

**Human Retinoic Acid Receptor Alpha  
(NR1B1, RARA, RAR $\alpha$ )  
Reporter Assay System**

**96-well Format Assays**  
Product # IB02201

▪

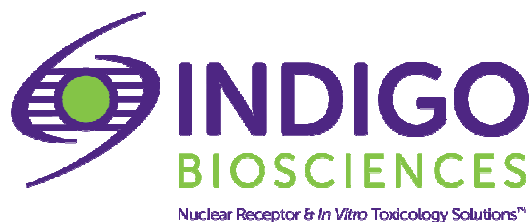
**Technical Manual**  
*(version 7.1i)*

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## Human RAR $\alpha$ Reporter Assay System 96-well Format Assays

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## ***I. Description***

### **▪ The Assay System ▪**

This nuclear receptor assay utilizes proprietary non-human cells engineered to provide constitutive, high-level expression of the **Human Retinoic Acid Receptor, Alpha (NR1B1)**, a ligand-dependent transcription factor commonly referred to as RARA or **RAR $\alpha$** .

INDIGO's Reporter Cells include the luciferase reporter gene functionally linked to a RAR $\alpha$ -responsive promoter. Thus, quantifying changes in luciferase expression in the treated reporter cells provides a sensitive surrogate measure of the changes in RAR $\alpha$  activity. The principal application of this assay is in the screening of test samples to quantify any functional activity, either agonist or antagonist, that they may exert against human RAR $\alpha$ .

RAR $\alpha$  Reporter Cells are prepared using INDIGO's proprietary **CryoMite™** process. This cryo-preservation method yields exceptional cell viability post-thaw, and provides the convenience of immediately dispensing healthy, division-competent reporter cells into assay plates. There is no need for cumbersome intermediate treatment steps such as spin-and-rinse of cells, viability determinations, cell titer adjustments, or the pre-incubation of reporter cells prior to assay setup.

INDIGO Bioscience's assays are all-inclusive cell-based assay kit. In addition to RAR $\alpha$  Reporter Cells, this kit provides two optimized media for use during cell culture and in diluting the user's test samples, the reference agonist *9-cis*-Retinoic Acid, Luciferase Detection Reagent, and a cell culture-ready assay plate.

### **▪ The Assay Chemistry ▪**

INDIGO's assays capitalize on the extremely low background, high-sensitivity, and broad linear dynamic range of bio-luminescence reporter gene technology.

Reporter Cells incorporate the cDNA encoding beetle luciferase, a 62 kD protein originating from the North American firefly (*Photinus pyralis*). Luciferase catalyzes the mono-oxidation of D-luciferin in a Mg<sup>+2</sup>-dependent reaction that consumes O<sub>2</sub> and ATP as co-substrates, and yields as products oxyluciferin, AMP, PP<sub>i</sub>, CO<sub>2</sub>, and photon emission. Luminescence intensity of the reaction is quantified using a luminometer and is reported in terms of Relative Light Units (RLU's).

INDIGO's assays feature a luciferase detection reagent specially formulated to provide stable light emission between 5 and 90+ minutes after initiating the luciferase reaction. Incorporating a 5-minute reaction-rest period ensures that light emission profiles attain maximal stability, thereby allowing assay plates to be processed in batch. By doing so, the signal output from all sample wells, from one plate to the next, may be directly compared within an experimental set.

### ▪ Preparation of Test Compounds ▪

Small molecule test compounds are typically solvated in DMSO at high concentrations; ideally 1,000x-concentrated stocks relative to the highest desired treatment concentration in the assay. Using high-concentration stocks minimizes DMSO carry-over into the assay plates. Immediately prior to setting up an assay, the master stocks are serially diluted using one of two alternative strategies:

1.) As described in *Step 2*, and depicted in Appendix 1 for the reference agonist, **Compound Screening Medium (CSM)** may be used as the diluent to make serial dilutions of test compounds to achieve the desired final assay concentration series.

Alternatively, if test compound solubility is expected to be problematic, 2.) DMSO may be used to make serial dilutions, thereby generating 1,000x-concentrated stocks for each independent test concentration. Treatment media are then prepared using CSM to make final 1,000-fold dilutions of the prepared DMSO dilution series.

Regardless of the dilution method used, the final concentration of total DMSO carried over into assay wells should not exceed 0.4%. DMSO-induced cytotoxicity can be expected above 0.4%.

