

Optimization of a LanthaScreen[®] Kinase assay for EGFR (ErbB1)

Overview

This protocol describes how to develop a LanthaScreen[®] kinase assay designed to detect and characterize kinase inhibitors. The development is performed in three steps:

- 1. Optimization of kinase concentration required to determine ATP $K_{m,app}$.**
The assay is first performed at a high concentration of ATP (1 mM) against a dilution series of kinase in order to determine the amount of kinase required to elicit an approximately 80% change between the minimum and maximum TR-FRET emission ratios (the EC_{80} value).
- 2. Determination of ATP $K_{m,app}$.**
Using the concentration of enzyme determined in step 1, the assay is then performed against a dilution series of ATP in order to determine the amount of ATP required to elicit a 50% change between the minimum and maximum TR-FRET emission ratios (the EC_{50} value). This concentration of ATP is referred to as the “apparent” K_m value for ATP, or the ATP $K_{m,app}$.
- 3. Optimization of kinase concentration required for assay at ATP $K_{m,app}$.**
Using the ATP $K_{m,app}$ concentration of ATP determined in step 2, the kinase titration is repeated in order to determine the concentration of kinase required to elicit an approximately 80% change between the minimum and maximum TR-FRET emission ratios at the ATP $K_{m,app}$ concentration of ATP (the EC_{80} value). This is the concentration of kinase that will be used in an assay to determine an IC_{50} value for an inhibitor.

Using the ATP and kinase concentrations determined above, the reaction is then performed in the presence of a dilution series of inhibitor, and the amount of inhibitor required to elicit a 50% change in TR-FRET ratio (the IC_{50}) is determined.

The experiments described in this document can be performed over two days, with steps one and two being performed on the first day, and step three and the inhibitor IC_{50} determination(s) being performed on the second day.

The optimization presented here is designed to maximize sensitivity of the assay towards both ATP-competitive as well as non-ATP competitive inhibitors. If desired, the assay can be performed at higher concentrations of ATP in order to be less sensitive towards ATP-competitive compounds. If such an assay is desired, step 1 is the only step that needs to be performed (at the chosen concentration of ATP) prior to performing the assay in the presence of inhibitors.

The data presented in this document is example data that was generated at Invitrogen. Specific results may vary based upon a variety of factors including the specific activity of the kinase, or the particular plate reader being used. In particular, the Emission Ratio measured can vary greatly between instruments. However, the quality of the data generated should be comparable to the data presented here. If you are reproducing the work presented in this document you should move between the various steps using the values determined in *your* experiments. If you are having trouble reproducing the data presented here, please do not hesitate to contact Invitrogen Technical Services or your Invitrogen representative.

Materials Required

Description	Part Name	Catalog #	Notes
Kinase Reaction Buffer	5X Kinase Buffer Additives: <i>None</i>	PV3189 (4 mL of 5X) <i>n.a.</i>	(1)
Kinase Antibody	EGFR (ErbB1) LanthaScreen® Eu-PY20	PV3872 (10 µg) PV5691 (25 µg)	(2)
Substrate	Alexa Fluor® 647-Poly GT	PV5693 (1 nmol) PV5836 (10 nmol)	(3)
Antibody Dilution Buffer 500 mM EDTA 10 mM ATP	TR-FRET Dilution Buffer Kinase Quench Buffer 10 mM ATP	PV3574 (100 mL) P2825 (1 mL) PV3227 (500 µL)	(4)

- (1) The kinase reaction buffer is supplied as a 5x concentrated stock. Prepare a 1x solution from this stock as described below. The 1x kinase reaction buffer is stable at room temperature.
- (2) The LanthaScreen Eu-PY20 antibody is supplied at an approximate concentration of 0.5 mg/mL. The molecular weight of the antibody is 150 kD. Thus, the stock concentration of 0.5 mg/mL antibody is 3.3 µM, or 3300 nM.
- (3) The substrate is supplied at a concentration of 30 µM.
- (4) The antibody dilution buffer does not contain EDTA. EDTA is added separately, prior to addition of antibody.

Preparing the 1x Kinase Reaction Buffer

Prepare a 1x solution of kinase reaction buffer from the 5x Kinase Buffer stock (listed above) by adding 4 mL of 5x stock to 16 mL H₂O to make 20 mL of 1x kinase reaction buffer.

