

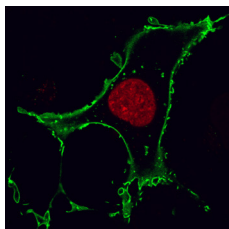
# CLIP-Cell™ TMR-Star



## S9219S

30 nmol Lot: 0041403

Store at: -20°C Exp: 3/17

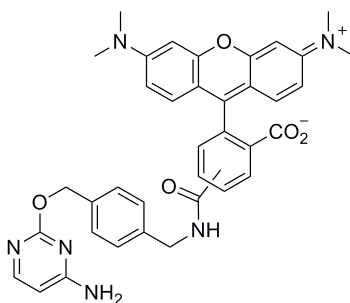


Live COS-7 expressing CLIP-H2B and SNAP-ADRβ2 were labeled with CLIP-Cell TMR-Star (red) and SNAP-Alexa Fluor® 488 (green).

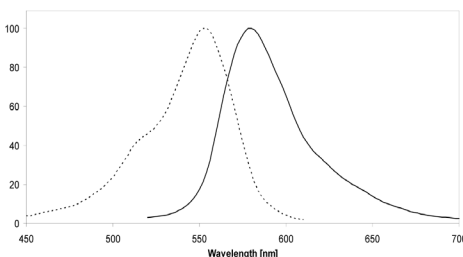
### Introduction

CLIP-Cell™ TMR-Star is a photostable red fluorescent substrate that can be used to label CLIP-tag™ fusion proteins inside living cells, on cell surfaces or *in vitro*. This cell-permeable substrate (BC-TMR) is based on tetramethylrhodamine and is suitable for standard rhodamine filter sets. It has an excitation maximum at 554 nm and emission maximum at 580 nm. This package includes 30 nmol of CLIP-Cell TMR-Star, sufficient to make 10 ml of a 3 μM CLIP-tag fusion protein labeling solution.

The CLIP-tag is a novel tool for protein research, allowing the specific, covalent attachment of virtually any molecule to a protein of interest. CLIP-tag is a small polypeptide based on mammalian O<sup>6</sup>-alkylguanine-DNA-alkyltransferase (AGT). CLIP-tag substrates are derivatives of benzylcytosine (BC). In the labeling reaction, the substituted benzyl group of the substrate becomes covalently attached to the reactive cysteine of CLIP-tag forming a stable thioether link. Although CLIP-tag is based on the same protein as SNAP-tag®, the benzylcytosine substrates form a separate class of substrates, different from the benzylguanine substrates recognized by SNAP-tag. CLIP-tag and SNAP-tag can be used for orthogonal simultaneous labeling.



**Figure 1.** Structure of CLIP-Cell TMR-Star (MW 642.7 g/mol)



**Figure 2.** Excitation (dotted line) and emission spectra of CLIP-Cell TMR-Star coupled to SNAP-tag/CLIP-tag in buffer at pH 7.5

There are two steps to using this system: sub-cloning and expression of the protein of interest as a CLIP-tag fusion, and labeling of the fusion with the CLIP-tag substrate of choice. Expression of CLIP-tag fusion proteins is described in the documentation supplied with CLIP-tag plasmids. The labeling of the fusion proteins with the CLIP-tag substrate is described below.

### Materials Required but not Supplied:

Cells expressing CLIP-tag fusion proteins  
Tissue culture materials and media  
Transfection reagents  
Fluorescence microscope with suitable filter set  
DMSO

### Storage

CLIP-Cell TMR-Star should be stored at -20°C (long term) or at 4°C in the dark (short term, less than 4 weeks). Protect the substrate from light and moisture. With proper storage at -20°C the substrate should be stable for at least two years dry or 3 months dissolved in DMSO.

### Quality Controls

**Purity and Characterization:** Purity of CLIP-Cell TMR-Star was determined by HPLC analysis to be 92%. Molecular weight [M+H]<sup>+</sup> was determined by MS to be 643.3 (643.3 expected).

***In vitro* Protein Labeling:** Reaction of CLIP-Cell TMR-Star (10 μM) with purified SNAP-tag protein (5 μM) *in vitro* for 60 minutes at 37°C, followed by mass spec analysis, indicated an efficiency of labeling of > 95%.

**Cellular Protein Labeling:** Cells transiently transfected with CLIP-tag vectors expressing Histone H2B (intracellular) were labeled with 3 μM CLIP-Cell TMR-Star for 60 minutes, and visualized by fluorescent microscopy. Only intracellular targets were efficiently labeled.

### Instructions for Cellular Labeling

CLIP-tag fusion proteins can be expressed by transient or by stable transfection. For expression of fusion proteins with CLIP-tag, refer to instructions supplied with the CLIP-tag plasmids. For cell culture and transfection methods, refer to established protocols.

Dissolve one vial of CLIP-tag substrate (30 nmol) in 50 μl DMSO to yield a labeling stock solution of 0.6 mM CLIP-tag substrate in DMSO. Mix by vortexing for 10 minutes until all the CLIP-tag substrate is dissolved.

