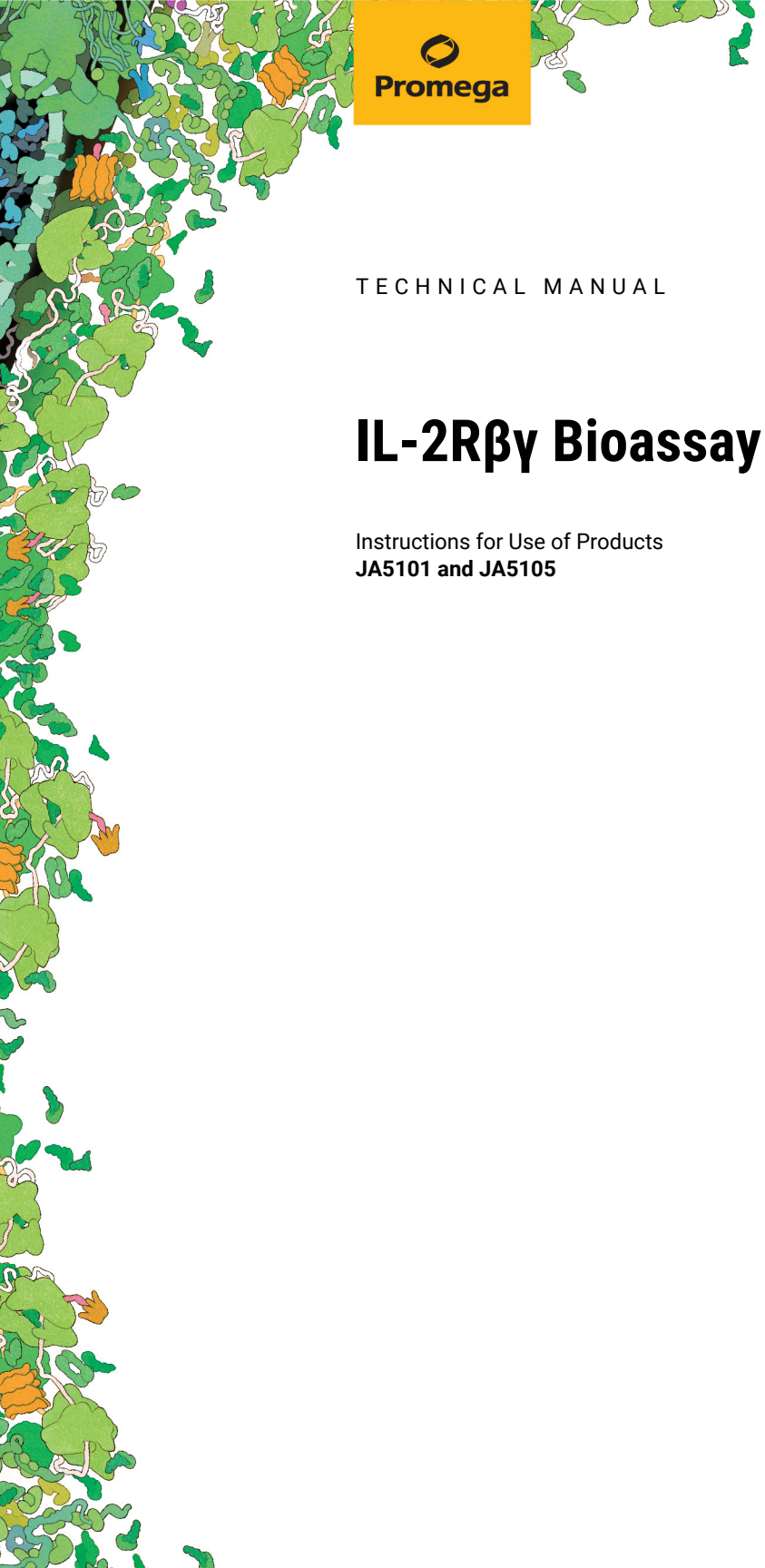


TECHNICAL MANUAL

IL-2Rβγ Bioassay

Instructions for Use of Products
JA5101 and JA5105

Revised 7/26
TM728

IL-2Rβγ Bioassay

All technical literature is available at: www.promega.com/protocols/
Visit the website to verify that you are using the most current version of this Technical Manual.
Email Promega Technical Services if you have questions on use of this system: techserv@promega.com

