IDS NXT

Technical manual IDS NXT rio

Contents

1 Preface

Introduction

IDS Imaging Development Systems GmbH has taken every possible care in preparing this manual. We however assume no liability for the content, completeness or quality of the information contained therein. The content of this manual is regularly updated and adapted to reflect the current status of the software. We furthermore do not guarantee that this product will function without errors, even if the stated specifications are adhered to.

Under no circumstances can we guarantee that a particular objective can be achieved with the purchase of this product.

Insofar as permitted under statutory regulations, we assume no liability for direct damage, indirect damage or damages suffered by third parties resulting from the purchase of this product. In no event shall any liability exceed the purchase price of the product.

Please note that the content of this manual is neither part of any previous or existing agreement, promise, representation or legal relationship, nor an alteration or amendment thereof. All obligations of IDS Imaging Development Systems GmbH result from the respective contract of sale, which also includes the complete and exclusively applicable warranty regulations. These contractual warranty regulations are neither extended nor limited by the information contained in this manual. Should you require further information on this product, or encounter specific problems that are not discussed in sufficient detail in the manual, please contact your local dealer or system installer.

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Contact

Visit our web site http://www.ids-nxt.com where you will find all the latest information about our software and hardware products. Please contact your local IDS distributors for first level support in your language. For a list of IDS distributors worldwide please go to our website http://www.ids-nxt.com.

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2 Symbols and hints

This symbol indicates hints with useful information for better understanding and using features and functions.

This symbol indicates important warnings for product safety to prevent damage.

This symbol indicates important warnings for personal safety to prevent injury.

3 Safety instructions

Read carefully these safety instructions before installing and using the product. The producer is not responsible for damages and injury, which can occur due to false handling of the product and ignoring the safety instructions. All warranty will be spoiled in this case.

Intended use

IDS industrial cameras are to be used to capture images for visualization and image processing tasks. They are designed for use in industrial environments. Observe the requirements for the proper use of this product. Failure to do so will render the warranty void.

- The product is not authorized for use in security relevant applications. If it is used in security relevant applications, the customer is responsible for the necessary approvals.

- If the product is modified or changed, all approval becomes invalid. In this case, the customer is responsible for ensuring product conformity.

- The warranty expires if the product is improperly disassembled, reworked or repaired by the customer or a third party and IDS Imaging Development Systems GmbH assumes no liability for defects. If you need service, please contact the support team.

- The product is not a toy. Operate and store out of the reach of children.

Protection against electrostatic discharge (ESD)

Board-level cameras are especially sensitive to electrostatic discharge. Make sure to avoid mechanical or electrical damage of the printed circuit board or its connections. Wear ESD-protective clothing and observe the rules for handling ESD-sensitive components.

- Do not touch the printed circuit board while it is powered.

- Always hold the board by the edges to avoid the risk of electrostatic discharge damage.

- For optimum ESD behavior, a clearance of 4 mm from non-shielded housings must be maintained all the way around. For shielded housings, a smaller clearance is possible.

- Attach the board to a conductive surface using the fixing screws. If this is not possible, ensure an insulating connection.

- Use connecting cable with a low-resistance shield on both sides.

Installation, operation and maintenance

The product must be connected, taken into operation and maintained only by appropriately qualified personnel. The error-free and safe operation of this product can only be ensured if it is properly transported, stored, set up and assembled, and operated and maintained with due care. The installation, inspection, maintenance, extension, and repair may only be done by authorized personnel.

- Observe the specifications in the documentation when installing the product.

- Do not subject the product to direct sunlight, moisture or shock. Ensure that the IP code of the product meets the requirements for the ambient conditions.

- Only operate the product under ambient conditions for which the respective product is approved. The use under other ambient conditions may result in damage.

- To avoid any damage to the connectors, only mount or remove the product with the cables disconnected.

- Lay cables in such a way that no one is endangered.

- Before starting up, check if the electrical wiring corresponds to the specifications in the documentation. Faulty wiring (overvoltage, undervoltage) can result in a damage in the electronics.

Transport

- Only use ESD packaging for storage and transport of ESD-sensitive components.

- Keep packing materials like films away from children. Abuse may result in suffocation.

Operation and power supply

The camera power supply must meet the requirements for SELV (safety extra low voltage)/LPS (limited power source) or ES1/PS2.

WARNING! Non-approved power supplies for camera operation may cause painful or dangerous electric shock. Serious injury or death may occur. Use a power supply that meet the requirements for SELV (safety extra low voltage)/LPS (limited power source) or ES1/PS2.

- In order to ensure electrical safety, we recommend using a shielded connection cable or grounding the camera housing so that the camera housing is connected to ground via the appropriate installation.

Avis pour le Canada
Fonctionnement et alimentation électrique

L'alimentation électrique de la caméra doit être conforme aux exigences de sécurité SELV (très basse tension de sécurité)/LPS (source à puissance limitée) ou ES1/PS2.

AVERTISSEMENT ! Avec un bloc d'alimentation non prévu pour les caméras, il existe des risques de décharges électriques douloureuses ou dangereuses. Celles-ci peuvent provoquer des blessures graves, voire mortelles. Utilisez un bloc d'alimentation conforme aux exigences de sécurité SELV (très basse tension de sécurité)/LPS (source à puissance limitée) ou ES1/PS2.

- *Pour garantir la sécurité électrique, nous recommandons l'utilisation d'un câble de connexion blindé ou la mise à la terre du boîtier de la caméra, afin que ce dernier soit relié correctement à la masse.*

CAUTION! As the camera housing may get hot depending on the operating conditions there may be risk of burns. Provide sufficient heat dissipation so that the housing temperature does not exceed 55 °C (131 °F).

NOTICE! Cameras with Power-over-Ethernet (PoE) can be powered from an external source or via PoE. The camera should not be supplied with both power sources at the same time, as this may cause irreparable damage to the camera.

Correct disposal

Dispose the camera and accessories properly and separately from other types of waste to encourage recycling of reusable materials and to protect the environment.

