ODU CONNECTOR KNOW HOW

Enabling **IEC 60601-1** compliant systems



IEC 60601-1 COMPLIANT AREAS OF APPLICATION

An important focus is the topic of the general electric safety in medical devices. Particularly in applications located in direct proximity to patients and operators, the approval authorities place maximum requirements on the electrical safety of medical products and the well-being of patients. This is regulated in the IEC 60601-1.

TECHNICAL REQUIREMENTS

The technical requirements stated in the IEC 60601-1 relate almost exclusively to protection from electric shock. In order to reduce the risk as much as possible, the standard for medical electrical equipment and systems stipulates “Means of Protection” (MOP). These are subdivided into two categories:

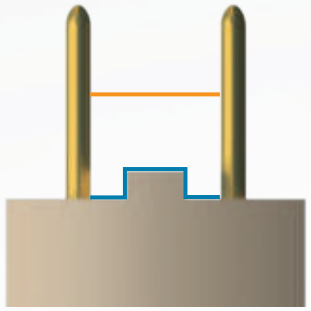
- Means of Patient Protection (MOPP)
- Means of Operator Protection (MOOP)

Essentially, the IEC 60601-1 requires that two means of protection for both patients and operators from electric shock must be applied in electrical medical equipment and systems (2 MOPP and/or 2 MOOP). In other words: if one means of protection fails, the other takes effect.

MEANS OF OPERATOR PROTECTION (MOOP) / MEANS OF PATIENT PROTECTION (MOPP)

The following table is valid for a medical device with a working voltage of max. 250 V AC (degree of pollution 2). Please refer to connector insert configuration for the working voltage of the connector.

Classification	Insulation	Creepage / clearance distance	Creepage distance extension
1 MOOP	1,500 V AC	2,5 mm	Basic
2 MOOP	3,000 V AC	5 mm	Double
1 MOPP	1,500 V AC	4 mm	Basic
2 MOPP	4,000 V AC	8 mm	Double



Clearance distance
Creepage distance

INTENSIVE CARE
e. g. heart-lung machines



BONE SURGERY
e. g. electrical bone saws



OPERATING ROOM
e. g. electric blankets



HOMECARE
e. g. electric wheelchairs



Photos: The ODU MEDI-SNAP® in close proximity to patients

To guarantee the means of protection described, the clearance and creepage distances must be increased. As soon as contacts are installed in the insulation body of a connector, clearance and creepage distances are generated between the conductive components.

- **Clearance distance:** The shortest distance between two contacts outside the solid insulation. A clearance distance collapses as soon as the voltage becomes too high for the distance between two contacts.
- **Creepage distance:** The shortest distance between two contacts along the surface of an insulation body.
  Creepage distances, on the other hand, tend to deteriorate gradually. Causes of this can be dirt and dust deposits on the insulation body or moisture caused by condensation which, for example, precipitates onto the insulation body due to significant changes in temperature. This temporarily results in the flow of leakage currents on the surface of the insulation body caused by a partial or complete loss of its insulating function.

WHAT DEGREE OF PROTECTION IS REQUIRED?

EXAMPLE: TYPICAL HOSPITAL ENVIRONMENT

ECG MONITOR WITH ELECTRICAL CONNECTIONS AND DIRECT PATIENT CONTACT:

2 x MOPP electrical insulation

ELECTRICALLY OPERATED HOSPITAL BED:

2 x MOPP electrical insulation



PROFESSIONALLY OPERATED MEDICAL DEVICES WITHOUT PATIENT CONTACT:

2 x MOOP electrical insulation

VIEW WEB PAGE

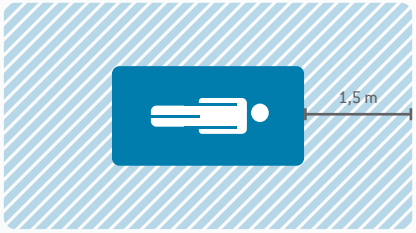


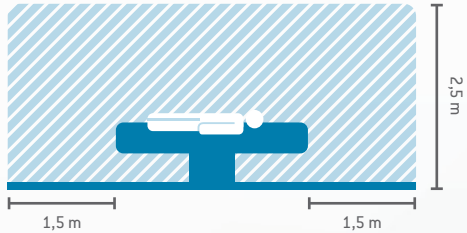


VIEW WHITE PAPER

DIRECT PATIENT ENVIRONMENT ACCORDING TO IEC 60601-1

- The patient environment is any area in which intentionally or unintentionally, an electrical connection can be established between the patient and or the operator and parts of the Medical Electrical Equipment.
- The patient is a living being who is undergoing a medical, surgical or dental procedure. This environment is also referred to as an active medical product in the MDR (Medical Devices Regulation), so by complying with IEC 60601-1, you also meet part of the MDR.
- The IEC 60601-1 standard only applies to devices and systems that are in direct physical or electrical contact with the patient “in the immediate vicinity of the patient”.
- In applications where the equipment or systems are not in the patient environment, procedures to protect persons other than the patient (for example medical personnel) (2 MOOP) are sufficient.





ODU MEDI-SNAP®

Size 1

The plugs are standard.
Choose your protection class by selecting the corresponding receptacle.





STRAIGHT PLUG – PUSH-PULL
2,000 mating cycles

IP50
S1



IP50
S2



IP64
S4



RIGHT-ANGLED PLUG – PUSH-PULL
2,000 mating cycles

IP50
W1



IP50
W2



BREAK-AWAY PLUG
5,000 mating cycles

IP67
A5



IN-LINE RECEPTACLE
5,000 mating cycles

IEC 60601-1: 2 MOOP[1] AND 1 MOPP[1]

IP50
K1



IP50
K2



RECEPTACLE
5,000 mating cycles

IEC 60601-1: 2 MOOP[1] AND 1 MOPP[1]

IP50
G1



IP50
G5



IP50
G6
(on request)



IP50
G8



RECEPTACLE
5,000 mating cycles

IEC 60601-1: 2 MOOP[1] AND 2 MOPP[1]

IP50
G9



IEC 60601-1: 2 MOOP[1] AND 2 MOPP[1]

IP64 / IP67
G4



IP64 / IP67
GE



IEC 60601-1: 2 MOOP[1] AND 2 MOPP[1]

IP64 / IP67 / IP68[2]
GA



ONE-PIECE RECEPTACLE
5,000 mating cycles

IEC 60601-1: 1 MOOP[1] AND 0 MOPP[1]

IP50
G2



[1] As per IEC 60601-1:2005 (VDE 0750-1:2013-12) in mated condition | [2] IP68 in unmated condition

ODU MEDI-SNAP®

Size 2

The plugs are standard.
Choose your protection class by selecting the corresponding receptacle.