*NOTE:* CSM is formulated to help stabilize hydrophobic test compounds in the aqueous environment of the assay mixture. Nonetheless, high concentrations of extremely hydrophobic test compounds diluted in CSM may lack long-term stability and/or solubility, especially if further stored at low temperatures. Hence, it is recommended that test compound dilutions are prepared in CSM immediately prior to assay setup and are considered to be 'single-use' reagents.

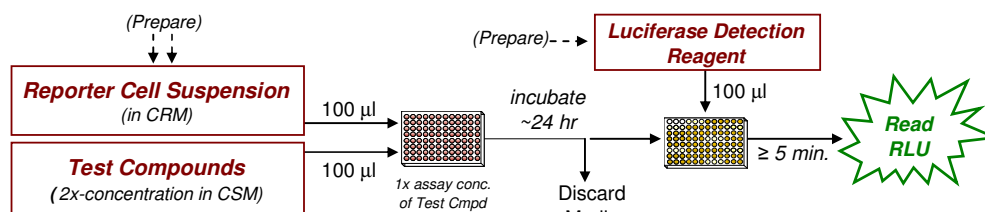
### ▪ Considerations for Automated Dispensing ▪

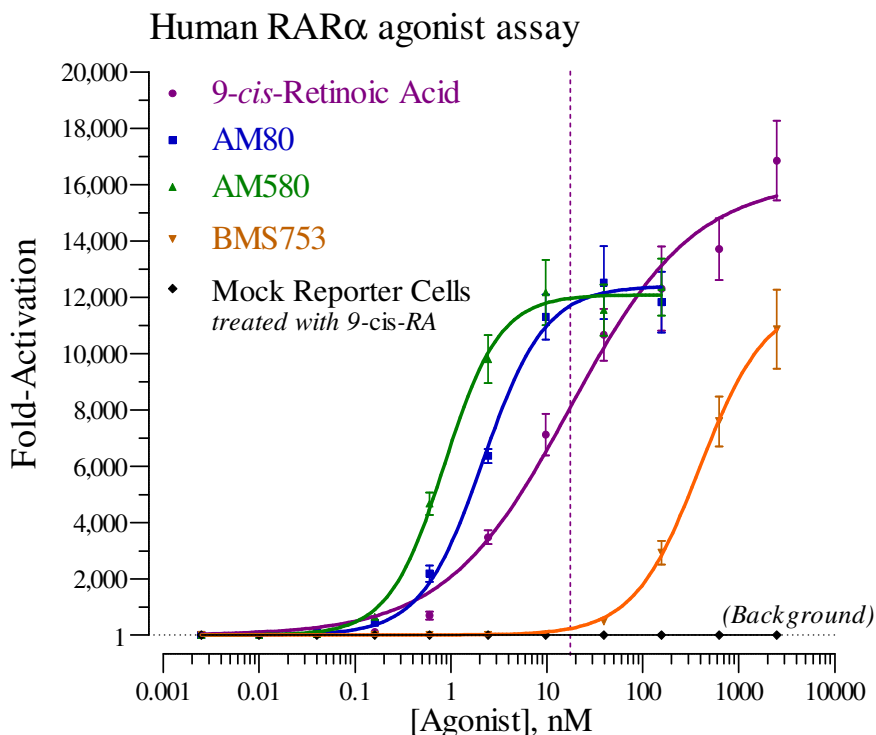
When processing a small number of assay plates, first carefully considered the dead volume requirement of your dispensing instrument before committing assay reagents to its setup. In essence, "dead volume" is the volume of reagent that is dedicated to the instrument; it will *not* be available for final dispensing into assay wells. The following Table provides information on reagent volume requirements, and available excesses.

Stock Reagent & Volume provided	Volume to be Dispensed (96-well plate)	Excess rgt. volume available for instrument dead volume
<b>Reporter Cell Suspension</b> 12 ml (prepared from kit components)	100 µl / well 9.6 ml / plate	~ 2.4 ml
<b>LDR</b> 12 ml (prepared from kit components)	100 µl / well 9.6 ml / plate	~ 2.4 ml

### ▪ Assay Scheme ▪

**Figure 1.** Assay workflow. *In brief*, Reporter Cells are dispensed into wells of the assay plate and then immediately dosed with the user's test compounds. Following 22 -24 hr incubation, treatment media are discarded and prepared Luciferase Detection Reagent (LDR) is added. Light emission from each assay well is quantified using a plate-reading luminometer.





