

User Guide

# MILLIPLEX® Multi-Pathway 9-Plex Magnetic Bead Kit

96-Well Plate

## 48-680MAG

Introduction .....	2	Washing Note .....	16
Principle .....	3	Equipment Settings .....	16
Storage Conditions Upon Receipt ...	4	Supplemental Protocols.....	18
Reagents Supplied .....	5	Representative Data .....	20
Materials Required (not included) ..	6	Troubleshooting .....	22
Safety Precautions .....	8	Product Ordering.....	26
Symbol Definitions .....	8	Well Map.....	27
Technical Guidelines.....	9	Notice.....	28
Sample Collection and Storage ....	10	Contact Information.....	28
Preparation of Reagents for		Technical Assistance .....	28
Immunoassay .....	12	Standard Warranty .....	28
Immunoassay Protocol .....	14	Safety Data Sheets (SDS) .....	28

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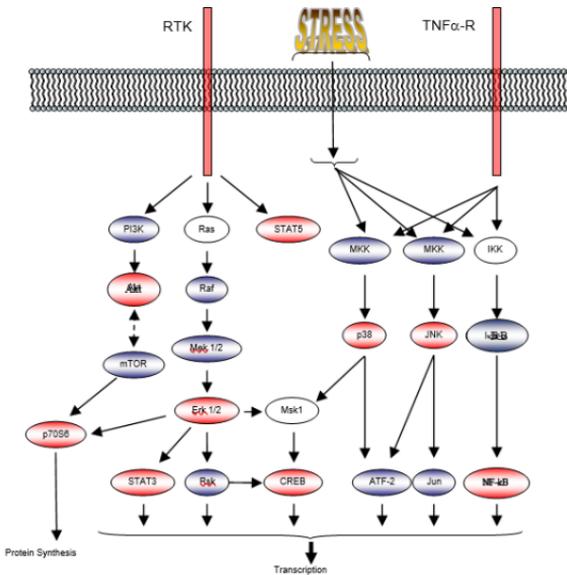
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# Introduction

Cells respond to their environment in many different ways through intracellular signaling. Signaling through RTKs (Receptor Tyrosine kinases) often promote increased metabolism and cell growth. Activation of ERK/MAP kinase and Akt are two of the key Ser/Thr kinases activated via RTK signaling, promoting increased activity of p70S6K (Thr412), Msk1, STAT3 (Ser727), CREB, and many other signaling intermediates. Other signaling pathways induced via stress or death receptors (ex. TNF $\alpha$ -R) promote p38, JNK, and NF- $\kappa$ B signaling pathways.

## Summary of Signaling Pathways



The MILLIPLEX<sup>®</sup> portfolio offers the broadest selection of analytes across a wide range of pathways. Once the panel of interest has been identified, you can rely on the quality we build into each kit to produce results you can trust. Performance criteria evaluated during the verification process include: cross-reactivity, assay CVs, kit stability, and sample behavior. In addition, each kit meets stringent Quality Control criteria to ensure lot-to-lot reproducibility.

Each MILLIPLEX<sup>®</sup> cell signaling and cellular metabolism panel/kit includes:

- Stimulated and unstimulated cell lysates provided to qualify assay performance
- Premixed magnetic beads to capture analytes of interest
- Optimized detection antibody cocktails designed to yield consistent analyte profiles within a panel

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The MILLIPLEX® Multi-Pathway 9-plex Magnetic Bead Signaling kit, phosphoprotein, is used to detect changes in phosphorylated ERK/MAP kinase 1/2 (Thr185/Tyr187), Akt (Ser473), STAT3 (Ser727), JNK (Thr183/Tyr185), p70S6K (Thr412), NF-κB (Ser536), STAT5A/B (Tyr694/699), CREB (Ser133), and p38 (Thr180/Tyr182) in cell lysates using the Luminex® system. The detection assay is a rapid, convenient alternative to Western Blotting and immunoprecipitation procedures. Each kit has sufficient reagents for one 96-well plate assay.

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Please read entire protocol before use.  
It is important to use same assay incubation conditions throughout your study.**

## Principle

MILLIPLEX® products are based on the Luminex® xMAP® technology — one of the most respected multiplex technologies available. This technology finds applications throughout the life sciences and enables a variety of bioassays, including immunoassays, on the surface of fluorescent-coded magnetic bead (MagPlex®-C and non-magnetic bead (MicroPlex®) microspheres.

- Luminex® products use proprietary techniques to internally color-code microspheres with multiple fluorescent dyes. Through precise concentrations of these dyes, distinctly colored bead sets of 500-5.6 μm non-magnetic or 80-6.45 μm magnetic polystyrene microspheres can be created, each of which is coated with a specific capture antibody.
- After an analyte from a test sample is captured by the bead, a biotinylated detection antibody is introduced.
- The reaction mixture is then incubated with Streptavidin-PE conjugate, the reporter molecule, to complete the reaction on the surface of each microsphere.
- The microspheres are illuminated, and the internal dyes fluoresce, marking the microsphere set(s) used in a particular assay. A second illumination source excites PE, the fluorescent dye on the reporter molecule.
- Finally, high-speed digital-signal processors identify each individual microsphere and quantify the result of its bioassay based on fluorescent reporter signals.

The capability of adding multiple conjugated beads to each sample results in the ability to obtain multiple results from each sample. Open-architecture xMAP® technology enables multiplexing of many types of bioassays reducing time, labor and costs over traditional methods.

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## Storage Conditions Upon Receipt

- Recommended storage for kit components is 2–8 °C.
- Once the control lysates have been reconstituted, immediately transfer contents into polypropylene vials. **DO NOT STORE RECONSTITUTED CONTROLS IN LYOPHILIZATION VIALS.** For long-term storage, freeze reconstituted standards and controls at  $\leq -70$  °C. Aliquot if needed. Avoid freeze/thaw cycles.
- **DO NOT FREEZE** Antibody-Immobilized Beads, Detection Antibody, and Streptavidin-Phycoerythrin.