According to the EC Directive 2012/19/EU (WEEE) we are obliged to take back this product, distributed by us after August 13, 2005, free of charge at the end of its useful life and to ensure it correct disposal. As this product is exclusively for commercial use (B2B), it must not be handed over to a public disposal facility. The product can be disposed of by specifying the date of purchase and the serial number at the following address:

IDS Imaging Development Systems GmbH
Dimbacher Str. 10
D-74182 Obersulm, Germany

4 IDS NXT rio

Housing/board-level	+/-
Dimensions height x width x length	34 x 44 x 73 mm
Mechanical specifications	Mechanical specifications
IP code	**IP 30** • Protection against the ingression of small particles (diameter ≥ 2.5 mm) • No protection against water
Ambient conditions	Ambient conditions
Lens mount	C-mount, see Optical specifications
Mounting holes bottom/top/side/front	4/0/0/0
Thread diameter	M3
Status LED	Status LED
Interface connector	GigE RJ45, screwable
Power supply	Input I/O connector (M12): 12-24 V DC +20 %, max. 1 A Input GigE connector (RJ45): PoE 41-57 V DC, max. 350 mA
I/O connector	12-pin M12 connector, screwable
Electrical specifications	Electrical specifications

4.1 Standards and directives

IDS Imaging Development Systems GmbH hereby confirms that this product has been developed, designed and manufactured in compliance with the following European directives

- 2014/30/EU: EMC - Electromagnetic compatibility

- 2011/65/EU: RoHS - Restriction of the use of certain hazardous substances in electrical and electronic equipment

- Regulation (EC) No. 1907/2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

- The CE declaration of conformity is available on the IDS website.

If the product is modified or changed all approval becomes invalid. In this case the customer is responsible for ensuring product conformity.

Product type	IDS NXT rio
Information for CE EMC specifications	EN 61000-6-2 EN 55035 EN 61000-6-4* EN 55032 (Class A)
Information for USA This equipment has been tested and found to comply with part 15 of the FCC Rules	Class A

Information for Canada Renseignements pour le Canada	CAN ICES-3 (A)/NMB-3(A)
Information for UL	UL 62368-1 CAN/CSA C22.2 No. 62368-1-14
Information for UK EMC specifications	UKCA EN 61000-6-2 EN 55035 EN 61000-6-4* EN 55032 (Class A)
Further information	RCM KC (R-R-img-NXTrio)

* Cameras are intended exclusively for use in industrial environments.

This product may cause interference when used in residential areas. Such use is to be avoided unless the user takes measures to prevent interference emissions.

For customers in the Republic of Korea

사 용 자 안 내 문
이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

For customers in the USA

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Name of Responsible Party

IDS Imaging Development Systems, Inc.

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Stoneham, MA 02180

U.S.A.

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4.2 Ambient conditions

The temperature values given below refer to the outer device temperature of the camera housing. The temperature inside of the camera housing is generally higher than the outer temperature and may be up to 70 °C (158 °F).

Device temperature during operation	0 °C … 55 °C
	32 °F … 131 °F
Device temperature during storage	-20 °C … 60 °C
	-4 °F … 140 °F
Humidity	20 % … 80 %, relative, non-condensing

Non-condensing means that the relative air humidity must be below 100 %. Otherwise, moisture will form on the camera surface. If, for example, air has a relative humidity of 40 % at 35 °C (95 °F), the relative humidity will increase to over 100 % if the air cools down to 19.5 °C (67 °F); condensation begins to form.

CAUTION! As the camera housing may get hot depending on the operating conditions there may be risk of burns. Provide sufficient heat dissipation so that the housing temperature does not exceed 55 °C (131 °F).

Notes on ambient conditions

- Avoid high air humidity levels and rapid temperature changes when using IDS cameras.

- Temperatures below +4 °C (39 °F) combined with excessive relative air humidity levels can cause icing.

- Note that with increasing device temperatures, the image quality may decrease due to thermal noise, even if the camera is operated below the maximum specified temperature.

Provide sufficient heat dissipation to keep temperatures within the specified ranges. The exact temperature conditions depend on the mounting situation. In general, the following recommendations apply:

- Use a thermally-conductive surface, like a metal plate or a heat sink, for a passive heat dissipation.

- If necessary, provide an active cooling for example by means of a fan.

Vibration and shock resistance

Vibration and shock resistance of the cameras corresponds to EN 60068-2-6 and EN 60068-2-27.
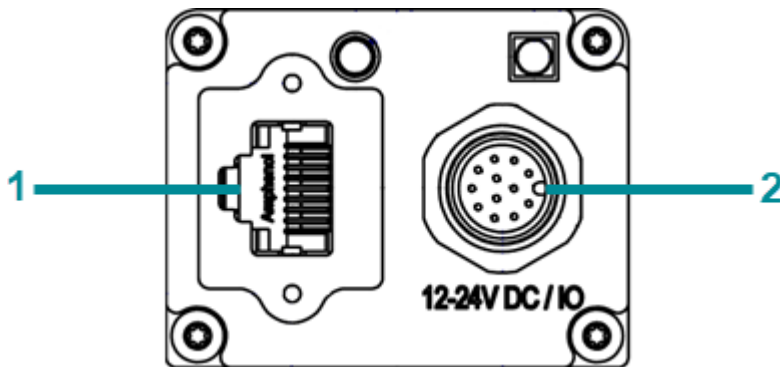
4.3 Connecting a IDS NXT rio

Fig. 1: IDS NXT rio

- 1: Pin assigmnet GigE connector (RJ45, 8-pin)

- 2: Pin assignment I/O connector (M12, 12-pin)

> **NOTICE!** The camera can be supplied with voltage both from an external source and via Power-over-Ethernet (PoE). The camera should not be supplied through both voltage sources at once as this can irreparably damage the camera.

1. Install the IDS NXT cockpit.

2. Make sure that your camera is powered (LEDs are flashing), either with the I/O connector or with PoE (Power-over-Ethernet).

3. Connect the camera to to a Gigabit Ethernet port on the PC either directly or using switches.

Cables

- Use Cat5e type cables or better for the complete connection between your camera and the host PC.

- The cable length of each segment must not exceed 100 m. A segment is a continuous cable connection between two network devices (e.g. PC, camera, switch).

Network devices involved

All devices that contribute to the network connection between camera and host PC (e.g. switches) should support at least 1000 Mbit/s to ensure a consistent connection.

It is recommended that each device uses Jumbo Frames, if possible. Otherwise the maximum possible packet size will be used. Refer to your device's manual how to configure Jumbo Frames.

Network adapter settings

Your camera should be connected to a separate network card or port. Do not use the same as for your internet connection (or other communication network) because this reduces the bandwidth for image data transfer and can lead to incomplete or lost images.

