



**LEGEND MAX<sup>™</sup>**  
ELISA Kit



**SARS-CoV-2 Spike S1 Human IgM**

Cat. No. 448207

ELISA Kit for Accurate Quantitation of SARS-CoV-2 Spike S1  
Human IgM from Serum and Plasma.

BioLegend, Inc.  
[biolegend.com](http://biolegend.com)

***It is highly recommended that this manual be read in its entirety before using this product. Do not use this kit beyond the expiration date.***

*For Research Purposes Only. Not for use in diagnostic or therapeutic procedures. Purchase does not include or carry the right to resell or transfer this product either as a stand-alone product or as a component of another product. Any use of this product other than the permitted use without the express written authorization of BioLegend is strictly prohibited.*

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# LEGEND MAX™ SARS-CoV-2 Spike S1 Human IgM ELISA Kit

## Introduction:

SARS-CoV-2 is an enveloped non-segmented positive-sense RNA coronavirus that infects the human respiratory-epithelial cells, and is the cause of the coronavirus disease 2019 (COVID-19). One of its structural proteins includes the spike protein (S). The S protein consists of the S1 subunit which contains a receptor binding domain (RBD) that is capable of recognizing and binding with the cell surface receptor, and playing a key role in viral entry. Assays to detect virus-specific antibodies are important to understand the prevalence of infection and the course of the immune system.

The BioLegend LEGEND MAX™ SARS-CoV-2 Spike S1 Human IgM ELISA Kit is an Enzyme-Linked Immunosorbent Assay (ELISA) with a 96-well strip plate that is pre-coated with SARS-CoV-2 Spike Protein S1. This kit is specifically designed for the accurate quantitation of SARS-CoV-2 Spike S1 Human IgM from serum and plasma. It is analytically validated with ready-to-use reagents.

## Materials Provided:

Description	Quantity	Volume (per bottle)	Part #
SARS-CoV-2 Spike S1 Human IgM Pre-coated 96-well Strip Microplate	1 plate		750002385
SARS-CoV-2 Spike S1 Human IgM Detection Antibody	1 bottle	12 mL	750002389
SARS-CoV-2 Spike S1 Human IgM lyophilized Standard	1 vial	lyophilized	750002387
Avidin-HRP	1 bottle	12 mL	77897
Assay Buffer B	1 bottle	25 mL	79128
Wash Buffer (20X)	1 bottle	50 mL	78233
Substrate Solution F	1 bottle	12 mL	79132
Stop Solution	1 bottle	12 mL	79133
Plate Sealers	4 sheets		78101

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## Materials to be Provided by the End-User:

- Microplate reader able to measure absorbance at 450 nm
- Adjustable pipettes to measure volumes ranging from 1 µL to 1,000 µL
- Deionized water
- Wash bottle or automated microplate washer
- Log-Log graph paper or software for data analysis
- Tubes to prepare standard dilutions
- Timer
- Polypropylene vials

## Storage Information:

Store unopened kit components between 2°C and 8°C. Do not use this kit beyond its expiration date.

Opened or Reconstituted Components	
Microplate wells	If not all microplate strips are used, remove the excess strips by pressing up from underneath each strip. Place excess strips back in the foil pouch with the included desiccant pack and reseal. Store between 2°C and 8°C for up to one month.
Standard	The remaining reconstituted standard stock solution and can be aliquoted into polypropylene vials and stored at -70°C for up to one month. Avoid repeated freeze-thaw cycles.
Detection Antibody	Store opened reagents between 2°C and 8°C and use within one month.
Avidin-HRP	
Assay Buffer B	
Wash Buffer (20X)	
Substrate Solution F	
Stop Solution	

## Health Hazard Warnings:

1. Reagents that contain preservatives may be harmful if ingested, inhaled or absorbed through the skin. Refer to the MSDS online at BioLegend's website for details ([www.biolegend.com/msds](http://www.biolegend.com/msds)).
2. Substrate Solution F is harmful if inhaled or ingested. Avoid skin, eye and clothing contact.
3. To reduce the likelihood of blood-borne transmission of infectious agents, handle all serum, plasma and other biological fluids in accordance with NCCLS regulations.
4. Stop Solution contains strong acid. *Wear eye, hand, and face protection.*

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5. Before disposing of the plate, rinse it with an excess amount of tap water.

### **Specimen Collection and Handling:**

Specimens should be clear and non-hemolyzed. If possible, unknown samples should be run at a number of dilutions to determine the optimal dilution factor that will ensure accurate quantitation.