## Reagents Supplied

Reagents	Volume	Quantity	Cat. No.
MILLIPLEX® 9-plex Multi-Pathway, Magnetic Beads (20X)	180 µL	1 tube	42-680MAG
MILLIPLEX® 9-plex Multi-Pathway, Biotin (20X) (Detection Antibody)	180 µL	1 tube	44-680KMG
MILLIPLEX® Lysis Buffer (1X)	55 mL	1 bottle	443-040
MILLIPLEX® Assay Buffer 2 (1X)	55 mL	1 bottle	43-041
MILLIPLEX® HeLa Cell Lysate: Unstimulated	-	1 vial	47-205
MILLIPLEX® A431 Cell Lysate: EGF	-	1 vial	47-210
MILLIPLEX® HeLa Cell Lysate: TNFα/Calyculin A	-	1 vial	47-230
MILLIPLEX® MCF7 Cell Lysate: IGF1	-	1 vial	47-216
MILLIPLEX® Streptavidin-Phycoerythrin (25X)	150 µL	1 tube	45-001H
MILLIPLEX® Amplification Buffer (1X)	3 mL	1 bottle	43-024A
Set of one 96-well Filter Plate and 2 sealers	-	1 set	-
Set of one 96-well Plate and 2 sealers	-	1 set	-
Empty mixing vials	-	3 vials	-

Analyte	Magnetic Bead Region
CREB	13
JNK	18
NF-κB	36
p38	38
ERK1/2	42
Akt	47
p70S6K	57
STAT3	63
STAT5	65

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## Materials Required (Not included)

### Reagents

- Protease inhibitors (Cat. No. 535140 or similar product)
- Coomassie or BCA-based total protein assay (Cat. No. 71285 or similar product) or an assay normalization control, such as the GAPDH (Cat. No. 46-667MAG) MAPmate™ or  $\beta$ -Tubulin (Cat. No. 46-713MAG) MAPmate™
- MAGPIX® Drive Fluid PLUS (Cat. No. 40-50030), xMAP® Sheath Fluid PLUS (Cat. No. 40-50021), or xMAP® Sheath Concentrate PLUS (Cat. No. 40-50023)
- 10X Assay Buffer 1 (Cat. No. MPEQ-AB) if using a magnetic plate washer (see Supplemental Protocols)

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## Instrumentation/Materials

- Adjustable pipettes with tips capable of delivering 25  $\mu$ L to 1000  $\mu$ L
- Multichannel pipettes capable of delivering 25  $\mu$ L to 200  $\mu$ L
- Reagent reservoirs
- Polypropylene microfuge tubes
- Rubber bands
- Aluminum foil
- Absorbent pads
- Laboratory vortex mixer
- Sonicator (Branson Ultrasonic Cleaner Model No. B200 or equivalent)
- Titer plate shaker (Lab-Line Instruments Model No. 4625 or equivalent)
- Luminex<sup>®</sup> 200<sup>™</sup>, HTS, FLEXMAP 3D<sup>®</sup>, MAGPIX<sup>®</sup> instrument with xPONENT<sup>®</sup> software, or xMAP<sup>®</sup> INTELLIFLEX instrument with INTELLIFLEX software by Luminex<sup>®</sup> Corporation
- Plate stand (Cat. No. MX-STAND, if using filter plate)
- Filter devices for clearing lysates
  - 2 mL or greater, Cat. No. SLHVX13NL
  - 0.5–2 mL, Cat. No. UFC40DV25
  - Less than 0.5 mL, Cat. No. UFC30DV25
  - For 96 well plates, Cat. No. MSBVN1210
- Use of a hand-held Magnetic Separation Block (Cat. No. 40-285 or equivalent) is recommended. If using an Automatic Plate washer for magnetic beads (BioTek<sup>®</sup> ELx405, Cat. No. 40-015 or equivalent), consult Supplemental Protocols.
- If using the filter plate, a vacuum filtration unit (Vacuum Manifold, Cat. No. MSVMHTS00 or equivalent with Vacuum Pump, Cat. No. WP6111560 or equivalent). Consult Supplemental Protocols Section for Filter Plate protocol use.

## Safety Precautions

- All tissue components and biological materials should be handled as potentially hazardous. Follow universal precautions as established by the Centers for Disease Control and Prevention and by the Occupational Safety and Health Administration when handling and disposing of infectious agents.
- Sodium azide or Proclin™ has been added to some reagents as a preservative. Although the concentrations are low, Sodium azide may react with lead and copper plumbing to form highly explosive metal azides. Dispose of unused contents and waste in accordance with international, federal, state and local regulations.

## Symbol Definitions

Ingredient	Cat. No.	Full Label	
A431 Cell Lysate: EGF treated	47-210		<b>Danger.</b> Harmful if swallowed Causes skin irritation. Causes serious eye damage. Very toxic to aquatic life. Toxic to aquatic life with long lasting effects. Avoid release to the environment. IF SWALLOWED: Call a POISON CENTER/ doctor if you feel unwell. Collect spillage. Dispose of contents/ container to an approved waste disposal plant.
MCF7 Cell Lysate: IGF treated	47-216		
HeLa Cell Lysate: Unstimulated	47-205		
HeLa Cell Lysate: TNF $\alpha$ + Calyculin A	47-230		

## Technical Guidelines

To obtain reliable and reproducible results, the operator should carefully read this entire manual and fully understand all aspects of each assay step before running the assay. The following notes should be reviewed and understood before the assay is set up.

