



**Zebrafish Retinoic Acid Receptor Alpha, isoform A**  
**(nr1b1 isoA; zfRARaa; zfRARα)**  
**Reporter Assay System**

**3x 32 Assays in 96-well Format**  
Product # Z02201-32

■

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

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## **Zebrafish RAR $\alpha$ Reporter Assay System**

### **3x 32 Assays in 96-well Format**

<b>I. Description</b>	
▪ The Assay System.....	3
▪ The Assay Chemistry.....	3
▪ Preparation of Test Compounds.....	4
▪ Assay Scheme.....	4
▪ Assay Performance.....	5
<b>II. Product Components &amp; Storage Conditions</b> .....	6
<b>III. Materials to be Supplied by the User</b> .....	6
<b>IV. Assay Protocol</b>	
▪ A word about <i>Antagonist</i> -mode assay setup.....	7
▪ <i>DAY 1 Assay Protocol</i> .....	7
▪ <i>DAY 2 Assay Protocol</i> .....	9
<b>V. Related Products</b> .....	10
<b>VI. Limited Use Disclosures</b> .....	10
<b>APPENDIX 1: Example Scheme for Serial Dilution</b> .....	11

## I. Description

### ▪ The Assay System ▪

This nuclear receptor assay utilizes proprietary non-human cells engineered to provide constitutive, high-level expression of the **Zebrafish (*Danio rerio*) Retinoic Acid Receptor, Alpha A (nr1b1 isoform A)**, a ligand-dependent transcription factor referred to herein as **zfRARaa**.

INDIGO's Reporter Cells express a hybrid zebrafish RARaa receptor in which the native N-terminal ligand binding domain (LBD) has been substituted with that of the yeast GAL4 LBD sequence. Accordingly, the resident luciferase reporter gene is functionally linked to tandem copies of the Gal4 upstream activation sequence (UAS). Thus, quantifying changes in luciferase expression in the treated reporter cells provides a specific and sensitive surrogate measure of ligand-induced changes in zfRARaa activity. The principal application of this assay is in the screening of test samples to quantify any functional bioactivity that they may exert against zebrafish RARaa. In particular, zebrafish reporter assays are used in the monitoring of environmental samples for the presence of bio-active chemical pollutants.

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 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 the cells prior to assay setup.

INDIGO Bioscience's Nuclear Receptor Assays are all-inclusive cell-based assay kits. In addition to zfRARaa Reporter Cells, this kit provides two optimized media for use during cell culture and in diluting the user's test samples, a reference agonist, Luciferase Detection Reagent, and a cell culture-ready assay plate.

### ▪ The Assay Chemistry ▪

INDIGO's nuclear receptor 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  $Mg^{+2}$ -dependent reaction that consumes  $O_2$  and ATP as co-substrates, and yields as products oxyluciferin, AMP,  $PP_i$ ,  $CO_2$ , 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 Nuclear Receptor 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.

