

TECHNICAL DATA SHEET

SAFETY LIGHT CURTAIN SENSOR Emitter and Receiver **QE series**



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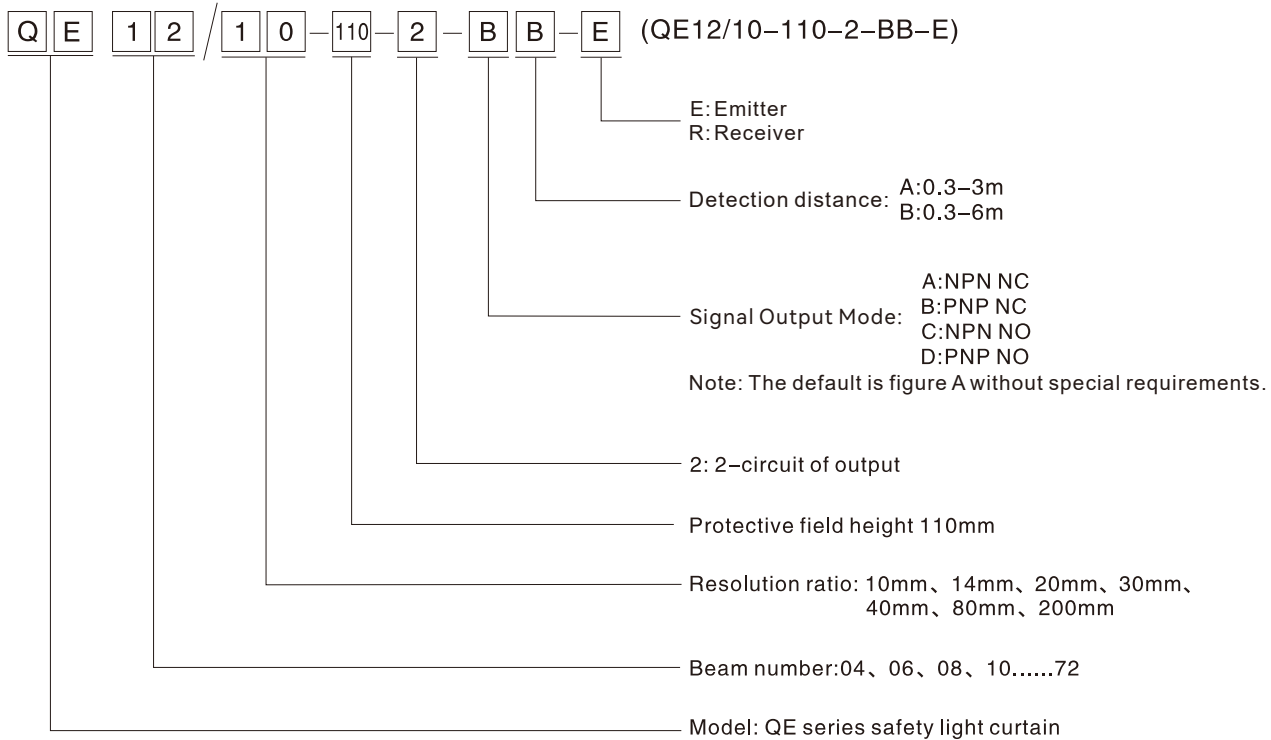


GB/T 19001-2016

Product application

- A. Light curtain can achieve full protection for the slider can be stopped at any position on the press machine.
- B. The light curtain can only achieve upper dead point protection if the slider can not be stopped at any position on the press machine.
- C. Realize the regional protection for the industry manipulator, injection molding machines, packaging equipment, automation equipment, assembly wires and other dangerous work area.
- D. Used to detect and alarm object.

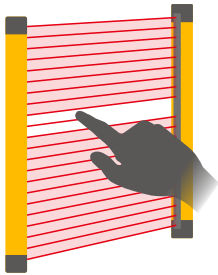
The specifications of QE type safety light curtain are as follows:



Resolution ratio

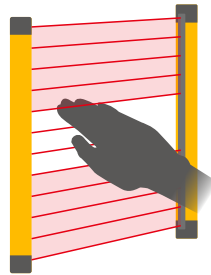
Depending on the usage environment and requirements, it is important to choose the appropriate beam spacing

Finger protection



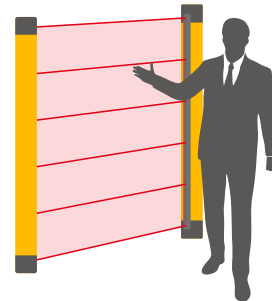
Detection capability
10/14/20mm
diameter

Hand protection



Detection capability
30/40mm
diameter

Arm/body protection



Detection capability
80/200mm
diameter

Technical data

Basic data of Receiver and Emitter

Standard packaging	
Product model	QE series
Standard configuration	One receiver, one transmitter, two data lines, one right-angle rack, and one t-shaped screw
Light curtain form	Infrared radiation type
Application	Standard industrial environment

Features	
Resolution ratio	10mm, 14mm, 20mm, 30mm, 40mm, 80mm, 200mm
Check the accuracy	18mm, 22mm, 28mm, 38mm, 48mm, 88mm, 208mm
Number of beams	04、06、08、10.....72
Overall dimension	30mm*30mm*L, L is the length of emitter and receiver.
Detection distance	30-6000mm
Response time	≤15ms

Synchronization	
Consumption current	≤200mA
Output mode	2-circuit of PNP, with current of 500mA and voltage below 1.5V, polarity, short circuit and over-cutting protection
Output status	ON (receiving indicator green light)
Indicator light	Transmitter: power indicator light (red); receiver: output indicator light on (green), blackout (red)
Wavelength	850nm
Type of light	Infrared light (NIR), invisible
Function	Automatic reset

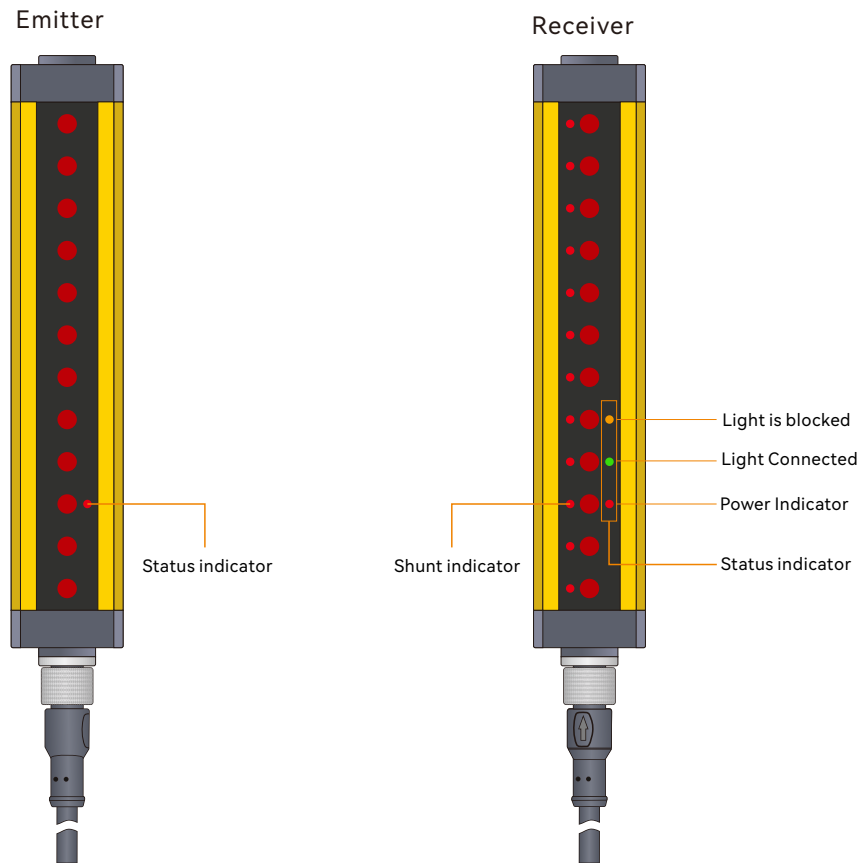
Mechanical data	
Housing material	Metal
Metal shell	Aluminium
Lens front screen material	Acrylic
Upper and lower cover materials	ABS reinforced nylon PA66+30% GF

Performance data	
Protection circuit	Short circuit protection Overvoltage protection
Supply voltage	24VDC, -20...20%
Maximum current consumption	150mA
Fuse	2A half time interval

Environmental data	
Protection grade	IP65
Resistance to ambient light	Incandescent light: illumination of light-receiving surface 3000Lx; Sunlight: illumination of light-receiving surface 10000Lx
Ambient temperature	Working temperature: - 10~+40 °C (but not frozen), storage temperature: - 25 ~+55 °C
Ambient humidity	Working time: 35~85% RH, saving time: 35~95% RH

Output	
Number of safe output circuits (OSSD)	2-circuit
Type	Safety circuit output circuit OSSD
Minimum switch voltage high	18V
Minimum switch voltage low	2.5V
Typical switching voltage	22.5V
Voltage type	DC
Maximum current load	380mA
Load inductance	two thousand
Load capacity	zero point three
Maximum residual current	0.2mA
Typical residual current	0.002MA
Voltage drop	1.5V
Safety switch output 1	Connection pin 4, WHITE OSSD1
Switching element	Transistor PNP
Safety switch output 2	Connection pin 5, GREEN OSSD2
Switching element	Transistor PNP
Certificate	
CE TÜV	No.E8A 104143 0001 Rev.00
ROHS certification	No.BSTDG180811032001CC
CE TYPE 4	No.ICR Polska/VC/HS221214
UL	No. 4790783741.1-S
GB/T	No. HIC180327 GB/T 19001-2016 idt ISO 9001:2015