- FOR RESEARCH USE ONLY. NOT FOR USE IN DIAGNOSTIC PROCEDURES.
- Do not use beyond the expiration date on the label.
- Do not mix or substitute reagents with those from other lots or sources.
- The Antibody-Immobilized Beads are light sensitive and must be protected from light at all times. Cover the assay plate containing beads with opaque plate lid or aluminum foil during all incubation steps.
- It is important to allow all reagents to warm to room temperature (20-25 °C) before use in the assay.
- Incomplete washing can adversely affect the assay outcome. All washing must be performed with the Assay Buffer provided.
- Any unused mixed Antibody-Immobilized Beads may be stored in the Mixing Bottle at 2-8 °C for up to one week.
- The plate should be read immediately after the assay is finished. If, however, the plate cannot be read immediately, seal the plate, cover with aluminum foil or an opaque lid, and store the plate at 2-8 °C for up to 24 hours. Prior to reading, agitate the plate on the plate shaker at room temperature for 10 minutes. Delay in reading a plate may result in decreased sensitivity for some analytes.
- The titer plate shaker should be set at a speed to provide maximum orbital mixing without splashing of liquid outside the wells. For the recommended plate shaker, this would be a setting of 5-7 which is approximately 500-800 rpm.
- Ensure that the needle probe is clean. This may be achieved by sonication and/or alcohol flushes.
- When reading the assay on the Luminex® 200™ instrument, adjust probe height according to the protocols recommended by Luminex® to the kit filter plate using 3 alignment discs. When reading the assay on the FLEXMAP 3D® instrument, adjust probe height according to the protocols recommended by Luminex® to the kit filter plate using 1 alignment disc. When reading the assay on the MAGPIX® instrument, adjust probe height according to the protocols recommended by Luminex® to the kit filter plate using 2 alignment discs.
- For the FLEXMAP 3D® instrument, when using the solid plate in the kit, the final suspension should be in 150 µL and 75 µL should be aspirated.
- For the xMAP® INTELLIFLEX instrument, adjust probe height based on the type of plate you are using, place an alignment disk or an alignment sphere in the well according to the protocol recommended by Luminex®.
- Vortex all reagents well before adding to plate.

## Sample Collection and Storage

### Considerations for Cell Stimulation.

1. Treating cells with growth factors (ex. EGF), cytokines (ex. TNF $\alpha$ ), or other compounds (ex. Arsenite) induce a multitude of signaling cascades. The duration of stimulation in addition to the concentration of the respective factor/compound should be considered since they influence the degree of phosphorylation of any given analyte.
2. Cellular responses to growth factors are typically improved when cells have been serum starved prior to treatment.
3. Cell lines will differ in the robustness of their signaling response for any given stimulation.
4. The suggested working range of protein concentration for the assay is 1 to 25  $\mu\text{g}$  of total protein/well (25  $\mu\text{L}$ /well at 40 to 1000  $\mu\text{g}/\text{mL}$ ). A total protein amount of 10  $\mu\text{g}/\text{well}$  is generally a good starting point for lysates for which target protein expression levels are unknown.

### Preparation of Cell Lysates

MILLIPLEX<sup>®</sup> Lysis Buffer is supplied as **1X** stock solution. The Lysis Buffer contains phosphatase inhibitors *including* 1 mM sodium orthovanadate ( $\text{Na}_3\text{VO}_4$ ) but does **NOT** contain protease inhibitors. It is recommended that protease inhibitors (Cat. No. 535140 or a similar product) be added immediately before use.

### Suggested cell lysis protocol for adherent cells

1. After treatments, wash cells with ice cold Buffered Saline (PBS or TBS) and drain.
2. Add ice-cold **1X** MILLIPLEX<sup>®</sup> Lysis Buffer with freshly added protease inhibitors to cells (0.6 mL per 150 mm dish, 0.3 mL per 100 mm dish, or 0.1 mL per well of 24-well plate).
3. Scrape adherent cells off the dish with a cell scraper. Transfer the cell suspension into a centrifuge tube and gently rock for 10-15 minutes at 4 °C.
4. Remove particulate matter by filtration.
  - Suggested filters:
    - 2 mL or greater, Cat. No. SLPBDZ5NZ
    - 0.5-2 mL, Cat. No. UFC ODV 25
    - Less than 0.5 mL, Cat. No. UFC30DV00
5. Aliquot and store the lysate at -70 °C. The lysate should be stable for several months.
6. It is recommended that the lysate be diluted at least 1:10 with PBS for determining the protein concentration with Coomassie-based assays or 1:4 for BCA assays. Alternatively, protein quantification may be omitted if an assay normalization control, such as the GAPDH (Cat. No. 46-667MAG) MAPmate<sup>™</sup> or  $\beta$ -Tubulin (Cat. No. 46-713MAG) MAPmate<sup>™</sup>, is used.

## Suggested cell lysis protocol for non-adherent cells

1. Pellet the cells by centrifugation (500-1000 x g) in a tabletop centrifuge for 5 minutes.
2. Wash the cells in ice-cold PBS or TBS.
3. Add ice-cold **1X** MILLIPLEX® Lysis Buffer containing freshly prepared protease inhibitors to cells (1 mL per  $1 \times 10^7$  cells).
4. Gently rock the lysate for 10-15 minutes at 4 °C.
5. Remove particulate matter by filtration (See above). Aliquot and store the lysate at -70 °C. The lysate should be stable for several months.
6. It is recommended that the lysate be diluted at least 1:10 in PBS for determining the protein concentration with Coomassie-based assays or 1:4 for BCA assays. Alternatively, protein quantification may be omitted if an assay normalization control, such as the GAPDH (Cat. No. 46-667MAG) MAPmate™ or  $\beta$ -Tubulin (Cat. No. 46-713MAG) MAPmate™, is used.

## Cell lysis protocol for cells in sterile 96-well tissue culture plates

Adherent or non-adherent cells seeded or grown in sterile 96-well tissue culture grade plates can be washed, treated, and lysed in the same plate, but need to be filtered in a separate 96-well filter plate. Wash the cells by centrifugation in a microplate carrier 2 minutes at 500 x g.