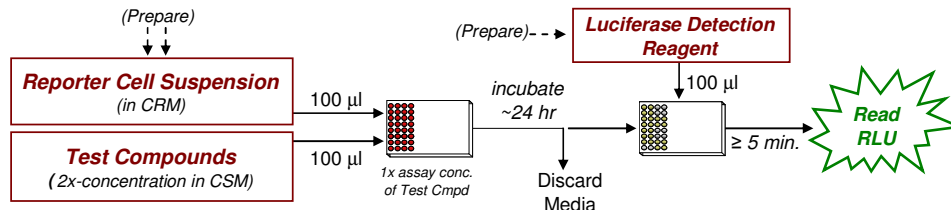
### ▪ Preparation of Test Compounds ▪

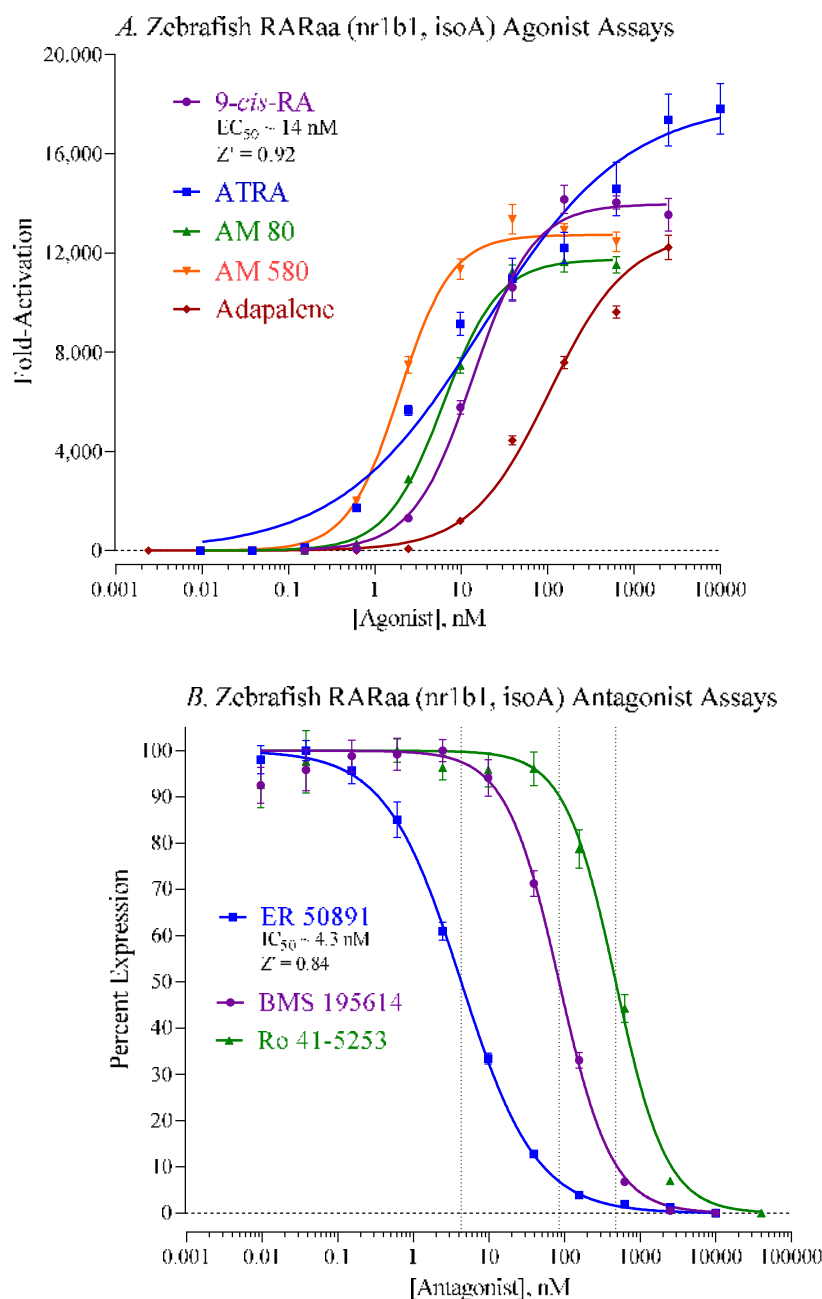
Most commonly, test compounds are solvated at high-concentrations (preferably  $\geq 1,000\times$ ) in DMSO, and these are stored as master stocks. Master stocks are then diluted to appropriate working concentrations immediately prior to setting up the assay. Dilute test compounds to 2x-concentration stocks using **Compound Screening Medium (CSM)**, as described in *Step 2* of the **Assay Protocol**. The final concentration of total DMSO carried over into assay reactions should never exceed 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.

### ▪ 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 2** Validation of the zfRARα Assay was performed using manual dispensing and following the protocol described in this Technical Manual. *A.) Agonist dose-response analyses.* Reference agonists 9-*cis*-Retinoic Acid (9-*cis*-RA; provided), all *trans*-Retinoic Acid (ATRA), AM 80, AM 580, and Adapalene (all from Tocris);  $n \geq 3$  / treatment. APPENDIX 1 describes a 7-point dilution scheme for the provided reference agonist 9-*cis*-RA. *B.) Antagonist dose-response analyses.* Assay wells were co-treated with a fixed  $EC_{50}$  concentration of the agonist 9-*cis*-RA and varying concentrations of the individual antagonists ER 50891, BMS 195614 (Tocris) and Ro 41-5253 (Enzo). Luminescence was quantified and 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  $EC_{50}$  /  $IC_{50}$  values determined using GraphPad Prism software.

<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.  $Z' = 1 - [3 * (SD^{Control} + SD^{Bkg}) / (RLU^{Control} - RLU^{Bkg})]$

## II. Product Components & Storage Conditions

This Zebrafish RARα Assay kit contains materials to perform three distinct groups of assays in a 96-well plate format. Reagents are configured so that each group will comprise 32 assays. If desired, however, reagents may be combined to perform either 64 or 96 assays.

The individual aliquots of Reporter Cells are provided as single-use reagents. Once thawed, cells can NOT be refrozen or maintained in extended culture with any hope of retaining downstream assay performance. Therefore, extra volumes of these reagents should be discarded after assay setup.

Assay kits are shipped on dry ice. **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 2 of this protocol.** Upon receipt of the kit transfer it to -80°C storage. If you wish to first inventory the individual kit components be sure to first transfer and submerge the tube of cells in dry ice.

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>
▪ zfRARα 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, 800 μM (in DMSO) (reference agonist)	1 x 30 μL	-20°C
▪ Detection Substrate	3 x 2.0 mL	<b>-80°C</b>
▪ Detection Buffer	3 x 2.0 mL	-20°C
▪ Plate frame	1	ambient
▪ Snap-in, 8-well strips (white, sterile, cell-culture ready)	12	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* deep-well plates, *or* appropriate similar vessel for generating dilution series of reference compound(s) and test compound(s).
- *Optional*: antagonist reference compound.
- *Optional*: clear 96-well cell culture assay plate 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<sub>50</sub> – EC<sub>85</sub>) of a known agonist AND the test compound(s) to be evaluated for antagonist activity. This assay kit includes an 800 µM stock solution of **9-*cis*-Retinoic Acid**, an agonist of zfRARα that may be used to setup antagonist-mode assays. 40 nM 9-*cis*-Retinoic Acid typically approximates EC<sub>80</sub> in this assay. Hence, it presents a suitable assay concentration of challenge agonist to be used when screening test compounds for inhibitory activity.