Serum: Use a serum separator tube and allow clotting for at least 30 minutes, then centrifuge for 10 minutes at 1,000 x *g*. Remove serum layer and assay immediately or store serum samples at < -70°C. Avoid repeated freeze-thaw cycles.

Plasma: Collect blood samples in citrate, heparin or EDTA containing tubes. Centrifuge for 10 minutes at 1,000 x *g* within 30 minutes of collection. Assay immediately or store plasma samples at < -70°C. Avoid repeated freeze-thaw cycles.

### **Reagent and Sample Preparation:**

Note: All reagents should be diluted immediately prior to use.

1. Dilute the 20X Wash Buffer to 1X with deionized water. For example, make 1 liter of 1X Wash Buffer by adding 50 mL of 20X Wash Buffer to 950 mL of deionized water. If crystals have formed in the 20X Wash Buffer, bring to room temperature and vortex until dissolved.
2. Reconstitute the lyophilized SARS-CoV-2 Spike S1 Human IgM Standard by adding the volume of Assay Buffer B to make the 200 ng/mL standard stock solution (refer to LEGEND MAX Kit Lot-Specific Certificate of Analysis/ LEGEND MAX Kit Protocol). Allow the reconstituted standard to sit at room temperature for 15-20 minutes, then briefly vortex to mix completely.
3. In general, at least a 1000-fold dilution of serum and plasma samples with Assay Buffer B is recommended. If further dilution is necessary, samples should be further diluted with Assay Buffer B.

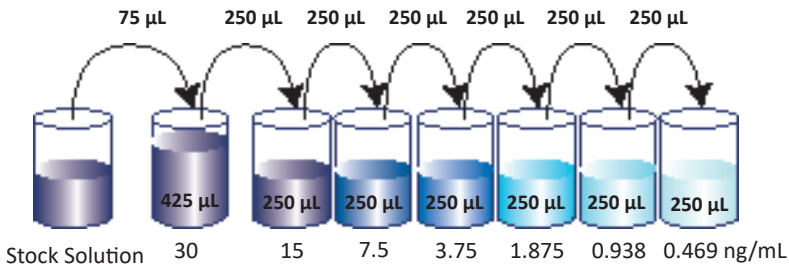
### **Assay Procedure:**

Note: Do not mix reagents from different kits or lots. Reagents and/or antibodies from different manufacturers should not be used with this kit.

1. Bring all reagents to room temperature prior to use. It is strongly recommended that all standards and samples be run in duplicate or triplicate. A standard curve is required for each assay.
2. If not all microplate strips will be used, remove the excess strips by pressing up from underneath each strip. Place excess strips back in the foil pouch with the included desiccant pack and reseal.
3. Prepare 500 µL of the 30 ng/mL top standard by diluting 75 µL of the standard

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stock solution in 425  $\mu\text{L}$  of Assay Buffer B. Perform six two-fold serial dilutions of the 30 ng/mL top standard in separate tubes using Assay Buffer B as the diluent. Thus, the SARS-CoV-2 Spike S1 Human IgM standard concentrations in the tubes are 30 ng/mL, 15 ng/mL, 7.5 ng/mL, 3.75 ng/mL, 1.875 ng/mL, 0.938 ng/mL, and 0.469 ng/mL, respectively. Assay Buffer B serves as the zero standard (0 ng/mL).


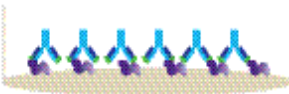
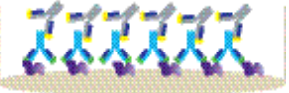
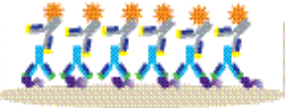
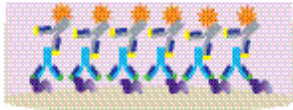