1. For non-adherent cells, centrifuge tissue culture plate 2 minutes at 500 x g to pellet cells, if using adherent cells skip to next step.
2. Remove the media via aspiration and add 100  $\mu$ L ice-cold PBS or TBS.
3. For non-adherent cells, repeat step 1.
4. Remove wash via aspiration.
5. Add 35  $\mu$ L/well ice-cold 1X MILLIPLEX® Lysis Buffer containing freshly prepared protease inhibitors.
6. Place the plate on an orbital shaker (600–800 rpm) for 10-15 minutes at 4 °C.
7. Pipette samples up and down without making bubbles.
8. Transfer the lysate to a 96-well filter plate that has been pre-wetted with 5  $\mu$ L Lysis Buffer/well.
9. Place a low protein binding, 96-well round bottom or V-bottom plate underneath the filter plate.
10. Centrifuge the stacked plates for 5 minutes at 500 x g.
11. Store the filtered lysate at -70 °C until ready for use.
12. It is recommended that the lysate be diluted at least 1:10 in PBS for determining the protein concentration with Coomassie-based assays or 1:4 for BCA assays. Alternatively, protein quantification may be omitted if an assay normalization control, such as the GAPDH (Cat. No. 46-667MAG) MAPmate™ or  $\beta$ -Tubulin (Cat. No. 46-713MAG) MAPmate™, is used.

## Preparation of Reagents for Immunoassay

### Preparation of 9-plex Multi-Pathway Magnetic Beads

MILLIPLEX® magnetic beads are provided as a **20X** stock solution and should be protected from light.

1. Sonicate **20X** stock magnetic beads for 15 seconds, then vortex for 30 seconds.
2. Dilute the beads to **1X** by combining 0.150 mL beads with 2.85 mL of MILLIPLEX® Assay Buffer 2. Use one of the mixing vials provided.
3. Vortex the **1X** capture beads for 15 seconds.
4. For use, transfer 1X beads with a pipette into a reservoir, do not pour from mixing vial.
5. Please note that multiplexing phospho-specific and total or panTyr MAPmate™ pairs is not recommended due to cross-reactivity.

### Preparation of Biotin-Labeled Detection Antibody and Streptavidin-PE

MILLIPLEX® Detection Antibody is provided as a **20X** stock solution.

1. Vortex the 20X Detection Antibody stock for 10 seconds, it may be necessary to centrifuge briefly after vortexing for complete recovery of contents.
2. Dilute the Detection Antibody to 1X by combining 0.150 mL of Detection Antibody with 2.85 mL of MILLIPLEX® Assay Buffer 2. Use one of the mixing vials provided.
3. Vortex the MILLIPLEX® Streptavidin-Phycoerythrin 1:25 (SAPE) for 10 seconds.
4. Dilute SAPE by combining 0.120 mL of Streptavidin-Phycoerythrin with 2.88 mL of MILLIPLEX® Cell Signaling Assay Buffer 2. Use one of the mixing vials provided.
5. Transfer 1X biotinylated detection antibody and SAPE with a pipette to separate reservoirs. Do not pour from mixing vials.

### Multiplexing additional MILLIPLEX® Cell Signaling Magnetic MAPmates™ with the 9-plex Multi-Pathway Magnetic Bead Kit, phosphoprotein.

Additional Cell Signaling Phospho-MAPmates™ may be combined with this kit, up to a maximum of 9 additional MAPmates™.

**Please note** that Total or PanTyr MAPmate™ pairs should not be multiplexed with the 9-plex Multi-Pathway Kit, phosphoprotein.

1. For each additional Magnetic Bead MAPmate™, sonicate **20X** stock capture beads for 15 seconds, then vortex for 30 seconds.
2. Add 0.150 mL Multi-Pathway 9-plex Magnetic beads to the mixing vial.
3. For each additional MAPmate™, add 0.150 mL from each antibody bead vial to the mixing vial and bring final volume to 3.0 mL with Assay Buffer 2. Vortex the mixed beads well.

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4. Use the same preparation volumes for the Detection Antibody.

**Example 1:** When using 2 additional MAPmates™, add 0.150 mL 9-plex Multi-Pathway Beads/Detection Antibody and 0.150 mL of each additional MAPmate™ Beads/Detection Antibody to the mixing vial. Then add 2.55 mL Assay Buffer 2, for a final volume of 3.0 mL.

**Example 2:** When using 5 additional MAPmates™, add 0.150 mL 9-plex Multi-Pathway Beads/Detection Antibody and 0.150 mL of each additional MAPmate™ Beads/Detection Antibody to the mixing vial. Then add 2.1 mL Assay Buffer 2, for a final volume of 3.0 mL.

## Preparation of lyophilized MILLIPLEX® Cell Lysates

(Cat. No. 47-205, 47-210, 47-216 and 47-230)

MILLIPLEX® HeLa Cell Lysate: Unstimulated (Cat. No. 47-205) is provided as a lyophilized stock of cell lysate prepared from unstimulated HeLa cells and is used as an unstimulated control. A431 Cell Lysate: EGF (Cat. No. 47-210) is provided as a lyophilized stock of cell lysate prepared from A431 cells treated with 100 ng/mL EGF (5 min). MCF7 Cell Lysate: IGF-1 (Cat. No. 47-216) is provided as a lyophilized stock of cell lysate prepared from MCF7 cells stimulated with 50 ng/mL IGF-1 (10 min). HeLa Cell Lysate: TNF $\alpha$ /Calyculin A (Cat. No. 47-230) is provided as a lyophilized stock of cell lysate prepared from HeLa cells pretreated with 50 nM calyculin A (15 min) prior to stimulation with 50 ng/mL TNF $\alpha$  (15 min). Each of the cell lysates were prepared in MILLIPLEX® Lysis Buffer containing protease inhibitors and lyophilized for stability. The lysates can be used as unstimulated and stimulated control samples or alternatively, to create calibration curves for relative quantification of different phosphoprotein analytes.