Store this stock solution in the dark at 4°C, or for extended storage at -20°C. Different stock concentrations can be made, depending on the requirements. The substrate is soluble in DMSO up to at least 10 mM.

### Protocol for Labeling Reaction:

1. Dilute the labeling stock solution 1:200 in medium to yield a labeling medium of 3 μM dye substrate. Mix dye with medium thoroughly by pipetting up and down 10 times (necessary for reducing backgrounds). For best performance, add the CLIP-tag substrate to complete medium, including serum (0.5% BSA can be used for experiments carried out in serum-free media). Do not prepare more medium with CLIP-tag substrate than will be consumed within one hour.
2. Replace the medium on the cells expressing a CLIP-tag fusion protein with the CLIP-tag labeling medium and incubate at 37°C, 5% CO<sub>2</sub> for 60 minutes.

Number of Wells in Plate	Recommended Volume for Cell Labeling
6	1 ml
12	500 μl
24	250 μl
48	100 μl
96	50 μl

These recommendations are for culturing cells in polystyrene plates. For confocal imaging, we recommend using chambered coverglass such as Lab-Tek II Chambered Coverglass which is available in a 1, 2, 4 or 8 well format from Nunc ([www.nuncbrand.com](http://www.nuncbrand.com)).

3. Wash the cells three times with tissue culture medium with serum and incubate them in fresh medium for 30 minutes. Replace the medium one more time to remove unreacted CLIP-tag substrate that has diffused out of the cells.
4. Image the cells using an appropriate filter set. CLIP-tag fusion proteins labeled with CLIP-Cell TMR-Star should have an excitation maximum at 554 nm and an emission maximum at 580 nm, and can be imaged with standard rhodamine filter sets.

We recommend routinely labeling one well of non-transfected or mock-transfected cells as a negative control.

### Notes

#### Blocking Unreacted CLIP-tag with CLIP-Cell Block

In many cases the labeling of a non-transfected cell sample or a mock-transfected cell sample will be completely sufficient as a control. In some cases, however, it may be desirable to block the CLIP-tag activity in a cell sample expressing the CLIP-tag fusion protein to generate a control. This can be achieved using a nonfluorescent CLIP-tag substrate, bromoethynylcytosine (CLIP-Cell Block). CLIP-Cell Block may also be used in pulse-chase experiments to block the CLIP-tag reactivity during the chase between two pulse-labeling steps. A protocol for blocking is included with CLIP-Cell Block (NEB #S9220).

(see other side)

## Optimizing Labeling

Optimal substrate concentrations and reaction times range from 1–10  $\mu\text{M}$  and 30–60 minutes, respectively, depending on experimental conditions and expression levels of the CLIP-tag fusion protein. Best results are usually obtained at concentrations between 1 and 5  $\mu\text{M}$  substrate and 60 minutes reaction time. Increasing substrate concentration and reaction time usually results in a higher background and does not necessarily increase the signal to background ratio.

## Stability of Signal

The turnover rates of the CLIP-tag fusion protein under investigation may vary widely depending on the fusion partner. We have seen half-life values ranging from less than one hour to more than 12 hours. Where protein turnover is rapid, we recommend analyzing the cells under the microscope immediately after the labeling reaction or, if the application allows it, fixing the cells directly after labeling.

## Fixation of Cells

After labeling the CLIP-tag fusion proteins, the cells can be fixed with standard fixation methods such as para-formaldehyde, ethanol, methanol, methanol/acetone etc., without loss of signal. We are not aware of any incompatibility of the CLIP-tag label with any fixation method.

## Counterstaining

Cells can be counterstained with any live-cell dye that is compatible with the fluorescent properties of the CLIP-tag substrate for simultaneous microscopic detection. We routinely add 5  $\mu\text{M}$  Hoechst 33342 to the medium prior to the final 30 minutes incubation (Step 3) as a DNA counterstain for nuclear visualization. Counterstaining of cells is also possible after fixation and permeabilization.

## Immunocytochemistry

Antibody labeling can be performed after CLIP-tag labeling and fixation of the cells according to standard protocols without loss of the CLIP-tag signal. The fixation conditions should be selected based on experience with the protein of interest. For example, some fixation methods destroy epitopes of certain proteins and therefore do not allow antibody staining afterwards.

## Troubleshooting for Cellular Labeling

### No Labeling

If no labeling is seen, the most likely explanation is that the fusion protein is not expressed. Verify the transfection method to confirm that the cells contain the fusion gene of interest. If this is confirmed, check for expression of the CLIP-tag fusion protein via Western blot using Anti-SNAP-tag Antibody (NEB #P9310). This antibody shows high crossreactivity with the CLIP-tag and can be used for Western blot detection. Alternatively, CLIP-Vista Green (NEB #S9235) can be used to confirm presence of CLIP-tag fusion in cell extracts following SDS-PAGE, without the need for Western blotting.

