

# Technical Data Sheet

## QDot™ PbS Quantum Dots

Version 4.0  
Revised Date 12/09/2021

### Introduction and product highlights

QDot™ PbS (Lead Sulfide) Quantum Dots absorb the light from high energy photons up to near-infrared (NIR) range and re-emit in NIR range. The absorption/emission profiles can be tuned from 800 to 2200 nm, simply by changing nanoparticle sizes from 2 to 12 nm. This material has outstanding light absorption and photoelectrical properties, and is utilised for near-infrared (NIR) or short-wave infrared (SWIR) image sensors. The material is also suitable for X-ray sensors, solar cells and infrared LEDs. For specific application convenience, two lines of QDs are available:


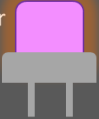

- With specific absorption peak in 800 – 2200 nm range
- With specific emission peak in 900 – 1600 nm range

QDot™ PbS Quantum Dots have following advantages:

1. Optoelectronic device grade QDs to be used in in near-infrared (NIR) or short-wave infrared (SWIR) image sensors
2. Unprecedented absorption/emission peaks accuracy and reproducibility (up to  $\pm 5$  nm)
3. Narrow particle size distribution (FWHM of absorption and emission  $< 100$ - $120$  nm, STDV  $< 5$ - $10\%$ ) for higher devices performance

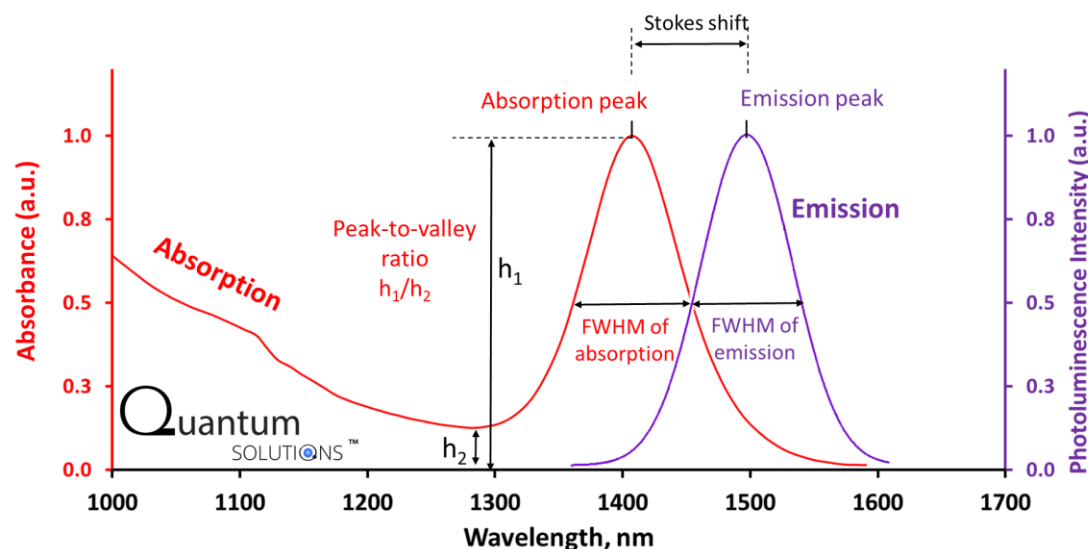
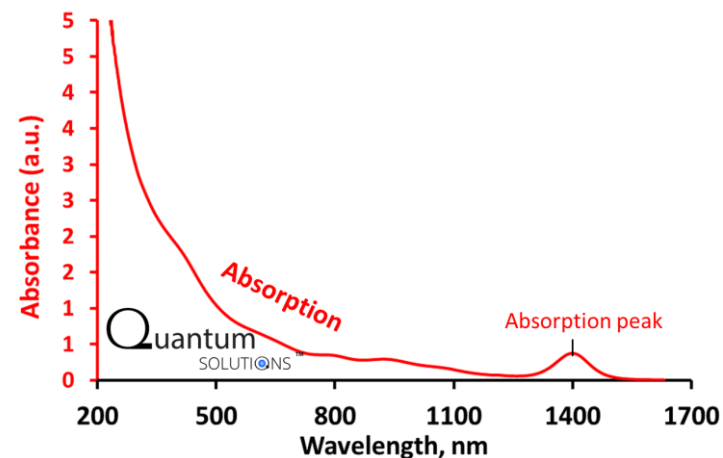
### Application fields