MILLIPLEX® Cell Lysates as an unstimulated and stimulated control

1. Reconstitute each of the lyophilized cell lysates in 100  $\mu$ L of ultrapure water, for each vial this will yield 100  $\mu$ L of lysate at a total protein concentration of 2 mg/mL.
2. Gently vortex and incubate the reconstituted lysates for 5 min at RT (store on ice).
3. Pipette 150  $\mu$ L of MILLIPLEX® Assay Buffer 2 to each cell lysate vial and vortex mix. The cell lysate is now prepared for use in the MILLIPLEX® 9-plex Multi-Pathway Magnetic Bead Kit.
4. If desired, unused lysate may be stored in its original container at -80 °C for up to one month.

## Immunoassay Protocol (96-well Solid Plate and Hand-held Magnetic Separation Block)

1. Dilute filtered lysates at least 1:1 in MILLIPLEX® Assay Buffer. The suggested working range of protein concentration for the assay is 1 to 25 µg of total protein/well (25 µL/well at 40 to 1,000 µg/mL).
2. Add 50 µL of Assay Buffer into each well of the plate. Cover and mix on a plate shaker for 10 minutes at room temperature (20-25 °C).
3. Decant Assay Buffer and remove the residual amount from all wells by inverting the plate and tapping it smartly onto absorbent towels several times.
4. Vortex the 1X bead suspension for 10 seconds. Add 25 µL of 1X bead suspension to each well.
5. Add 25 µL of Assay Buffer, reconstituted control cell lysates and sample lysates to appropriate wells and incubate overnight (16-20 hours) at 2-8 °C on a plate shaker (600-800 rpm) protected from light.
6. Attach handheld magnetic separation block to plate, allow 60 seconds for beads to settle and decant samples and controls.
7. Remove plate from magnetic separation block and wash plate with 100 µL Assay Buffer per well (see Washing Note below). Repeat for a total of two washes.
8. Add 25 µL/well of **1X** MILLIPLEX® Detection Antibody.
9. Seal, cover with lid and incubate with agitation on a plate shaker for 1 hour at room temperature (20-25 °C).
10. Attach Magnetic Separation Block, wait for 60 seconds and decant Detection Antibody.
11. Add 25 µL of 1X MILLIPLEX® Streptavidin-Phycoerythrin (SAPE).
12. Seal, cover with lid and incubate with agitation on a plate shaker for 15 minutes at room temperature (20-25 °C).

Add 50 µL Assay Buffer per well

Shake 10 min, RT  
Decant

- Add 25 µL 1X beads to wells
- Add 25 µL Assay Buffer to the blank well
- Add 25 µL control and sample lysates to appropriate wells

Incubate overnight (16-20 hours) at 4 °C with shaking; dark

Wash 2X with 100 µL Assay Buffer. Add 25 µL 1X Detection Antibody.

Incubate 1 hr at RT with shaking; dark

Remove Detection Antibody and add 25 µL 1X Streptavidin-PE (SAPE)

Incubate 15 min at RT with shaking; dark

13. **DO NOT REMOVE SAPE.** Add 25  $\mu\text{L}$  of MILLIPLEX<sup>®</sup> Amplification Buffer to each well.
14. Seal, cover with lid and incubate with agitation on a plate shaker for 15 minutes at room temperature (20-25 °C).
15. Attach Magnetic Separation Block, wait for 60 seconds and decant SAPE/Amplification buffer.
16. Suspend beads in 150  $\mu\text{L}$  of MILLIPLEX<sup>®</sup> Assay Buffer and mix on plate shaker for 5 minutes. Analyze using the Luminex<sup>®</sup> system.

**DO NOT REMOVE SAPE** and add 25  $\mu\text{L}$  Amplification buffer



Incubate 15 min at RT with shaking; dark

Remove Streptavidin-PE/Amplification buffer and resuspend beads in 150  $\mu\text{L}$  Assay Buffer. Read results using appropriate Luminex<sup>®</sup> instrument.

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## Washing Note

For hand-held magnet, rest plate on magnet for 60 seconds to allow complete settling of magnetic beads. Remove well contents by gently decanting the plate in an appropriate waste receptacle and gently tapping on absorbent pads to remove residual liquid. Wash plate with 100  $\mu$ L of Assay Buffer by removing plate from magnet, adding Assay Buffer, shaking for 30 seconds, reattaching to magnet, letting beads settle for 60 seconds and removing well contents as previously described after each wash. Repeat wash steps as recommended in Assay Procedure.

## Equipment Settings

Luminex<sup>®</sup> 200™, HTS, FLEXMAP 3D<sup>®</sup>, MAGPIX<sup>®</sup> instruments with xPONENT<sup>®</sup> software and xMAP<sup>®</sup> INTELLIFLEX instrument with INTELLIFLEX software:

These specifications are for the above listed instruments and software. Luminex<sup>®</sup> instruments with other software (for example, MasterPlex<sup>®</sup>, StarStation, LiquiChip, Bio-Plex<sup>®</sup> Manager™, LABScan™100) would need to follow instrument instructions for gate settings and additional specifications from the vendors for reading Luminex<sup>®</sup> magnetic beads.

For magnetic bead assays, each instrument must be calibrated and performance verified with the indicated calibration and verification kits.