General Assay Conditions

Kinase reactions are performed in a 10 µL volume in low-volume 384-well plates. Typically, Corning model 3676 (black) or 3673 (white) plates are used. The concentration of substrate in the assay is 100 nM, and the 1x kinase reaction buffer consists of 50 mM HEPES pH 7.5, 0.01% BRIJ-35, 10 mM MgCl₂, and 1 mM EGTA, plus any additional additives that may be required for a specific kinase. Kinase reactions are allowed to proceed for 1 hour at room temperature before a 10 µL preparation of EDTA (20 mM) and Eu-labeled antibody (4 nM) in TR-FRET dilution buffer are added. The final concentration of antibody in the assay well is 2 nM, and the final concentration of EDTA is 10 mM. The plate is allowed to incubate at room temperature for at least 30 minutes before being read on a plate reader configured for LanthaScreen® TR-FRET.

Plate Readers

The data presented in this document were generated using a BMG LABTECH Pherastar plate reader using the LanthaScreen® filter block available from BMG. The assay can be performed on a variety of plate readers including those from Tecan (Ultra, Safire², and InfiniTE F500), Molecular Devices (Analyst and M5), and Perkin Elmer (EnVision, Victor, and ViewLux). Visit www.invitrogen.com/Lanthascreen® or contact Invitrogen Discovery Sciences technical support at 800-955-6288 (select option 3 and enter 40266), or email tech_support@invitrogen.com for more information on performing LanthaScreen® assays on your particular instrument.

Example Protocols

The following example protocols describe the various steps using 16-point dilutions of the variable reagent (kinase, ATP, or inhibitor) in triplicate.

Step 1: Titration of Kinase at 1 mM ATP

- (1.1) In an appropriate tube or vial, prepare 1200 μL of kinase in 1x kinase reaction buffer at 2 times the highest concentration of kinase to be tested. In this example, 0.2 $\mu\text{g}/\text{mL}$ (200 ng/mL) was the highest concentration of kinase to be tested, and the stock concentration of kinase was 430 $\mu\text{g}/\text{mL}$.

Calculations:

$$\text{Kinase: Stock} = 430 \mu\text{g}/\text{mL} \quad 1\text{x} = 0.2 \mu\text{g}/\text{mL} \quad 2\text{x} = 0.4 \mu\text{g}/\text{mL}$$

		<u>[Initial]</u>		<u>[Final 2x]</u>
Kinase:	1.1 μL	*	430 $\mu\text{g}/\text{mL}$	= 1200 μL * 0.4 $\mu\text{g}/\text{mL}$
Buffer:	1198.9 μL kinase reaction buffer			

Procedure:

Add 1.1 μL of 430 $\mu\text{g}/\text{mL}$ kinase to 1198.9 μL kinase reaction buffer.

Keep the diluted kinase on ice until needed.

- (1.2) In a low-volume 384-well plate, fill each well in columns 1–3, rows 2–16 (B through P) with 5 μL kinase reaction buffer. Place 10 μL of the kinase solution prepared in step 1.1 in the top well of each column, and then perform a 2-fold serial dilution down the plate by removing 5 μL of kinase from the top well, adding this to the well below, mixing, and repeating with the next well below. Discard 5 μL of solution from the bottom well such that each well contains 5 μL of kinase solution.
- (1.3) In an appropriate container, prepare 1 mL of substrate and ATP in kinase reaction buffer at 2 times the final concentration of each that is desired in the assay. If a 1 mL solution is prepared in a plastic reagent reservoir (trough), then the next addition step can be performed using a multichannel pipette.

Calculations:

$$\text{Substrate: Stock} = 30 \mu\text{M} \quad 1\text{x} = 0.1 \mu\text{M} \quad 2\text{x} = 0.2 \mu\text{M}$$

$$\text{ATP: Stock} = 10 \text{mM} \quad 1\text{x} = 1 \text{mM} \quad 2\text{x} = 2 \text{mM}$$

		<u>[Initial]</u>		<u>[Final 2x]</u>
Substrate:	6.7 μL	*	30 μM	= 1000 μL * 0.2 μM
ATP:	200 μL	*	10 mM	= 1000 μL * 2 mM
Buffer:	793.3 μL kinase reaction buffer			

Procedure:

Add 6.7 μL of 30 μM substrate and 200 μL of 10 mM ATP to 793.3 μL kinase reaction buffer.

- (1.4) Start the kinase reaction by adding 5 μL of the substrate + ATP solution prepared in step 1.3 to each well of the assay plate.
- (1.5) Cover the assay plate and allow the reaction to proceed for 1 hour at room temperature.
- (1.6) Prior to completion of the kinase reaction, prepare 1 mL of a solution of EDTA and Eu-labeled antibody at 2 times the desired final concentrations of each reagent in TR-FRET dilution buffer. The antibody is stable in EDTA for several hours, but because it is sensitive to high concentrations of EDTA, we recommend first adding the concentrated EDTA to the dilution buffer, mixing the solution well, and then adding the antibody before mixing further.