To ensure optimum performance of the network connection, you need to install the latest drivers for your network card.

The transfer rate of GigE network adapters for PCI slots is limited to approximately 110-120 MByte/s. USB Ethernet adapter can have different restrictions, depending on the model.

For operating IDS NXT cameras, it is recommended:

- Maximize the receive buffer size or stack buffer size.
- Enable Jumbo Frames.

5 Mechanical specifications

The mechanical data for each camera model can be found on our website directly at the respective camera model beneath in the "Downloads" tab.
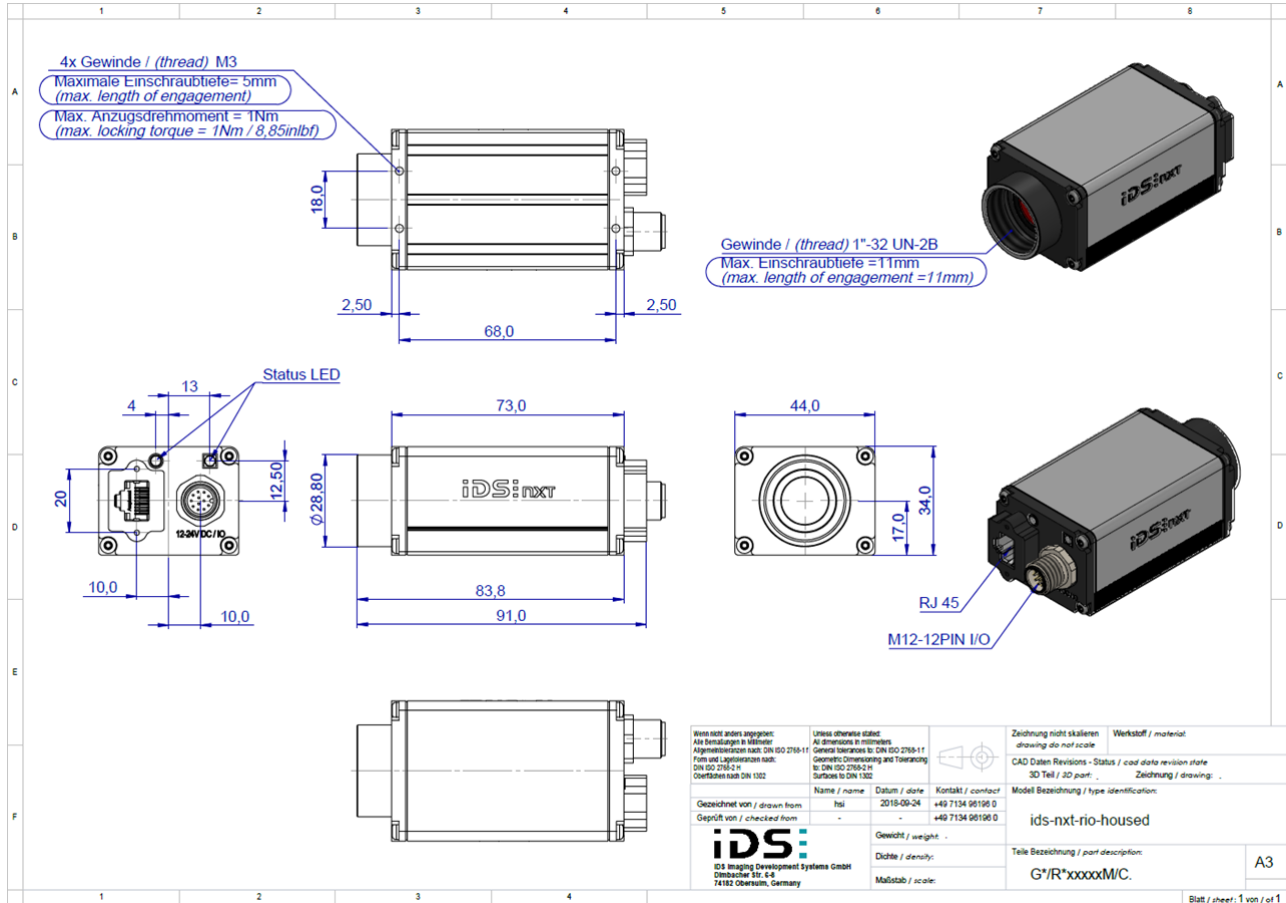

Fig. 2: IDS NXT rio

NOTICE! The camera connectors may be damaged if you install or remove the camera with plugged in cables. Therefore, first unplug the GigE and/or I/O cable from the camera.

6 Electrial specifications

6.1 Pin assignment GigE connector (RJ45)

8-pin RJ45 socket

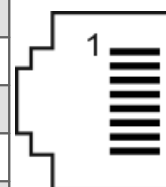| Pin	Designation 100BASE-TX	Designation 1000BASE-T	
1	Tx+	BI_DA+	
2	Tx-	BI_DA-	
3	Rx+	BI_DB+	
4		BI_DC+	
5		BI_DC-	
6	Rx-	BI_DB-	
7		BI_DD+	
8		BI_DD-	

Fig. 3: RJ45 socket, camera rear view

The RJ45 socket of the IDS NXT rio complies with the IEC 60603-7 standard.

6.2 Pin assignment I/O connector

12-pin M12 connector (Attend 216A-12MSR)

| Pin	Signal	Description
1	VBUS	Power supply: 12-24 V DC +20 %
2	VBUS GND	Reference level (ground) for power supply and RS-232
3	Opto IN (0)	Trigger input with optocoupler
4	Opto IN (1)	Input 1 with optocoupler
5	Opto IN (COM)	Reference level for all Opto IN
6	Opto OUT (COM)	Reference level for all Opto OUT
7	Opto OUT (1)	Output 1 with optocoupler
8	Opto OUT (2)	Output 2 with optocoupler
9	RS232 (RxD)	Serial interface
10	RS232 (TxD)	Serial interface
11	Opto IN (2)	Input 2 with optocoupler
12	Opto OUT (0)	Flash output with optocoupler
Shield	Shield	Shield
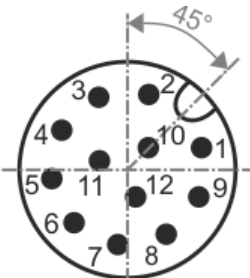
Fig. 4: I/O connector, camera rear view

You can check the color assignment of the cable on the Website directly at the specific accessory item.