Instrument	Calibration Kit	Verification Kit
Luminex® 200™ and HTS	xPONENT® 3.1 compatible Calibration Kit (Cat. No. LX2R-CAL-K25)	Performance Verification Kit (Cat. No. LX2R-PVER-K25)
FLEXMAP 3D®	FLEXMAP 3D® Calibrator Kit (Cat. No. F3D-CAL-K25)	FLEXMAP 3D® Performance Verification Kit (Cat. No. F3D-PVER-K25)
xMAP® INTELLIFLEX	xMAP® INTELLIFLEX Calibration Kit (Cat. No. IFX-CAL-K20)	xMAP® INTELLIFLEX Performance Verification Kit (Cat. No. IFX-PVER-K20)
MAGPIX®	MAGPIX® Calibration Kit (Cat. No. MPX-CAL-K25)	MAGPIX® Performance Verification Kit (Cat. No. MPX-PVER-K25)

**NOTE:** When setting up a Protocol using the xPONENT® software, you must select MagPlex as the Bead Type in the Acquisition settings.

**NOTE:** These assays cannot be performed on any instruments running Luminex® IS 2.3 or Luminex® 1.7 software.

The Luminex® probe height must be adjusted to the plate provided in the kit. Please use Cat. No. MAG-PLATE, if additional plates are required for this purpose.

Events	50 per bead	
Sample Size	100 µL	
Gate Settings	8,000 to 15,000	
Reporter Gain	Default (Low PMT)	
Time Out	60 seconds	
Bead Region	CREB	13
	JNK	18
	NF-κB	36
	p38	38
	ERK1/2	42
	Akt	47
	p70S6K	57
	STAT3	63
	STAT5	65

## Supplemental Protocols

### Analysis of viscous cell lysates

Some cell lysates may not flow through the filter plate efficiently due to high viscosity or the formation of particulate matter from long-term storage. For these samples, the initial capture and wash steps can be done in microcentrifuge tubes. The beads are then transferred into 96-well filter plates for the rest of the assay.

- Add 25  $\mu\text{L}$ /assay point of 1X beads to a 500  $\mu\text{L}$  centrifuge tube.
- Next, add lysate diluted in MILLIPLEX<sup>®</sup> Assay Buffer 2 to a final volume of 100  $\mu\text{L}$  or higher.
- Vortex the mixture at high speed for 15 seconds then sonicate for an additional 15 seconds.
- Rotate the mixture overnight at 2-8  $^{\circ}\text{C}$ , protected from light.
- Centrifuge the beads for 1 min at 2,000  $\times g$  and carefully remove the supernatant to minimize bead loss.
- Resuspend the pelleted beads in 25  $\mu\text{L}$ /assay point of MILLIPLEX<sup>®</sup> Assay Buffer 2.
- Transfer 25  $\mu\text{L}$  of the bead mixture to pre-wet filter plate wells and proceed to step 4 of the Immunoassay protocol.

### Filter Plate Immunoassay Protocol

**NOTE:** This protocol requires the use of the included 96-well Filter plate and a Vacuum Manifold (Vacuum Manifold, Cat. No. MSVMHTS00 or equivalent with Vacuum Pump, Cat. No. WP6111560).

1. Dilute filtered lysates at least 1:1 in MILLIPLEX<sup>®</sup> Assay Buffer. The suggested working range of protein concentration for the assay is 1 to 25  $\mu\text{g}$  of total protein/well (25  $\mu\text{L}$ /well at 40 to 1,000  $\mu\text{g}/\text{mL}$ ).
2. Pre-wet filter plate with 25  $\mu\text{L}$ /well of MILLIPLEX<sup>®</sup> Assay Buffer. Remove by vacuum filtration by placing the filter plate over a vacuum manifold and gently applying vacuum. Gently blot the bottom of the filter plate on a paper towel to remove excess liquid.
3. Vortex the 1X bead suspension for 10 seconds. Add 25  $\mu\text{L}$  of 1X bead suspension to each well.
4. Add 25  $\mu\text{L}$  of Assay Buffer, reconstituted control cell lysates and sample lysates to appropriate wells and incubate overnight (16-20 hours) at 2-8  $^{\circ}\text{C}$ . Seal, cover with lid and incubate with agitation on a plate shaker at 600-800 rpm.

Add 25  $\mu\text{L}$  Assay Buffer per well



Remove buffer by vacuum

- Add 25  $\mu\text{L}$  1X beads to wells
- Add 25  $\mu\text{L}$  Assay Buffer to the blank well
- Add 25  $\mu\text{L}$  control and sample lysates to appropriate wells



Incubate overnight (16-20 hours) at 4  $^{\circ}\text{C}$  with shaking; dark

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5. Remove the lysate by vacuum filtration.
6. Add 100  $\mu\text{L}$ /well of MILLIPLEX<sup>®</sup> Assay Buffer. Remove buffer by vacuum filtration and gently blot the bottom of the filter plate on a paper towel. Repeat this step again for a total of two washes.
7. Add 25  $\mu\text{L}$ /well of **1X** MILLIPLEX<sup>®</sup> Detection Antibody.
8. Seal, cover with lid and incubate with agitation on a plate shaker for 1 hour at room temperature (20-25 °C).
9. Remove Detection Antibody by vacuum and gently blot the bottom of the filter plate on a paper towel.
10. Add 25  $\mu\text{L}$  of 1X MILLIPLEX<sup>®</sup> Streptavidin-Phycoerythrin (SAPE).
11. Seal, cover with lid and incubate with agitation on a plate shaker for 15 min at room temperature (20-25 °C).
12. **DO NOT REMOVE** SAPE. Add 25  $\mu\text{L}$  of MILLIPLEX<sup>®</sup> Amplification Buffer to each well.
13. Seal, cover with lid and incubate with agitation on a plate shaker for 15 min at room temperature (20-25 °C).
14. Remove MILLIPLEX<sup>®</sup> SAPE/Amplification buffer by vacuum filtration and gently blot the bottom of the filter plate on a paper towel.
15. Resuspend beads in 150  $\mu\text{L}$  of MILLIPLEX<sup>®</sup> Assay Buffer and mix on plate shaker for 5 minutes.
16. Analyze using the Luminex<sup>®</sup> system.