Calculations:

EDTA: Stock = 500 mM 1x = 10 mM 2x = 20 mM
Antibody: Stock = 3300 nM 1x = 2 nM 2x = 4 nM

			<u>[Initial]</u>			<u>[Final 2x]</u>
EDTA:	40 μ L	*	500 mM	=	1000 μ L	* 20 mM
Antibody:	1.2 μ L	*	3300 nM	=	1000 μ L	* 4 nM
Buffer:	958.8 μ L TR-FRET Dilution Buffer					

Procedure:

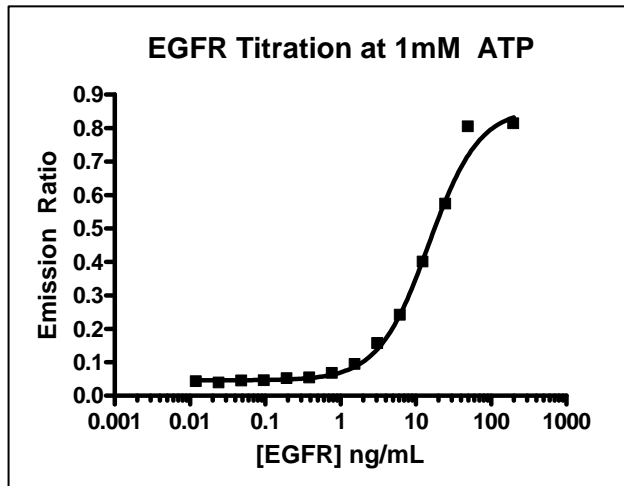
Add 40 μ L of 500 mM EDTA and 1.2 μ L of 3300 nM antibody to 958.8 μ L TR-FRET Dilution Buffer.

- (1.7) Add 10 μ L of the Eu-antibody + EDTA solution prepared in step 1.6 to each well of the assay plate and mix briefly, either by pipette or on a plate shaker.
- (1.8) Cover the assay plate and incubate for 30 minutes at room temperature before reading on an appropriate plate reader.
- (1.9) Plot the resulting TR-FRET emission ratio against the concentration of kinase, and fit the data to a sigmoidal dose-response curve with a variable slope. Calculate the EC₈₀ concentration from the curve. The following equation can be used with GraphPad™ Prism® software:

$$F=80$$
$$\log EC_{50} = \log ECF - (1/\text{HillSlope}) * \log(F/(100-F))$$
$$Y = \text{Bottom} + (\text{Top} - \text{Bottom}) / (1 + 10^{((\text{Log} EC_{50} - X) * \text{HillSlope}))}$$

Alternatively, the amount of kinase needed to elicit an 80% change in TR-FRET response may be estimated from a visual inspection of the curve. It is important that the reactions in the next step of this protocol be performed at or below the EC₈₀ concentration of kinase.

Figure 1: Example of Kinase Titration at 1 mM ATP



The EC₈₀ value determined from the example data was 43.0 ng/mL kinase. Based on this result, 43.0 ng/mL kinase was used for the following step of this protocol.

Step 2: Titration of ATP at the Initial EC₈₀ Concentration of Kinase to determine ATP K_{m,app}

- (2.1) In a small tube or vial, prepare 50 μL of a 2 mM ATP solution by adding 10 μL of 10 mM ATP to 40 μL of kinase reaction buffer.
- (2.2) In a low-volume 384-well plate, fill each well in columns 1–3, rows 2 through 16 (B through P) with 5 μL kinase reaction buffer. Place 10 μL of the 2 mM ATP solution prepared in step 2.1 in the top well of each column, and then perform a 2-fold serial dilution down the plate by removing 5 μL of ATP from the top well, adding this to the well below, mixing, and repeating with the next well below. Discard 5 μL of solution from the bottom well such that each well contains 5 μL of ATP solution in kinase reaction buffer.
- (2.3) In an appropriate container, prepare 1 mL of a solution of substrate and kinase in kinase reaction buffer at 2 times the final concentration of each that is desired in the assay. If a 1000 μL solution is prepared in a plastic reagent reservoir (trough), then the next addition step can be performed using a multichannel pipette.