> The maximum length of the I/O cable is 30 m. The cable must be shielded.

Power supply

> **NOTICE!** The camera can be supplied with voltage both from an external source and via Power-over-Ethernet (PoE). The camera should not be supplied through both voltage sources at once as this can irreparably damage the camera.

Voltage	Input I/O connector (M12): 12-24 V DC +20 %
	Input GigE connector (RJ45): PoE 41-57 V DC
Current	Input I/O connector (M12): min. 1 A
	Input GigE connector (RJ45): min. 350 mA
Residual ripple	120 mVpp

IDS Imaging Development Systems GmbH recommends to adjust the power supply to the power requirement of the camera to limit overheating in case of short circuit.

To ensure the electrical safety, the camera power supply must meet the requirements for SELV (safety extra low voltage) / LPS (limited power source) or ES1 / PS2. The camera power supply must be rated by the values given in the table above. It also must ensure that the voltage values given in the table above are available at the input of the camera.

Avis pour le Canada:

IDS Imaging Development Systems GmbH recommande d'adapter l'alimentation électrique aux besoins de la caméra afin de limiter la surchauffe en cas de court-circuit.

Pour garantir la sécurité électrique, l'alimentation de la caméra doit être conforme aux exigences de sécurité SELV (très basse tension de sécurité)/LPS (source à puissance limitée) ou ES1/PS2. L'alimentation de la caméra doit respecter les valeurs indiquées dans le tableau ci-dessus. Elle doit également répondre au fait que les tensions indiquées dans le tableau ci-dessus sont présentes à l'entrée de la caméra.

Information on the power consumption of individual camera models can be found in the model data sheet.

Keep in mind that a voltage drop will occur when you use long cables for power supply to the camera. Choose the size of the cable in such a way that the supply voltage available at the input of the camera is at least 12 V.

To supply the IDS NXT rio camera with power using PoE or PoE+, you can use PoE injectors or switches that are compatible with IEEE standard 802.3af or IEEE standard 802.at.
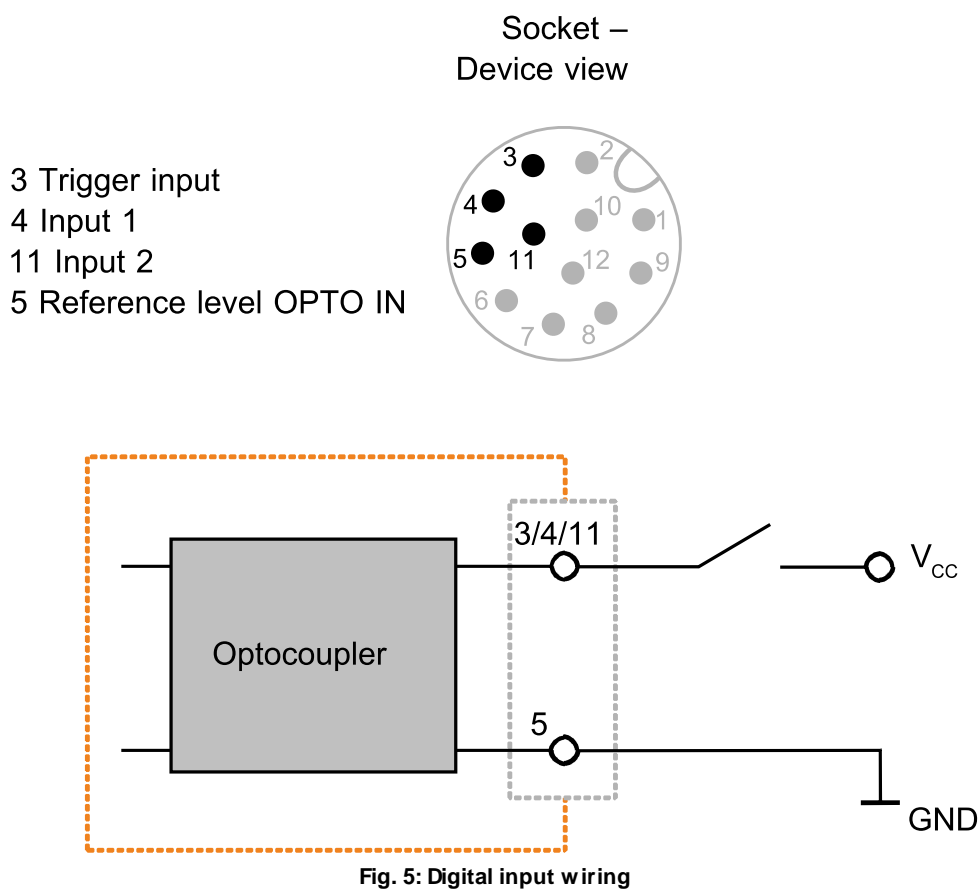
6.3 Digital input wiring

	Symbol	Minimum	Typical	Maximum	Unit
Input low range	V_{IL}	0	0	1	V
Input high range	V_{IH}	5	-	24	V
Input leakage current	I_I	-	-	-	µA
Trigger edge steepness		35	-	-	V/ms
Trigger pulse width (edge)		10	-	-	µs

For interpreting the trigger signal, either the rising or the falling edge can be used. The digital inputs are galvanically isolated using optocouplers to protect the device and the PC against surges. Only DC voltages may be applied to the digital inputs.

The signal source for an input must be able to carry a load of at least 20 mA.

Digital input wiring

Socket –
Device view

3 Trigger input
4 Input 1
11 Input 2
5 Reference level OPTO IN

Fig. 5: Digital input wiring

Pin 5 is the reference level (GND) for all inputs. All three inputs can also be used with different voltages.

Absolute maximum rating

	Symbol	Max.	Unit
Voltage range	V_{CC}	30	V

6.4 Digital output wiring

	Symbol	Minimum	Typical	Maximum	Unit
Recommended supply voltage	V_{CC}	-	-	30	V
Collector-emitter saturation voltage	$V_{CE(SAT)}$	0.03	-	0.15	V
Collector-emitter breakdown voltage	$V_{(BR)CE}$	100	-	-	V
Collector current continuous	I_C	-	-	150	mA

The digital outputs are galvanically isolated using optocouplers to protect the device and the PC against surges. Only DC voltages may be applied to the digital outputs.