Wash 2X with 100  $\mu\text{L}$  Assay Buffer. Add 25  $\mu\text{L}$  1X Detection Antibody.



Incubate 1 hr at RT with shaking; dark

Remove Detection Antibody and add 25  $\mu\text{L}$  1X Streptavidin-PE (SAPE)



Incubate 15 min at RT with shaking; dark

**DO NOT REMOVE** SAPE and add 25  $\mu\text{L}$  Amplification buffer



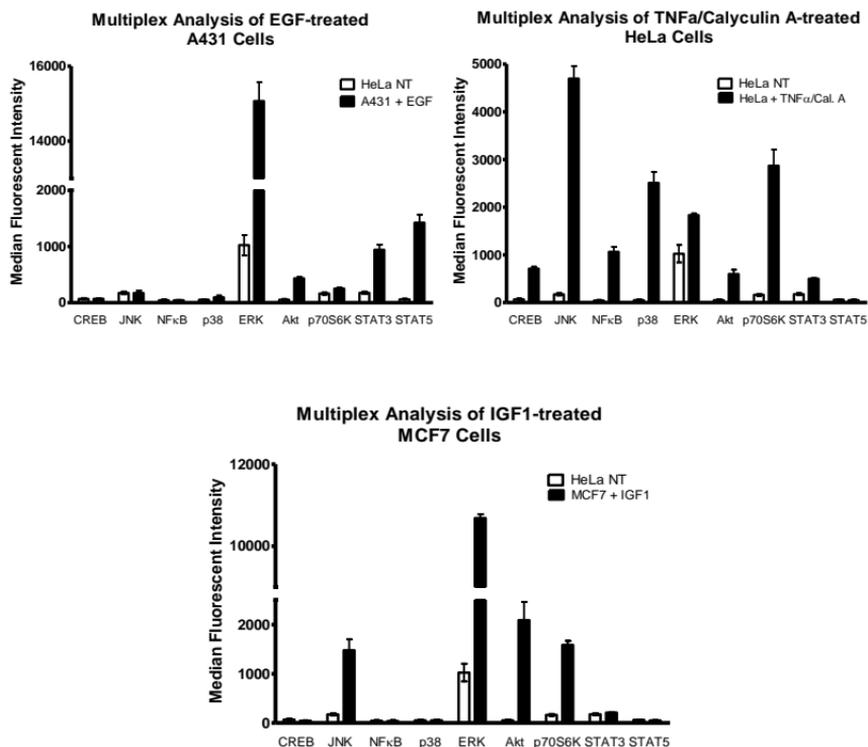
Incubate 15 min at RT with shaking; dark

Remove Streptavidin-PE/ Amplification buffer and resuspend beads in 150  $\mu\text{L}$  Assay Buffer. Read results using appropriate Luminex<sup>®</sup> instrument.

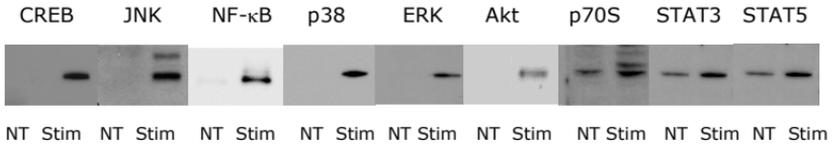
## Plate Washer Use

The use of a plate washer is not a recommended method of washing for cell signaling assays. Deterioration of assay performance and well-to-well variability have been noted when using plate washers. If desired, MPEQ-AB may be purchased and used as a general wash buffer with plate washers. MPEQ-AB should be diluted to 1X for use in plate washers. Follow standard protocol wash instructions when using a plate washer (2 washes after sample incubation). Contact Tech Service if additional instructions are required.

## Representative Data



**Figure 1. Multiplex analysis of A431, MCF-7 or HeLa cells treated with EGF, IGF1 or TNF-α/calyculin A.** HeLa untreated (NT), A431 cells stimulated with 100 ng/mL of EGF (5 min), MCF-7 cells stimulated with 50 ng/mL of IGF1 (10 min) and HeLa cells pretreated with 50 nM calyculin A (15 min) prior to stimulation with 50 ng/mL TNF-α (15 min) were assayed. The cells were lysed in MILLIPLEX® Lysis Buffer containing protease inhibitors. Each lysate (20 μg total protein) was diluted in MILLIPLEX® Assay Buffer 2 and analyzed according the assay protocol (lysate incubation at 4 °C overnight). The Median Fluorescence Intensity (MFI) was measured with the Luminex® system. The figures represent the average and standard deviation of four replicate wells.



**Figure 2. Immunoprecipitation/Western Blot analysis of multiplexed analytes in various cells.** Cell lysates (10 to 50  $\mu\text{g}$ , described in Figure 1) were mixed with capture antibodies to immunoprecipitate each respective protein. The immunoprecipitated proteins were separated on SDS-PAGE, transferred to nitrocellulose, and probed with biotin labeled phospho-specific detection antibodies. The proteins were imaged using Streptavidin-HRP and chemiluminescent substrate. NT-non-treated lysate control, Stim-stimulated lysate control.

## Troubleshooting

<b>Problem</b>	<b>Probable Cause</b>	<b>Solution</b>
Insufficient Bead Count	Bead mix prepared inappropriately	Sonicate bead vials and vortex just prior to adding to bead mix bottle according to protocol. Agitate bead mix intermittently in reservoir while pipetting this into the plate.
	Samples cause interference due to particulate matter or viscosity	See above. Also sample probe may need to be cleaned with Alcohol flush, back flush and washes; or if needed probe should be removed and sonicated.
	Probe height not adjusted correctly	When reading the assay on the Luminex® 200™ instrument, adjust probe height to the kit solid plate or to the recommended Millipore filter plates using 3 alignment discs. When reading the assay on the MAGPIX® instrument, adjust probe height to the kit solid plate or to the recommended filter plates using 2 alignment discs. When reading the assay on the FLEXMAP 3D® instrument, adjust probe height to the kit solid plate using 1 alignment disc. For the FLEXMAP 3D® instrument, when using the solid plate in the kit, the final suspension should be in 150 µL and 75 µL should be aspirated. When reading the assay on the xMAP® INTELLIFLEX instrument, adjust probe height based on the type of plate you are using, place an alignment disk or an alignment sphere in the well according to the protocol recommended by Luminex®.
Background is too high	Background wells were contaminated	Avoid cross-well contamination by using sealer appropriately, and pipeting with Multichannel pipets without touching reagent in plate.
	Insufficient washes	Increase number of washes.