Since you will be assaying your kinase at < 100 ng/mL, first prepare a 1:100 intermediate dilution of the kinase stock by combining 2 μL of the 430 $\mu\text{g}/\text{mL}$ of EGFR with 198 μL of kinase buffer. Use this intermediate dilution of kinase to prepare the solution.

Calculations:

Substrate:	Stock = 30 μM	1x = 0.1 μM	2x = 0.2 μM
Kinase:	Initial conc. = 4300 ng/mL*	1x = 43.0 ng/mL	2x = 86.0 ng/mL
	* 1:100 dilution of stock		

			[Initial]			[Final 2x]
Substrate:	6.7 μL	*	30 μM	=	1000	* 0.2 μM
Kinase:	20 μL	*	400 ng/mL	=	1000	* 86.0 ng/mL
Buffer:	973.3 μL kinase reaction buffer					

Procedure:

Add 6.7 μL of 30 μM substrate and 20 μL of 4300 ng/mL kinase to 973.3 μL kinase reaction buffer.

- (2.4) Start the kinase reaction by adding 5 μL of the substrate + kinase solution prepared in step 2.3 to each well of the assay plate.
- (2.5) Cover the assay plate and allow the reaction to proceed for 1 hour at room temperature.
- (2.6) Prior to completion of the kinase reaction, prepare 1 mL of a solution of EDTA and Eu-labeled antibody at 2 times the desired final concentrations of each reagent in TR-FRET dilution buffer. The antibody is stable in EDTA for several hours, but because it is sensitive to high concentrations of EDTA, we recommend first adding the concentrated EDTA to the dilution buffer, mixing the solution well, and then adding the antibody before mixing further.

Calculations:

EDTA: Stock = 500 mM 1x = 10 mM 2x = 20 mM
 Antibody: Stock = 3300 nM 1x = 2 nM 2x = 4 nM

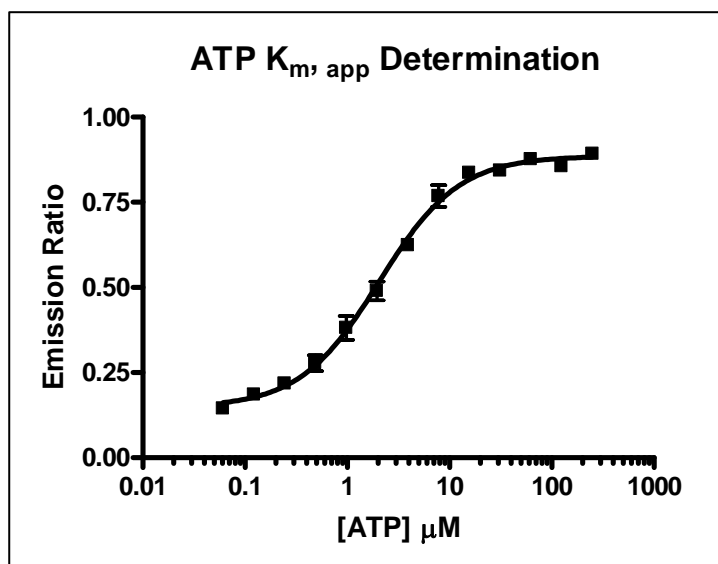
			<u>[Initial]</u>			<u>[Final 2x]</u>
EDTA:	40 μ L	*	500 mM	=	1000 μ L	* 20 mM
Antibody:	1.2 μ L	*	3300 nM	=	1000 μ L	* 4 nM
Buffer:	958.8 μ L TR-FRET Dilution Buffer					

Procedure:

Add 40 μ L of 500 mM EDTA and 1.2 μ L of 3300 nM antibody to 958.8 μ L TR-FRET Dilution Buffer.

- (2.7) Add 10 μ L of the Eu-antibody + EDTA solution prepared in step 2.6 to each well of the assay plate and mix briefly, either by pipette or on a plate shaker.
- (2.8) Cover the assay plate and incubate for 30 minutes at room temperature before reading on an appropriate plate reader.
- (2.9) Plot the resulting TR-FRET emission ratio against the concentration of ATP, and fit the data to a sigmoidal dose-response curve with a variable slope. Calculate the EC_{50} concentration from the curve. This is the ATP $K_{m,app}$ for your kinase under these assay conditions.

Figure 2: Example of ATP $K_{m,app}$ Determination Curve



The EC_{50} value determined from the example data was 2.5 μ M ATP. Based on this result, 2.5 μ M ATP was used for the following step of this protocol.