QDot™ PbS Quantum Dots absorb the light through all visible and near-infrared (NIR) range and re-emit in NIR range from 800 to 2200 nm depending on nanoparticle sizes from 2 to 12 nm respectively. Due to exceptional photoelectrical properties, QDot™ PbS Quantum Dots are used as an active material in NIR or SWIR image sensors. The material is also suitable for X-ray sensors, solar cells and infrared LEDs.

SWIR IMAGE SENSORS		
For VIS-SWIR image sensors on silicon CMOS readout, used for cameras in machine vision, automotive and consumer electronics		
<b>X-RAY IMAGING</b> Next generation active material for X-ray scanning 	<b>NIR QD LEDs</b> Active material for NIR LEDs in 900-2300 nm range 	<b>SOLAR CELLS</b> Increases the efficiency of silicon based solar panels 

#### QDot™ PbS QDs selection guide

QDot™ PbS Quantum Dots have a broad absorption profile, from high energy photons up to NIR light. Looking closer in the NIR range reveals that QDs can be categorised according to their absorption profile (red line “Absorption”) or emission profile (purple line “Emission”). Absorption profile is categorised according to the first excitonic absorption peak, the absorption FWHM and the peak-to-valley ratio. Emission profile is characterised by emission peak, emission FWHM and PLQY. The difference between the first excitonic absorption peak and emission peak is called a Stokes shift. Follow Table 1 to choose QDot™ materials based on absorption (abs) parameters, and Table 2 to choose QDot™ materials based on emission (em) parameters. QDot™ PbS QDs can be supplied as a solid paste/powder that is easily soluble in octane or any other non-polar solvents (hexane, toluene, chloroform, chlorobenzene, dichlorobenzene) in a wide range of concentration up to 100-150 mg/mL. PbS QDs in a solution form (octane, toluene or other non-polar solvents) are also available.



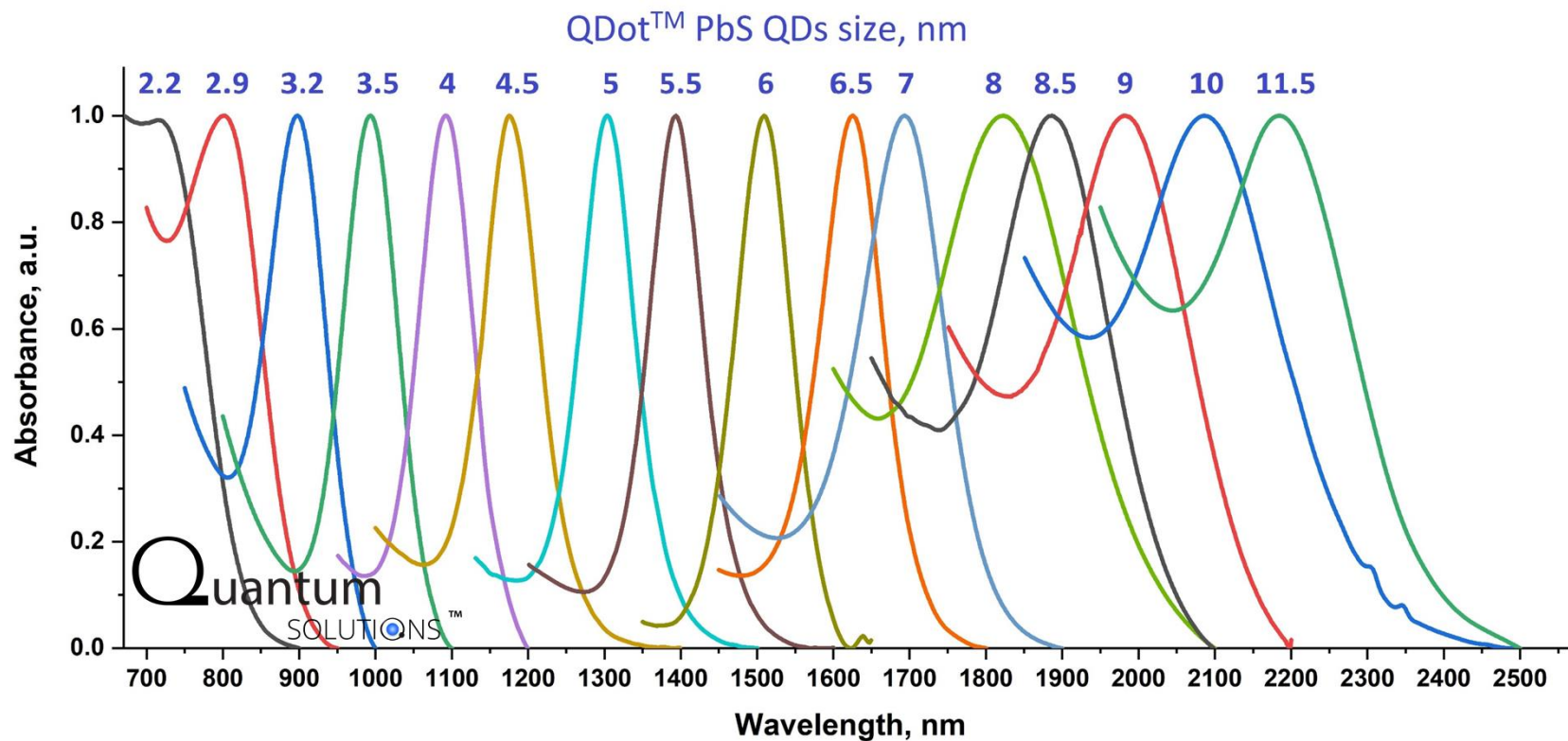
**Table 1. Specification of QDot™ PbS Quantum Dots according to absorption (abs) peak**