4. Wash plate 4 times with at least 300  $\mu\text{L}$  of 1X Wash Buffer per well and blot any residual buffer by firmly tapping the plate upside down on absorbent paper. All subsequent washes should be performed similarly.
5. Add 50  $\mu\text{L}$  of Assay Buffer B to each well that will contain samples.
6. Add 50  $\mu\text{L}$  of standard dilutions or samples to the appropriate wells.
7. Seal the plate with a Plate Sealer included in the kit and incubate the plate at room temperature for 2 hours while shaking.
8. Discard the plate contents into a sink, then wash the plate 4 times with 1X Wash Buffer as in step 4.
9. Add 100  $\mu\text{L}$  of SARS-CoV-2 Spike S1 Human IgM Detection Antibody solution to each well, seal the plate and incubate at room temperature for 1 hour while shaking.
10. Discard the contents of the plate into a sink, then wash the plate 4 times with 1X Wash Buffer as in step 4.
11. Add 100  $\mu\text{L}$  of Avidin-HRP solution to each well, seal the plate and incubate at room temperature for 30 minutes while shaking.
12. Discard the contents of the plate into a sink, then wash the plate 5 times with 1X Wash Buffer as in step 4. For this final wash, soak wells in 1X Wash Buffer for 30 seconds to 1 minute for each wash. This will help minimize background.
13. Add 100  $\mu\text{L}$  of Substrate Solution F to each well and incubate for 15 minutes in the dark. Wells containing SARS-CoV-2 Spike S1 human IgM should turn blue in color with an intensity proportional to its concentration

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It is not necessary to seal the plate during this step.

14. Stop the reaction by adding 100  $\mu$ L of Stop Solution to each well. The solution color should change from blue to yellow.
15. Read absorbance at 450 nm within 10 minutes. If the reader is capable of reading at 570 nm, the absorbance at 570 nm can be subtracted from the absorbance at 450 nm.

**Assay Procedure Summary**

1. Wash 4 times  
Add 50  $\mu$ L Assay Buffer B to standard wells and sample wells  

2. Add 50  $\mu$ L diluted standards to standard wells  
Add 50  $\mu$ L of samples to sample wells  
Incubate 2 hr, RT, shaking  

3. Wash 4 times  
Add 100  $\mu$ L Detection Antibody solution  
Incubate 1 hr, RT, shaking  

4. Wash 4 times  
Add 100  $\mu$ L Avidin-HRP solution  
Incubate 30 min, RT, shaking  

5. Wash 5 times  
Add 100  $\mu$ L Substrate Solution F  
Incubate 15 min, RT, in the dark  

6. Add 100  $\mu$ L Stop Solution  

7. Read absorbance at 450 nm and 570 nm



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## Calculation of Results:

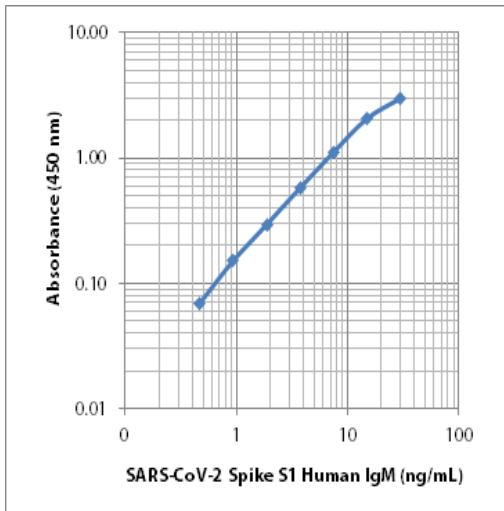
The data can be best calculated with computer-based curve-fitting software using a 5- or 4-parameter logistics curve-fitting algorithm. If an appropriate software is not available, use log-log graph paper to determine sample concentrations. Determine the mean absorbance for each set of duplicate or triplicate standards, controls, and samples. Plot the standard curve on log-log graph paper with standard concentration on the X-axis and absorbance on the Y-axis. Draw a best fit line through the standard points. To determine the unknown sample concentrations, find the mean absorbance value of the unknown concentration on the Y-axis and draw a horizontal line to the standard curve. At the point of intersection, draw a vertical line to the X-axis and read the sample concentration.

**Because human serum/plasma samples have been diluted prior to the assay, their measured concentrations must be multiplied by the appropriate dilution factor.**

If a test sample's absorbance value falls outside the linear portion of the standard curve, the test sample needs to be re-analyzed at a higher (or lower) dilution as appropriate.

### Typical Data:

This standard curve was generated at BioLegend for demonstration purposes only. A standard curve must be run with each assay.



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## Performance Characteristics:

**Specificity:** No cross reactivity was observed when this kit was used to analyze SARS-CoV-2 Spike-S1 Human IgG and SARS-CoV-2 Spike-S1 Human IgA1 at 1000 ng/mL.