Step 3: Titration of Kinase at ATP $K_{m,app}$

- (3.1) In an appropriate tube or vial, prepare 1200 μL of kinase in kinase reaction buffer at 2 times the highest concentration of kinase to be tested. In this example, 0.2 $\mu\text{g}/\text{mL}$ (200 ng/mL) was the desired highest concentration of kinase to be tested, and the stock concentration of kinase was 430 $\mu\text{g}/\text{mL}$.

Calculation:

Kinase: Stock = 430 $\mu\text{g}/\text{mL}$ 1x = 0.2 $\mu\text{g}/\text{mL}$ 2x = 0.4 $\mu\text{g}/\text{mL}$

			<u>[Initial]</u>				<u>[Final 2x]</u>
Kinase:	1.1 μL	*	430 $\mu\text{g}/\text{mL}$	=	1200 μL	*	0.4 $\mu\text{g}/\text{mL}$
Buffer:	1198.9 μL kinase reaction buffer						

Procedure:

Add 1.1 μL of 430 $\mu\text{g}/\text{mL}$ kinase to 1198.9 μL kinase reaction buffer.

Keep the diluted kinase on ice until needed.

- (3.2) In a low-volume 384-well plate, fill each well in columns 1–3, rows 2 through 16 (B through P) with 5 μL of kinase reaction buffer. Place 10 μL of the kinase solution as prepared above in the top well of each column, and then perform a 2-fold serial dilution down the plate by removing 5 μL of kinase from the top well, adding this to the well below, mixing, and repeating with the next well below. Discard 5 μL of solution from the bottom well such that each well contains 5 μL of kinase solution.
- (3.3) In an appropriate container, prepare 1 mL of a solution of substrate and ATP in kinase reaction buffer at 2 times the final concentration of each reagent desired in the assay.

Since you will be assaying your kinase at $< 10 \mu\text{M}$ ATP, first prepare 200 μL of a 100 μM intermediate dilution of ATP in water by adding 2 μL of 10 mM ATP to 198 μL H_2O . Use this intermediate dilution of ATP to prepare the solution.

If a 1000 μL solution is prepared in a plastic reagent reservoir (trough), then the next addition step can be performed with a multichannel pipette.

Calculations:

Substrate: Stock = 30 μM 1x = 0.1 μM 2x = 0.2 μM

ATP: Stock = 100 μM 1x = 2.5 μM 2x = 5.0 μM

			<u>[Initial]</u>				<u>[Final 2x]</u>
Substrate:	6.7 μL	*	30 μM	=	1000 μL	*	0.2 μM
ATP:	50.0 μL	*	100 μM	=	1000 μL	*	5.0 μM
Buffer:	943.3 μL kinase reaction buffer						

Procedure:

Add 6.7 μL of 30 μM substrate and 50.0 μL of 100 μM ATP to 943.3 μL kinase reaction buffer.

- (3.4) Start the kinase reaction by adding 5 μL of the substrate + ATP solution prepared in step 3.3 to each well of the assay plate.
- (3.5) Cover the assay plate and allow reaction to proceed for 1 hour at room temperature.
- (3.6) Prior to completion of the kinase reaction, prepare 1 mL of a solution of EDTA and Eu-labeled antibody at 2 times the desired final concentrations of each reagent in TR-FRET dilution buffer. The antibody is stable in

EDTA for several hours, but because it is sensitive to high concentrations of EDTA we recommend first adding the concentrated EDTA to the dilution buffer, mixing the solution well, and then adding the antibody before mixing further.

Calculations:

EDTA: Stock = 500 mM 1x = 10 mM 2x = 20 mM
 Antibody: Stock = 3300 nM 1x = 2 nM 2x = 4 nM

			<u>[Initial]</u>			<u>[Final 2x]</u>
EDTA:	40 µL	*	500 mM	=	1000 µL	* 20 mM
Antibody:	1.2 µL	*	3300 nM	=	1000 µL	* 4 nM
Buffer:	958.8 µL TR-FRET Dilution Buffer					

Procedure:

Add 40 µL of 500 mM EDTA and 1.0 µL of 3300 nM antibody to 958.8 µL TR-FRET Dilution Buffer.