Operation and display



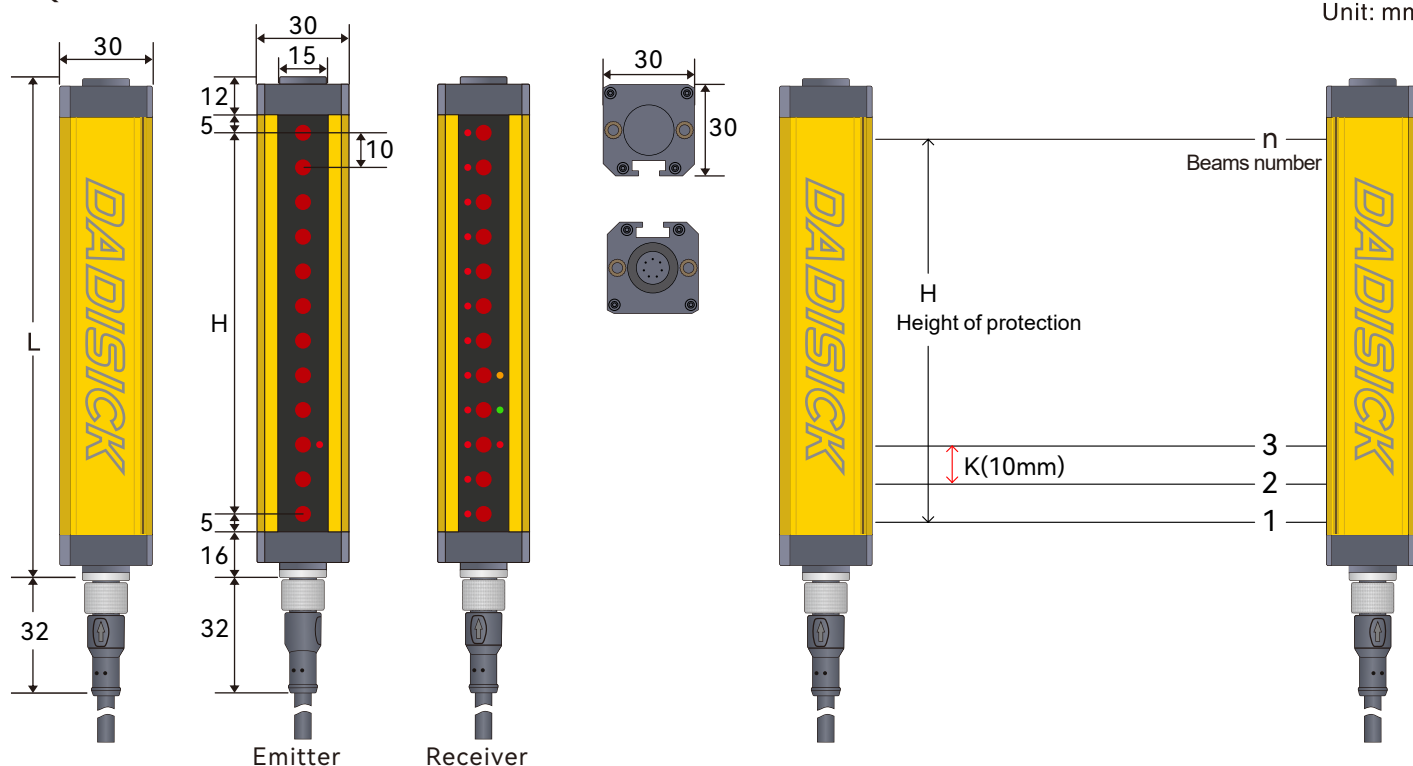
Status indicator	LED status Indicator	Explain
Emitter	Red, always on	Turns on the power
Receiver	Red, always on	Turns on the power
	Green	All light paths are connected
	Yellow	The light is blocked or misaligned
	Lights flashing	Interference or overstep detection range

Shunt indicator	LED shunt Indicator	Explain
Receiver	Red light up	The light is blocked or misaligned
	Red light out	The light paths are connected

Dimensioned drawings

QE 10mm series

Unit: mm



Remarks

L: Total length of light screen

H: Height of protected area

K: Resolution ratio

n: Beams number

 $L = 12 + 5 + H + 5 + 16$ $H = (n - 1) * 10$

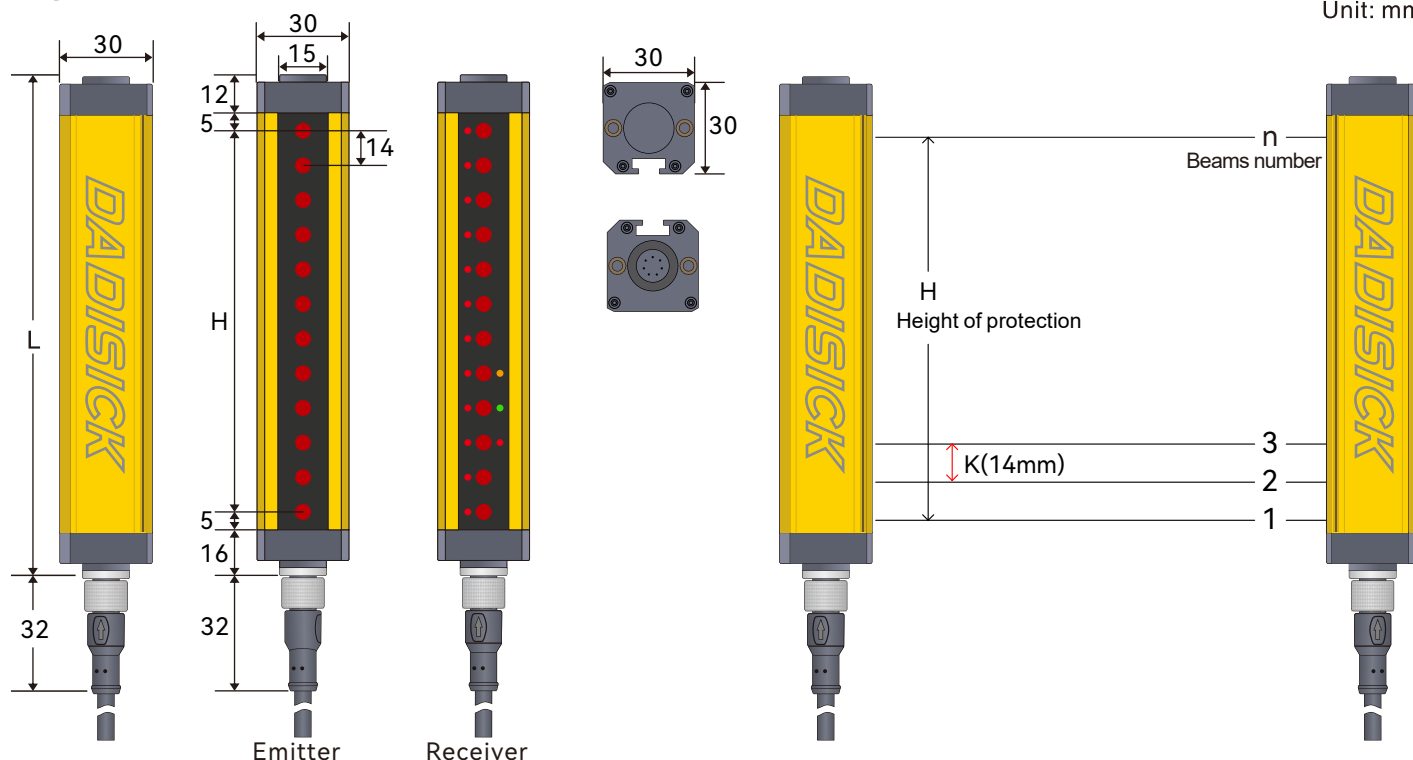
QE 10mm specification list

Resolution	Light beam	Protection height (H)	Total height (L)	Product model	Signal output mode		Detection range
					Two outputs	PNP output	
10mm (K)	12	110	148	QE12/10-110	2	PNP	0.3-6m
	14	130	168	QE14/10-130	2	PNP	0.3-6m
	16	150	188	QE16/10-150	2	PNP	0.3-6m
	18	170	208	QE18/10-170	2	PNP	0.3-6m
	20	190	228	QE20/10-190	2	PNP	0.3-6m
	22	210	248	QE22/10-210	2	PNP	0.3-6m
	24	230	268	QE24/10-230	2	PNP	0.3-6m
	26	250	288	QE26/10-250	2	PNP	0.3-6m
	28	270	308	QE28/10-270	2	PNP	0.3-6m
	30	290	328	QE30/10-290	2	PNP	0.3-6m
	32	310	348	QE32/10-310	2	PNP	0.3-6m
	34	330	368	QE34/10-330	2	PNP	0.3-6m
	36	350	388	QE36/10-350	2	PNP	0.3-6m
	38	370	408	QE38/10-370	2	PNP	0.3-6m
	40	390	428	QE40/10-390	2	PNP	0.3-6m
	42	410	448	QE42/10-410	2	PNP	0.3-6m
	44	430	468	QE44/10-430	2	PNP	0.3-6m
	46	450	488	QE46/10-450	2	PNP	0.3-6m
	48	470	508	QE48/10-470	2	PNP	0.3-6m
	50	490	528	QE50/10-490	2	PNP	0.3-6m
	52	510	548	QE52/10-510	2	PNP	0.3-6m
	54	530	568	QE54/10-530	2	PNP	0.3-6m
	56	550	588	QE56/10-550	2	PNP	0.3-6m
	58	570	608	QE58/10-570	2	PNP	0.3-6m
	60	590	628	QE60/10-590	2	PNP	0.3-6m
	62	610	648	QE62/10-610	2	PNP	0.3-6m
	64	630	668	QE64/10-630	2	PNP	0.3-6m
	66	650	688	QE66/10-650	2	PNP	0.3-6m
	68	670	708	QE68/10-670	2	PNP	0.3-6m
	70	690	728	QE70/10-690	2	PNP	0.3-6m

Dimensioned drawings

QE 14mm series

Unit: mm



Remarks

L: Total length of light screen

H: Height of protected area

K: Resolution ratio

n: Beams number

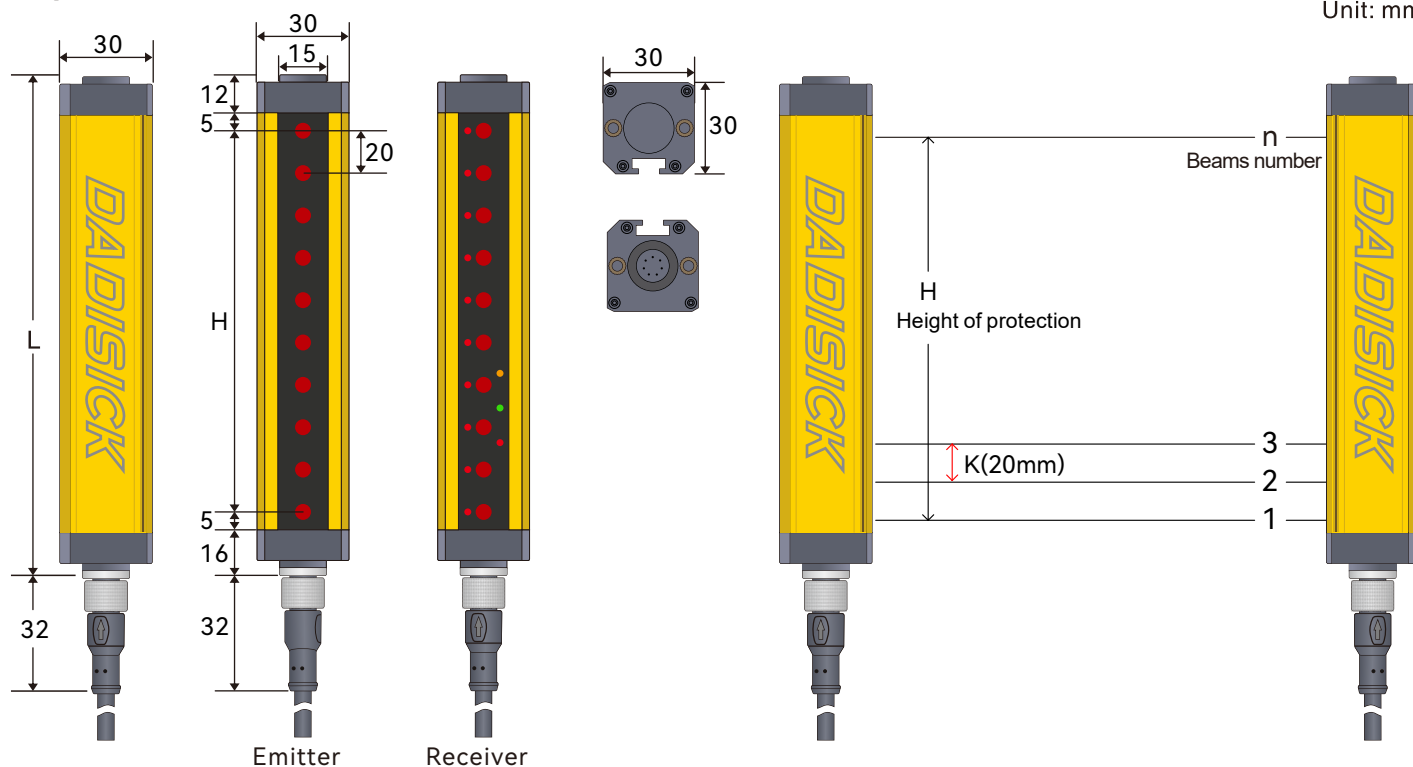
 $L = 12 + 5 + H + 5 + 16$ $H = (n - 1) * 14$