STRAIGHT PLUG – PUSH-PULL

2,000 mating cycles

IP50
S1



IP50 / 64
S4



BREAK-AWAY PLUG

2,000 mating cycles

IP64
A5



+

RECEPTACLE

5,000 mating cycles

IEC 60601-1: 2 MOOP[1] AND 1 MOPP[1]
IP50
G1



IEC 60601-1: 2 MOOP[1] AND 2 MOPP[1]
IP64
G4

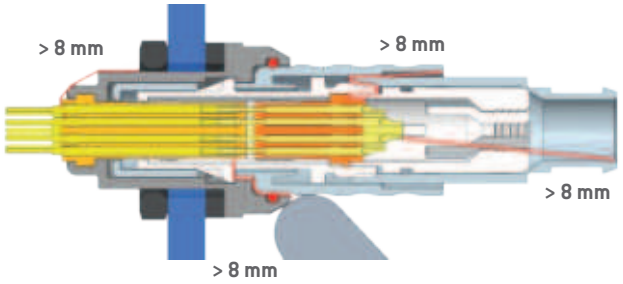


IEC 60601-1: 2 MOOP[1] AND 1 MOPP[1]
IP50
G5



Sectional View

Example shows Size 1



SIZE	1	2
Number of contacts	2 – 14	4 – 34
Contact diameter	0.5 – 1.3 mm	0.5 – 2.0 mm
Termination cross-section	AWG 28 / 0.08 mm² up to AWG 18 / 1 mm²	AWG 28 / 0.08 mm² up to AWG 20 / 0.5 mm²
Single contact nominal current [2]	4 – 12 A	4 – 15 A
Nominal current insert	4 – 12 A	4 – 15 A
Clearance and creepage distance (contact to contact)	0.5 – 1.3 mm	0.5 – 1.6 mm
Clearance and creepage distance (contact to touchable parts)	> 8 mm	> 8 mm
Test voltage SAE A S13441 (contact to contact)	0.7 – 1.9 kV AC	1.3 – 3 kV AC
Test voltage (contact to housing)	4 kV AC	4 kV AC
Working voltage (operating voltage) of connector	7.5 – 48 V AC/DC [3]	25 – 48 V AC/DC [3]

[1] As per IEC 60601-1:2005 (VDE 0750-1:2013-12) in mated condition | [2] see catalog for derating factor | [3] This brochure considers inserts with a max. working voltage of 48V AC/DC. For higher voltages, please get in contact with the ODU application center. Please read and adhere to the safety instructions in the catalog to ensure safe operation.

ODU MINI-SNAP®

Series L

IEC 60601-1: 2 MOOP[1] AND 2 MOPP[1]

PLUG

5,000 mating cycles

IP50
SA



IP50
SB



RECEPTACLE[2]

5,000 mating cycles

IP50
G1



IP50
G5



IP50
GA



IP50
GK



Series K

IEC 60601-1: 2 MOOP[1] AND 2 MOPP[1]

PLUG

5,000 mating cycles

IP68
SA



IP68
SB



RECEPTACLE[2]

5,000 mating cycles

IP68
G1



IP68
G3



IP68
G4





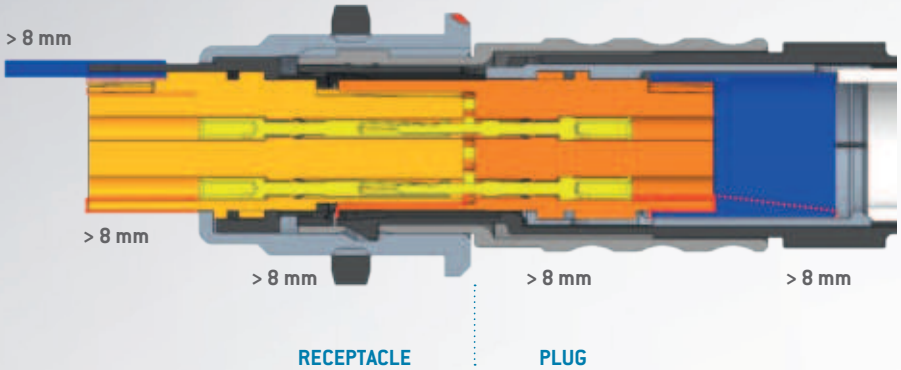


[1] As per IEC 60601-1:2005 (VDE 0750-1:2013-12) in mated condition | [2] The shown pin layouts are only examples. Please see next page for details.