1. Description 2
2. Product Components and Storage Conditions 12
3. Before You Begin 13
   - 3.A. Materials to Be Supplied By the User 13
4. Assay Protocol 14
   - 4.A. Plate Layout Design 16
   - 4.B. Preparing Reagents, Test and Reference Samples 17
   - 4.C. Preparing and Plating IL-2Rβγ Bioassay Cells 17
   - 4.D. Preparing Serial Dilutions 18
   - 4.E. IL-15 Stimulation Assay 19
   - 4.F. Preparing and Adding Bio-Glo-NL™ Reagent 20
   - 4.G. Data Analysis 20
5. Troubleshooting 21
6. References 22
7. Appendix 22
   - 7.A. Composition of Buffers 22
8. Summary of Changes 22

Promega

1. Description

The IL-2 receptor (IL-2R) is a type 1 cytokine receptor consisting of three subunits: IL-2Rα (CD25), IL-2/IL-15Rβ (CD122) and IL-2Rγ (CD132). The high-affinity (K_d ~10^{-11}M) trimeric receptor form consists of all three subunits and is found on regulatory T cells (Treg), activated CD4 and CD8 effector T cells and some natural killer (NK) cells, as well as various endothelial cell types. A medium-affinity (K_d ~10^{-9}M) heterodimeric receptor form, containing only IL-2Rβ and IL-2Rγ, is found on CD8+ effector memory T cells and most NK cells. IL-2Rγ is also known as the γ common chain (γc) and is found in receptors for IL-4, IL-7, IL-9, IL-15 and IL-21 (1).

High-dose recombinant IL-2 therapy (aldesleukin; trade name Proleukin) was approved in the 1990s for metastatic renal cell carcinoma and metastatic melanoma. Initially this therapy regime was thought to expand only patient effector T cells and NK cells. However, it was later discovered that high-dosage IL-2 promoted the expansion and development of immunosuppressive Treg cells, which are generally regarded as undesirable in the tumor microenvironment. In contrast, today low-dose regiments are being investigated for treating a variety of autoimmunity diseases, as Treg cells are involved in self-antigen tolerance. To avoid the pitfalls and side effects associated with high-dose IL-2 (short half-life, vascular leakage syndrome, hypotension and liver toxicity), other IL-2 and IL-15 molecules are in development that target the medium-affinity receptor and the cell types that express it (2). For cancer therapeutic purposes, avoiding the high-affinity receptor cell types (Treg and vascular and lung endothelial) and increasing the CD8-to-Treg ratio may enhance a positive and safer response.

IL-15 is a functionally related cytokine. However, unlike IL-2, it has no effect on Treg cells. IL-15 also has a trimeric receptor form, IL-15Rα (CD215), which contains a structural binding sushi domain at the N terminus, IL-2/IL-15Rβ (CD122) and IL-15Rγ (CD132). IL-15 can bind and signal effector cells in three ways. It predominantly signals in membrane form for a wide variety of cells that express both IL-15 and IL-15Rα, including monocyte, macrophage and dendritic cells (3). In this scenario, IL-15Rα chaperones IL-15 from the endoplasmic reticulum to the surface where it can trans-present to a variety of IL-15Rβγ-expressing cells (NK, CD8+ T, NKT and B cells; 4). A soluble form of the heterodimer receptor/cytokine complex can also be secreted for cytokine presentation to IL-15Rβγ-expressing effector cells (5). Finally, although monomeric IL-15 is rarely detected, it can bind directly to the IL-15Rβγ, but with lower affinity (6).