QE 14mm specification list

Resolution	Light beam	Protection height (H)	Total height (L)	Product model	Signal output mode		Detection distance
					Two outputs	PNP output	
14mm (K)	6	70	108	QE06/14-70	2	PNP	0.3-6m
	8	98	136	QE08/14-98	2	PNP	0.3-6m
	10	126	164	QE10/14-126	2	PNP	0.3-6m
	12	154	192	QE12/14-154	2	PNP	0.3-6m
	14	182	220	QE14/14-182	2	PNP	0.3-6m
	16	210	248	QE16/14-210	2	PNP	0.3-6m
	18	238	276	QE18/14-238	2	PNP	0.3-6m
	20	266	304	QE20/14-266	2	PNP	0.3-6m
	22	294	332	QE22/14-294	2	PNP	0.3-6m
	24	322	360	QE24/14-322	2	PNP	0.3-6m
	26	350	388	QE26/14-350	2	PNP	0.3-6m
	28	378	416	QE28/14-378	2	PNP	0.3-6m
	30	406	444	QE30/14-406	2	PNP	0.3-6m
	32	434	472	QE32/14-434	2	PNP	0.3-6m
	34	462	500	QE34/14-462	2	PNP	0.3-6m
	36	490	528	QE36/14-490	2	PNP	0.3-6m
	38	518	556	QE38/14-518	2	PNP	0.3-6m
	40	546	584	QE40/14-546	2	PNP	0.3-6m
	42	574	612	QE42/14-574	2	PNP	0.3-6m
	44	602	640	QE44/14-602	2	PNP	0.3-6m
	46	630	668	QE46/14-630	2	PNP	0.3-6m
	48	658	696	QE48/14-658	2	PNP	0.3-6m
	50	686	724	QE50/14-686	2	PNP	0.3-6m
	52	714	752	QE52/14-714	2	PNP	0.3-6m
	54	742	780	QE54/14-742	2	PNP	0.3-6m
	56	770	808	QE56/14-770	2	PNP	0.3-6m
	58	798	836	QE58/14-798	2	PNP	0.3-6m
	60	826	864	QE60/14-826	2	PNP	0.3-6m
	62	854	892	QE62/14-854	2	PNP	0.3-6m
	64	882	920	QE64/14-882	2	PNP	0.3-6m
	66	910	948	QE66/14-910	2	PNP	0.3-6m
	68	938	976	QE68/14-938	2	PNP	0.3-6m
	70	966	1004	QE70/14-966	2	PNP	0.3-6m
	72	994	1032	QE72/14-994	2	PNP	0.3-6m

QE 20mm series

Unit: mm



Remarks

L: Total length of light screen

H: Height of protected area

K:Resolution ratio

n:Beams number

$$L = 12 + 5 + H + 5 + 16$$

$$H = (n-1) * 20$$

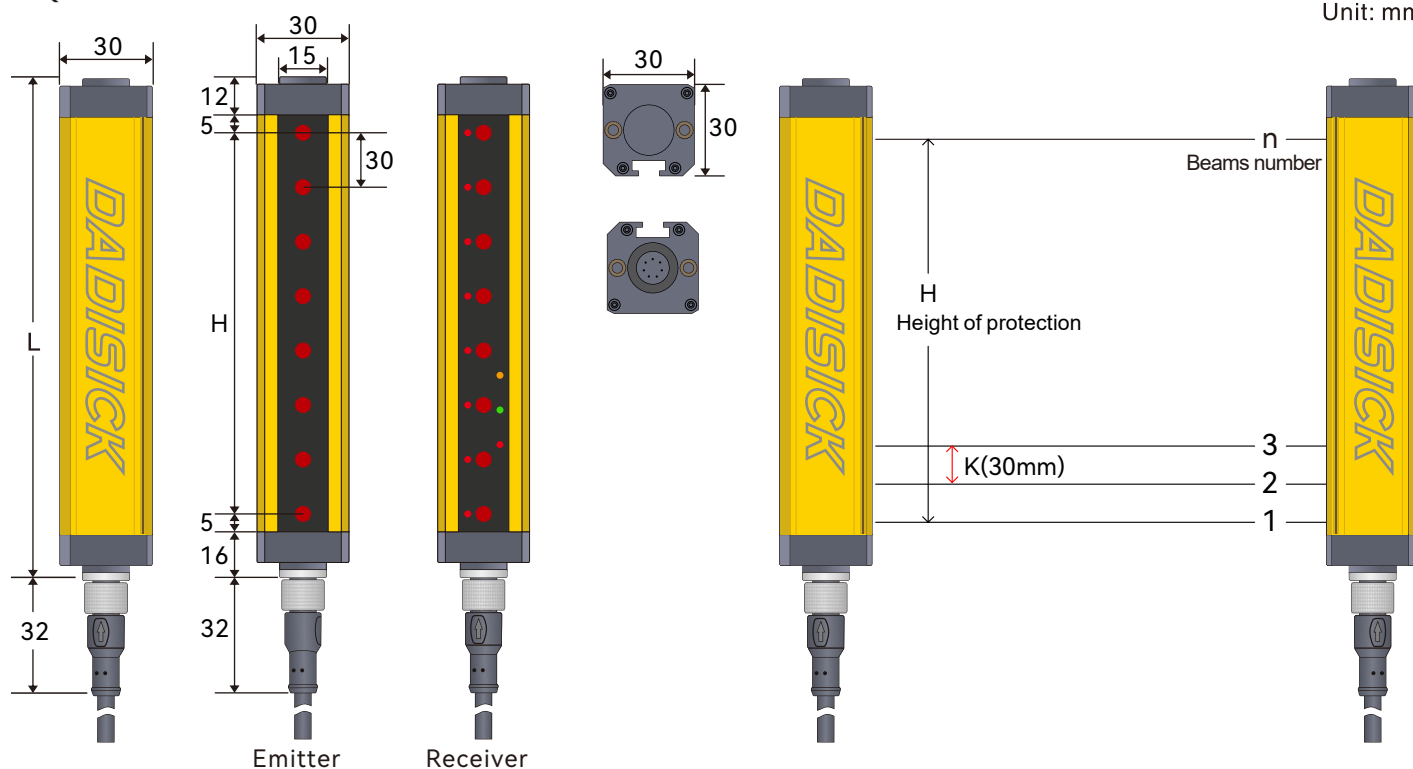
QE 20mm specification list

Resolution	Light beam	Protection height (H)	Total height (L)	Product model	Signal output mode		Detection distance
					Two outputs	PNP output	
20mm (K)	6	100	138	QE06/20-100	2	PNP	0.3-6m
	8	140	178	QE08/20-140	2	PNP	0.3-6m
	10	180	218	QE10/20-180	2	PNP	0.3-6m
	12	220	258	QE12/20-220	2	PNP	0.3-6m
	14	260	298	QE14/20-260	2	PNP	0.3-6m
	16	300	338	QE16/20-300	2	PNP	0.3-6m
	18	340	378	QE18/20-340	2	PNP	0.3-6m
	20	380	418	QE20/20-380	2	PNP	0.3-6m
	22	420	458	QE22/20-420	2	PNP	0.3-6m
	24	460	498	QE24/20-460	2	PNP	0.3-6m
	26	500	538	QE26/20-500	2	PNP	0.3-6m
	28	540	578	QE28/20-540	2	PNP	0.3-6m
	30	580	618	QE30/20-580	2	PNP	0.3-6m
	32	620	658	QE32/20-620	2	PNP	0.3-6m
	34	660	698	QE34/20-660	2	PNP	0.3-6m
	36	700	738	QE36/20-700	2	PNP	0.3-6m
	38	740	778	QE38/20-740	2	PNP	0.3-6m
	40	780	818	QE40/20-780	2	PNP	0.3-6m
	42	820	858	QE42/20-820	2	PNP	0.3-6m
	44	860	898	QE44/20-860	2	PNP	0.3-6m
	46	900	938	QE46/20-900	2	PNP	0.3-6m
	48	940	978	QE48/20-940	2	PNP	0.3-6m
	50	980	1018	QE50/20-980	2	PNP	0.3-6m
	52	1020	1058	QE52/20-1020	2	PNP	0.3-6m
	54	1060	1098	QE54/20-1060	2	PNP	0.3-6m
	56	1100	1138	QE56/20-1100	2	PNP	0.3-6m
	58	1140	1178	QE58/20-1140	2	PNP	0.3-6m
	60	1180	1218	QE60/20-1180	2	PNP	0.3-6m
	62	1220	1258	QE62/20-1220	2	PNP	0.3-6m
	64	1260	1298	QE64/20-1260	2	PNP	0.3-6m
	66	1300	1338	QE66/20-1300	2	PNP	0.3-6m
	68	1340	1378	QE68/20-1340	2	PNP	0.3-6m
70	1380	1418	QE70/20-1380	2	PNP	0.3-6m	
72	1420	1458	QE72/20-1420	2	PNP	0.3-6m	