The output of the optocoupler can be used as an open collector or open emitter output. This means that the output signal can be connected to ground or to the supply voltage. The output signal is active if the collector-emitter switch is closed.

An additional, external supply voltage is required for the output wiring, which is independent of the supply voltage of the camera.

Open collector wiring

Socket –
Device view

12 Flash output
7 Output 1
8 Output 2
6 Reference level OPTO OUT

V_{cc} max. 30 V
max. 150 mA

R_v

Flash

Optocoupler

7/8/12

6

GND

Fig. 6: Wiring as open collector
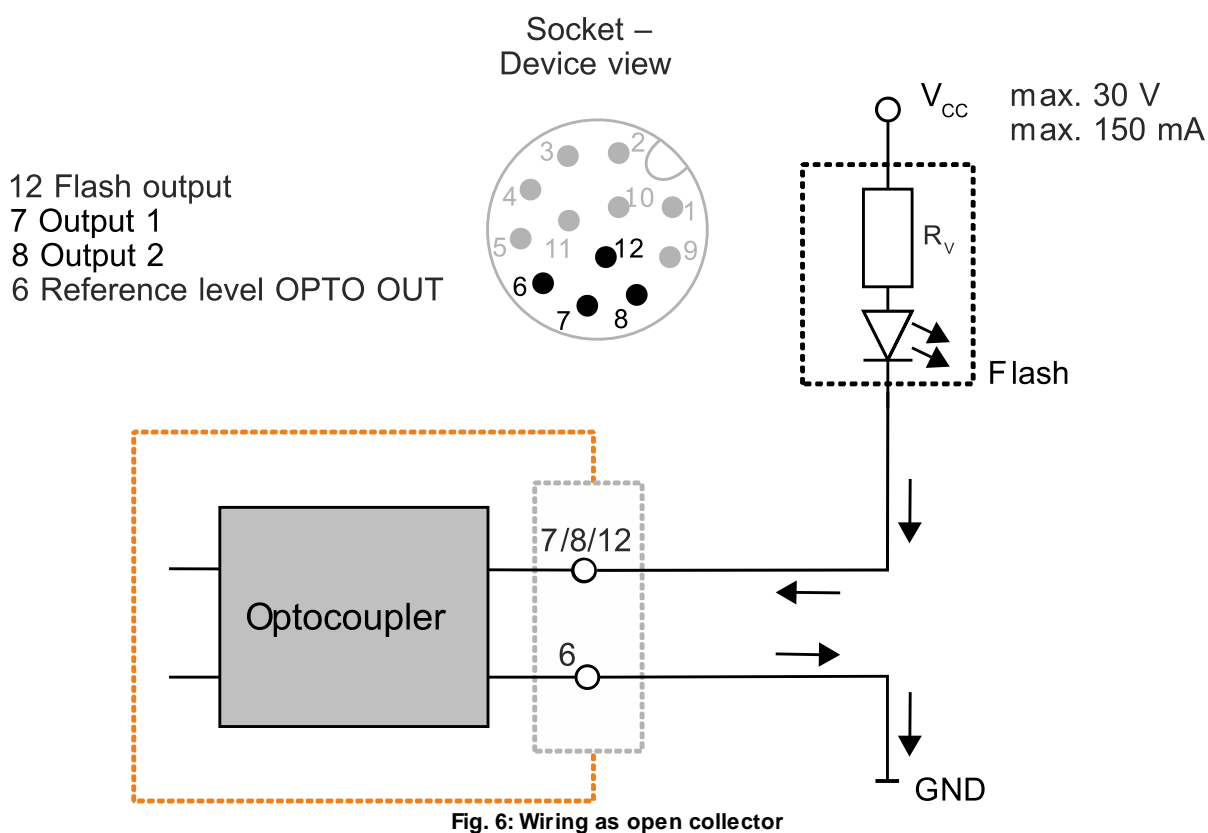
Pin 6 is the reference level (GND) for all outputs. All three outputs can be connected simultaneously as open collector.