- (3.7) Add 10 µL of the Eu-antibody + EDTA solution prepared in step 3.6 to each well of the assay plate and mix briefly, either by pipette or on a plate shaker.
- (3.8) Cover the assay plate and incubate for 30 minutes at room temperature before reading on an appropriate plate reader.
- (3.9) Plot the resulting TR-FRET emission ratio against the concentration of ATP, and fit the data to a sigmoidal dose-response curve with a variable slope. Calculate the EC₈₀ concentration from the curve. The following equation can be used with GraphPad™ Prism® software:

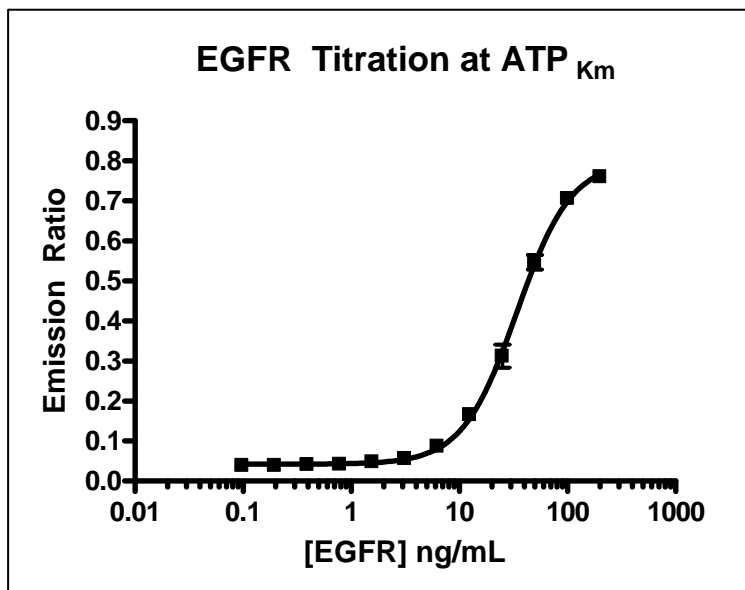
$$F=80$$

$$\log EC_{50} = \log ECF - (1/\text{HillSlope}) * \log(F/(100-F))$$

$$Y = \text{Bottom} + (\text{Top} - \text{Bottom}) / (1 + 10^{((\text{Log} EC_{50} - X) * \text{HillSlope}))}$$

Alternatively, the amount of kinase needed to elicit an 80% change in TR-FRET response may be estimated from a visual inspection of the curve. It is important that the reactions performed to determine the IC₅₀ value of an inhibitor be performed at or below the EC₈₀ concentration of the kinase determined from this graph.

Figure 3: Example of Kinase Titration at ATP $K_{m,app}$



The EC_{80} value determined from the example data was 75.0 ng/mL kinase. Based on this result, 75.0 ng/mL kinase was used to determine inhibitor IC_{50} values when performing the assay at 2.5 μ M ATP.

Step 4: Determination of Inhibitor IC_{50} Value.

(4.1) The general procedure for determining an inhibitor IC_{50} value is as follows:

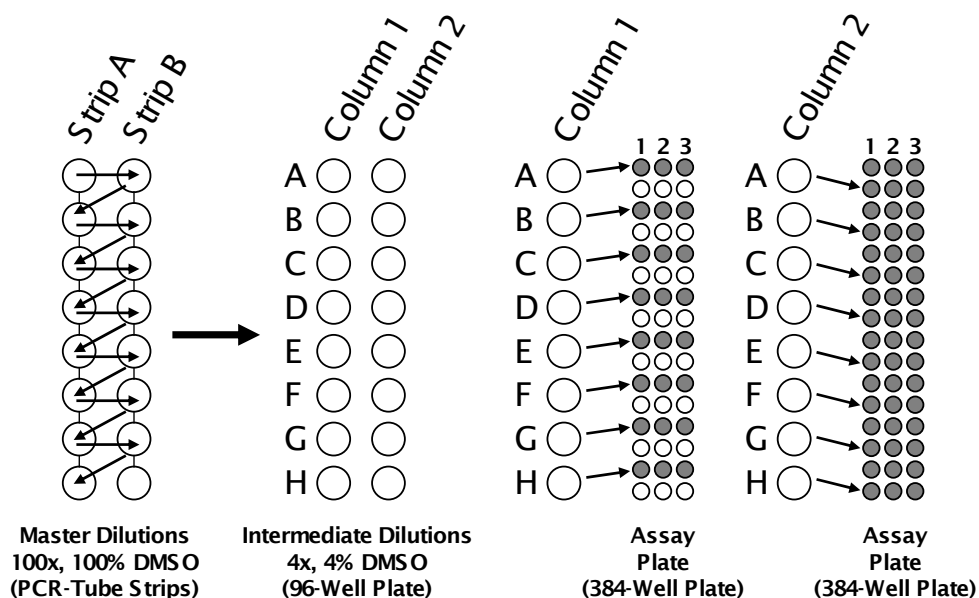
1. Add 2.5 μ L of inhibitor in 4% DMSO at 4-fold the final assay concentration to triplicate assay wells.
2. To start the reaction, add 5 μ L of kinase + substrate at 2-fold the final assay concentration, followed by 2.5 μ L of ATP at 4-fold the final reaction concentrations.
3. The remainder of the protocol is similar to previous steps.