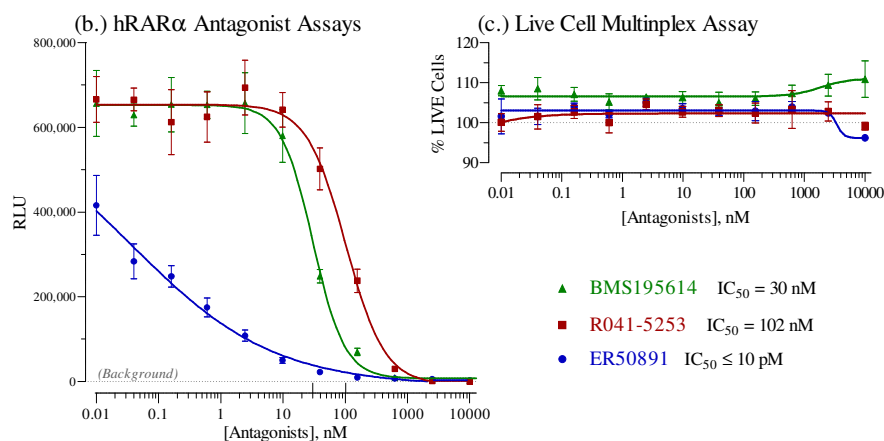
**Figure 2a. Agonist dose-response analyses of the RAR $\alpha$  Assay.**

Validation of the RAR $\alpha$  Assay was performed using manual dispensing and following the protocol described in this Technical Manual, using reference agonists 9-*cis*-Retinoic Acid (9-*cis*-RA; provided), AM80 (Tocris), AM580 (Tocris) and BMS753 (Tocris). In addition, to assess the level of background signal contributed by non-specific factors that may cause activation of the luciferase reporter gene, “Mock” reporter cells were specially prepared to contain only the luciferase reporter vector (mock reporter cells are not provided with assay kits). Final assay concentrations of agonist treatment media ranged between 2.5  $\mu$ M and 2.5 pM, and included a 'no-treatment' control (n  $\geq$  6 / treatment; highest [DMSO]  $\leq$  0.025% *f.c.*. APPENDIX 1 describes an abbreviated 8-point dilution scheme.) Mock Reporter Cells were identically treated with 9-*cis*-RA. Luminescence was quantified using a GloMax-Multi+ plate-reading luminometer (Promega Corp.). Average Relative Light Units (RLU) and their respective values of Standard Deviation (SD), Coefficient of Variation (CV), and Signal-to-Background (S/B) were determined for each treatment concentration. Z' values were calculated as described by Zhang, *et al.* (1999)<sup>1</sup>. Non-linear regression analyses were performed and EC<sub>50</sub> values determined using GraphPad Prism software.

**RESULTS:** RAR $\alpha$  reporter cells treated with 2,500 nM 9-*cis*-RA yielded an EC<sub>50</sub> value of 17.5 nM, S/B  $\sim$  16,800, and Z' = 0.75. Mock reporter cells treated with 9-*cis*-RA demonstrate no luminescence above plate background. Thus, luminescence results strictly through ligand-dependent activation of the human RAR $\alpha$  expressed in these reporter cells.

<sup>1</sup> Zhang JH, Chung TD, Oldenburg KR. (1999) A Simple Statistical Parameter for Use in Evaluation and Validation of High Throughput Screening Assays. *J Biomol Screen.*:4(2), 67-73.

$$Z' = 1 - [3 * (SD^{\text{Control}} + SD^{\text{Background}}) / (RLU^{\text{Control}} - RLU^{\text{Background}})]$$



**Figure 2b. Validation of RAR $\alpha$  antagonist dose-responses performed in combination with INDIGO's Live Cell Multiplex Assay.**

RAR $\alpha$  antagonist assays were performed using BMS195614, R041-5253, and ER50891 (all from Tocris). To confirm that the observed drop in RLU values resulted from receptor inhibition, not induced cell death, the relative numbers of live cells in each assay well were determined at the end of the treatment period using INDIGO's Live Cell Multiplex (LCM) Assay (#LCM-01).