Dimensioned drawings

QE 30mm series

Unit: mm



Remarks

L: Total length of light screen

H: Height of protected area

K: Resolution ratio

n: Beams number

 $L = 12 + 5 + H + 5 + 16$ $H = (n - 1) * 30$

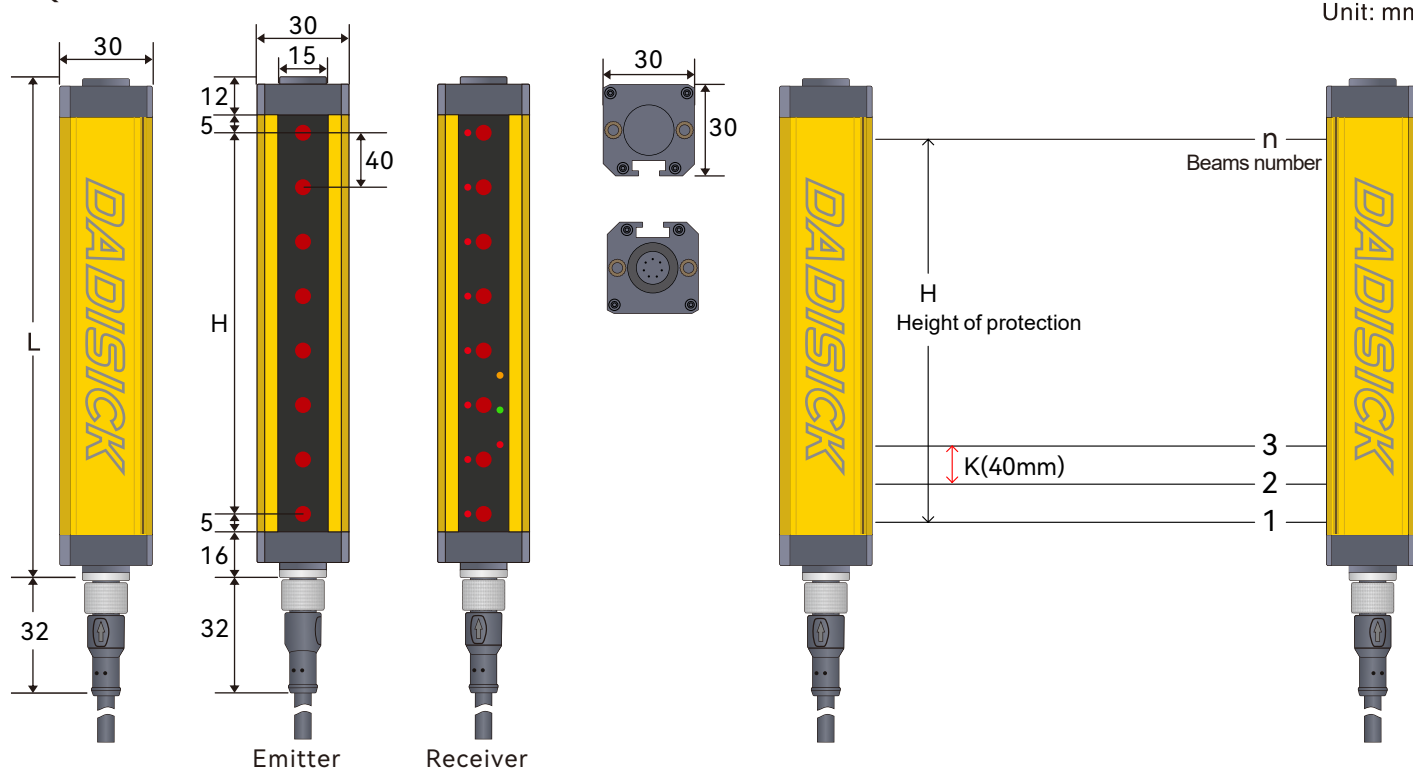
QE 30mm specification list

Resolution	Light beam	Protection height (H)	Total height (L)	Product model	Signal output mode		Detection distance
					Two outputs	PNP output	
30mm (K)	4	90	128	QE04/30-90	2	PNP	0.3-6m
	6	150	188	QE06/30-150	2	PNP	0.3-6m
	8	210	248	QE8/30-210	2	PNP	0.3-6m
	10	270	308	QE10/30-270	2	PNP	0.3-6m
	12	330	368	QE12/30-330	2	PNP	0.3-6m
	14	390	428	QE14/30-390	2	PNP	0.3-6m
	16	450	488	QE16/30-450	2	PNP	0.3-6m
	18	510	548	QE18/30-510	2	PNP	0.3-6m
	20	570	608	QE20/30-570	2	PNP	0.3-6m
	22	630	668	QE22/30-630	2	PNP	0.3-6m
	24	690	728	QE24/30-690	2	PNP	0.3-6m
	26	750	788	QE26/30-750	2	PNP	0.3-6m
	28	810	848	QE28/30-810	2	PNP	0.3-6m
	30	870	808	QE30/30-870	2	PNP	0.3-6m
	32	930	968	QE32/30-930	2	PNP	0.3-6m
	34	990	1028	QE34/30-990	2	PNP	0.3-6m
	36	1050	1088	QE36/30-1050	2	PNP	0.3-6m
	38	1110	1148	QE38/30-1110	2	PNP	0.3-6m
	40	1170	1208	QE40/30-1170	2	PNP	0.3-6m
	42	1230	1268	QE42/30-1230	2	PNP	0.3-6m
	44	1290	1328	QE44/30-1290	2	PNP	0.3-6m
	46	1350	1388	QE46/30-1350	2	PNP	0.3-6m
	48	1410	1448	QE48/30-1410	2	PNP	0.3-6m
	50	1470	1508	QE50/30-1470	2	PNP	0.3-6m
	52	1530	1568	QE52/30-1530	2	PNP	0.3-6m
	54	1590	1628	QE54/30-1590	2	PNP	0.3-6m
	56	1650	1688	QE56/30-1650	2	PNP	0.3-6m
	58	1710	1748	QE58/30-1710	2	PNP	0.3-6m
	60	1770	1808	QE60/30-1770	2	PNP	0.3-6m
	62	1830	1868	QE62/30-1830	2	PNP	0.3-6m
	64	1890	1928	QE64/30-1890	2	PNP	0.3-6m
	66	1950	1988	QE66/30-1950	2	PNP	0.3-6m
	68	2010	2048	QE68/30-2010	2	PNP	0.3-6m
	70	2070	2108	QE70/30-2070	2	PNP	0.3-6m
	72	2130	2168	QE72/30-2130	2	PNP	0.3-6m

Dimensioned drawings

QE 40mm series

Unit: mm



Remarks

L: Total length of light screen

H: Height of protected area

K: Resolution ratio

n: Beams number

 $L = 12 + 5 + H + 5 + 16$ $H = (n - 1) * 40$

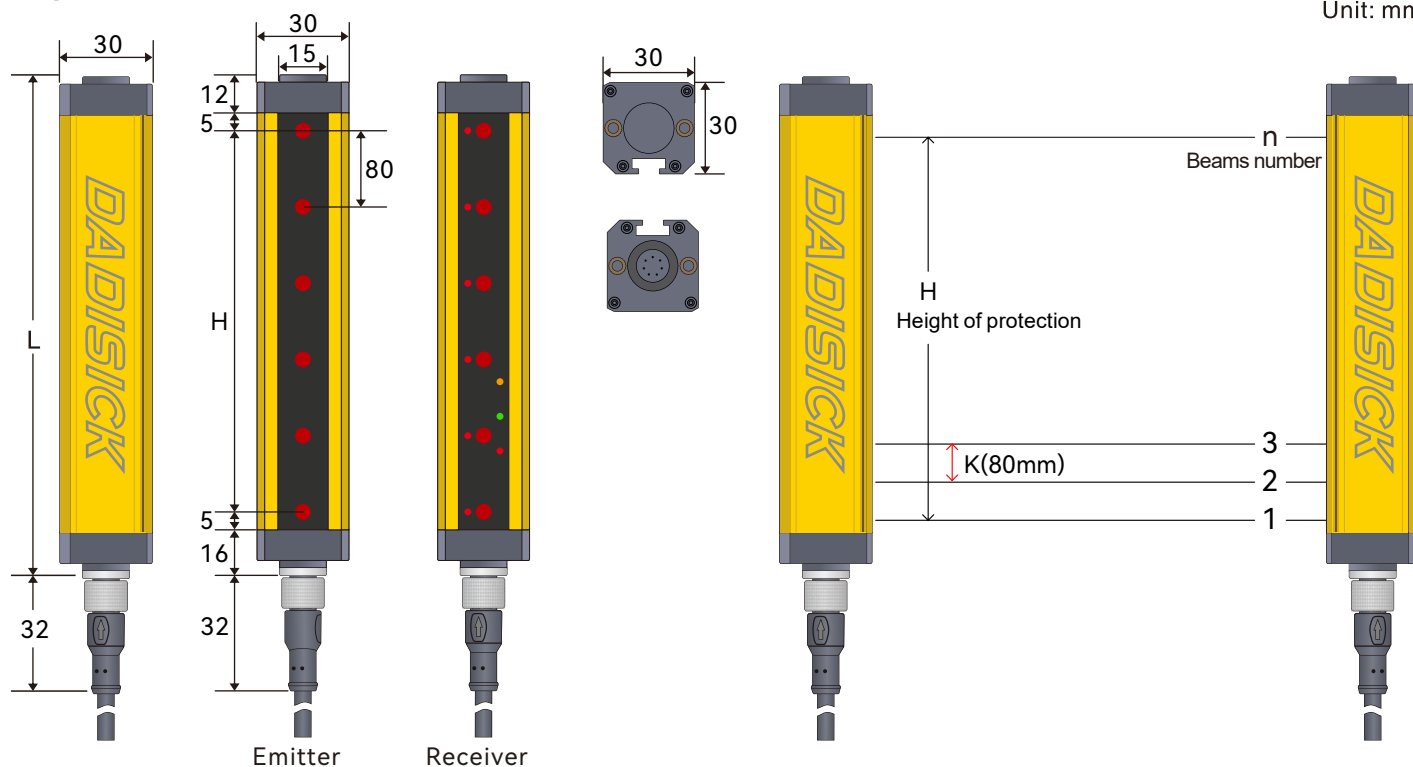
QE 40mm specification list

Resolution	Light beam	Protection height (H)	Total height (L)	Product model	Signal output mode		Detection distance
					Two outputs	PNP output	
40mm (K)	4	120	158	QE04/40-120	2	PNP	0.3-6m
	6	200	238	QE06/40-200	2	PNP	0.3-6m
	8	280	318	QE08/40-280	2	PNP	0.3-6m
	10	360	398	QE10/40-360	2	PNP	0.3-6m
	12	440	478	QE12/40-440	2	PNP	0.3-6m
	14	520	558	QE14/40-520	2	PNP	0.3-6m
	16	600	638	QE16/40-600	2	PNP	0.3-6m
	18	680	718	QE18/40-680	2	PNP	0.3-6m
	20	760	798	QE20/40-760	2	PNP	0.3-6m
	22	840	878	QE22/40-840	2	PNP	0.3-6m
	24	920	958	QE24/40-920	2	PNP	0.3-6m
	26	1000	1038	QE26/40-1000	2	PNP	0.3-6m
	28	1080	1118	QE28/40-1080	2	PNP	0.3-6m
	30	1160	1198	QE30/40-1160	2	PNP	0.3-6m
	32	1240	1278	QE32/40-1240	2	PNP	0.3-6m
	34	1320	1358	QE34/40-1320	2	PNP	0.3-6m
	36	1400	1438	QE36/40-1400	2	PNP	0.3-6m
	38	1480	1518	QE38/40-1480	2	PNP	0.3-6m
	40	1560	1598	QE40/40-1560	2	PNP	0.3-6m
	42	1640	1678	QE42/40-1640	2	PNP	0.3-6m
	44	1720	1758	QE44/40-1720	2	PNP	0.3-6m
	46	1800	1838	QE46/40-1800	2	PNP	0.3-6m
	48	1880	1918	QE48/40-1880	2	PNP	0.3-6m
	50	1960	1998	QE50/40-1960	2	PNP	0.3-6m
	52	2040	2078	QE52/40-2040	2	PNP	0.3-6m
	54	2120	2158	QE54/40-2120	2	PNP	0.3-6m
	56	2200	2238	QE56/40-2200	2	PNP	0.3-6m
	58	2280	2318	QE58/40-2280	2	PNP	0.3-6m
	60	2360	2398	QE60/40-2360	2	PNP	0.3-6m
	62	2440	2478	QE62/40-2440	2	PNP	0.3-6m
	64	2520	2558	QE64/40-2520	2	PNP	0.3-6m
	66	2600	2638	QE66/40-2600	2	PNP	0.3-6m
	68	2680	2718	QE68/40-2680	2	PNP	0.3-6m
	70	2760	2798	QE70/40-2760	2	PNP	0.3-6m
	72	2840	2878	QE72/40-2840	2	PNP	0.3-6m