Catalogue Number	Core type	Absorption peak (Abs=1)	Average PbS core size	Capping ligand	Ligand concentration	Appearance	FWHM of absorption (Abs=1)	Peak-to-valley ratio	Stokes shift	Max solubility in nonpolar solvents	Form available
QDot™ PbS-800-abs	PbS	800±15 nm	~2.9 nm	Oleic acid	40-50 wt%	Black paste	-	≥ 1.2	~ 140 nm	>150 mg/mL	- Solid - Toluene 10 mg/mL - Octane 10 mg/mL
QDot™ PbS-900-abs	PbS	900±15 nm	~3.2 nm	Oleic acid	35-45 wt%	Black paste	≤ 120 nm	≥ 1.5	~ 120 nm	>150 mg/mL	
QDot™ PbS-920-abs	PbS	920±15 nm	~3.4 nm	Oleic acid	35-45 wt%	Black paste	≤ 120 nm	≥ 1.5	~ 120 nm	>150 mg/mL	
QDot™ PbS-1000-abs	PbS	1000±15 nm	~3.6 nm	Oleic acid	35-45 wt%	Black paste	≤ 120 nm	≥ 2	~ 110 nm	>100 mg/mL	
QDot™ PbS-1100-abs	PbS	1100±15 nm	~4.0 nm	Oleic acid	30-40 wt%	Black powder	≤ 120 nm	≥ 3	~ 100 nm	>100 mg/mL	
QDot™ PbS-1200-abs	PbS	1200±15 nm	~4.5 nm	Oleic acid	30-40 wt%	Black powder	≤ 120 nm	≥ 4	~ 90 nm	>100 mg/mL	
QDot™ PbS-1300-abs	PbS	1300±15 nm	~5.0 nm	Oleic acid	30-40 wt%	Black powder	≤ 120 nm	≥ 5	~ 80 nm	>100 mg/mL	
QDot™ PbS-1400-abs	PbS	1400±15 nm	~5.5 nm	Oleic acid	25-35 wt%	Black powder	≤ 120 nm	≥ 5	~ 70 nm	>100 mg/mL	
QDot™ PbS-1420-abs	PbS	1420±15 nm	~5.6 nm	Oleic acid	25-35 wt%	Black powder	≤ 120 nm	≥ 5	~ 70 nm	>100 mg/mL	
QDot™ PbS-1500-abs	PbS	1500±15 nm	~6.0 nm	Oleic acid	25-35 wt%	Black powder	≤ 120 nm	≥ 6	~ 50 nm	>50 mg/mL	
QDot™ PbS-1520-abs	PbS	1520±15 nm	~6.1 nm	Oleic acid	25-35 wt%	Black powder	≤ 120 nm	≥ 6	~ 50 nm	>50 mg/mL	
QDot™ PbS-1600-abs	PbS	1600±20 nm	~6.4 nm	Oleic acid	20-30 wt%	Black powder	≤ 120 nm	≥ 6	~ 40 nm	>50 mg/mL	
QDot™ PbS-1700-abs	PbS	1700±25 nm	~7.0 nm	Oleic acid	20-30 wt%	Black powder	≤ 150 nm	≥ 3	N/A	>50 mg/mL	