Final assay concentrations of the respective antagonists ranged between 10  $\mu$ M and 10 pM, including a 'no antagonist' control ( $n \geq 6$  per treatment; highest [DMSO]  $\leq 0.1\%$  *f.c.*). Each treatment also contained 15 nM (approximating EC<sub>50</sub>) 9-*cis*-RA as challenge agonist. Assay plates were incubated for 23 hrs, then processed according to the LCM Assay protocol to quantify relative numbers of live cells per treatment condition. Plates were then further processed to quantify RAR $\alpha$  activity for each treatment condition.

*Results:* BMS195614, R041-5253, and ER50891 all caused dose-dependent reduction in RLU values. The LCM Assay reveals no significant variance in the numbers of live cells per assay well, up to the maximum treatment concentration of 10  $\mu$ M. Hence, the observed reduction in RLU values can be attributed to dose-dependent inhibition of RAR $\alpha$  activity, and *not* to induced cell death.

*NOTE:* RLU values will vary slightly between different production lots of reporter cells, and can vary *significantly* between different makes and models of luminometers.

## II. Product Components & Storage Conditions

This Human RAR $\alpha$  assay kit contains materials to perform assays in a single 96-well assay plate.

**Reporter cells are temperature sensitive! To ensure maximal viability the tube of cells must be maintained at -80°C until immediately prior to the rapid-thaw procedure described in Step 3 of this protocol.**

Assay kits are shipped on dry ice. Upon receipt of the kit transfer it to -80°C storage. If you wish to first inspect and inventory the individual kit components be sure to first transfer and submerge the tube of reporter cells in dry ice.

The aliquot of Reporter Cells is provided as a single-use reagent. Once thawed, reporter cells can NOT be refrozen, nor can they be maintained in extended culture with any hope of retaining downstream assay performance. Therefore, extra volumes of these reagents should be discarded after assay setup.

The date of product expiration is printed on the Product Qualification Insert (PQI) enclosed with each kit.

<u>Kit Components</u>	<u>Amount</u>	<u>Storage Temp.</u>
▪ RAR $\alpha$ Reporter Cells	1 x 2.0 mL	<b>-80°C</b>
▪ Cell Recovery Medium (CRM)	1 x 10.5 mL	-20°C
▪ Compound Screening Medium (CSM)	1 x 35 mL	-20°C
▪ 9- <i>cis</i> -Retinoic Acid, 10 mM (in DMSO) (reference agonist for RAR $\alpha$ )	1 x 30 $\mu$ L	-20°C
▪ Detection Substrate	1 x 6.0 mL	<b>-80°C</b>
▪ Detection Buffer	1 x 6.0 mL	-20°C
▪ 96-well assay plate (white, sterile, cell-culture ready)	1	ambient

## III. Materials to be Supplied by the User

The following materials must be provided by the user, and should be made ready prior to initiating the assay procedure:

### DAY 1

- dry ice bucket (*Step 3*)
- cell culture-rated laminar flow hood.
- 37°C, humidified 5% CO<sub>2</sub> incubator for mammalian cell culture.
- 37°C water bath.
- 70% alcohol wipes
- 8-channel electronic, repeat-dispensing pipettes & sterile tips
- disposable media basins, sterile.
- sterile multi-channel media basins (such as the Heathrow Scientific "Dual-Function Solution Basin"), *or* sterilized 96 deep-well blocks (*e.g.*, Axygen Scientific, #P-2ML-SQ-C-S), *or* appropriate similar vessel for generating dilution series of reference and test compound(s).
- *Optional*: antagonist reference compound (see Fig. 2b).
- *Optional*: clear 96-well assay plate, sterile, cell culture treated, for viewing cells on *Day 2*.

**DAY 2** plate-reading luminometer.

## IV. Assay Protocol

Review the entire Assay Protocol before starting. Completing the assay requires an overnight incubation. *Steps 1-8* are performed on **Day 1**, requiring less than 2 hours to complete. *Steps 9-14* are performed on **Day 2** and require less than 1 hour to complete.

### ▪ A word about Antagonist-mode assay setup ▪

Receptor inhibition assays expose the Reporter Cells to a constant, sub-maximal concentration (typically between  $EC_{50}$  –  $EC_{85}$ ) of a known agonist AND the test compound(s) to be evaluated for antagonist activity. This RAR $\alpha$  assay kit includes a 10 mM stock solution of **9-cis-Retinoic Acid**, an agonist of RAR $\alpha$  that may be used to setup antagonist-mode assays. 20 nM 9-cis-Retinoic Acid typically approximates  $EC_{50}$  in this assay. Hence, it presents a reasonable assay concentration of agonist to be used when screening test compounds for inhibitory activity.

