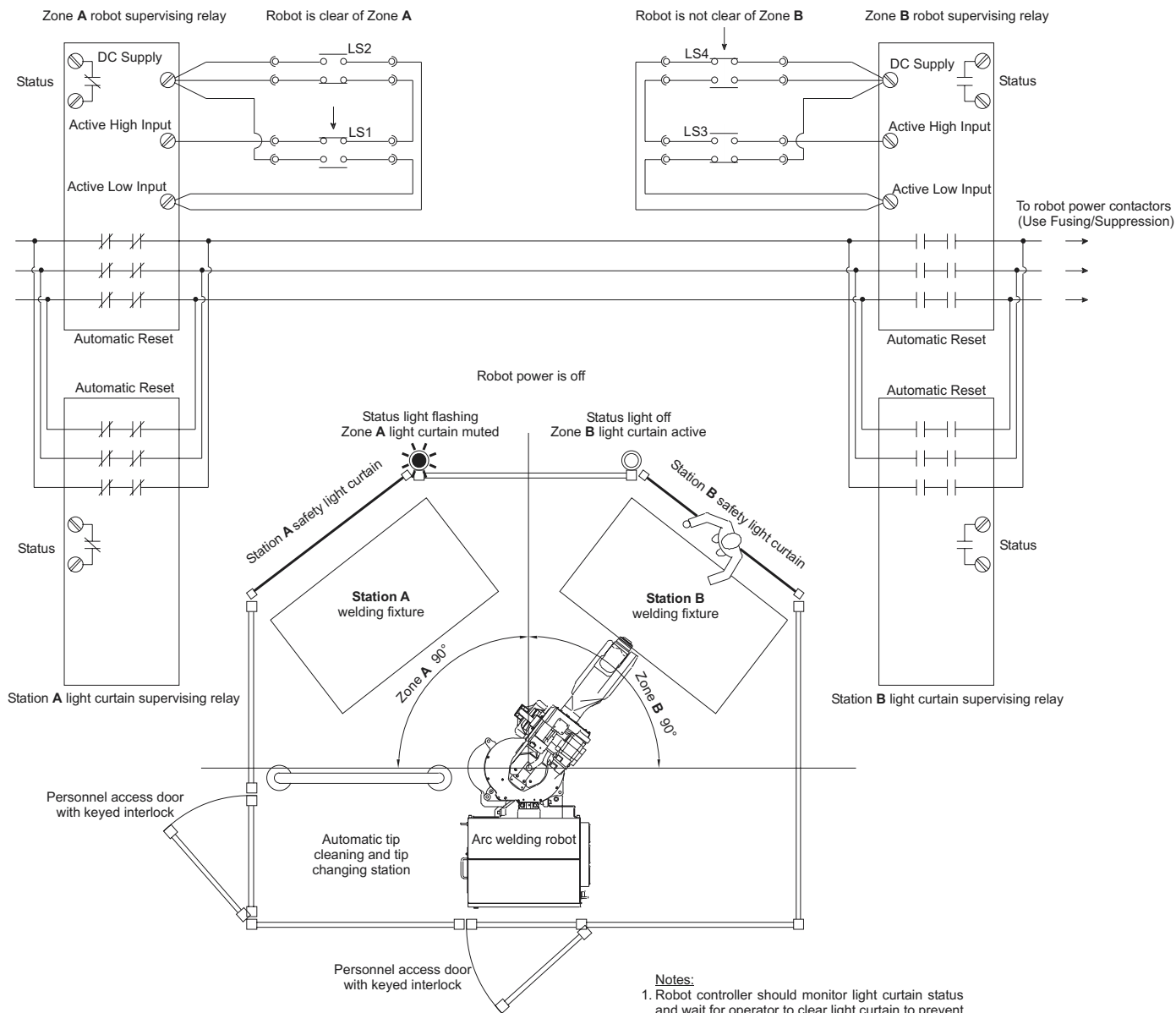
The keyed door interlock switches are never muted. Anytime a maintenance worker enters the cell to perform service on the robot, the robot stops all motion.

This application represents a two-zone system. Each zone is diverse complementary redundant and independently configurable. The zone limit system generates a separate, control-reliable 'Clear of Operator' signal when it is outside of each respective operator area. Each 'Clear of Operator' signal is sent to an approved safety relay or cell controller that monitors the interaction of the zone limit system with the light curtains, gate switches, and the robot.