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 µl of treatment media is combined with 100 µl of pre-dispensed [Reporter Cells + agonist]. Consequently, one must prepare the bulk suspension of cells to contain a **2x**-concentration of the challenge agonist 9 *cis*-RA. **APPENDIX 1** provides a dilution scheme that may adjusted appropriately to prepare the cell suspension supplemented with the desired 2x EC<sub>80</sub> concentration (~80 nM) of 9-*cis*-RA.

**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 5.3*): Prepare Test Compound treatment media for *Agonist*- or *Antagonist-mode* screens.

The final concentration of total DMSO carried over into assay reactions should never exceed 0.4%.

Note that, in *Step 6*, 100 µl of the prepared treatment media is added into assay wells that have been pre-dispensed with 100 µl 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 assay kit includes an 800 µM stock of the reference agonist **9-*cis*-Retinoic Acid**. The following 7-point treatment series, with concentrations presented in 4-fold decrements, provides a complete dose-response: 800, 200, 50.0, 12.5, 3.13, 0.781 and 0.195 nM. Always include 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 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: 1 tube for 32 assay wells, 2 tubes for 64 assay wells, and 3 tubes for 96 assay wells. Transfer the tube(s) into a rack and, *without delay*, perform a rapid thaw of the frozen cells by transferring a 3.0 ml volume of 37°C CRM into each tube of frozen cells. Recap the tube of cells and immediately place it in a 37°C water bath for 5 - 10 minutes. If only one tube of reporter cells is thawed (32 assays), the resulting volume of cell suspension will be 3.6 ml.

(continued ...)

*Third*, work in the cell culture hood to *carefully* mount four sterile 8-well strips into the blank assay plate frame. Strip-wells are fragile. Note that they have keyed ends (square and round), hence, they will fit into the plate frame in only one orientation.

4.) Retrieve the tube of 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 cells several times to disperse cell aggregates and gain a homogenous cell suspension. Without delay, dispense 100  $\mu$ l / well of cell suspension into the strip-wells mounted in the plate frame.

~ 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 EC80-concentration of challenge agonist (refer to "*A word about antagonist-mode assay setup*", pg. 7). Dispense 100  $\mu$ l / well of cell suspension into the strip-wells mounted in the plate frame.

*NOTE 5.1:* 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 5.2:* Users sometimes wish to examine the cells using a microscope. If so, the extra volume of cell suspension provided with each kit may be dispensed (100  $\mu$ l/well) into a clear 96-well cell culture treated assay plate, followed by 100  $\mu$ l/well of CSM. Incubated overnight in identical manner to those cells contained in the white assay plate.

*NOTE 5.3:* 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 up to 3 hours before proceeding to *Step 6*.

6.) Dispense 100  $\mu$ l of 2x-concentration treatment media into appropriate assay wells.

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

*NOTE:* Ensure a high-humidity ( $\geq 85\%$ ) 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 the appropriate number of vials of **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. Once at room temperature, gently invert each tube several times to ensure homogenous solutions.

*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:* To read 32 assay wells, transfer the entire volume of 1 vial of Detection Buffer into 1 vial of Detection Substrate, thereby generating a 4 ml volume of **Luciferase Detection Reagent (LDR)**. Mix gently to avoid foaming.

12.) After 22-24 hours of incubation, remove media contents from each well.

*NOTE:* Because the assay plate is composed of a frame with snap-in strip-wells, the practice of physically ejecting media is NOT advised. Do *not* touch the well bottoms or run the tip of the aspiration device around the bottom circumference of the assay well. Such practices will result in destruction of the cells and greatly increased well-to-well variability. Complete removal of the media is efficiently performed by tilting the plate on edge and aspirating media using an 8-pin manifold (*e.g.*, Wheaton Science Microtest Syringe Manifold, # 851381) affixed to a vacuum-trap apparatus.

13.) Add 100 µl of **LDR** to each well of the assay plate. Allow the assay plate to rest at room temperature for at least 5 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>Zebrafish RAR<math>\alpha</math> Assay Products</b>	
Z02201-32	Zebrafish RAR $\alpha$ Reporter Assay System 3x 32 assays in 96-well format
Z02201	Zebrafish RAR $\alpha$ Reporter Assay System 1x 96-well format assay
<b>Human RAR<math>\alpha</math> Assay Products</b>	
IB02201-32	Human RAR $\alpha$ Reporter Assay System 3x 32 assays in 96-well 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>	
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

Please refer to INDIGO Biosciences website for updated product offerings.

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## VI. Limited Use Disclosures

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Example scheme for the serial dilution of 9-*cis*-Retinoic Acid reference agonist, and the setup of a zfRARα dose-response assay.