We find that adding the reference agonist to the bulk suspension of Reporter Cells (*i.e.*, prior to dispensing into assay wells) is the most efficient and precise method of setting up antagonist assays, and it is the method presented in *Step 5b* of the following protocol. Note that, in *Step 6*, 100  $\mu$ l of treatment media is combined with 100  $\mu$ l of pre-dispensed [Reporter Cells + agonist]. Consequently, one must prepare the bulk suspension of Reporter Cells to contain a 2x-concentration of the reference agonist. **APPENDIX 1** provides a dilution scheme that may be used as a guide when preparing cell suspension supplemented with a desired 2x-concentration of agonist.

**DAY 1 Assay Protocol:** All steps must be performed using aseptic technique.

**1.) Remove Cell Recovery Medium (CRM) and Compound Screening Medium (CSM)** from freezer storage and thaw in a 37°C water bath.

**2.) Prepare dilutions of treatment compounds** (first see *Note 5.4*): Prepare Test Compound treatment media for *Agonist-* or *Antagonist-mode* screens.

The final concentration of total DMSO, or any organic solvent, carried over into assay reactions should not exceed 0.4%.

Note that, in *Step 6*, 100  $\mu$ l of the prepared treatment media is added into assay wells that have been pre-dispensed with 100  $\mu$ l of Reporter Cells. Hence, to achieve the desired *final* assay concentrations one must prepare treatment media with a 2x-concentration of the test and reference material(s). Use **CSM** to prepare the appropriate dilution series. Plan dilution volumes carefully; this assay kit provides 35 ml of CSM.

**Preparing the positive control:** This RAR $\alpha$  assay kit includes a 10 mM stock solution of **9-cis-Retinoic Acid**, a reference agonist of RAR $\alpha$ . We find the following 8-point treatment series, with concentrations presented in 4-fold decrements, provides a suitable dose-response: 2500, 625, 156, 39.1, 9.77, 2.44, 0.610, and 0.153 nM, and including a 'no treatment' control. **APPENDIX 1** provides an example for generating such a dilution series.

**3.) Rapid Thaw of the Reporter Cells:** *First*, retrieve the tube of **CRM** from the 37°C water bath and sanitize the outside surface with a 70% ethanol swab.

*Second*, retrieve **Reporter Cells** from -80°C storage and immerse in dry ice to transport the tube to a laminar flow hood. When ready, transfer the tube of cells to a rack and perform a *rapid thaw* of the frozen cells by transferring a 10 ml volume of 37°C CRM into the tube of frozen cells. Recap the tube of cells and immediately place it in a 37°C water bath for 5 - 10 minutes. The resulting volume of cell suspension will be 12 ml.



4.) Retrieve the tube of Reporter Cell Suspension from the water bath. Sanitize the outside surface of the tube with a 70% alcohol swab, then transfer it into the cell culture hood.

5.) *a. Agonist-mode assays.* Gently invert the tube of Reporter Cells several times to gain a homogenous cell suspension. Without delay, dispense 100 µl of cell suspension into each well of the assay plate.

~ or ~

*b. Antagonist-mode assays.* Gently invert the tube of Reporter Cells several times to disperse any cell aggregates, and to gain a homogenous cell suspension. Supplement the bulk suspension of Reporter Cells with the desired 2x-concentration of reference agonist (refer to "A word about antagonist-mode assay setup", pg. 8). Dispense 100 µl of cell suspension into each well of the assay plate.

*NOTE 5.1:* If INDIGO's Live Cell Multiplex Assay is to be incorporated, a minimum of 3 'cell blank' wells (meaning cell-free, but containing 'Compound Screening Media') must be included in the assay plate to allow quantification of plate-specific fluorescence background (refer to the LCMA Technical Manual).

*NOTE 5.2:* Take special care to prevent cells from settling during the dispensing period. Allowing cells to settle during the transfer process, and/or lack of precision in dispensing uniform volumes across the assay plate *will* cause well-to-well variation (= increased Standard Deviation) in the assay.

*NOTE 5.3:* Users sometimes wish to examine the reporter cells using a microscope. If so, the extra volume of cell suspension provided with each kit may be dispensed (100 µl/well) into a clear 96-well cell culture treated assay plate, followed by 100 µl/well of CSM. Incubated overnight in identical manner to those reporter cells contained in the white assay plate.