**Sensitivity:** The minimum detectable concentration of SARS-CoV-2 Spike S1 Human IgM is  $0.089 \pm 0.01$  ng/mL (n=6)

**Recovery:** SARS CoV-2 Spike S1 Human IgM at 3 different concentrations was spiked into 6 different samples, each of Serum, Citrate plasma, EDTA plasma, and Heparin plasma. Sample recovery was then analyzed with the LEGEND MAX™ SARS-CoV-2 Spike S1 Human IgM ELISA kit.

Sample Type	N	% Recovery
Serum	6	106
Citrate Plasma	6	111
EDTA Plasma	6	107
Heparin Plasma	6	107

**Linearity:** Human serum and plasma samples were first diluted to 1000-fold. They were then spiked with high concentrations of SARS-CoV-2 Spike S1 Human IgM, and then diluted 2-fold in serial to produce samples within the dynamic range of the kit. Samples were then assayed to determine the dilutional linearity.

Sample Type	N	% Linearity
Serum	6	99
Citrate Plasma	6	100
EDTA Plasma	6	100
Heparin Plasma	6	100

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*Intra-Assay Precision:* Sixteen replicates of each of two samples containing different concentrations of SARS-CoV-2 Spike S1 Human IgM were tested in one assay.

Concentration	Sample 1	Sample 2
Number of Replicates	16	16
Mean Concentration (ng/mL)	22.2	1.7
Standard Deviation	1.0	0.04
% CV	4.5	2.3

*Inter-Assay Precision:* Two samples containing different concentrations of SARS-CoV-2 Spike S1 Human IgM were tested in ten independent assays

Concentration	Sample 1	Sample 2
Number of Assays	10	10
Mean Concentration (ng/mL)	23.3	1.5
Standard Deviation	1.7	0.12
% CV	7.3	7.9

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## Troubleshooting Guide:

Problem	Probable Cause	Solution
High Background	Background wells were contaminated	Avoid cross-well contamination by using the provided plate sealers. Use multichannel pipettes and change tips between pipetting samples and reagents.
	Insufficient washes	Increase number of washes. Increase soaking time between washes prior to addition of substrate solution.
	TMB Substrate Solution was contaminated	TMB Substrate Solution should be clear and colorless prior to addition to wells. Use a clean container prior to pipetting substrate solution into wells.
No or poor signal	Detection Antibody, Avidin-HRP or Substrate solution were NOT added	Rerun the assay and follow the protocol.
	Wrong reagent or reagents were added in wrong sequential order	
	Insufficient plate agitation	The plate should be agitated during all incubation steps using a plate shaker at a speed where solutions in wells are within constant motion without splashing.
	The wash buffer contains Sodium Azide (NaN <sub>3</sub> )	Avoid Sodium Azide contamination in the wash buffer as it inhibits HRP activity.
	Incubations were done at an inappropriate temperature, timing or without agitation	Rerun the assay and follow the protocol.
Low or poor standard curve signal	The standard was incorrectly reconstituted or diluted	Adjust the calculations and follow the protocol.
	Standard was inappropriately stored	Store the reconstituted standard stock solution in polypropylene vials at -70°C. Avoid repeated freeze-thaw cycles.
	Reagents added to wells with incorrect concentrations	Check for pipetting errors and the correct reagent volume.

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Problem	Probable Cause	Solution
Signal is high, standard curves have saturated signal	Standard reconstituted with less volume than required	Reconstitute new lyophilized standard with the correct volume of solution recommended in the protocol.
	Standards/samples, detection antibody, Avidin-HRP or substrate solution were incubated for too long	Rerun the assay and follow the protocol.
Sample readings are out of range	Samples contain no or below detectable levels of the analyte	If samples are below detectable levels, it may be possible to use a larger sample volume. Contact technical support for appropriate protocol modifications.
	Samples contain analyte concentrations greater than highest standard point	Samples may require dilution and analysis.
High variation in samples and/or standards	Multichannel pipette errors	Confirm that pipette calibrations are accurate.
	Plate washing was not adequate or uniform	Ensure pipette tips are tightly secured. Ensure uniformity in all wash steps.
	Non-homogenous samples	Thoroughly mix samples before assaying.
	Samples may have high particulate matter	Remove particulate matter by centrifugation.
	Cross-well contamination	Do not reuse plate sealers.  Always change tips for reagent additions. Ensure that pipette tips do not touch the reagents on the plate.

**Notes**

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**ELISA Plate Template**

	1	2	3	4	5	6	7	8	9	10	11	12
A												
B												
C												
D												
E												
F												
G												
H												



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