ODU MINI-SNAP®

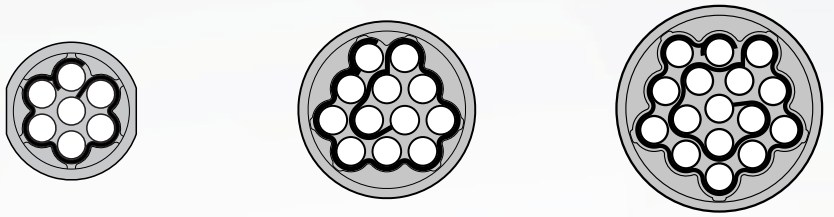
Sectional View

Example shows Series L Size 2



Pin layout

Size 1 Size 2 Size 3



SIZE	1	2	3
Number of contacts	7	12	16
Contact diameter	0.7 mm	0.7 mm	0.7 mm
Termination cross-section	AWG 28 / 0.08 mm² up to AWG 22 / 0.38 mm²	AWG 28 / 0.08 mm² up to AWG 20 / 0.5 mm²	AWG 28 / 0.08 mm[1] up to AWG 20 / 0.5 mm[1]
Single contact nominal current [1]	7 A	7 A	7 A
Nominal current insert	4.5 A	3.8 A	3.5 A
Clearance and creepage distance (contact to contact)	0.9 mm	1.2 mm	1.3 mm
Clearance and creepage distance (contact to touchable parts)	> 8 mm	> 8 mm	> 8 mm
Test voltage SAE A S13441 (contact to contact)	1 kV AC	1,300 V AC	1,500 V AC
Test voltage (contact to housing)	4 kV AC	4 kV AC	4 kV AC
Working voltage (operating voltage) of connector	36 V AC/DC [2]	48 V AC/DC [2]	48 V AC/DC [2]

[1] see catalog for derating factor | [2] This brochure considers inserts with a max. working voltage of 48V AC/DC. For higher voltages, please get in contact with the ODU application center.
Please read and adhere to the safety instructions in the catalog to ensure safe operation.

ODU GROUP WORLDWIDE



PRODUCTION AND LOGISTICS SITES

Germany	Otto Dunkel GmbH
China	ODU (Shanghai) Connectors Manufacturing Co., Ltd.
Mexico	ODU Mexico Manufacturing S. de R.L. de C.V.
Romania	ODU Romania Manufacturing SRL
USA	ODU North American Logistics Inc.

HEADQUARTERS

ODU GmbH & Co. KG
Pregelstraße 11, 84453 Mühldorf a. Inn, Germany
Phone: +49 8631 6156-0, Fax: +49 8631 6156-49, E-mail: sales@odu.de

SALES LOCATIONS

ODU (Shanghai) International Trading Co., Ltd.
Phone: +86 21 58347828-0
E-mail: sales@odu.com.cn
www.odu.com.cn

ODU (HK) Trading Co., Ltd.
Phone: +852 3963-9588
E-mail: sales@odu.hk
www.odu.hk

ODU Denmark ApS
Phone: +45 2233 5335
E-mail: sales@odu-denmark.dk
www.odu-denmark.dk

ODU-France SARL
Phone: +33 1 3935-4690
E-mail: sales@odu.fr
www.odu.fr

ODU Italia S.R.L.
Phone: +39 331 8708847
E-mail: sales@odu-italia.it
www.odu-italia.it

ODU Japan K.K.
Phone: +81 3 6441 3210
E-mail: sales@odu.co.jp
www.odu.co.jp

ODU Korea Inc.
Phone: +82 2 6964 7181
E-mail: sales@odu-korea.kr
www.odu-korea.kr

ODU Romania Manufacturing SRL
Phone: +40 269 704638
E-mail: sales@odu-romania.ro
www.odu-romania.ro

ODU Scandinavia AB
Phone: +46 176 18262
E-mail: sales@odu.se
www.odu.se

ODU-UK Ltd.
Phone: +44 330 002 0640
E-mail: sales@odu-uk.co.uk
www.odu-uk.co.uk

ODU-USA Inc.
Phone: +1 805 484-0540
E-mail: sales@odu-usa.com
www.odu-usa.com

Further information and specialized representatives can be found at:
www.odu-connectors.com/contact

Simply scan the QR code to download the entire publication.

www.odu-connectors.com

All dimensions are in mm. Some figures are for illustrative purposes only. Subject to change without notice. Errors and omissions excepted.
We reserve the right to change our products and their technical specifications at any time in the interest of technical improvement.
This publication supersedes all prior publications. This publication is also available as a PDF file that can be downloaded from
www.odu-connectors.com

ODU CM MUE

ODU Fiber Optic / 0V / 1121 / EN