Open emitter wiring

Socket –
Device view

12 Flash output
7 Output 1
8 Output 2
6 Reference level OPTO OUT
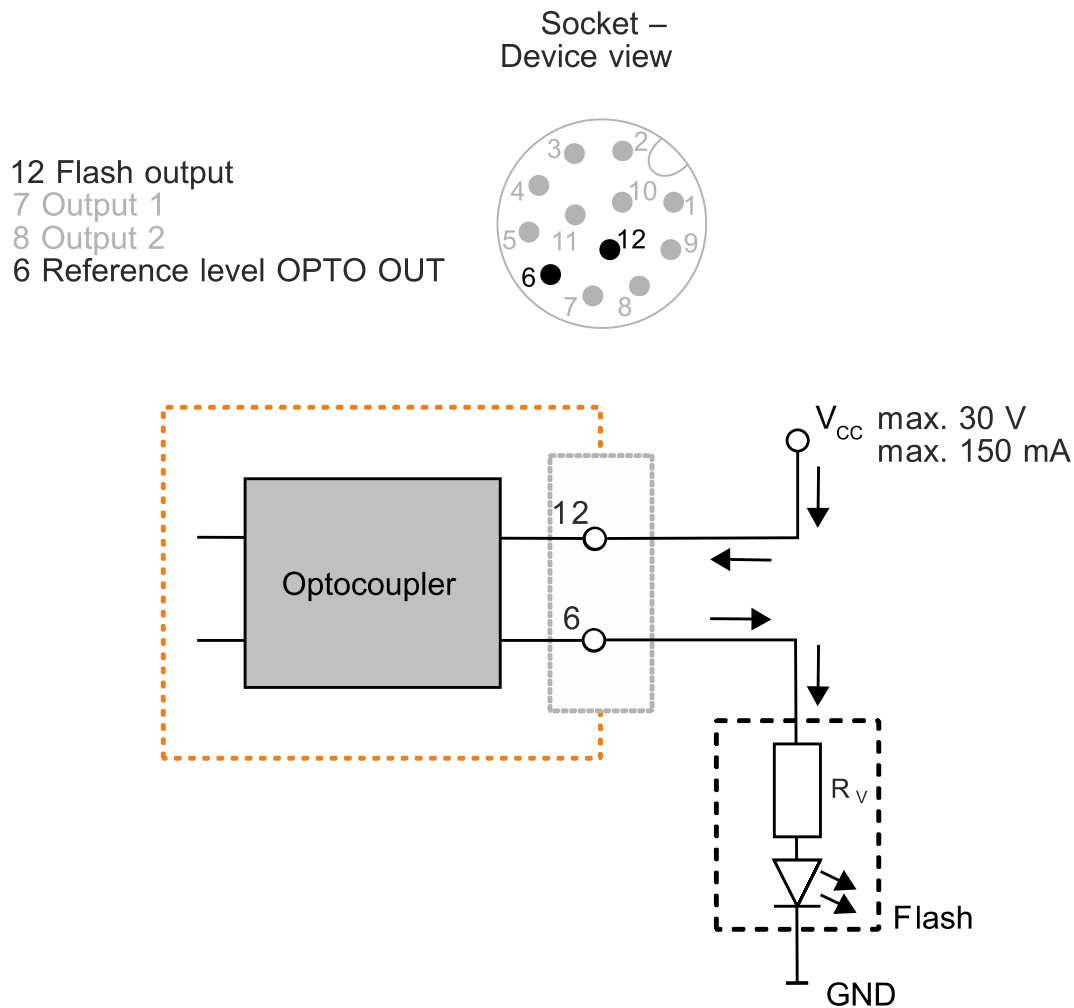

V_{CC} max. 30 V
max. 150 mA

Fig. 7: Wiring as open emitter

Only one output can be connected as an open emitter, since the load is on pin 6. The other outputs cannot be used anymore.

6.5 RS-232 wiring

The IDS NXT rio has a serial interface of the type RS-232:

- Baud rate: 300 … 230 400 Baud

- Input voltage: max. ±15 V

- Output voltage: -5,7 V to +6.2 V

- Data rate: max. 250 kbps

- Compatible with TIA/EIA-232-F standard

- Permissible range according to RS-232 from ±3 V to ±15 V

The data rate of the serial interface depends on the capacity and length of the cable.

7 Status LED
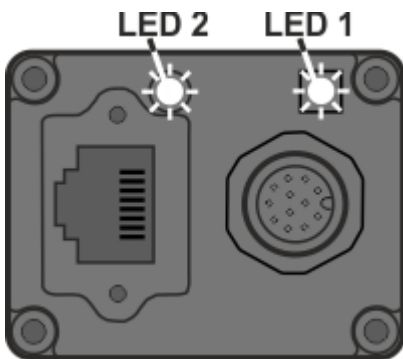
Fig. 8: Status LEDs

The camera has two LEDs that indicate information of the current status.

- LED 1: camera status (two-color)

- LED 2: Network status (two-color)

LED 1

Camera is off/no power	⬜ ⬜ ⬜ ⬜ ⬜ ⬜ ⬜ ⬜
Camera is booting	🟩 ⬜ 🟩 ⬜ 🟩 ⬜ 🟩 ⬜
Camera is ready	🟩 🟩 ⬜ ⬜ 🟩 🟩 ⬜ ⬜
Camera is open	🟩 🟩 🟩 🟩 🟩 🟩 🟩 🟩
Camera is ready - no valid IP address	🟩 🟩 🟥 ⬜ 🟩 🟩 🟥 ⬜
No firmware loaded	🟥 🟥 🟥 🟥 🟥 🟥 🟥 🟥
Service firmware active	🟧 🟧 ⬜ ⬜ 🟧 🟧 ⬜ ⬜

LED 2

No network connection	⬜ ⬜ ⬜ ⬜ ⬜ ⬜ ⬜ ⬜
Network connection OK	🟩 🟩 🟩 🟩 🟩 🟩 🟩 🟩
Network connection OK + data transfer	🟩 🟧 🟧 🟧 🟩 🟧 🟧 🟧
Continuous data transfer	🟧 🟧 🟧 🟧 🟧 🟧 🟧 🟧
Network error	🟥 🟥 ⬜ ⬜ 🟥 🟥 ⬜ ⬜

8 Optical specifications

8.1 Immersion depth for lenses

Some C-mount lenses reach deep into the camera flange. This may cause the lens to push against the back of the filter glass inside the camera or even make it impossible to screw in the lens.

The table below indicates the maximum possible immersion depth. The actual immersion depth of a lens is given in the relevant data sheet. As lens parts with a small diameter are allowed to reach deeper into the camera flange, the immersion depths are specified based on the diameter (named as A, B, and C in the image below).

Beside the immersion depth also the back focal length has to be considered, that means the distance between the last lens and the sensor (named "bfl" in the image below). The back focal length can be calculated for C-mount/TFL-mount with the following formula:

$$bfl = 17,526 - x$$

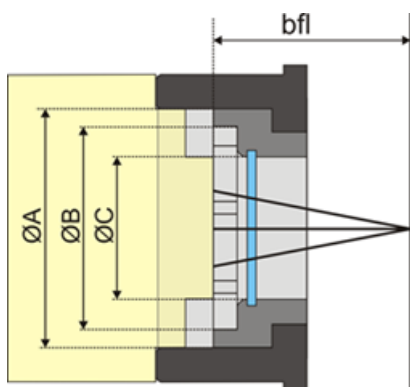x stands for the maximum immersion depth (see table below).

Fig. 9: Camera front (sectional view)

> The data given in the table include the following tolerances as a safety clearance:
> - Immersion depth: 0.2 mm
> - Diameter: 0.2 mm

Type	Thread depth (min.)	for diameter at lens end [mm] Ø A	resulting maximum immersion depth [mm]	minimum required back focal length [mm]
C-mount	5 mm	24.0	11.0	6.5

8.2 Position accuracy of the sensor

The following illustrations show the tolerance margins of the sensor position relative to the outer camera front. A maximum error in all directions (rotation, translation) cannot occur at the same time.
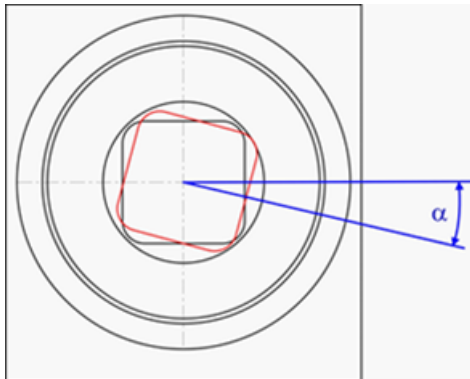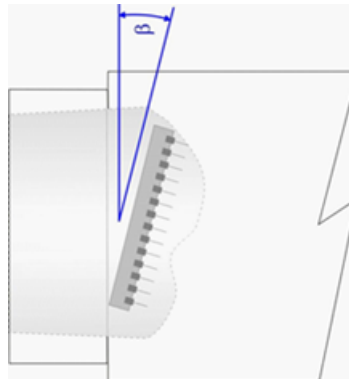

Fig. 10: Position accuracy of the sensor (1)

Fig. 11: Position accuracy of the sensor (2)

It cannot be guaranteed that the sensor cover glass or filter glass are absolutely parallel to each other.

