



**Rabbit (polyclonal)  
Anti-TTK/Mps1 [pTpS<sup>33/37</sup>]  
Phosphospecific  
Antibody, Unconjugated  
PRODUCT ANALYSIS SHEET**

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<b>Catalog Number:</b>	44-1325G (10 mini-blot size)
<b>Lot Number:</b>	See product label
<b>Volume:</b>	100 µL
<b>Form of Antibody:</b>	Rabbit polyclonal immunoglobulin in Dulbecco's phosphate buffered saline (without Mg <sup>2+</sup> and Ca <sup>2+</sup> ), pH 7.3 (+/- 0.1), 50% glycerol with 1.0 mg/mL BSA (IgG, protease free) as a carrier.
<b>Preservative:</b>	0.05% sodium azide (Caution: sodium azide is a poisonous and hazardous substance. Handle with care and dispose of properly.)
<b>Purification:</b>	Purified from rabbit serum by sequential epitope-specific chromatography. The antibody has been negatively preadsorbed using a non-phosphopeptide corresponding to the site of phosphorylation to remove antibody that is reactive with non-phosphorylated TTK. The final product is generated by affinity chromatography using TTK/Mps1-derived peptide that is phosphorylated at threonine 33 and serine 37.
<b>Immunogen:</b>	The antiserum was produced against a chemically synthesized phosphopeptide derived from the region of human TTK that contains threonine 33 and serine 37.
<b>Target Summary:</b>	TTK (also known as Mps1; monopolar spindles checkpoint kinase ) is a ~97 kDa cell cycle-regulated kinase and an essential component of the mitotic spindle checkpoint. TTK/Mps1 is shown to have maximal activity during M phase and minimal expression in anaphase where it becomes a target of anaphase promoting complex (APC). TTK/hMps1 is a Chk2 kinase where it binds and directly phosphorylates Chk2 kinase at threonine 68. TTK is phosphorylated on several serine and threonine sites including threonines 33 and 360, and serines 37, 362 and 363. Once phosphorylated, TTK/Mps1 is localized to kinetochores where it executes its checkpoint function and regulates multiple cell-cycle related processes, including cell cycle arrest.
<b>Reactivity:</b>	Human.
<b>Applications:</b>	The antibody has been used in Western blotting and Immunostaining.
<b>Suggested Working Dilutions:</b>	For Western blotting applications, we recommend using the antibody at a 1:1000 starting dilution. The optimal antibody concentration should be determined empirically for each specific application.
<b>Storage:</b>	Store at -20°C. We recommend a brief centrifugation before opening to settle vial contents. Then, apportion into working aliquots and store at -20°C. For shipment or short-term storage (up to one week), 2-8°C is sufficient.
<b>Expiration Date:</b>	Expires one year from date of receipt when stored as instructed.
<b>Positive Controls Used:</b>	Active TTK protein, immunoprecipitated nocadazole-treated HeLa cell lysates.

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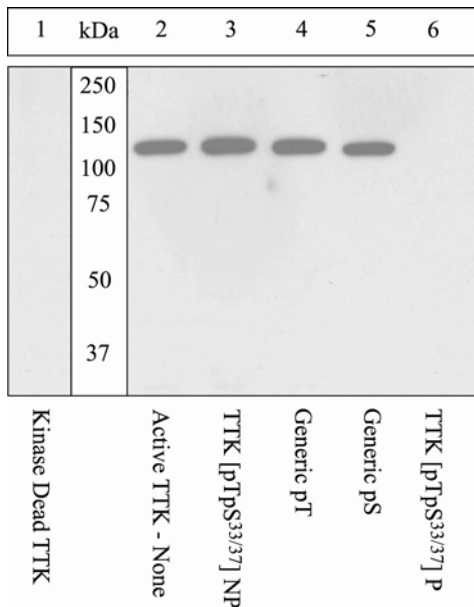
**Related Products:****Antibodies:**

TTK [pTpSpS<sup>360/362/363</sup>], Cat. # 44-1330G  
 Aurora A Kinase [pT<sup>288</sup>], Cat. # 1210G  
 RSK1 [pSpS<sup>221/227</sup>], Cat.# 44- 926G  
 RSK1 [pSpS<sup>363/369</sup>], Cat.# 44- 926G  
 Inhibitor-2 [pT<sup>72</sup>], Cat. # 44-1160G  
 ERK1/2[pTpY<sup>185/187</sup>], Cat. # 44-680G  
 PAK1/2/3 [pT<sup>423</sup>], Cat. # 44-942G