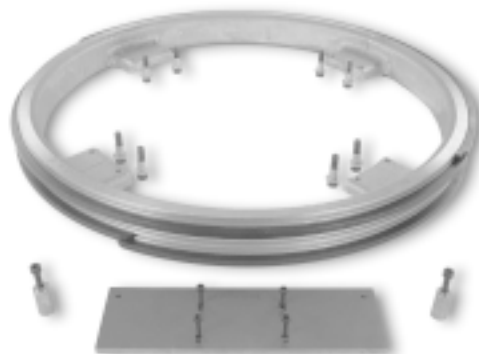
Balluff accomplishes control reliability with two limit switches and a set of two complementary cams per zone. In this application, there would be a total of four limit switches contained in a single housing and four cams held in a single cam tray.







Robot Zone Limit Systems



Robot Manufacturer	Model	Axis	Zones	Description	Ordering Code	Notes		
FANUC	R-2000i	1	3	Limit switch with Harting Han 24DD	BNL-FANUC-2000-AXIS-1-3-ZONE	BNS-113-X518-B06-L12-61-A22-06		
				Cam tray switch bracket & hardware				
				Cam set			BNN-520-R373-xxx.x/yyyy.y	One set required per zone
				Set-up gauge	BNN-520-R373-10	Reusable		
FANUC	R-2000i	2	1	Limit switch with 8-pole circular, cam drum, switch bracket, 8-pole flex cable, hardware	BNL-2000-AXIS-2-1-ZONE	Includes limit switch and cable BNS-113-B02-L12-61-A22-02-C093 BKS-08-PIN-FEMALE-MINI-HI-FLEX		
				Cam set			BNN-UR-xxx.x/yyyy.y-125-12	One set required
				Set-up gauge			BNL-Z/GAUGE-X508	Reusable
FANUC	S-430i/iw	1	3	Limit switch with Harting Han 32EE (GM)	BNL-FANUC-430-AXIS-1-SYSTEM	BNS-113-X524-D06-L12-100-22-06 BNL-5304-120-06-R373 BNS-R373-HA-1		
				Cam tray with hardware				
				Switch bracket with hardware			BNN-520-R373-xxx.x/yyyy.y	One set required per zone
				Cam set			BNN-520-R373-10	Reusable
				Set-up gauge				
FANUC	S-430i/iw	1	3	Limit switch with Harting Han 24DD	BNL-FANUC-430-AXIS-1-3-ZONE	BNS-113-X518-D06-612-100-22-06		
				Cam tray without hardware				
				Switch bracket and hardware			BNN-520-R373-xxx.x/yyyy.y	One set required per zone
				Cam set			BNN-520-R373-10	Reusable
				Set-up gauge				
FANUC	S-430i/iw	1	2	Limit switch with Harting Han 24DD	BNL-430-AXIS-1-2-ZONE	BNL-113-X518-D04-L12-100-22-04 BNL-5304-120-04-R342-X02		
				Cam tray with hardware				
				Switch bracket and all hardware			BNN-520-R350-xxx.x/yyyy.y	One set required per zone
				Cam set			BNL-Z/DOWEL-PIN-M14X80-KIT	Reusable
				Installation dowel pins			BNL-Z/GAUGE-X508	Reusable
				Set-up gauge				
FANUC	S-430i/iw	2	1	Limit switch with 8-pole circular, cam drum, switch bracket, 8-pole flex cable, hardware	BNL-FANUC-430-AXIS-2-SYSTEM	Includes limit switch and cable BNS-113-B02-L12-61-A22-02-C093 BKS-08-PIN-FEMALE-MINI-HI-FLEX		
				Cam set			BNN-UR-xxx.x/yyyy.y-125-12	One set required
				Set-up gauge			BNL-Z/GAUGE-X508	Reusable
FANUC	S-430i/iw	3	1	Limit switch with 8-pole circular, cam drum, switch bracket, 8-pole flex cable, hardware	BNL-FANUC-430-AXIS-3-SYSTEM	Includes limit switch and cable BNS-113-B02-L12-61-A22-02-D016 BKS-08-PIN-FEMALE-MINI-HI-FLEX		
				Cam set			BNN-UR-xxx.x/yyyy.y-125-12	One set required
				Set-up gauge			BNL-Z/GAUGE-X508	Reusable
FANUC	S-420i	1	3	Limit switch with Harting Han 32EE	BNL-FANUC-420-AXIS-1-SYSTEM	BNS-113-X524-D6-L12-100-22-06 BNL-5304-120-06-R342-GM		
				Cam tray, switch bracket, hardware				
				Cam set			BNN-520-R350-xxx.x/yyyy.y	One set required per zone
				Installation dowel pins			BNL-Z/DOWEL-PIN-M14X80-KIT	Reusable
				Set-up gauge			BNL-Z/GAUGE-X508	Reusable