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<b>Problem</b>	<b>Probable Cause</b>	<b>Solution</b>
Beads not in region or gate	Luminex® not calibrated correctly or recently	Calibrate Luminex® based on Instrument Manufacturer's instructions, at least once a week or if temperature has changed by > 3 °C.
	Gate Settings not adjusted correctly	Some Luminex® instruments (for example, Bio-Plex®) require different gate settings than those described in the Kit protocol. Use Instrument default settings.
	Wrong bead regions in protocol template	Check kit protocol for correct bead regions or analyte selection.
	Incorrect sample type used	Samples containing organic solvents or if highly viscous should be diluted or dialyzed as required.
	Instrument not washed or primed	Prime the Luminex® 4 times to rid of air bubbles, wash 4 times with sheath fluid or water if there is any remnant alcohol or sanitizing liquid.
Signal for whole plate is same as background	Beads were exposed to light	Keep plate and bead mix covered with dark lid or aluminum foil during all incubation steps.
	Incorrect or no Detection Antibody was added	Add appropriate Detection Antibody and continue.
Signals too high	Streptavidin-Phycoerythrin was not added	Add Streptavidin-Phycoerythrin according to protocol. If Detection Antibody has already been removed, sensitivity may be low.
	Calibration target value set too high	With some Luminex® Instrument (for example, Bio-Plex®) Default target setting for RP1 calibrator is set at High PMT. Use low target value for calibration and reanalyze plate.
Sample readings are out of range	Plate incubation was too long with samples	Use shorter incubation time.
	Samples contain no or below detectable levels of analyte	If below detectable levels, it may be possible to use higher sample volume. Check with tech support for appropriate protocol modifications.

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<b>Problem</b>	<b>Probable Cause</b>	<b>Solution</b>
High Variation in samples	Multichannel pipet may not be calibrated	Calibrate pipets.
	Plate washing was not uniform	Confirm all reagents are removed completely in all wash steps.
	Samples may have high particulate matter or other interfering substances	See above.
	Plate agitation was insufficient	Plate should be agitated during all incubation steps using a vertical plate shaker at a speed where beads are in constant motion without causing splashing.
	Cross well contamination	Check when reusing plate sealer that no reagent has touched sealer. Care should be taken when using same pipet tips that are used for reagent additions and that pipet tip does not touch reagent in plate.

## FOR FILTER PLATES ONLY

<b>Problem</b>	<b>Probable Cause</b>	<b>Solution</b>
Filter plate will not vacuum	Vacuum pressure is insufficient	Increase vacuum pressure such that 0.2 mL buffer can be suctioned in 3-5 seconds.
	Samples have insoluble particles	Centrifuge samples just prior to assay setup and use supernatant.
	High lipid concentration	After centrifugation, remove lipid layer and use supernatant.
Plate leaked	Vacuum Pressure too high	Adjust vacuum pressure such that 0.2 mL buffer can be suctioned in 3-5 seconds. May need to transfer contents to a new (blocked) plate and continue.
	Plate set directly on table or absorbent towels during incubations or reagent additions	Set plate on plate holder or raised edge so bottom of filter is not touching any surface.
	Insufficient blotting of filter plate bottom causing wicking	Blot the bottom of the filter plate well with absorbent towels after each wash step.
	Pipette touching plate filter during additions	Pipette to the side of plate.
	Probe height not adjusted correctly	Adjust probe to 3 alignment discs in well H6.
	Sample too viscous	May need to dilute sample.

## Product Ordering

<b>Replacement Reagents</b>	<b>Cat. No.</b>
MILLIPLEX® 9-plex Multi-Pathway - Magnetic Beads (20X)	42-680MAG
MILLIPLEX® 9-plex Multi-Pathway, Biotin (20X) (Detection Antibody)	44-680KMG
MILLIPLEX® Lysis Buffer (1X)	43-040
MILLIPLEX® Assay Buffer 2 (1X)	43-041
MILLIPLEX® HeLa Cell Lysate: Unstimulated	47-205
MILLIPLEX® A431 Cell Lysate: EGF	47-210
MILLIPLEX® HeLa Cell Lysate: TNF $\alpha$ /Calyculin A	47-230
MILLIPLEX® MCF7 Cell Lysate: IGF1	47-216
MILLIPLEX® Streptavidin-Phycoerythrin (25X)	45-001H
MILLIPLEX® Amplification Buffer (1X)	43-024A
Set of two MILLIPLEX® 96-well Plates with sealers	MAG-PLATE
Set of two MILLIPLEX® 96-well Filter Plates with sealers	MX-PLATE

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## Well Map

	1	2	3	4	5	6	7	8	9	10	11	12
A	Assay Buffer 2 Blank	HeLa: TNF $\alpha$ /CaIA positive control										
B	Assay Buffer 2 Blank	HeLa: TNF $\alpha$ /CaIA positive control										
C	HeLa: Unstim negative control	Sample 1										
D	HeLa: Unstim negative control	Sample 1										
E	A431: EGF positive control	Sample 2										
F	A431: EGF positive control	Sample 2										
G	MCF7: IGF1 positive control	Etc.										
H	MCF7: IGF1 positive control	Etc.										

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