<b>QDot™ PbS-1800-abs</b>	PbS	1800±30 nm	~7.5 nm	Oleic acid	15-25 wt%	Black powder	≤ 200 nm	≥ 2	N/A	>50 mg/mL	- Solid - Octane 10 mg/mL
<b>QDot™ PbS-1900-abs</b>	PbS	1900±50 nm	~8.2 nm	Oleic acid	15-25 wt%	Black powder	≤ 220 nm	≥ 1.5	N/A	50 mg/mL	
<b>QDot™ PbS-2000-abs</b>	PbS	2000±50 nm	~9.1 nm	Oleic acid	10-20 wt%	Black powder	≤ 220 nm	≥ 1.5	N/A	50 mg/mL	
<b>QDot™ PbS-2100-abs</b>	PbS	2100±50 nm	~10.2 nm	Oleic acid	<15 wt%	Black powder	-	-	N/A	50 mg/mL	- Solid
<b>QDot™ PbS-2200-abs</b>	PbS	2200±50 nm	~11.6 nm	Oleic acid	<15 wt%	Black powder	-	-	N/A	50 mg/mL	

QDot™ PbS Quantum Dots with different solvents, concentrations, emission and absorptions peaks are available upon request.

#### Optical profiles of QDot™ PbS Quantum Dots according to absorption (abs) peak

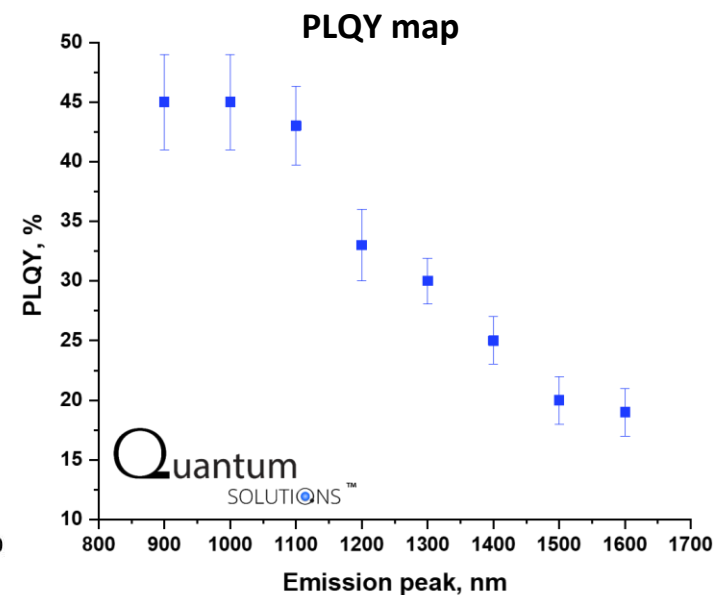
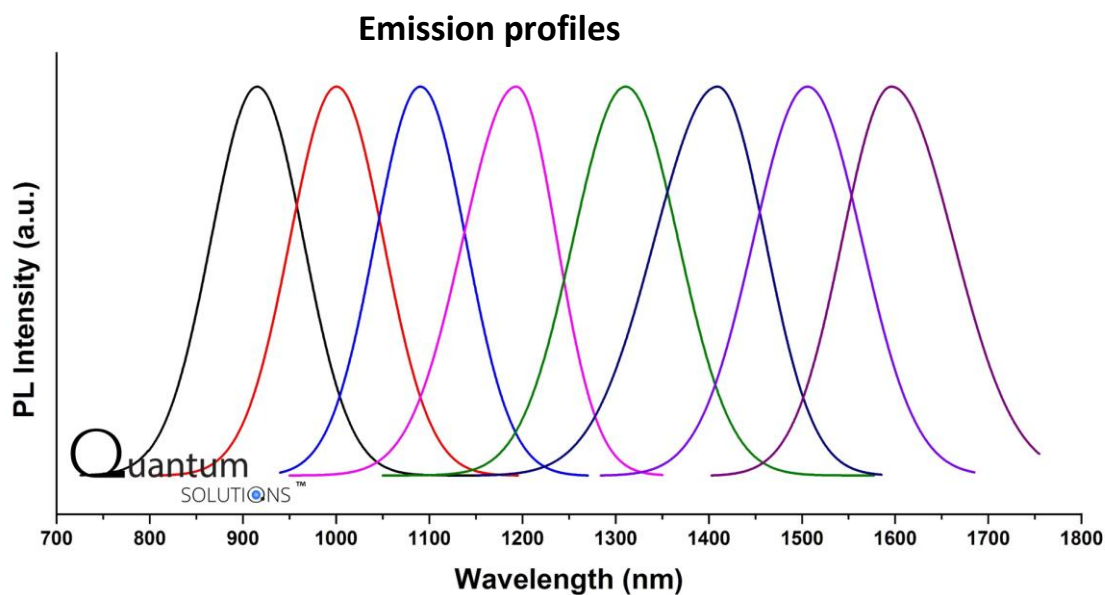
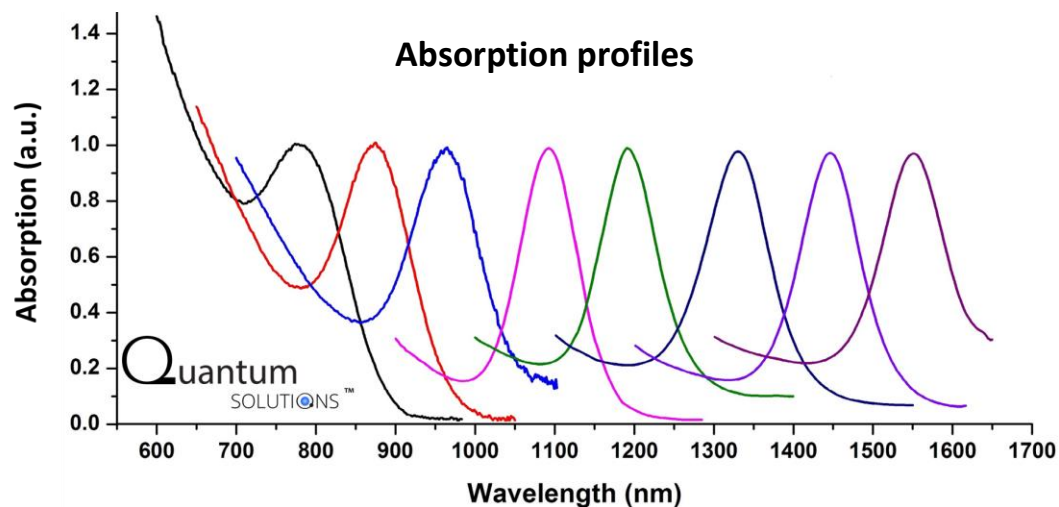