Mechanical Switches

Robot Zone Limit System

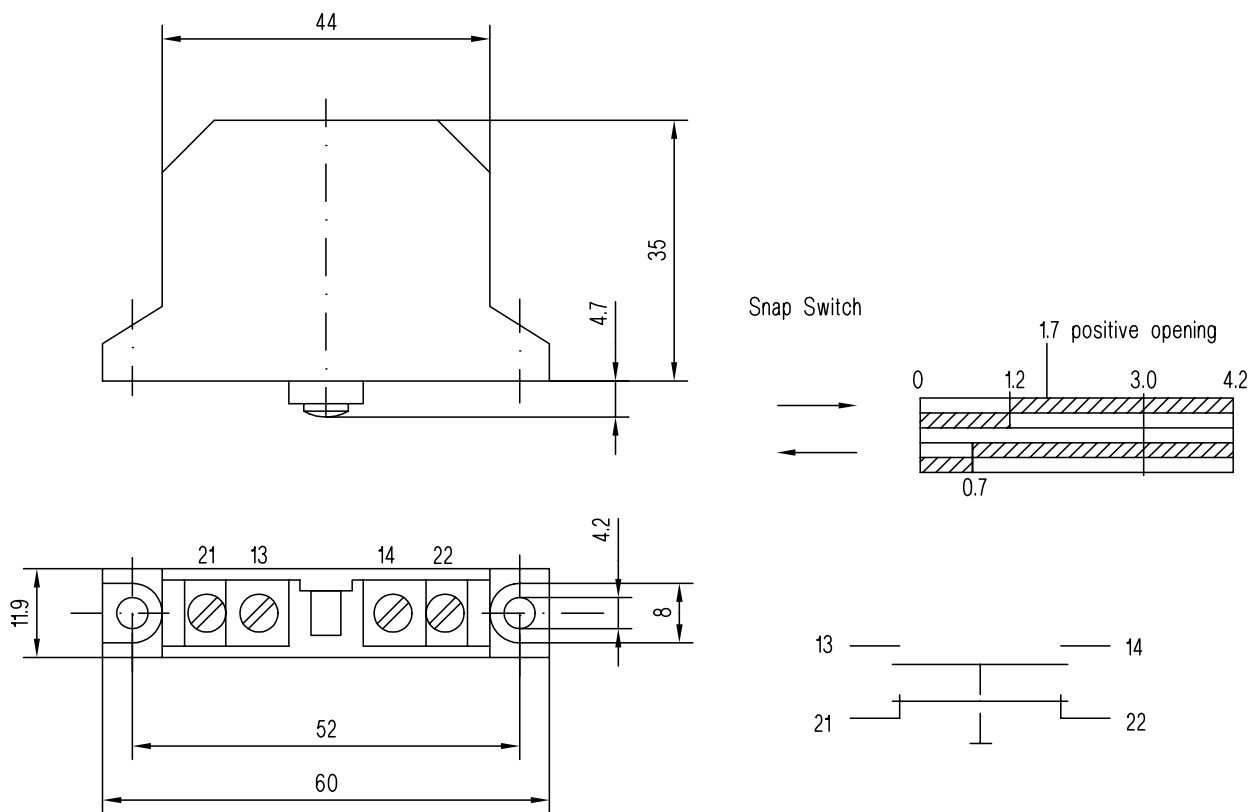
Robot Manufacturer	Model	Axis	Zones	Description	Ordering Code	Notes
FANUC	S-420i	1	3	Limit switch with Harting Han 24DD Cam tray, switch bracket, hardware	BNL-FANUC-420-AXIS-1-3-ZONE	BNS-113-X518-D6-L12-100-22-06 BNL-5304-120-06-R342-GM
				Cam set	BNN-520-R350-xxx.x/yyyy.y	One set required per zone
				Installation dowel pins	BNL-Z/DOWEL-PIN-M14X80-KIT	Reusable
				Set-up gauge	BNL-Z/GAUGE-X508	Reusable
FANUC	S-420i	2	1	Limit switch with 8-pole circular, integrated rotatable 180°/180° cams, with bracket 8-pole flex cable, hardware	BNL-FANUC-420-AXIS-2-SYSTEM	Includes limit switch and cable. BNS-113-B02-L12-61-A22-02-D016 BKS-08-PIN-FEMALE-MINI-HI-FLEX
				Set-up gauge	BNL-Z/GAUGE-X508	Reusable
FANUC	M710i	1	3	Limit switch with Harting Han 24DD Cam tray with hardware Switch bracket with hardware	BNL-FANUC-M710i-AXIS-1-3-ZONE	BNS-113-X518-D06-L12-100-22-06
				Cam set	BNN-TR-xxx/yyyy-280-12	One set required per zone
				Set-up gauge	BNL-Z/GAUGE-X508	Reusable
FANUC	M-710i	2	1	Limit switch with 8-pole circular, cam drum switch bracket, 8-pole flex cable, hard stop hardware	BNL-FANUC-M710i-2-1-ZONE	Includes limit switch and cable BNS-113-B02-L12-61-A22-02-D016 BKS-08-PIN-FEMALE-MINI-HI-FLEX
				Cam set	BNN-UR-xxx.x/yyyy.y-125-12	One set required
				Set-up Gauge	BNL-Z/GAUGE-X508	Reusable
FANUC	M-710iT (track)	1	2	Limit switch with Harting Han 24DD	BNS-113-X518-D04-L12-100-22-04	Call Balluff for application assistance
				Cam tray without hardware	BNL-5310-120-S04-...	Must specify side slung or underslung
				Switch bracket without hardware	CALL BALLUFF	
				Linear cams	BNN-ZN-...-12, BNN-HNT, BNN-MTE-012	80m/min max speed