C-mount/TFL-mount lenses can also be subject to inaccuracies of the flange back distance. The tolerance usually is ±0.05 mm. In some cases, however, the inaccuracies of camera and lens might add up, resulting in a total error > 0.05 mm.

Position accuracy, in each direction	±0.3 mm
Horizontal/vertical rotation (α)	±1.0°
Translational rotation (β)	±1.0°
Flange back distance	±0.05 mm

9 Filter glasses

Filter types

Cleaning the filter glasses

9.1 Filter types

Every camera has a filter glass in the front flange to prevent the entry of dust particles. Color cameras by default use an IR cut filter (type HQ), which is required to ensure correct color rendering. For monochrome cameras, the standard filter is a glass filter (type GL). The filter type is given at the end of the model name.

The following table shows an overview of the different optical filters used in IDS cameras:

Filter type	Name	Refractive index (n_{Filter})	Glass type	Thickness (f)	Cut-on wavelength	Cut-off wavelength	Non-reflective
IR cut filter	HQ	1.53	D263	1 mm	-	650 ±10 nm	On one side
Glass	GL	1.53	D263T	1 mm	330 nm	-	On both sides
Daylight cut filter	DL	1.53	RG695	1 mm	695 nm	-	-

You can tell the filter type from the outside by its coloration:

- Reddish glass: HQ filter

- Plain glass: GL filter

- Opaque glass: DL filter

> ℹ️ All sensors have a cover glass. The transmission of the cover glass is taken into account in the camera data sheet.
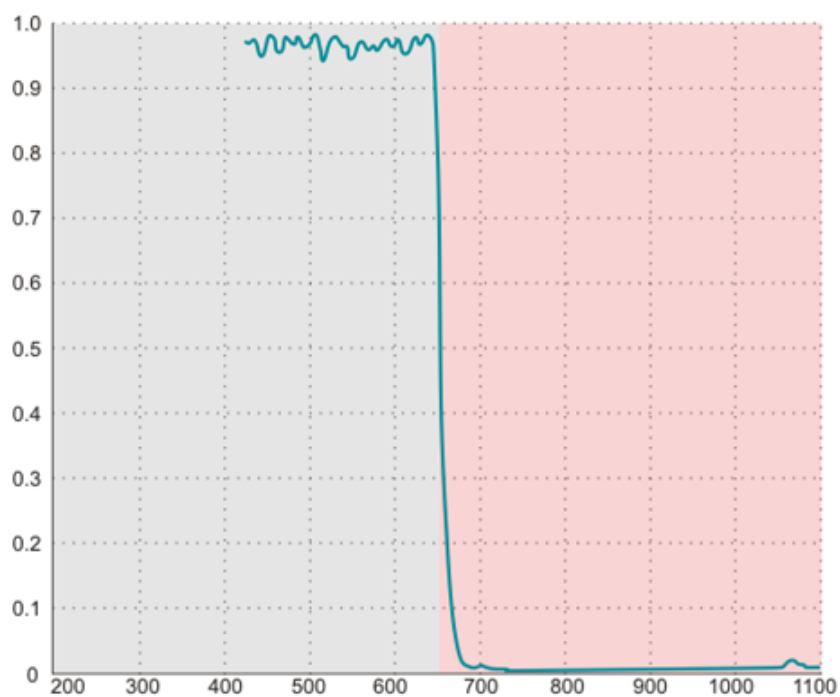
Infrared cut filter (type HQ)
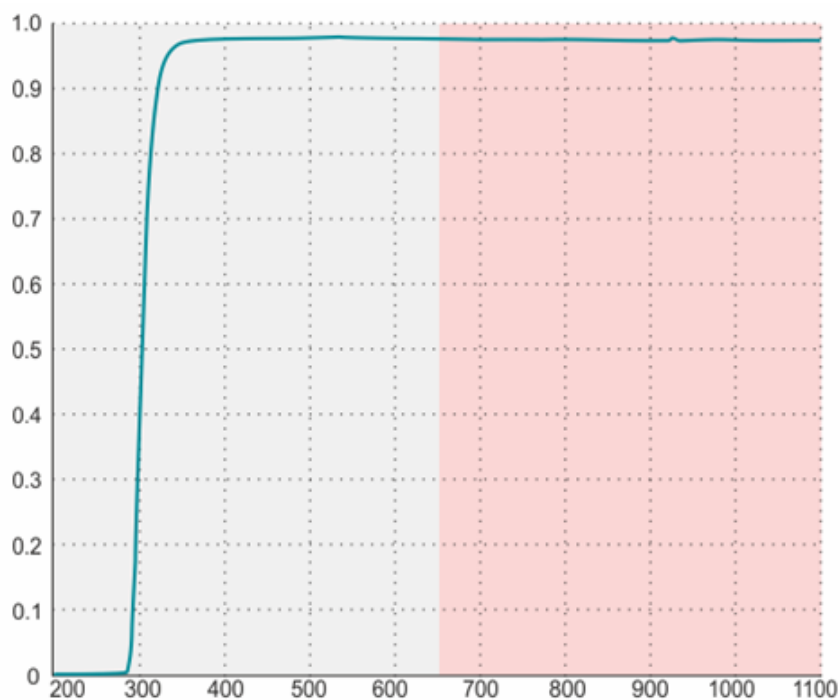

Fig. 12: HQ filter

Plain glass filter (typ GL)