PAK 1/2/3 [pS<sup>141</sup>], Cat. # 44-940G  
 $\beta$ -Catenin [pS<sup>45</sup>], Cat. # 44-208G  
 ROCK II [pT<sup>249</sup>], Cat. # 44-257G  
 ROCK1 [1113/1114] CSSA, Cat. # 44-258G  
 Rac/Cdc42 [pS<sup>71</sup>], Cat. # 44-214G  
 SHP2 [pY<sup>580</sup>], Cat. # 44-558G  
 SHP2 [pS<sup>576</sup>], Cat. # 44-557G  
 CDK 1 [pTpY<sup>14/15</sup>], Cat. # 44-686G

**References:**

Palframan, W.J., et al. (2006) Anaphase inactivation of the spindle checkpoint. *Science* 313(5787):680-684.  
 Shimogawa, M.M., et al. (2006) Mps1 phosphorylation of Dam1 couples kinetochores to microtubule plus ends at metaphase. *Curr. Biol.* 16(15):1489-1501.  
 Zhao, Y. and R.H. Chen (2006) Mps1 phosphorylation by MAP kinase is required for kinetochore localization of spindle-checkpoint proteins. *Curr. Biol.* 16(17):1764-1769  
 Jaspersen, S.L., et al. (2004) Cdc28/Cdk1 regulates spindle pole body duplication through phosphorylation of Spc42 and Mps1. *Dev. Cell.* 7(2):263-274.  
 Fisk, H.A., et al. (2004) A field guide to the Mps1 family of protein kinases. *Cell Cycle* 3(4):439-442.  
 Vigneron, S., et al. (2004) Kinetochore localization of spindle checkpoint proteins: who controls whom? *Mol. Biol. Cell.* 15(10):4584-4596.  
 Chan, J.K. and T.J. Yen (2003) The mitotic checkpoint: a signaling pathway that allows a single unattached kinetochore to inhibit mitotic exit. *Prog. Cell Cycle Res.* 5:431-439. Review.  
 Stucke, V.M., et al. (2002) Human Mps1 kinase is required for the spindle assembly checkpoint but not for centrosome duplication. *EMBO J.* 21(7):1723-1732.

**Peptide Competition and Mutant Analysis**

NIH3T3 fibroblast lysates, spiked with 1 ng active GST tagged-TTK protein [Invitrogen, Cat. # PV3792] (2-6) or Kinase dead mutant TTK protein (1) were resolved on a 10% polyacrylamide gel and transferred to PVDF. The membrane was blocked with a 3% BSA-TBST buffer for one hour at room temperature, and then incubated with the TTK [pTpS<sup>33/37</sup>] antibody for two hours at room temperature in 3% BSA-TBST buffer, following prior incubation with: no peptide (2), the non-phosphopeptide corresponding to the phosphopeptide immunogen (3), a generic phosphothreonine-containing peptide (4), a generic phosphoserine (5), or the phosphopeptide immunogen corresponding to TTK [pTpS<sup>33/37</sup>] (6). After washing, the membrane was incubated with goat F(ab')<sub>2</sub> anti-rabbit IgG HRP conjugate (Cat. # ALI4404) and signals were detected using the Pierce SuperSignal™ reagent.

The data show that the signal detected in the active TTK protein was selectively blocked by the phosphopeptide corresponding to TTK [pTpS<sup>33/37</sup>]. The data also show the loss of phosphorylation signal on kinase dead protein indicating that the signal is phosphorylation site-specific.

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## Western Blotting Procedure