Multiple pathways can be activated by IL-2/IL-15 signaling. In lymphocytes, JAK/STAT signaling begins with JAK1 and JAK3 tyrosine kinase recruitment and activation at the receptor cytoplasmic domains. These kinases recruit and activate STAT3 and 5 with phosphorylated dimer/tetramer translocation to the nucleus for transcriptional activation of a variety of proteins, including Bcl-2, c-myc, c-fos and c-jun. In a second pathway, Shc adapter protein recruitment to the IL-2/IL-15Rβ subunit occurs with activation of Grb2. Grb2 is in the PI3K pathway and can ultimately phosphorylate Akt, or it can activate RAS-RAF and finally MAPK. These pathways affect cell proliferation, anti-apoptotic survival and cytotoxic effector functions.

The IL-2Rβγ Bioassay[a,b] (Cat.# JA5101, JA5105) is a bioluminescent cell-based assay designed to measure human IL-2Rβγ receptor stimulation or inhibition in a thaw-and-use format. The IL-2Rβγ Bioassay Cells are also provided in a Cell Propagation Model (CPM) format (Cat.# J3392), which includes cryopreserved cells that can be thawed, propagated and banked for long-term use. Cell banks for the IL-2Rβγ Bioassay, Propagation Model (Cat.# GA1410), are also available.

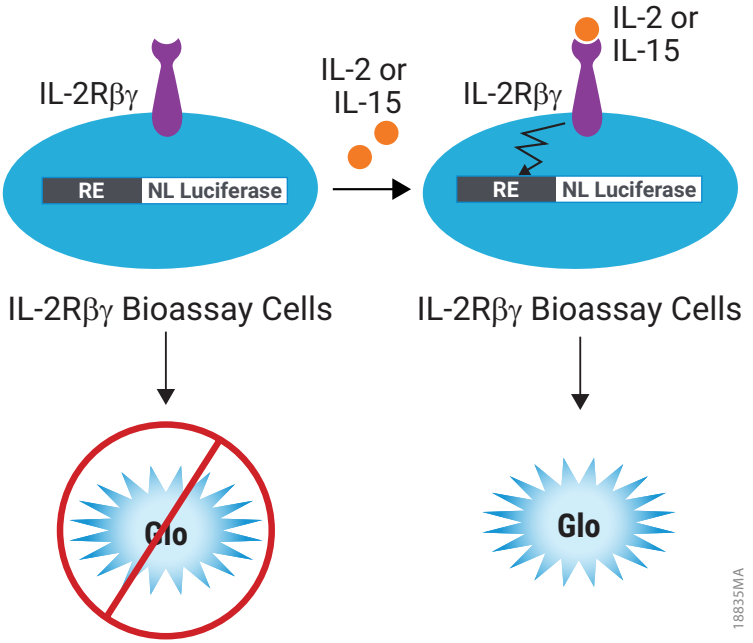
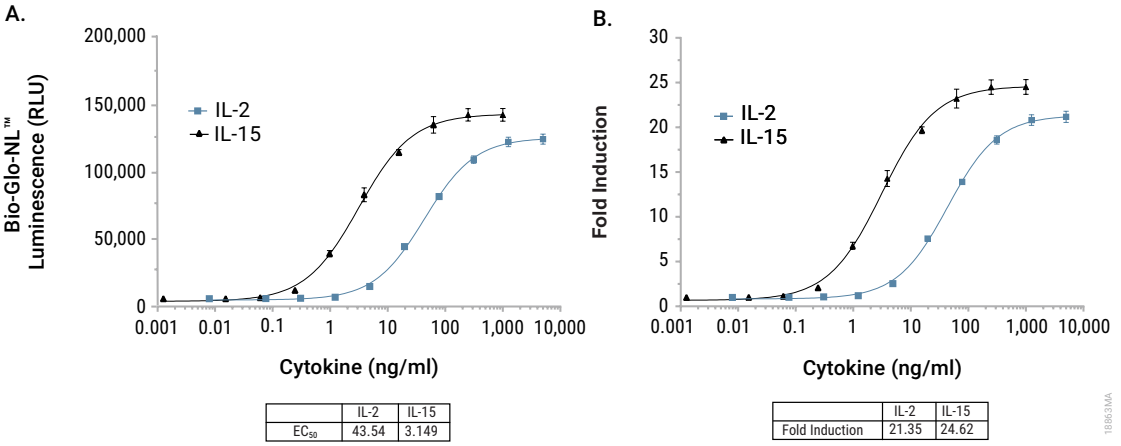