				Self-threading screws	Z/SCREW-M4-X-20-ST-BE-DIN-7513	
				Set-up gauge	BNL-Z/GAUGE-X508	Reusable
FANUC	M-710iT (track)	2	1	Limit switch with 8-pole circular, cam drum, switch bracket, 8-pole flex cable, hard stop, hardware	BNL-FANUC-M710iT-AXIS-2-1-ZONE	Includes limit switch and cable BNS-113-B02-L12-61-A22-02-D016 BKS-08-PIN-FEMALE-MINI-HI-FLEX
				Cam set	BNN-UR-xxx.x/yyyy.y-125-12	One set required
				Set-up gauge	BNL-Z/GAUGE-X508	Reusable
FANUC	M-16i/M-16iL/ARC MATE 120i	1	3	Limit switch with Harting Han 32EE (GM) cam tray with hardware Switch Bracket with Hardware	BNL-FANUC-M16iL-AXIS-1-SYSTEM	BNS-113-X524-D06-L12-100-22-06
				Cam set	BNN-TR-xxx/yyyy-250-12	One set required per zone
				Set-up gauge	BNL-Z/GAUGE-X508	Reusable
FANUC	M-16i/M-16iL/ARC MATE 120i	1	3	Limit switch with Harting Han 24DD Cam tray with hardware Switch bracket with hardware	BNL-FANUC-M16iL-AXIS-1-3-ZONE	BNS-113-X518-D06-L12-100-22-06
				Cam set	BNN-TR-xxx/yyyy-250-12	One set required per zone
				Set-up gauge	BNL-Z/GAUGE-X508	Reusable
ABB	6400	1	3	Limit switch with Harting Han 24DD	BNS-113-X518-D06-L12-100-22-06	
				Cam Tray	BNL-R545-CAM-TRAY-RINGS	Consult factory for availability
				Cam tray bracket - order 4	BNL-R545-CAM-TRAY-BRACKET	Consult factory for availability
				Switch bracket with hardware	BNS-R545-LIMIT-SWITCH-BRACKET	Consult factory for availability
				Cam set	BNN-520-R545-xxx.x/yyyy.y	Consult factory for availability
				Set-up gauge	BNN-520-R545-10	Reusable
NACHI	SH 200 SH 166	1	3	Limit switch with Harting Han 24DD Cam tray with hardware Switch bracket with hardware	BNL-NACHI-SH200-AXIS-1-3-ZONE	BNS-113-X518-B06-L12-61-A22-06
				Cam set	BNL-S20-R545-360-T-SEG-KIT	One set required per zone
				Set-up gauge	BNL-Z/GAUGE-X508	Reusable