### Weak Labeling

Weak labeling may be caused by insufficient exposure of the fusion protein to the substrate. Try increasing the concentration of CLIP-tag substrate and/or the incubation time, following the guidelines above. Alternatively, the protein may be poorly expressed and/or turn over rapidly. If the protein has limited stability in the cell, it may help to analyze the samples immediately after labeling.

### High Background

Background fluorescence may be controlled by reducing the concentration of CLIP-tag substrate used and by shortening the incubation time. The presence of fetal calf serum or BSA during the labeling incubation should reduce non-specific binding of substrate to surfaces.

### Signal Strongly Reduced After Short Time

If the fluorescence signal decreases rapidly, it may be due to instability of the fusion protein. The signal may be stabilized by fixing the cells. Alternatively, try switching CLIP-tag from the N- to the C-terminus or vice versa.

Photobleaching is not generally a problem as the CLIP-Cell TMR-Star substrate is very photostable. However, if problems with photobleaching are experienced, addition of a commercially available anti-fade reagent may be helpful.

## Instructions for Labeling of Proteins *in vitro*:

1. Dissolve the vial of CLIP-Cell TMR-Star substrate (50 nmol) in 50  $\mu\text{l}$  of DMSO to yield a stock solution of 1 mM CLIP-tag substrate. Mix by vortexing for 10 minutes until all the CLIP-tag substrate is dissolved. Dilute this 1 mM stock solution 1:4 in fresh DMSO to yield a 250  $\mu\text{M}$  stock for labeling proteins *in vitro*.
2. Set up the reactions, in order, as follows:

Component	Volume	Final Concentration
Deionized Water	32 $\mu\text{l}$	
5X CLIP-tag Reaction Buffer	10 $\mu\text{l}$	1X
50 mM DTT	1 $\mu\text{l}$	1 mM
50 $\mu\text{M}$ CLIP-tag Purified Protein	5 $\mu\text{l}$	5 $\mu\text{M}$
250 $\mu\text{M}$ CLIP-tag Substrate	2 $\mu\text{l}$	10 $\mu\text{M}$
<b>Total Volume</b>	50 $\mu\text{l}$	

3. Incubate in the dark for 60 minutes at 37°C.
4. Run sample on an SDS-PAGE gel and detect using a fluorescent gel scanner or store samples at –20°C or –80°C in the dark.

### Removal of Unreacted Substrate (optional)

After the labeling reaction, the unreacted substrate can be separated from the labeled CLIP-tag fusion protein by gel filtration or dialysis. Please refer to the vendor's instructions for the separation tools used.

### Notes for Labeling *in vitro*

We recommend the routine addition of 1 mM DTT to all buffers used for handling, labeling and storage of the CLIP-tag. The stability of the CLIP-tag is improved in the presence of reducing agents; however, it can also be labeled in their absence if handling at temperatures above 4°C is minimized.

CLIP-tag fusion proteins can be purified before labeling, but the labeling reaction also works in non-purified protein solutions (including cell lysates).

## Troubleshooting for Labeling *in vitro*

### Solubility

If solubility problems occur with the CLIP-tag fusion protein, we recommend testing a range of pH (pH 5.0–pH 10.0) and ionic strengths. The salt concentration may also need to be optimized for the particular fusion protein (50–250 mM).

### Loss of Protein Due to Aggregation or Sticking to Tube

If stickiness of the fusion protein is a problem, we recommend adding Tween 20 at a final concentration of 0.05% to 0.1%. The CLIP-tag activity is not affected by this concentration of Tween 20.

### Incomplete Labeling

If exhaustive labeling of a protein sample is not achieved using the recommended conditions, try the following protocol modifications: Increase the incubation time to two hours total at 25°C or to 24 hours at 4°C; or halve the volume of protein solution labeled. Both approaches may be combined. If poor labeling continues, we recommend checking the activity of the CLIP-tag using CLIP-Vista Green.

If the CLIP-tag fusion has been stored in the absence of DTT or other reducing agent, or has been stored at 4°C for a prolonged period, its activity may be compromised. Include 1 mM DTT in all solutions of the CLIP-tag fusion protein, and store the fusion protein at –20°C.

Using less than the recommended amount of substrate stock solution can significantly slow down the reaction rate.

### Loss of Activity of Protein of Interest

If the fusion protein is particularly sensitive to degradation or to loss of activity, try reducing the labeling time or decreasing the labeling temperature. We recommend overnight incubation when labeling at 4°C.

**Notice to Buyer/User:** The Buyer/User has a non-exclusive license to use this system or any component thereof for **RESEARCH AND DEVELOPMENT PURPOSES ONLY**. Commercial use of this system or any components thereof requires a license from New England Biolabs, Inc., 240 County Road Ipswich, MA 01938. For detailed information, see: [www.neb.com/cia/legal](http://www.neb.com/cia/legal).