*NOTE 5.4:* For logistical reasons, some users find it more convenient to first plate the reporter cells and then prepare their test compound dilutions. That strategy works equally well. Once plated, cells may be placed in an incubator for ~ 3 hours before proceeding to *Step 6*.

*NOTE 5.5:* If well-to-well variation due to 'edge-effects' is a concern this problem *may* be mitigated by dispensing sterile liquid into the *inter-well* spaces of the assay plate. Simply remove 1 tip from the 8-channel dispenser and dispense 100 µl of sterile water into each of the seven inter-well spaces per column of wells.

6.) Dispense 100 µl of 2x-concentration treatment media into appropriate assay wells.

7.) Transfer the assay plate into a cell culture incubator (37°C, humidified 5% CO<sub>2</sub>) for 22 - 24 hours.

*NOTE:* Ensure a high-humidity (≥ 70%) environment within the cell culture incubator. This is critical to prevent the onset of deleterious "edge-effects" in the assay plate.

8.) For greater convenience on *Day 2*, retrieve **Detection Substrate** and **Detection Buffer** from freezer storage and place them in a dark refrigerator (4°C) to thaw overnight.

**DAY 2 Assay Protocol:** Subsequent manipulations do *not* require special regard for aseptic technique and may be performed on a bench top.

9.) 30 minutes before intending to quantify receptor activity, remove **Detection Substrate** and **Detection Buffer** from the refrigerator and place them in a low-light area so that they may equilibrate to room temperature.

*NOTE:* Do NOT actively warm Detection Substrate above room temperature. If these solutions were not allowed to thaw overnight at 4°C, a room temperature water bath may be used to expedite thawing.

10.) Set the plate-reader to "luminescence" mode. Set the instrument to perform a single 5 second "plate shake" prior to reading the first assay well. Read time may be set to 0.5 second (500 mSec) per well, *or less*.

11.) *Immediately before proceeding to Step 12*, transfer the entire volume of Detection Buffer into the vial of Detection Substrate, thereby generating a 12 ml volume of **Luciferase Detection Reagent (LDR)**. Mix gently to avoid foaming.

12.) Following 22 - 24 hours of incubation discard all media contents by ejecting it into an appropriate waste container. *Gently* tap the inverted plate onto a clean absorbent paper towel to remove residual droplets. Cells will remain tightly adhered to well bottoms.

13.) Add 100 µl of **LDR** to each well of the assay plate. Allow the assay plate to rest at room temperature for 5 - 10 minutes. Do not shake the assay plate during this period.

14.) Quantify luminescence.

## V. Related Products

<i>Product No.</i>	<i>Product Descriptions</i>
<b>RAR<math>\alpha</math> Assay Products</b>	
IB02201-32	Human RAR $\alpha$ Reporter Assay System 3x 32 assays in 8-well strips (96-well plate format)
IB02201	Human RAR $\alpha$ Reporter Assay System 1x 96-well format assay
IB02202	Human RAR $\alpha$ Reporter Assay System 1x 384-well format assays
Bulk volumes of assay reagents may be custom manufactured to accommodate any scale of HTS. Please Inquire.	
<b>LIVE Cell Multiplex (LCM) Assay</b>	
<i>Product No.</i>	<i>Product Descriptions</i>
LCM-01	Reagent volumes sufficient to perform <b>96</b> Live Cell Assays in 1x96-well, or 2x48-well, or 3x32-well assay plate formats
LCM-05	Reagent in 5x-bulk volume to perform <b>480</b> Live Cell Assays in any combination of 1x96-, 2x48-, or 3x32-well assay plate formats
LCM-10	Reagent in 10x-bulk volume to perform <b>960</b> Live Cell Assays in any combination of 1x96-, 2x48-, or 3x32-well assay plate formats
<b>INDIGlo Luciferase Detection Reagent</b>	
LDR-10, -25, -50, -500	INDIGlo Luciferase Detection Reagents in 10 mL, 25 mL, 50 mL, and 500 mL volumes

Please refer to INDIGO Biosciences' website for updated product offerings.

[www.indigobiosciences.com](http://www.indigobiosciences.com)

## VI. Limited Use Disclosures

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Product prices, availability, specifications, claims and technical protocols are subject to change without prior notice. The printed Technical Manual provided in the kit box will always be the most current version available.

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