Application Notes

- Cams are supplied as a set of complementary angles totaling 360 degrees.
- The two parts of each cam set are installed in adjacent channels in the cam tray.
- Cams sets are available from 15°...345° in increments of 7.5°.
- Insert complementary angles in cam ordering code, for example **BNN-520-R350-120.0/240.0** where $120^\circ + 240^\circ = 360^\circ$
- Cam types BNN-520 and BNN-TR greater than 180° are supplied as two segments that join together at assembly.
- Cam type BNN-UR greater than 180° is supplied as one segment that installs over the cam drum in one piece.

Accessories and Spare Parts	Description	Ordering Code	Notes
Rectangular Harting Han 24DD mating cable accessories	24/C, 18 AWG, FA F to flying leads	BKS-X518-CABLE-xxxFT	Data sheet U01447
	24/C, 18 AWG, ST F to flying leads	BKS-X518-CABLE-ST-xxxFT	Data sheet U01456
	31/C, 16 AQG, RAF to flying leads	BKS-X518-CABLE-HI-FLEX-100FT	For flex track
	24/C, 18 AWG, RAF to ST M	BKS-X518-CABLE-EXTENSION-xxxFT	Data sheet U01457
Circular 8-pole Brad Harrison style flexible cable	20 feet	BKS-08-PIN-FEMALE-MINI-HI-FLEX	
	90 feet	BKS-08-PIN-F-MINI-HI-FLEX-90FT	
Self-threading screw for securing cams		Z/SCREW-M4-X-20-ST-BE-DIN-7513	
Set screw for BNN-520 series cams		BNN-Z/SET-SCREW-701533	
End ramp for T-slot, includes ramp & mounting shoe assembly	Radii 30...50 mm	BNN-TRE-040-12	
	Radii 75... 124 mm	BNN-URE-075-12	
	Radii 125...249 mm	BNN-TRE-125-12	
	Radii 250 mm & up	BNN-TRE-250-12	
Friction block for T-slot, no spring & screw included		BNN-TRENU-1202	
T-slot joining segment for T-slot cams > 180°		BNN-HNT	
End ramp for U-channel, includes ramp & mounting shoe assembly	Radii 40...50 mm	BNN-URE-040-12	
	Radii 75... 124 mm	BNN-URE-075-12	
	Radii 125...249 mm	BNN-URE-125-12	
	Radii 250 mm & up	BNN-URE-250-12	
Friction block for U-channel, no spring or screw included		BNN-URENU-1202	
Limit switches	Harting Han 32EE connector (GM)	BNS-113-X524-D06-L12-100-22-06	Data Sheet F818953
	Harting Han 24DD connector	BNS-113-X518-D06-L12-100-22-06	Data Sheet F81398
	Harting Han 24DD connector	BNS-113-X518-D04-L12-100-22-04	Data Sheet F813899
	8-pole circular connector	BNS-113-D02-L12-100-22-02-C040	Data Sheet U01309
	8-pole circular connector	BNS-113-B02-L12-61-A22-02-C093	Data Sheet U01385
	8-pole circular connector	BNS-113-B02-L12-61-A22-02-D016	Data Sheet U01464
	8-pole circular connector	BNS-113-B02-L12-61-A12-02-D058	Data Sheet T01808
	8-pole circular connector	BNS-113-B03-L12-61-A12-03-D008	Data Sheet U01459
	8-pole circular connector	BNS-113-B03-L12-61-A12-04-D027	Data Sheet U01466

Accessories and Spare Parts	Description	Ordering Code	Notes
Alternate style cam trays and cam sets	Fanuc S430i 1-zone, 2-zone U-channel cam tray	BNL-5304-120-05-R342	Consult factory
	Use with U-channel cam set	BNN-520-R350-xxx.x/yyy.y	
	Fanuc S-430i 3-zone T-slot	BNL-5312-120-06-R373	Consult factory
	Use with T-slot cam set	BNN-TR-xxx.x/yyy.y-395-12	Consult factory
	Fanuc S-430i 1-zone, 2-zone T-slot	BNL-5312-120-04-R342	Consult factory
		BNL-5312-120-05-R342	Consult factory
	Use with T-slot cam set	BNN-TR-xxx.x/yyy.y-342-12	Consult factory
	Fanuc S-420i 3-zone T-slot	BNL-5312-120-06-R342	Consult factory
	Use with T-slot cam set	BNN-TR-xxx.x/yyy.y-342-12	Consult factory
Segmented cam kits - configurable for zone angles 15°...345° x 7.5°	U-channel segmented cam kit	BNN-520-R373-360-U-SEG-KIT	Order one per zone
	Use with cam tray	BNL-5304-120-06-R373	
	U-channel segmented cam kit	BNN-520-R350-360-U-SEG-KIT	Order one per zone
	Use with cam trays	BNL-5304-120-04-R342	
		BNL-5304-120-05-R342	
		BNL-5304-120-06-R342	
	T-slot segmented cam kit	BNN-TR-360-250-12-SEG-KIT	Consult factory
	Use with cam tray radius 250 mm		Order one per zone
		(M-16i/M-16iL/ARC Mate 120i)	
	T-slot segmented cam kit	BNN-TR-360-280-12-SEG-KIT	Consult factory
	Use with cam tray radius 280 mm		
	(M-710i/M710iW Axis 1)		



Technical Data

Switch actuation force at plunger	max. 18 N
Switch-back force	min. 0.8 N
Bounce time	< 3 ms
Contact opening width	2 x 1.2 mm
Changeover time	1.5 ms
Actuation velocity	min. 1 mm/min
No. of switching actuations	max. 3000/h
Repeatability of switch point	± 0.02 mm
Ambient temperature range	-30°C...+85°C