Dimensioned drawings

QE 80mm series

Unit: mm



Remarks

L: Total length of light screen

H: Height of protected area

K: Resolution ratio

n: Beams number

 $L = 12 + 5 + H + 5 + 16$ $H = (n - 1) * 80$

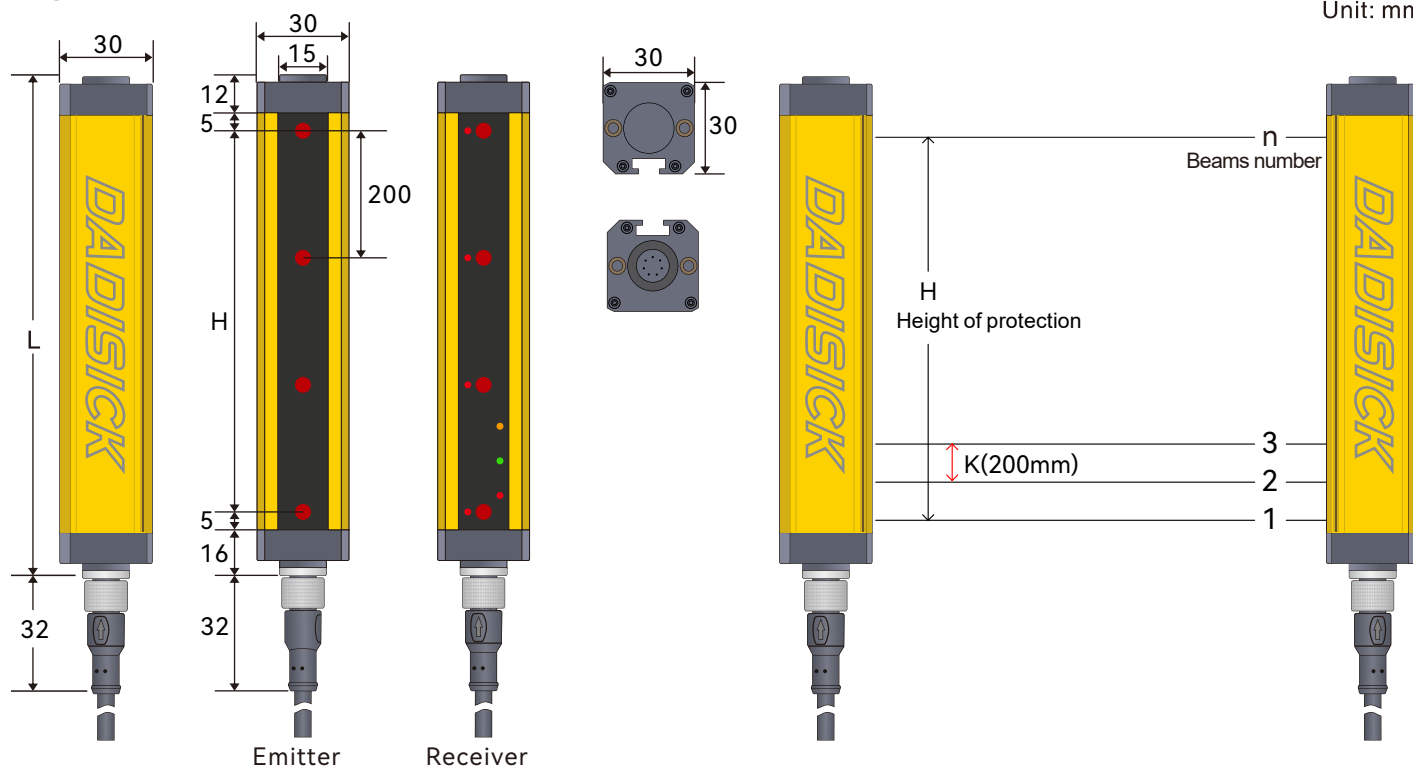
QE 80mm specification list

Resolution	Light beam	Protection height (H)	Total height (L)	Product model	Signal output mode		Detection distance
					Two outputs	PNP output	
80mm (K)	4	240	278	QE04/80-240	2	PNP	0.3-6m
	6	400	438	QE06/80-400	2	PNP	0.3-6m
	8	560	598	QE08/80-560	2	PNP	0.3-6m
	10	720	758	QE10/80-720	2	PNP	0.3-6m
	12	880	918	QE12/80-880	2	PNP	0.3-6m
	14	1040	1078	QE14/80-1040	2	PNP	0.3-6m
	16	1200	1238	QE16/80-1200	2	PNP	0.3-6m
	18	1360	1398	QE18/80-1360	2	PNP	0.3-6m
	20	1520	1558	QE20/80-1520	2	PNP	0.3-6m
	22	1680	1718	QE22/80-1680	2	PNP	0.3-6m
	24	1840	1878	QE24/80-1840	2	PNP	0.3-6m
	26	2000	2038	QE26/80-2000	2	PNP	0.3-6m
	28	2160	2198	QE28/80-2160	2	PNP	0.3-6m
	30	2320	2358	QE30/80-2320	2	PNP	0.3-6m
	32	2480	2518	QE32/80-2480	2	PNP	0.3-6m

Dimensioned drawings

QE 200mm series

Unit: mm



Remarks

L: Total length of light screen

H: Height of protected area

K: Resolution ratio

n: Beams number

 $L = 12 + 5 + H + 5 + 16$ $H = (n - 1) * 200$

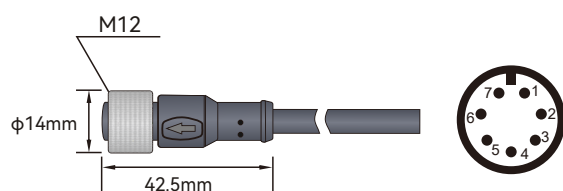
QE 200mm specification list

Resolution	Light beam	Protection height (H)	Total height (L)	Product model	Signal output mode		Detection distance
					Two outputs	PNP output	
200mm (K)	4	600	638	QE04/200-600	2	PNP	0.3-6m
	6	1000	1038	QE06/200-1000	2	PNP	0.3-6m
	8	1400	1438	QE08/200-1400	2	PNP	0.3-6m
	10	1800	1838	QE10/200-1800	2	PNP	0.3-6m
	12	2200	2238	QE12/200-2200	2	PNP	0.3-6m
	14	2600	2638	QE14/200-2600	2	PNP	0.3-6m
	16	3000	3038	QE16/200-3000	2	PNP	0.3-6m
	18	3400	3438	QE18/200-3400	2	PNP	0.3-6m

Electrical connection

Electrical interface	
Number of interfaces	2 (receiver and transmitter)
Type	M12 connector, 7-pin
Interface metal	Copper nickel plating
Plug material	GY384 gray 30P
Allowable typical conductor section	0.25mm ²
Maximum link cable	100m
Maximum allowable cable load	4.9A
Cable material	PVC
Shielding	shielded

Cable description:



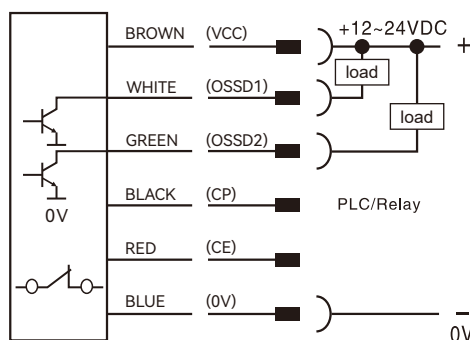
7-pin M12 cable connector straight
3m waterproof cable

Emitter Wiring diagram		
Pin number	Line color	Name
1	BROWN	24V DC
2	BLUE	0V
3	BLACK	CP
4	WHITE	NC
5	GREEN	NC
6	RED	CE
7	YELLOW	Ground wire

Receiver Wiring diagram		
Pin number	Line color	Name
1	BROWN	24V DC
2	BLUE	0V
3	BLACK	CP
4	WHITE	OSSD1
5	GREEN	OSSD2
6	RED	CE
7	YELLOW	Ground wire

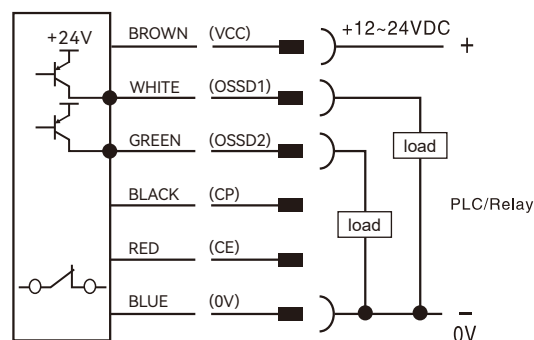
QE signal output selection (actual output of transistor working normally)