(4.2) A dilution series of inhibitor in 100% DMSO is first prepared at 100 times the concentrations to be assayed. By performing the initial dilutions in 100% DMSO, solubility problems associated with dilutions into aqueous buffer can be minimized.

This “master” dilution series of inhibitor can be prepared in two separate 8-tube PCR strips, and stored at -20° or -80° for use in future experiments. The dilutions are “staggered” between strips as shown in the left side of Figure 4:

1. Add 50 μ L of DMSO to tubes 2–8 of strip A, and all tubes of strip B.
2. Add 100 μ L of inhibitor in DMSO, at 100-fold the highest concentration to be tested in the experiment, to tube 1 of strip A.
3. Transfer 50 μ L of inhibitor from tube 1 of strip A to tube 1 of strip B.
4. After mixing, transfer 50 μ L from tube 1 of strip B to tube 2 of strip A.
5. This process is repeated for all but the final tube of strip B, which contains only DMSO (no inhibitor).

Figure 4: Preparing a Dilution Series of Inhibitor



- (4.3) From the master dilutions of inhibitor in 100% DMSO, intermediate dilutions are then prepared in two columns of a 96-well plate. The 96-well plate is used only as a convenient vessel for preparing the intermediate dilutions.
1. First, place 96 μL of kinase reaction buffer into all wells of two columns of a 96-well plate.
 2. Then, transfer 4 μL of the master inhibitor stock from strip A into column 1 of the 96 well plate, and 4 μL of the master inhibitor stock from strip B into column 2 of the 96-well plate.
 3. Mix the solutions well, either with a plate shaker or by mixing with a 20 μL multichannel pipette.
 4. Using an 8-channel pipette, add 2.5 μL of inhibitor from the intermediate dilution in the 96-well plate to the 384-well assay plate as shown in figure 4. Use column 1 of the intermediate stock to fill rows A, C, E, etc. of the 384-well assay plate, and column 2 to fill the alternating rows B, D, F, etc.
- (4.4) In an appropriate tube or vial, prepare 1000 μL of kinase + substrate in kinase reaction buffer at 2 times the highest concentration to be tested.

Since you will be assaying your kinase at < 100 ng/mL, first prepare a 1:100 intermediate dilution of the kinase stock by combining 2 μL of the 430 mg/mL of EGFR with 198 μL of kinase buffer. Use this intermediate dilution of kinase to prepare the solution.

Calculation:

Kinase: Initial conc. = 4300 ng/mL* 1x = 75 ng/mL 2x = 150 ng/mL
 * 1:100 Dilution of stock

Substrate: Stock = 30 μM 1x = 0.1 μM 2x = 0.2 μM

	<u>[Initial]</u>		<u>[Final 2x]</u>
Kinase:	34.9 μL	* 4300 ng/mL = 1000 μL	* 150 ng/mL
Substrate:	6.7 μL	* 30 μM = 1000 μL	* 0.2 μM
Buffer:	958.4 μL kinase reaction buffer		

Procedure:

Add 34.9 μL of 4300 ng/mL kinase and 6.7 μL of 30 μM substrate to 958.4 μL kinase reaction buffer

- (4.5) Add 5.0 μL of the kinase + substrate solution prepared in step 4.4 to each well of the assay plate.
 (4.6) In an appropriate container, prepare 1 mL of a solution of substrate and ATP in kinase reaction buffer at 4 times the final concentration of each reagent desired in the assay.

If a 1000 μL solution is prepared in a plastic reagent reservoir (trough), then the next addition step can be performed using a multichannel pipette.

Calculations:

ATP: Stock = 10000 μM 1x = 2.5 μM 4x = 10.0 μM

		[Initial]		[Final 4x]
ATP:	1.0 μL	10000 μM	1000 μL	10.0 μM
Buffer:	999.0 μL kinase reaction buffer			

Procedure:

Add 1.0 μL of 100 μM ATP to 999.0 μL kinase reaction buffer.