1. Lyse approximately  $10^7$  cells in 0.5 mL of ice cold Cell Lysis Buffer (formulation provided below). This buffer, a modified RIPA buffer, is suitable for recovery of most proteins, including membrane receptors, cytoskeletal-associated proteins, and soluble proteins. This cell lysis buffer formulation is available as a separate product which requires supplementation with protease inhibitors immediately prior to use (Cat. # FNN0011). Other cell lysis buffer formulations, such as Laemmli sample buffer and Triton-X 100 buffer, are also compatible with this procedure. Additional optimization of the cell stimulation protocol and cell lysis procedure may be required for each specific application.
2. Remove the cellular debris by centrifuging the lysates at 14,000 x g for 10 minutes. Alternatively, lysates may be ultracentrifuged at 100,000 x g for 30 minutes for greater clarification.
3. Carefully decant the clarified cell lysates into clean tubes and determine the protein concentration using a suitable method, such as the Bradford assay. Polypropylene tubes are recommended for storing cell lysates.
4. React an aliquot of the lysate with an equal volume of 2x Laemmli Sample Buffer (125 mM Tris, pH 6.8, 10% glycerol, 10% SDS, 0.006% bromophenol blue, and 130 mM dithiothreitol [DTT]) and boil the mixture for 90 seconds at 100°C.
5. Load 10-30 µg of the cell lysate into the wells of an appropriate single percentage or gradient minigel and resolve the proteins by SDS-PAGE.
6. In preparation for the Western transfer, cut a piece of PVDF slightly larger than the gel. Soak the membrane in methanol for 1 minute, then rinse with ddH<sub>2</sub>O for 5 minutes. Alternatively, nitrocellulose may be used.
7. Soak the membrane, 2 pieces of Whatman paper, and Western apparatus sponges in transfer buffer (formulation provided below) for 2 minutes.
8. Assemble the gel and membrane into the sandwich apparatus.
9. Transfer the proteins at 140 mA for 60-90 minutes at room temperature.
10. Following the transfer, rinse the membrane with Tris buffered saline for 2 minutes.
11. Block the membrane with blocking buffer (formulation provided below) for one hour at room temperature or overnight at 4°C.
12. Incubate the blocked blot with primary antibody at a 1:1000 starting dilution in Tris buffered saline supplemented with 3% Ig-free BSA and 0.1% Tween-20 overnight at 4°C or for two hours at room temperature.
13. Wash the blot with several changes of Tris buffered saline supplemented with 0.1% Tween 20.
14. Detect the antibody band using an appropriate secondary antibody, such as goat F(ab')<sub>2</sub> anti-rabbit IgG alkaline phosphatase conjugate (Cat. # ALI4405) or goat F(ab')<sub>2</sub> anti-rabbit IgG horseradish peroxidase conjugate (Cat. # ALI4404) in conjunction with your chemiluminescence reagents and instrumentation.

### Cell Lysis Buffer

#### Formulation:

10 mM Tris, pH 7.4  
100 mM NaCl  
1 mM EDTA  
1 mM EGTA  
1 mM NaF  
20 mM Na<sub>4</sub>P<sub>2</sub>O<sub>7</sub>  
2 mM Na<sub>3</sub>VO<sub>4</sub>  
0.1% SDS  
0.5% sodium deoxycholate  
1% Triton-X 100  
10% glycerol  
1 mM PMSF (made from a  
0.3 M stock in DMSO)  
or 1 mM AEBSF (water  
soluble version of PMSF)  
60 µg/mL aprotinin  
10 µg/mL leupeptin  
1 µg/mL pepstatin  
(alternatively, protease inhibitor cocktail  
such as Sigma Cat. # P2714 may be used)

### Transfer Buffer

#### Formulation:

2.4 gm Tris base  
14.2 gm glycine  
200 mL methanol  
Q.S. to 1 liter, then add  
1 mL 10% SDS.  
Cool to 4°C prior to use.

### Tris Buffered Saline

#### Formulation:

20 mM Tris-HCl, pH 7.4  
0.9% NaCl

### Blocking Buffer

#### Formulation:

100 mL Tris buffered  
saline  
3 gm Ig-free BSA  
0.1 mL Tween 20

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## Peptide Competition Experiment

Invitrogen's Phosphorylation Site Specific Antibodies (PSSAs) have been developed to enable the specific and sensitive detection of phosphorylation of particular amino acid residues in target proteins, while circumventing the need for protein purification, phosphopeptide mapping or handling radioactivity. The specificity of a PSSA in each experimental system can be confirmed through peptide competition. In this technique, aliquots of antibody are pre-incubated with peptide containing the sequence of the phosphopeptide immunogen used to raise the PSSA and the corresponding non-phosphopeptide. Following preincubation with the peptide, each antibody preparation is then used as a probe in antibody-based detection methods, such as Western blotting, immunocytochemistry, flow cytometry, or ELISA. With a PSSA specific for the phosphorylated target protein, pre-incubation with an excess of peptide containing the sequence of the phosphopeptide immunogen will block all antigen binding sites, while pre-incubation with the corresponding non-phosphopeptide will not affect the antibody.

Invitrogen has developed a line of control peptides specifically for use in peptide competition experiments with our PSSAs. These peptides, available as separate Invitrogen catalog items, are provided in pairs which contain the sequences of the phosphopeptide immunogen and the corresponding non-phosphopeptide.