NPN NC



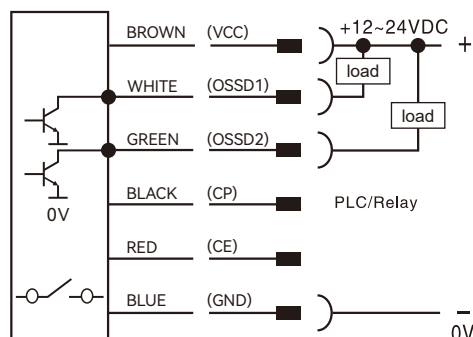
A

PNP NC



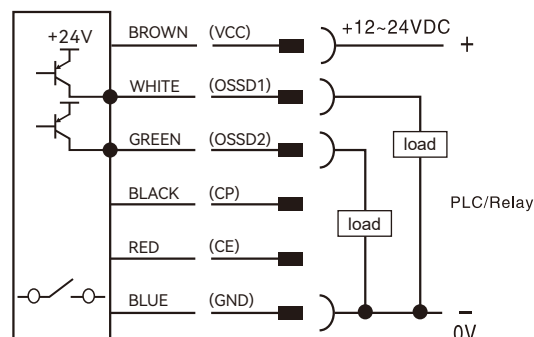
B

NPN NO

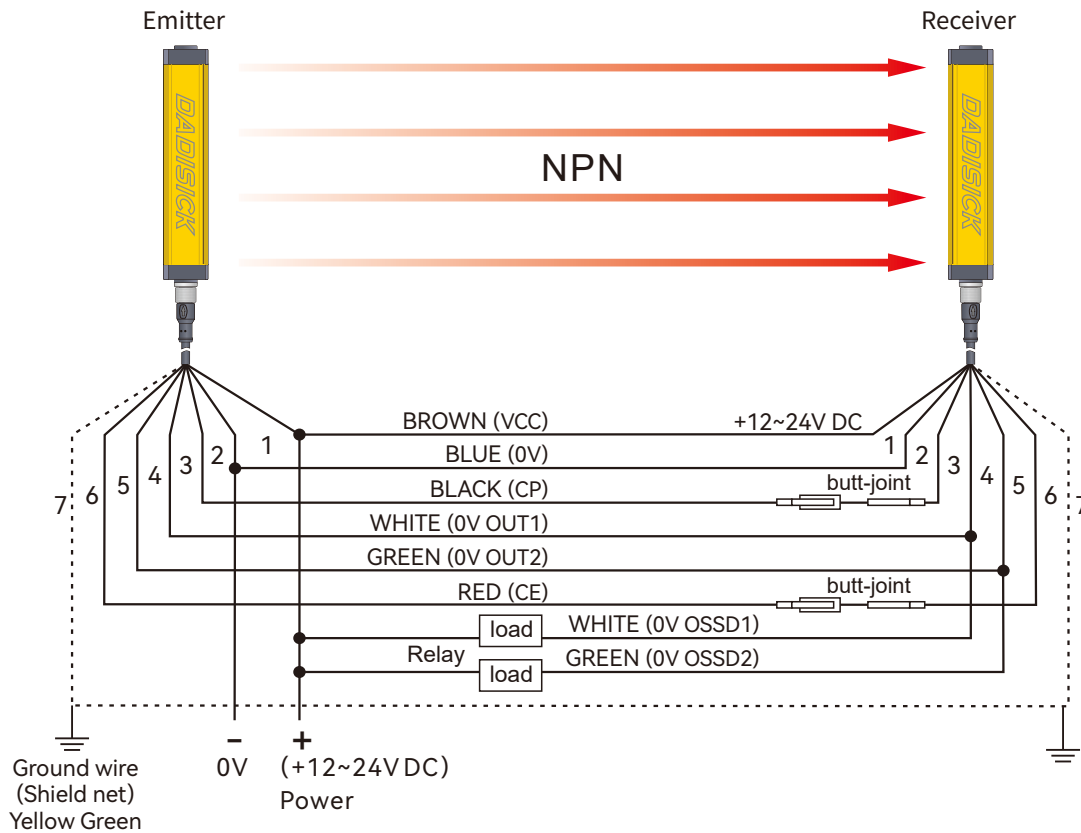


C

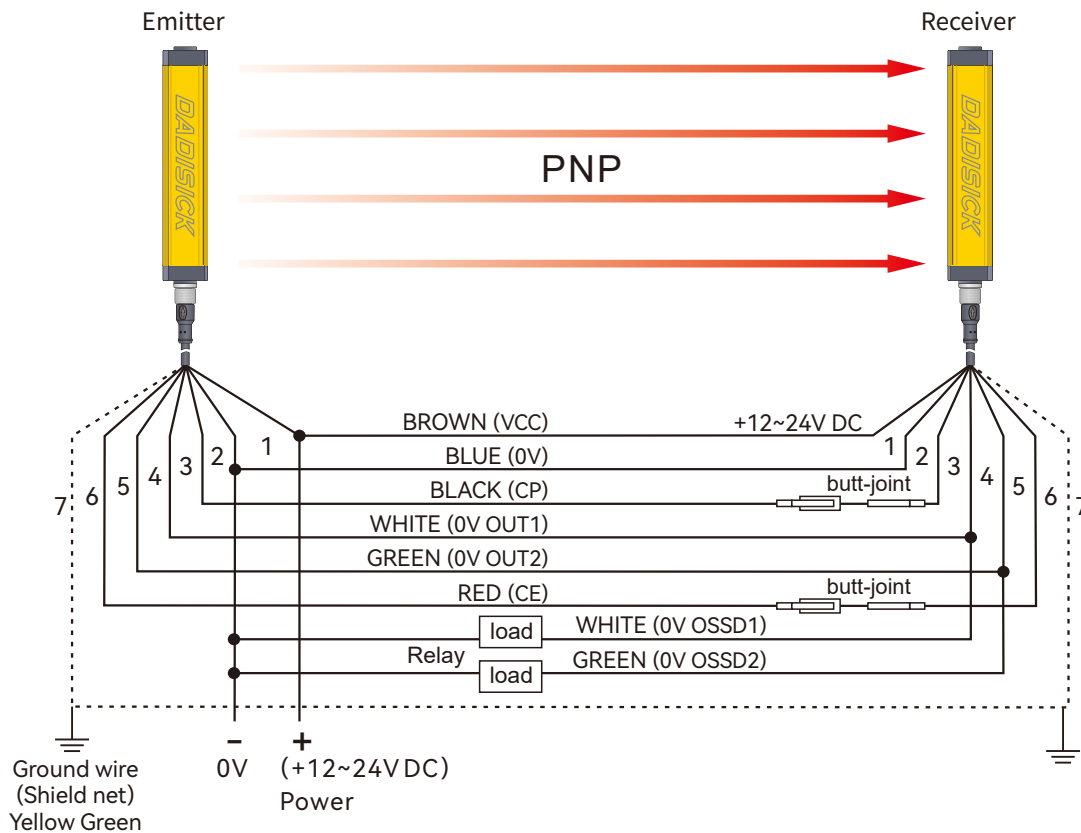
PNP NO



D

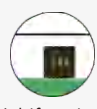
NPN output wiring diagram

This figure is an example of NPN double output 7-pin wiring.

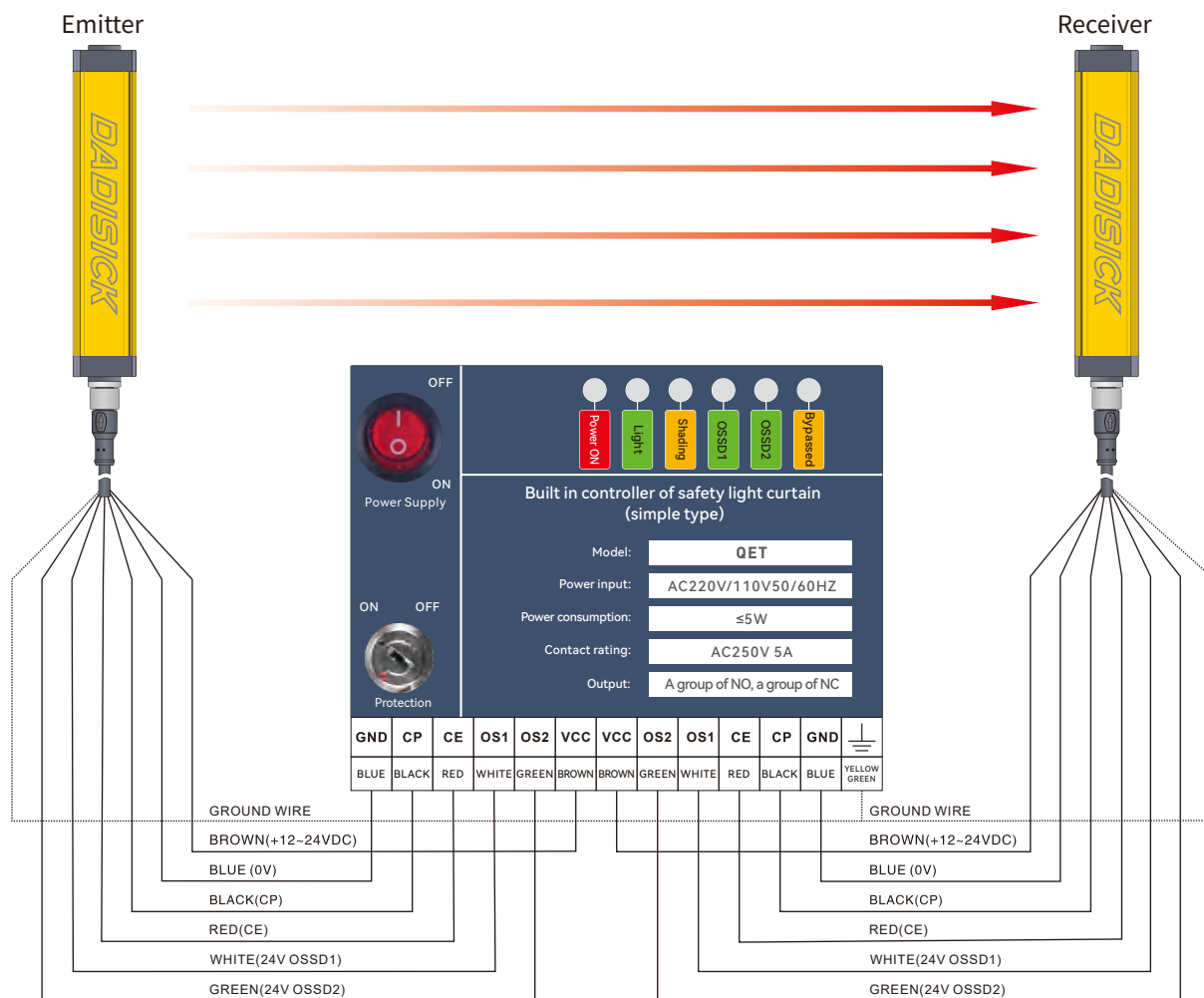
PNP output wiring diagram

This figure is an example of PNP double output 7-pin wiring.

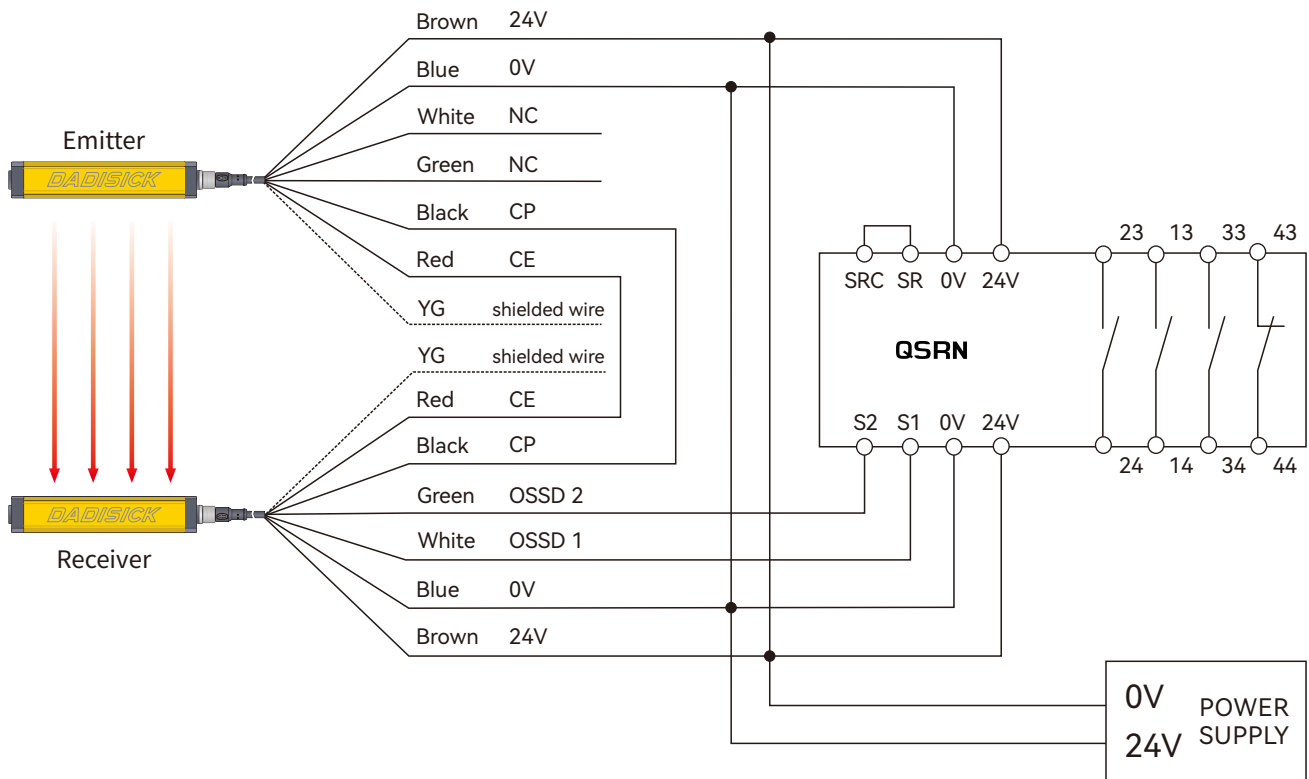
Selection of safety light curtain controller

Name	Order separately	Model	Descriptions
Built-in controller		QET	Used to monitor the signal processing of QE series light curtain, and output one group of NO and one group of NC.
Safety relay		QSRN	QSRN safety relays have three groups of NO and one group of NC, with strong control capabilities. They are suitable for various signal monitoring in industrial places with high safety requirements, including emergency stop signals, safety door opening and closing signals, safety light curtain signals, and two-handed button signals.
Safety relay	  Multifunctional switching switch	Ter-A	Equipped with a mode switch, it can be used for most safety components, such as light curtains, safety switches, carpet contacts, two handed switches, etc. Automatic/manual reset paddles for quick configuration. Dual channel monitoring circuit, safe and reliable.
Light curtain relay		QET-1	Output conversion between NC and NO for QE series light curtain.