Electrical Data

Insulation category	Gr."C" to VDE 0110
Nominal voltage	250 V~
Constant current	10A
Nominal supply current	2.5 A (220 V)
AC breaking capacity	25 A
(at 250 V, 40-60 Hz), $\cos\theta=0.7$	
Short-circuit protection	20A (slow blow) 25A (fast blow)

Construction

Housing material	Thermoplastic (fiberglass reinforced)
Contact material BSE 85	Silver
Contacts	Normally closed (21+22) Normally open (13+14)
Electrical Terminations	M 3.5 screw terminals with self-lifting clamps
Switching system	Double interrupting sliding contact operation. 1 NO + 1 NC. Normally closed, positive opening per IEC 947.5.1. Actuation via setbolt

Life Expectancy

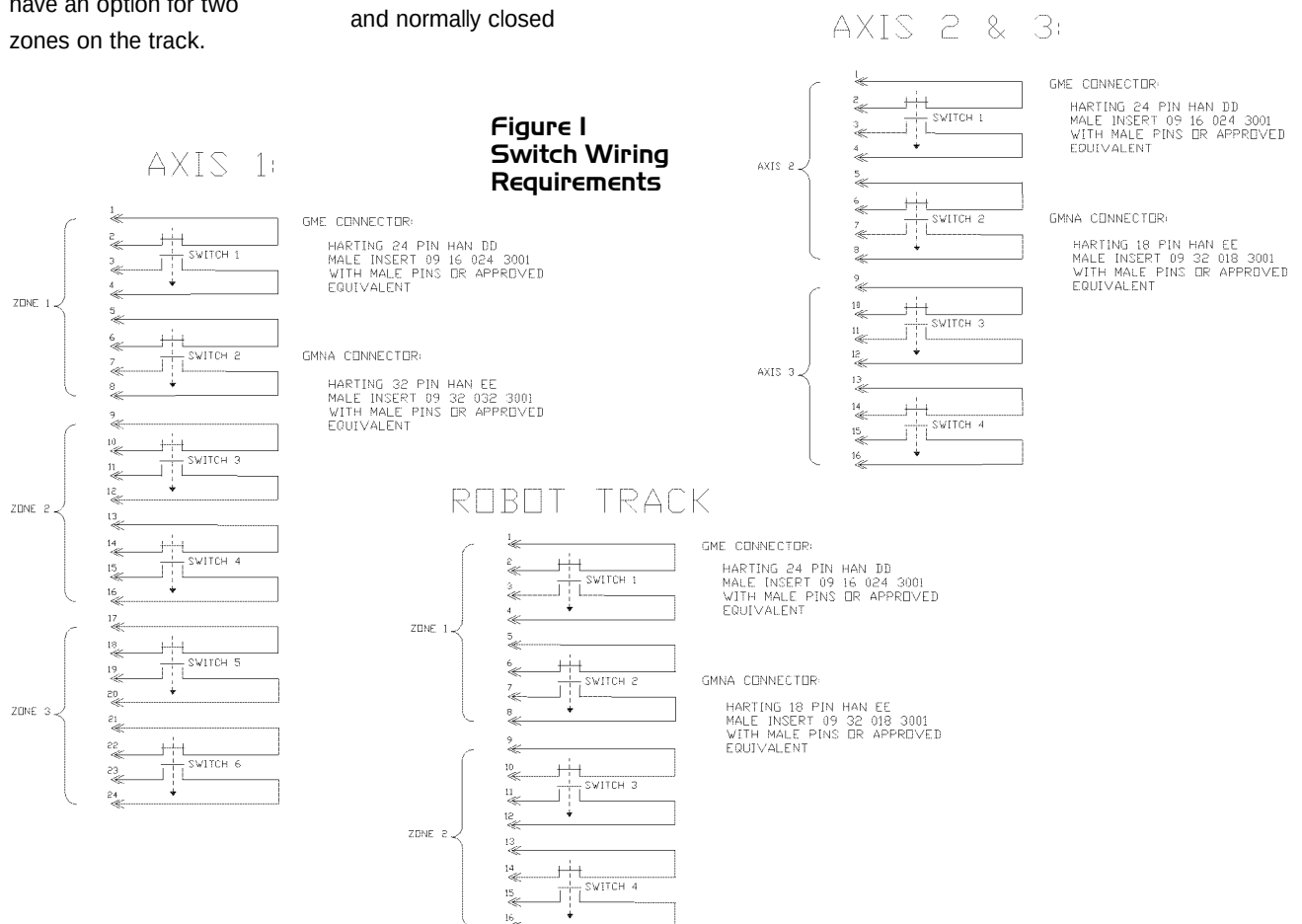
Mechanical	5 x 10 ⁶ operations
Electrical (VDE 0660 E 3)	Depends on cam velocity and switching frequency