Figure 1. Representation of the IL-2Rβγ Bioassay. The IL-2Rβγ Bioassay consists of a genetically engineered cell line, IL-2Rβγ Bioassay Cells. When IL-2 or IL-15 bind to the medium affinity CD122/CD132 heterodimeric receptor complex (IL-2Rβγ), receptor-mediated pathway signaling induces luminescence that can be detected upon addition of Bio-Glo-NL™ Reagent (Cat.# J3081, J3082, J3083) and quantified with a luminometer. In the absence of cytokine, no signaling occurs downstream of the CD122/CD132 complex and a luminescent signal is not generated.

1. Description (continued)



	IL-2	IL-15
EC_{50}	43.54	3.149

	IL-2	IL-15
Fold Induction	21.35	24.62

Figure 2. The IL-2Rβγ Bioassay responds to recombinant IL-2 and IL-15. The IL-2Rβγ Bioassay responds to recombinant IL-2 and IL-15. IL-2Rβγ Bioassay cells were prepared as described in this protocol and incubated with serial dilutions of recombinant IL-2 and IL-15. After a 6-hour incubation, Bio-Glo-NL™ Reagent was added and luminescence quantified using the GloMax® Discover System. Data were fitted to a 4PL curve using GraphPad Prism® software. The IL-2 EC_{50} was 43.5ng/ml (**Panel A**), with a fold induction of approximately 21 (**Panel B**). The IL-15 EC_{50} was 3.1ng/ml with a fold induction of approximately 25. **Panel A** shows raw luminescence measurements. **Panel B** displays the calculated fold induction. Data were generated using thaw-and-use cells.

Table 1. The IL-2Rβγ Bioassay Shows Precision, Accuracy and Linearity.

Parameter	Results	
Accuracy	% Expected Relative Potency	% Recovery
	50	90.3
	75	102.6
	125	105.7
	150	101.7
Repeatability (% CV)	100% (Reference)	3.6
Intermediate Precision (% CV)		8.4
Linearity (r^2)		0.996
Linearity (y = mx + b)		y = 1.08x–6.35

A 50–150% theoretical potency series of recombinant human IL-15 was analyzed in triplicate in three independent experiments performed on three days by two analysts (for a total of six independent experiments). Bio-Glo-NL™ Reagent was added and luminescence quantified using the GloMax® Discover System. Data were analyzed and relative potencies calculated after parallelism determination using JMP® software. Data were generated using thaw-and- use cells.

1. Description (continued)

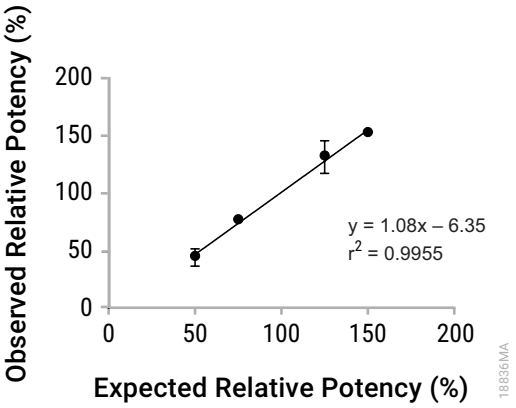
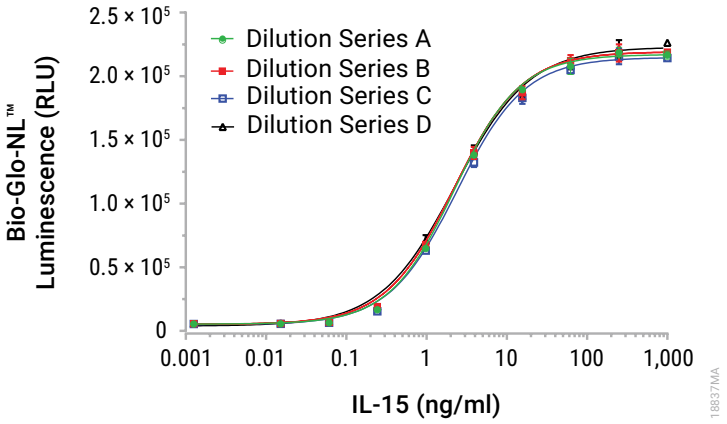