In performing the Peptide Competition Experiment, it is important to note that the optimal dilutions of both antibody and peptide should be determined empirically for each specific application. The optimal dilution of antibody in these procedures is below saturating, as determined by previous experiments in your system. If an optimal antibody dilution has not been determined in your system, please refer to the Suggested Working Dilution on the antibody Product Analysis Sheet for guidance on an appropriate starting dilution. The optimal dilution of peptide used in these procedures will depend on the overall affinity or avidity of the antibody, as well as the quantity of the target antigen. A 50-150 fold molar excess of peptide to antibody is found to be effective for most peptide competition experiments.

In the example presented below, the PSSA is used as a dilution of 1:1000 and the peptides are used at a concentration of 333 nM. The total volume of the phosphopeptide and non-phosphopeptide-pre-incubated antibody preparations is 2 mL, sufficient for probing Western blot strips, as well as for use in other antibody-based detection methods. Under these conditions, the molar excess of peptide to antibody is  $\geq 50$ .

### Procedure:

1. Prepare three *identical test samples*, such as identical PVDF or nitrocellulose strips to which the protein of interest has been transferred. The test samples should be blocked using a blocking buffer, such as Tris buffered saline supplemented with 0.1% Tween 20, and either 5% BSA or 5% non-fat dried milk.
2. Prepare 6.5 mL of *working antibody stock solution* (1:1000 in this example) by adding 6.5  $\mu$ L of antibody stock solution to 6.5 mL of buffer containing blocking protein, such as TBS supplemented with 0.1% Tween 20, and either 3% BSA or 3% non-fat dried milk.
3. Apportion the unused PSSA into working aliquots and store at  $-20^{\circ}\text{C}$  for future use (the stock PSSA contains 50% glycerol and will not freeze at this temperature).
4. Allow the *lyophilized control peptides* to reach room temperature, ideally under desiccation.
5. Reconstitute each of the control peptides (supplied at 0.1 mg/vial) to a concentration of 66.7  $\mu$ M with nanopure water. For a peptide with a molecular mass of 1500 (stated on the peptide Product Analysis Sheet), reconstitution with 1 mL water yields a solution with a concentration of 66.7  $\mu$ M.
6. Apportion the unused reconstituted peptide solutions into working aliquots and store at  $-20^{\circ}\text{C}$  for future use.
7. Label 3 test tubes as follows:
  - tube 1: water only no peptide control
  - tube 2: phosphopeptide
  - tube 3: non-phosphopeptide
8. Into each tube, pipette the following components:
  - tube 1: 2 mL diluted PSSA solution plus 10  $\mu$ L nanopure water
  - tube 2: 2 mL diluted PSSA solution plus 10  $\mu$ L phosphopeptide
  - tube 3: 2 mL diluted PSSA solution plus 10  $\mu$ L non-phosphopeptide
9. Incubate the three tubes for 30 minutes at room temperature with gentle rocking. During this incubation, the peptides have the chance to bind to the combining site of the antibody.
10. At the end of the incubation step, transfer the contents of each of the three tubes to clean reaction vessels containing one of the three identical test samples.

### For Western blotting strips:

- Incubate the strips with the pre-incubated antibody preparations for 1 hour at room temperature or overnight at  $4^{\circ}\text{C}$ .
- Wash each strip four times, five minutes each, to remove unbound antibody.
- Transfer each strip to a new solution containing a labeled secondary antibody [e.g., goat F(ab')<sub>2</sub> anti-rabbit IgG alkaline phosphatase conjugate (Cat. # ALI4405) or goat F(ab')<sub>2</sub> anti-rabbit IgG horseradish peroxidase conjugate (Cat. # ALI4404)].
- Remove unbound secondary antibody by thorough washing, and develop the signal using your chemiluminescent reagents and instrumentation.

The signal obtained with antibody incubated with the "Water Only, No Peptide Control" (Tube 1), represents the maximum signal in the assay. This signal should be eliminated by pre-incubation with the "Phosphopeptide" (Tube 2), while pre-incubation with the "Non-Phosphopeptide" (Tube 3) should not impact the signal. If the "Phosphopeptide" only partially eliminates the signal, repeat the procedure using twice the volume of water or peptide solutions listed in Step 8. If partial competition is seen following pre-incubation with the "Non-Phosphopeptide", repeat the procedure using half the volumes of water or peptide solutions listed in Step 8.

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