**Table 2. Specification of QDot™ PbS Quantum Dots according to emission (em) peak**

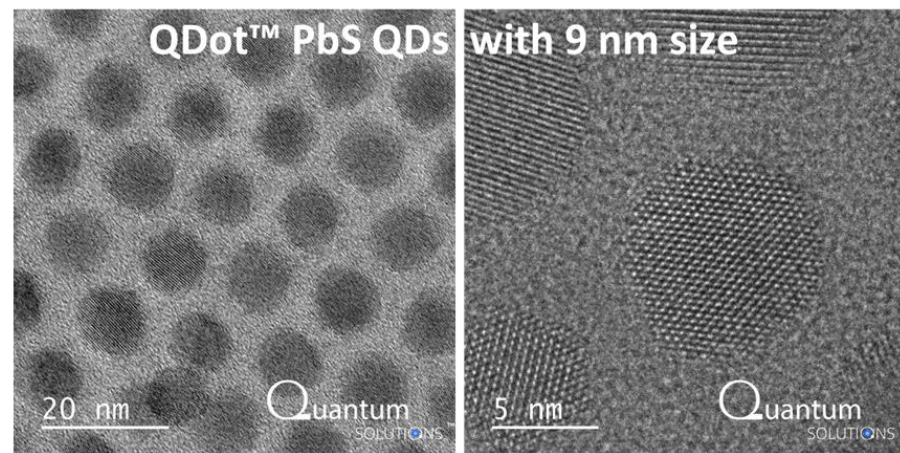
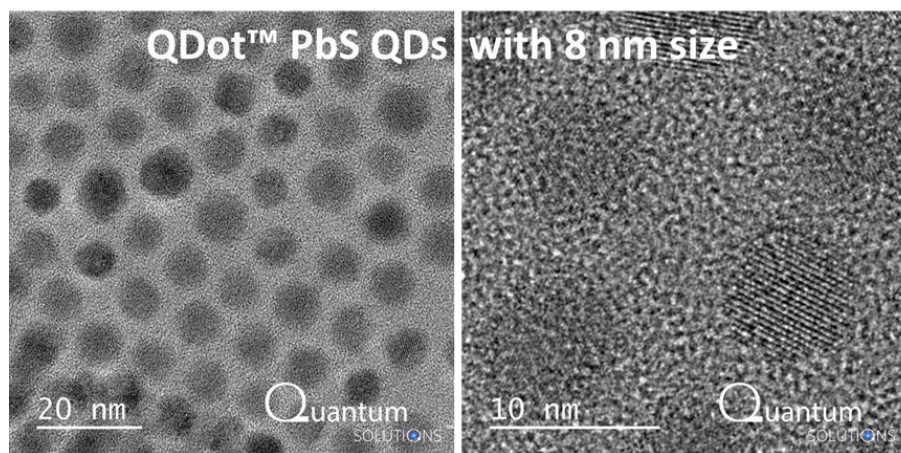
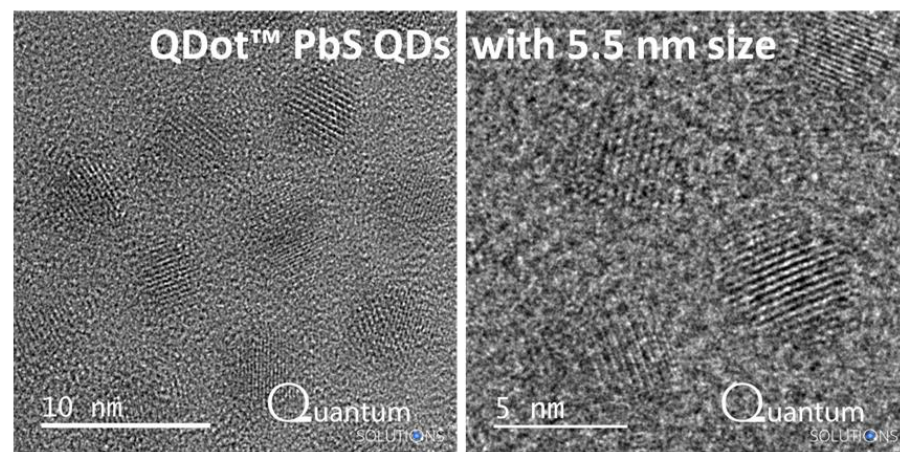
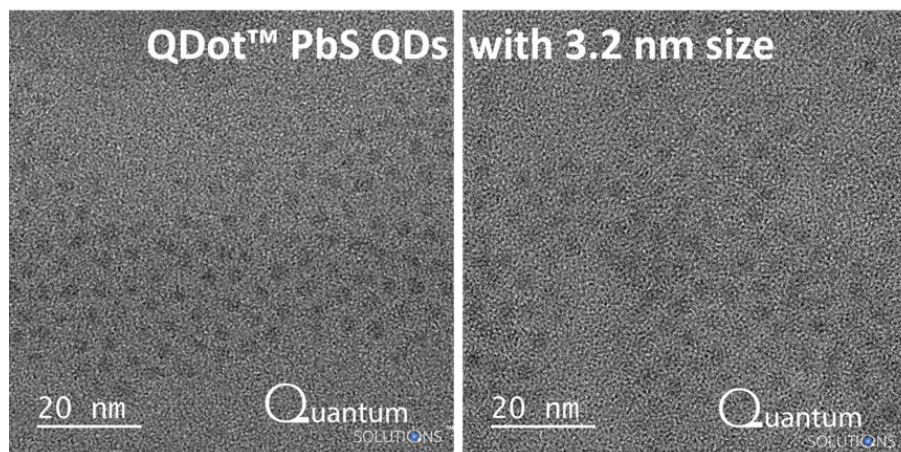
Catalogue Number	Core type	Emission peak (Abs=1)	Average PbS core size	Capping ligand	Ligand concentration	Appearance	FWHM of emission (Abs=1)	PLQY (Abs=0.1)	Stokes shift	Form available
QDot™ PbS-900-em	PbS	900±25 nm	~2.7 nm	Oleic acid	40-50 wt%	Black paste	≤ 130 nm	15-45% (see page 6)	~ 120 nm	- Solid - Toluene 10 mg/mL - Octane 10 mg/mL
QDot™ PbS-1000-em	PbS	1000±25 nm	~3.0 nm	Oleic acid	35-45 wt%	Black paste	≤ 130 nm		~ 110 nm	
QDot™ PbS-1100-em	PbS	1100±25 nm	~3.3 nm	Oleic acid	35-45 wt%	Black powder	≤ 130 nm		~ 100 nm	
QDot™ PbS-1200-em	PbS	1200±25 nm	~3.8 nm	Oleic acid	30-40 wt%	Black powder	≤ 130 nm		~ 90 nm	
QDot™ PbS-1300-em	PbS	1300±25 nm	~4.5 nm	Oleic acid	30-40 wt%	Black powder	≤ 140 nm		~ 80 nm	
QDot™ PbS-1400-em	PbS	1400±25 nm	~5 nm	Oleic acid	30-40 wt%	Black powder	≤ 140 nm		~ 70 nm	
QDot™ PbS-1500-em	PbS	1500±25 nm	~5.5 nm	Oleic acid	25-35 wt%	Black powder	≤ 140 nm		~ 50 nm	
QDot™ PbS-1600-em	PbS	1600±25 nm	~6 nm	Oleic acid	25-35 wt%	Black powder	≤ 140 nm		~ 40 nm	

QDot™ PbS Quantum Dots with different solvents, concentrations, emission and absorptions peaks are available upon request.

#### Optical profiles of QDot™ PbS Quantum Dots according to emission (em) peak



#### TEM images





### Notes for handling

Shelf Life 12 months. Shipping temperature from 4-25 °C. Storage temperature from 4-25 °C. Store in DARK conditions, in original packaging or in airtight, sealed packaging inside a glovebox (under inert atmosphere). Repackage or dissolve in a glovebox only. Use anhydrous solvents only. Avoid contact with air.

PbS QDs solids are easily soluble in octane, or any other non-polar solvents (hexane, toluene, chloroform, chlorobenzene, dichlorobenzene) in a wide range of concentrations up to 100-150 mg/mL (see Table 1). Dissolve in a glove box only. Use anhydrous solvents only. Filter the solution by PTFE or PVDF filters before processing. Follow the video for the detailed guide how to dissolve the QDot™ PbS powders:

<https://www.youtube.com/watch?v=-sLBZwA147c>

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#### QUANTUM SOLUTIONS

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