Wiring diagram of QET built-in controller

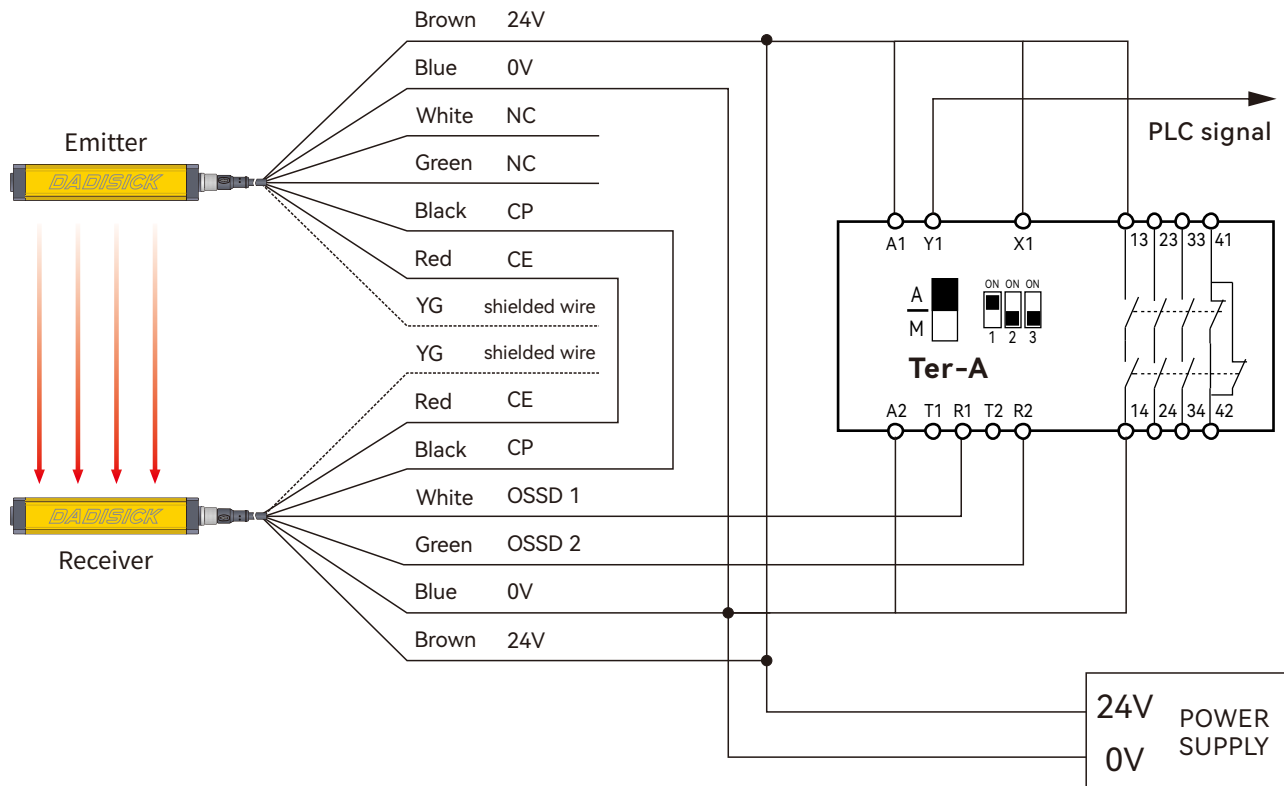


Wiring diagram of QSRN safety relay

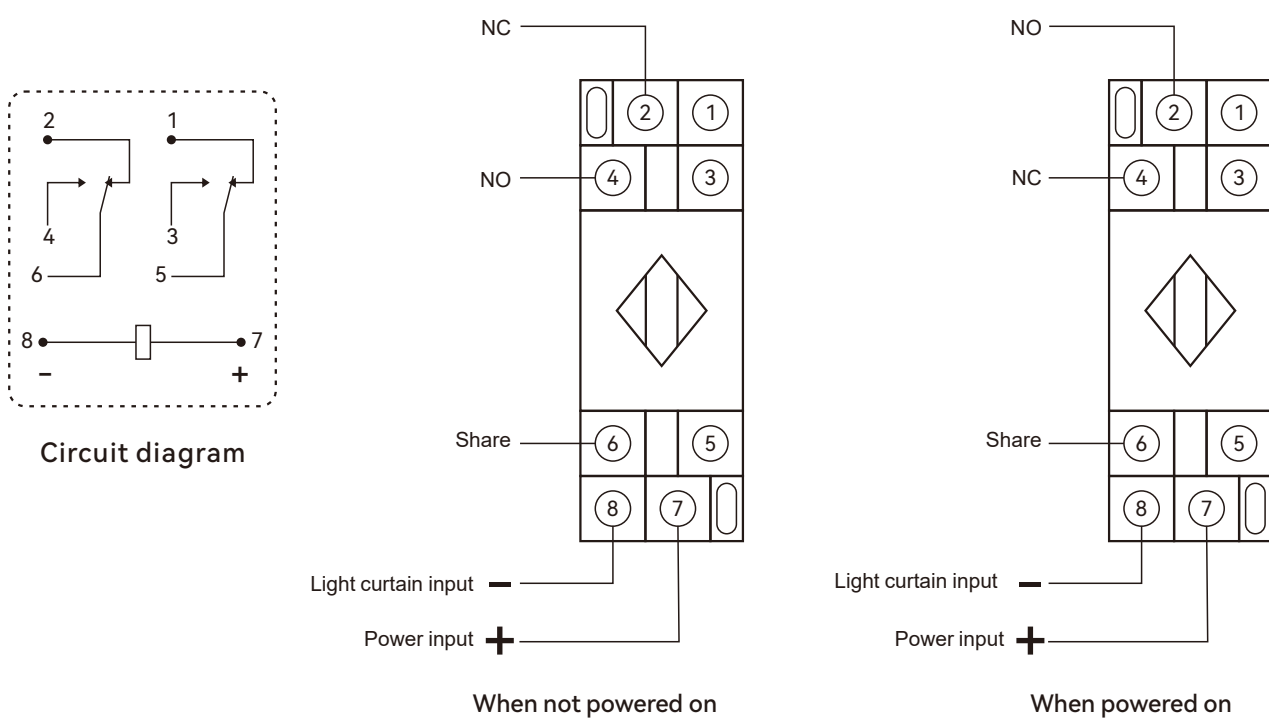


Wiring diagram of Ter-A safety relay

Dual channel light curtain PNP switch safety input, with automatic reset and PLC signal output.

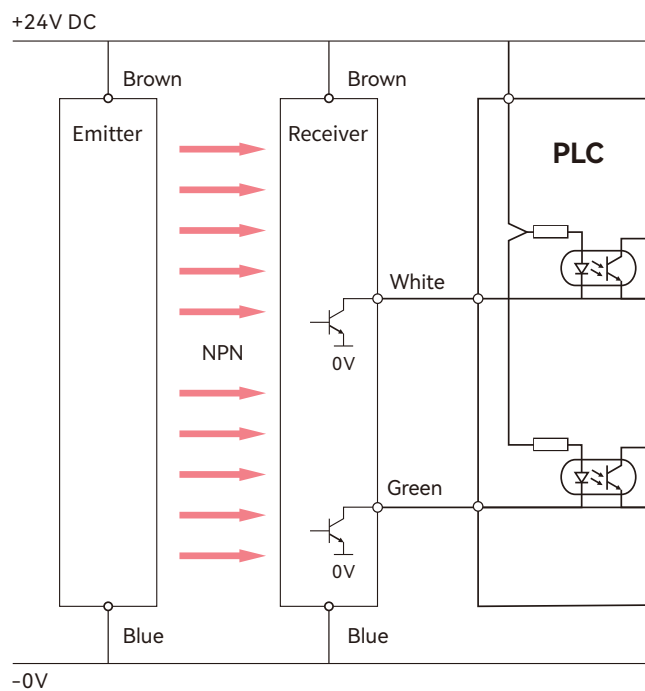


Wiring diagram of QET-1 light curtain relay

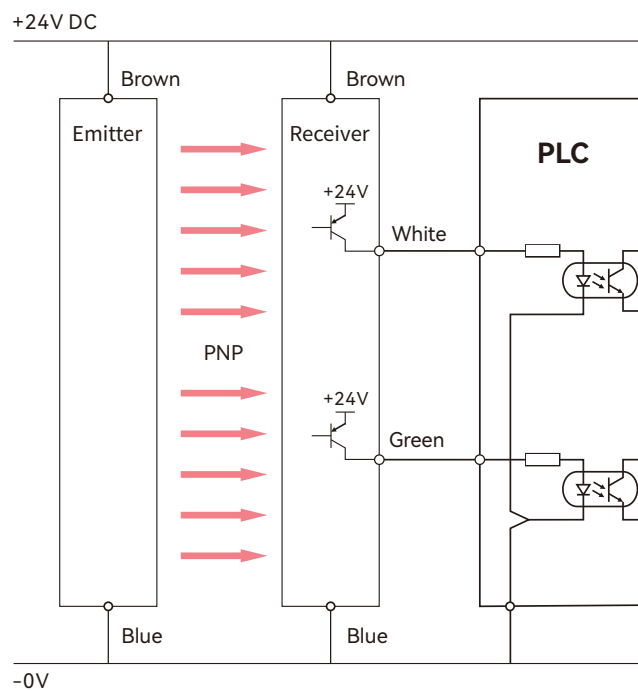


Wiring between light curtain and PLC and one-chip computer system

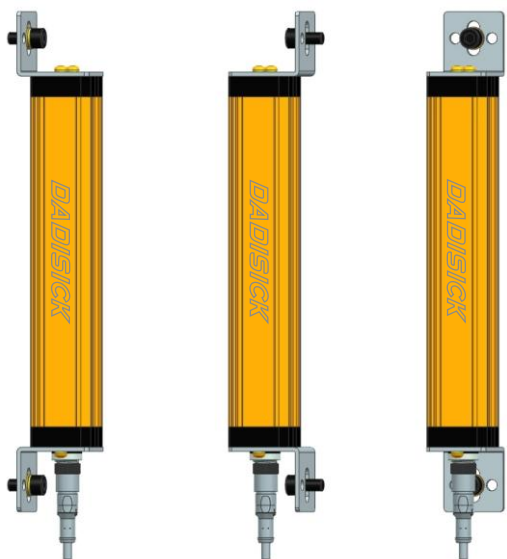
NPN wiring:



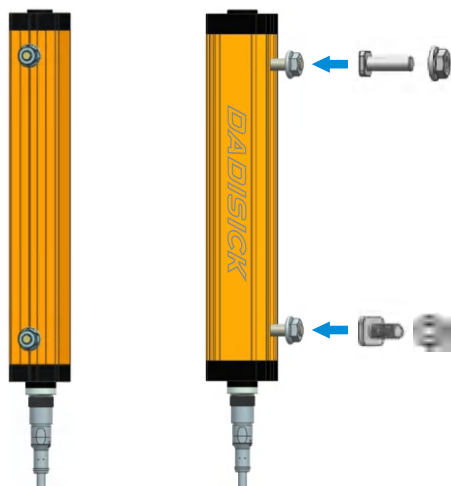
PNP wiring:



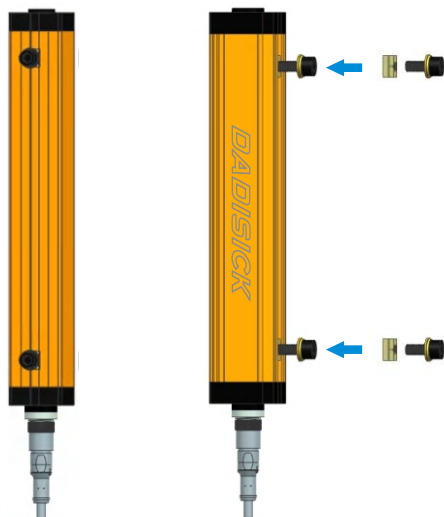
Accessories



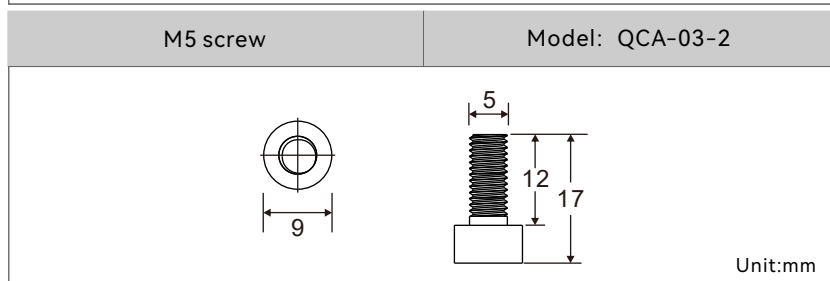
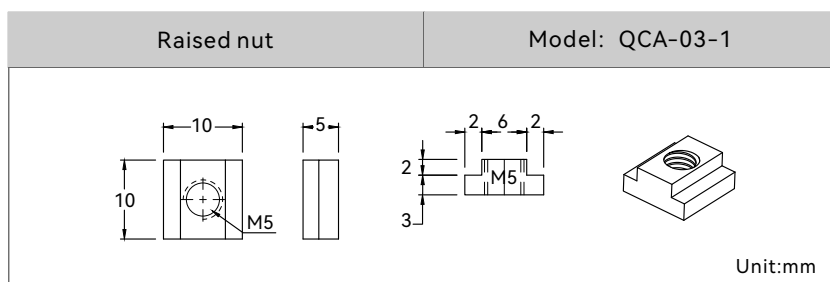
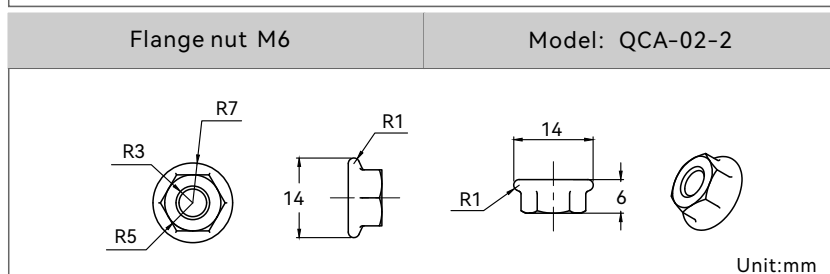
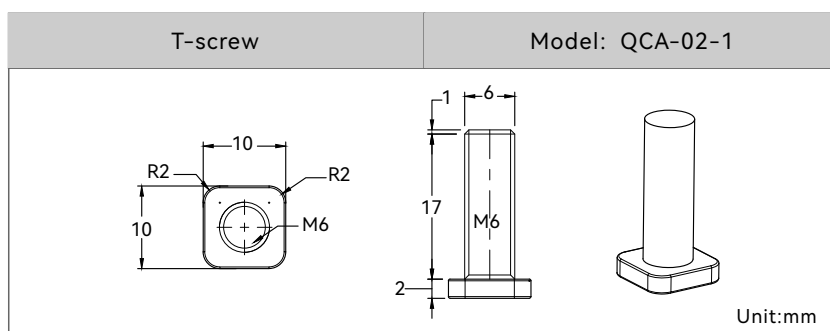
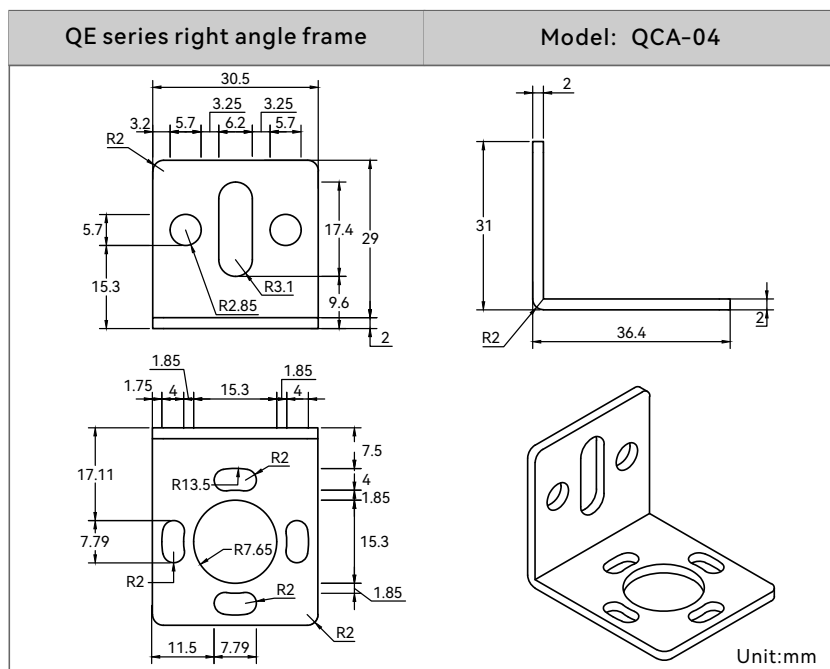
1. Installation method of lower right angle bracket
(Original accessories)

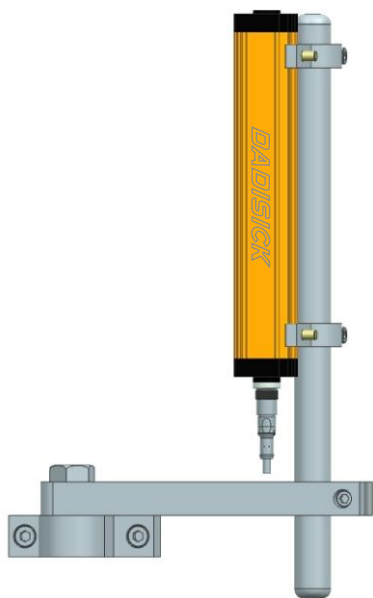


2. T-screw installation method
(Original accessories)



3. Installation method of convex nut
(Optional accessories)



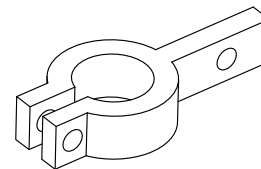
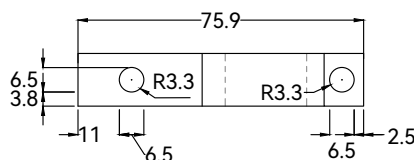
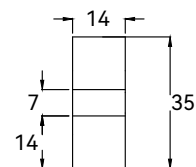
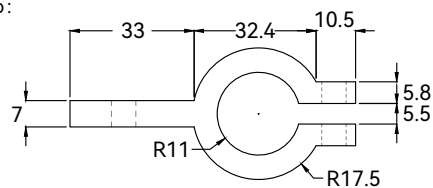


4. Stainless steel bracket installation
(Order separately)

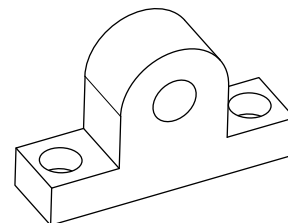
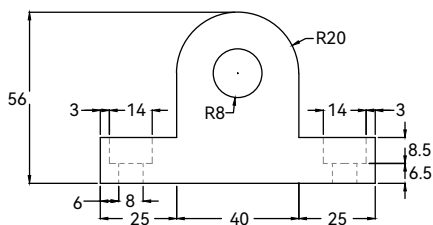
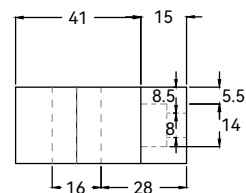
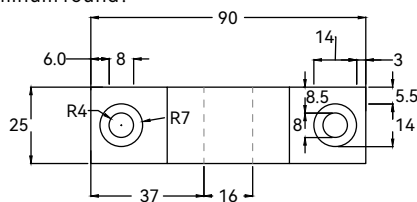
Stainless steel bracket installation

Model: QCA-01

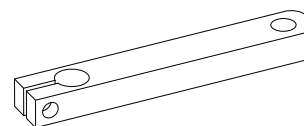
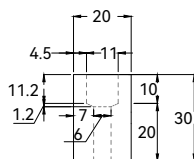
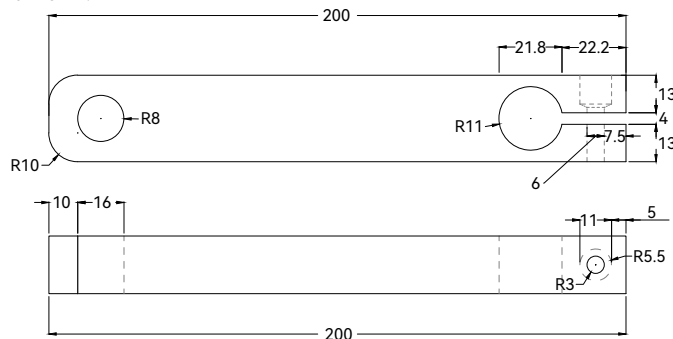
Clip:



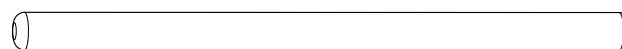
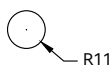
Aluminum round:



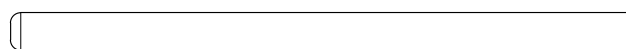
Aluminum arm:



Steel pipe:



Length: 400/500/600/700/800/1000 optional



Unit:mm