Fig. 13: Glass filter
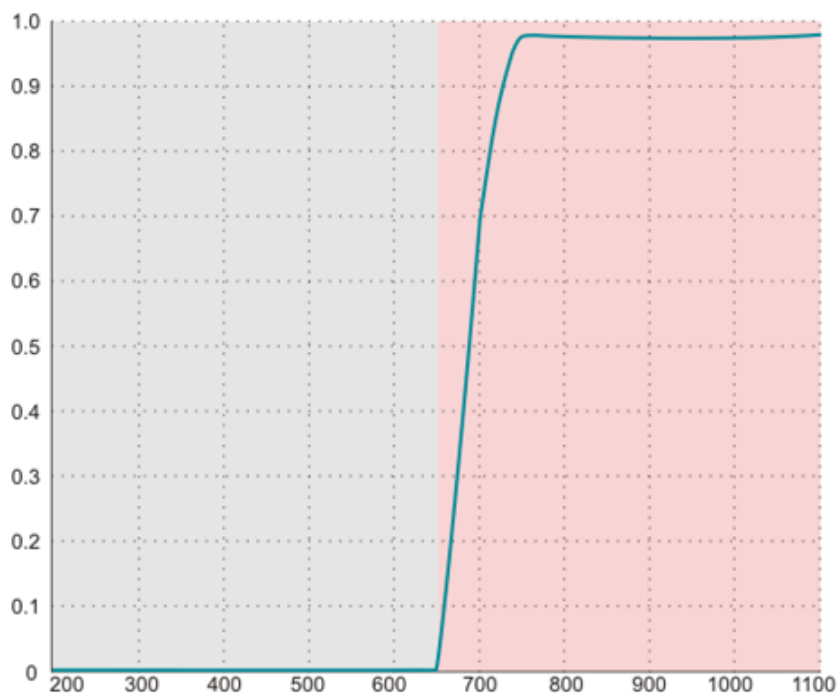
Daylight cut filter (type DL)

Fig. 14: DL cut filter

9.2 Cleaning the filter glasses

When handling the camera with its lens removed, the filter glass can get soiled from the outside. This might be visible in the images that are captured. The filter glass should therefore be cleaned in that case.

> It is strongly recommended to return the cameras to IDS Imaging Development Systems GmbH for professional cleaning.
> IDS Imaging Development Systems GmbH is not liable for any damage resulting from cleaning the filter glasses. This even applies if the following instructions have been observed.

Instructions for cleaning filter glasses

- The filter glasses may only be cleaned from the outside. If you remove the glasses, the sensor might get soiled.IDS Imaging Development Systems GmbH is not liable for any damage to the sensor resulting from removal of the filter glasses.

- First, remove dirt particles on the glass using compressed air. Do not use compressed air from compressors or spray cans since it often contains oil droplets or droplets of other liquids. For best results, use purified nitrogen from nitrogen bottles.

- Only use lint-free wipes or cotton-free swabs for cleaning. Never touch the filter glasses with your bare fingers because often, fingerprints cannot be removed completely afterwards.

- We recommend to use pure alcohol for cleaning. 100% isopropyl alcohol evaporates without leaving any residues. Only add small quantities of alcohol to the wipe. Never pour alcohol directly onto the camera.

> **NOTICE!** Never use cleaning agents containing acetone for cleaning the filter glasses! Acetone may damage the filter glass coating and may deteriorate the optical quality of the glasses.

Cameras with fixed filter glass

Use a wipe to wipe off dirt particles in a single sweep beyond the edge of the filter glass.

Fig. 15: Cleaning fixed filter glasses (1)

Fig. 16: Cleaning fixed filter glasses (2)

Cameras with replaceable filter glass

Use a wipe to wipe off dirt particles in a circular sweep.

Fig. 17: Cleaning interchangeable filter glasses

10 System specification

CPU	1.3 GHz Dual Core ARM Cortex-A53
FPGA	Xilinx Zynq UltraScale+ (ZU3CG)
RAM	2 GB DDR4
Flash	8 GB (with the system)

10.1 CNN

Operating system	Linux
Image preprocessing	- Demosaicing - AOI - Resolution scaling - CNN preprocessing modes - zeroto255 - zerotoone - CNN preprocessing modes from keras.applications.imagenet_utils.preprocess_input - tf - caffe - torch
Data postprocessing on CPU	- Softmax operation for classification - Box regression for object detection - User programmable processing on Dual Core ARM Cortex-A53

10.1.1 deep ocean core

Input data formats	- Up to 512 x 512 pixels - Tensor of shape (x, y, 3) for color - Tensor of shape (x, y, 1) for mono
Output data formats	- Float - Shape formatting can be defined in post-processing (depending on model and task)
Internal number format	16-bit fixed point - Integer and fractional bits individually optimized for each layer
Maximum number of layers in model	180 layers
Maximum model size	Any size fitting the RAM size (maximum 245 MB (1,6 MP mono), minimum 160 MB (6 MP color)
Supported operations/layers	2D convolution layer - Depthwise separable convolution layer - Average pooling layer - Max. pooling layer - Dense layer - Add layer

	• Concatenate layer • Squeeze-and-Excitation layer • ReLU activation • ReLU6 activation • Swish activation • Sigmoid activation • Batch normalization
Filter kernel/pooling parameters	• Kernel/pooling window: any rectangle up to 15 x 15 pixels • Kernel depth: any depth • Kernel/pooling stride: up to 15 pixels
Inference time	See Benchmark

10.1.2 Benchmark

Reference models from tensorflow.keras.applications

Architecture	Input format → output format	Single image inference time [ms]
MobileNet V1 α=1.0	(224, 224, 3) → (1000)	66
MobileNet V1 α=0.75	(224, 224, 3) → (1000)	50
MobileNet V1 α=0.5	(224, 224, 3) → (1000)	37
MobileNet V1 α=0.5	(128, 128, 3) → (1000)	14
MobileNet V1 α=0.25	(224, 224, 3) → (1000)	28
MobileNet V1 α=0.25	(128, 128, 3) → (1000)	10
MobileNet V2 α=1.0	(224, 224, 3) → (1000)	67
MobileNet V3 large alpha 1.0	(224, 224, 3) → (1000)	64
MobileNet V3 large alpha 0.75	(224, 224, 3) → (1000)	55
MobileNet V3 small alpha 1.0	(224, 224, 3) → (1000)	35
ResNet50	(224, 224, 3) → (1000)	285
MobileNet_V1_SSD	(300, 300, 3) → (scores: (3323, 81), boxes: (3323, 4), anchors: (3323, 4))	132