- (4.7) Start the kinase reaction by adding 2.5 μL of the ATP solution prepared in step 4.6 to each well of the assay plate .
 (4.8) Cover the assay plate and allow reaction to proceed for 1 hour at room temperature.
 (4.9) Prior to completion of the assay, prepare 1 mL of a solution of EDTA and Eu-labeled antibody at 2 times the desired final concentrations of each reagent in TR-FRET dilution buffer. The antibody is stable in EDTA for several hours, but because it is sensitive to high concentrations of EDTA, we recommend first adding the concentrated EDTA to the dilution buffer, mixing the solution well, and then adding the antibody before mixing further.

Calculations:

EDTA: Stock = 500 mM 1x = 10 mM 2x = 20 mM
 Antibody: Stock = 3300nM 1x = 2 nM 2x = 4 nM

			[Initial]			[Final 2x]
EDTA:	40 μL	*	500 mM	=	1000 μL	* 20 mM
Antibody:	1.2 μL	*	3300 nM	=	1000 μL	* 4 nM
Buffer:	958.8 μL TR-FRET Dilution Buffer					

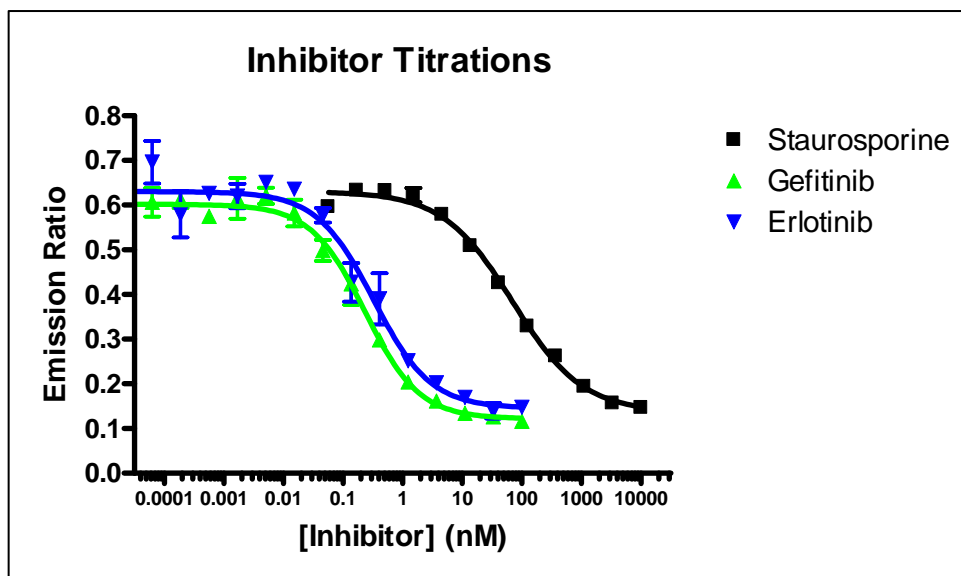
Procedure:

Add 40 μL of 500 mM EDTA and 1.2 μL of 3300 nM antibody to 959.0 μL TR-FRET Dilution Buffer

- (4.10) Add 10 μL of the Eu-antibody + EDTA solution prepared in step 4.9 to each well of the assay plate.
 (4.11) Cover the assay plate and incubate for 30 minutes at room temperature before reading on an appropriate plate reader.

(4.12) Plot the resulting TR-FRET emission ratio against the concentration of inhibitor, and fit the data to a sigmoidal dose-response curve with a variable slope. Calculate the EC_{50} concentration from the curve. This is equal to the IC_{50} value for the inhibitor.

Figure 5: Example of an IC_{50} Curve



The inhibition of EGFR with the inhibitor Staurosporine, Gefitinib and Erlotinib are displayed above.

The IC_{50} value for inhibition of EGFR (ErbB1) with the above inhibitor is shown in the table below.

Kinase	Inhibitor	IC_{50} (nM)	
		Literature	Observed
EGFR (ErbB1)	Staurosporine	NR	70.6
	Gefitinib	NR ¹	0.23
	Erlotinib	NR	0.32

NR = No value reported

¹ Wakeling et al. (Cancer Res. (2002) **62**: 5749-5754.) reported an IC_{50} value for Gefitinib from 9 – 59 nM for EGFR. However, specific assay conditions were not disclosed making it difficult to perform a direction comparison.

For convenience, titration curves can be normalized by dividing all values in the curve by the ratio obtained at the bottom of the curve. This will normalize the titration curves making data comparison between various instruments and gain settings easier. Normalizing the data will have no effect on the IC_{50} values or Z' prime.