Source: General Motors Corporation - Controls, Robotics & Welding
RS-I
GM Global Common Technical Specification for Production Robots
December 1, 1998

3.IO.3 Zone Limit Switches / Dynamic Limiting Devices

- Paint robots are exempted from the requirements of this section.
 - An optional zone limit switch / dynamic limiting device with 3 zones capability shall be available on the main rotational axis (axis 1 on a typical 6 axis robot). The next two principal axes shall have a single zone dynamic limiting device option available. Track mounted robots shall have an option for two zones on the track.
 - The size of the zone(s) shall be adjustable in no greater than 7.5 degrees increments. The position of the zone(s) shall be continuously adjustable throughout the range of each principal axis and be positively mounted.
 - Two cams operating two plunger type switches shall be used for each zone of protection. The plunger type limit switches shall be equipped with force guided, normally open and normally closed contacts. The cams and the switches shall be complementary such that one switch rides on its cam while the other switch is off its respective cam and they shall be positively mounted.
 - For the switch wiring requirements, see Fig. 1. The connectors shall be mounted on the robot base, except on track mounted robots, in which case they shall be mounted stationary.
- The connectors used shall be:
- For GME:
Harting 24 pin HAN DD male pins or approved equivalent for the axis 1, the axis 2-3 and the track connectors.
 - For GMNA:
Harting 32 pin (axis 1) and 18 pin (axes 2 and 3 and track) HAN EE with male pins or approved equivalent.

**Figure 1
Switch Wiring
Requirements**



**Source: American National Standards Institute / Robotic Industries Association
American National Standard for Industrial Robots and Robot Systems -
Safety Requirements
ANSI/RIA R15.06-1999**

10.2.3 Dynamic Limiting Devices

Dynamic limiting is the automatically controlled change in a robot's restricted space during a portion of the robot's system cycle. Control devices such as, but not limited to, cam operated limit switches, light curtains or control activated retractable hard stops may be utilized to further limit robot movement within the restricted space while the robot performs its task program provided the device and associated controls (hardware based or compliant with 6.4) are capable of stopping the robot motion under rated load and speed conditions. Dynamic limiting devices shall be electrically integrated in accordance with 10.4.6.

10.4.6 Safeguarding Device Electrical Integration

Safeguarding devices shall be integrated into the safety stop circuitry:

- Per 10.1 and 4.5.4, or
- Per table 3 if a risk assessment per clause 9 is performed.

10.1 Requirements of Safety Circuit Performance

The ultimate design requirement for safety systems is that, should they fail, the associated hazard is left in a safe state. Safety related parts of control systems shall be designed, constructed, selected, and assembled using basic safety principles for the intended application and can withstand:

- The expected operating stresses.
- The influence of the processed material.
- Other relevant external influences.

The performance criteria listed in 4.5 shall be used in the design of the safety circuit consistent with the associated level of hazard. These circuit requirements are for new installations.

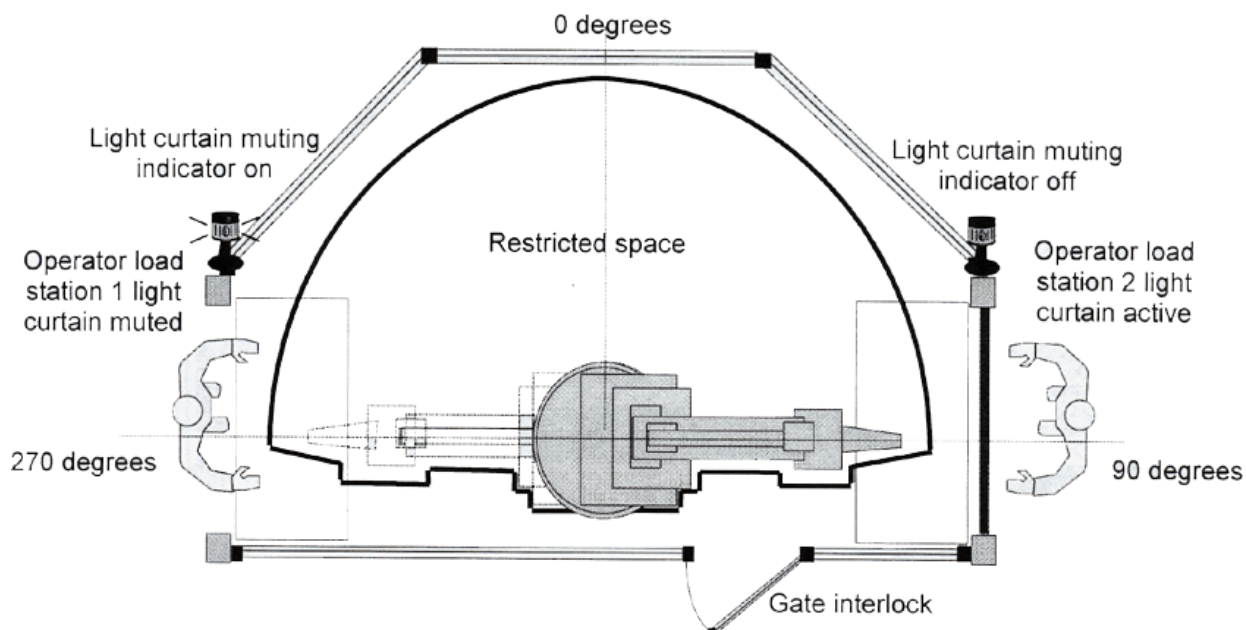
4.5.4 Control Reliable

Control reliable safety circuitry shall be designed, constructed and applied such that any single component failure shall not prevent the stopping action of the robot.

These circuits shall be hardware based or comply with 6.4, and include automatic monitoring at the system level.

- The monitoring shall generate a stop signal if a fault is detected. A warning shall be provided if a hazard remains after cessation of motion;
- Following detection of a fault, a safe state shall be maintained until the fault is cleared.
- Common mode failures shall be taken into account when the probability of such a failure occurring is significant.
- The single fault should be detected at time of failure. If not practicable, the failure shall be detected at the next demand upon the safety function.

Figure B.5 - Multiple operator station cell with muting base limit sensors

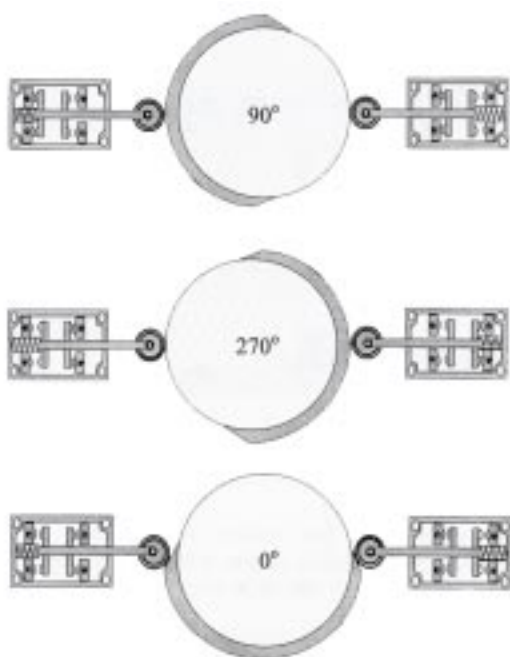


Mechanical hard stops prevent robot operation between 90 and 270 degrees, and allow operation between 270 and 90 degrees. Base limit switches are configured to operate in a diverse redundant

complimentary fashion and are monitored for timing and proper operation. The robot control will allow motion into adjacent operator station only if the light curtain in that station is clear. Additional base limit sensors are

normally utilized to enhance muting performance when the robot is at a safe distance from the operator stations. Gate interlock is always active in automatic mode (never muted). Muting

devices, indicators, and circuitry are monitored by the muting control for proper operation cyclically or when change of status occurs or should occur. NOTE: Muting devices are not necessarily mechanical switches.



Base muting limit switches with robot at 90 degrees:

Both of the closed sets of contacts shown on the left must be closed in order to mute light curtain at operator load station 1.

Base muting limit switches with robot at 270 degrees:

Both of the closed sets of contacts shown on the left must be closed in order to mute light curtain at operator station 2.

Base muting limit switches with robot at 0 degrees:

Transition period will require both light curtains to be clear for robot motion to occur with this design. Transition period will be dependent upon the degree of ramping and the type of switching element.

Complete Product Range:



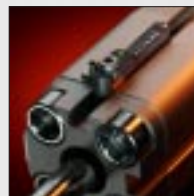
Tubular Inductives



Block-style Inductives



Capacitives



Magnetic Field Sensors



Optoelectronics



Electromechanicals



Micropulse™ Transducers



Transducer Accessories



Identification Systems



AS-Interface Systems



Remote Systems



Connectors/Accessories

<http://www.balluff.com>

USA
Balluff Inc.
8125 Holton Drive
Florence, KY 41042
Phone: (859) 727-2200
Toll-free: 1-800-543-8390
Fax: (859) 727-4823
E-Mail: balluff@balluff.com

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Balluff Canada, Inc.
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Mississauga, Ontario L5N 8G4
Phone: (905) 816-1494
Toll-free: 1-800-927-9654
Fax: (905) 816-1411
E-mail: balluff.canada@balluff.ca

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