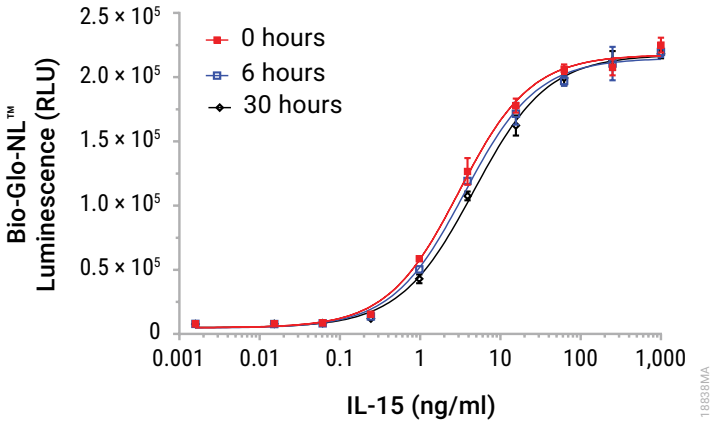
Figure 3. The IL-2Rβγ Bioassay shows precision, accuracy and linearity. A 50–150% theoretical potency series of recombinant human IL-15 was analyzed in triplicate in three independent experiments performed on three days by two analysts, for a total of six independent experiments, using the IL-2Rβγ Bioassay. Bio-Glo-NL™ Reagent was added and luminescence quantified using the GloMax® Discover System. Linearity and r^2 values were determined using GraphPad Prism® software. Data were generated using thaw-and-use cells.



	A	B	C	D
EC_{50}	2.389	2.356	2.555	2.411

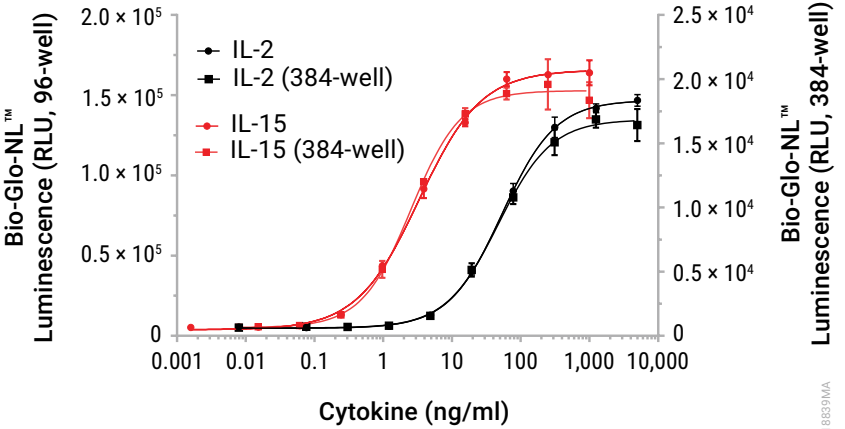
Figure 4. The IL-2Rβγ Bioassay demonstrates repeatability. Four separate serial dilution series of recombinant human IL-15 (A, B, C and D) were analyzed on four individual assay plates using the IL-2Rβγ Bioassay. Bio-Glo-NL™ Reagent was added and luminescence quantified using the GloMax® Discover System. Data were fitted to a 4PL curve using GraphPad Prism® software. The EC_{50} values are shown for the four assay plates. Data were generated using thaw-and-use cells.

1. Description (continued)



Hours	0	6	30
EC_{50}	3.071	3.575	4.658

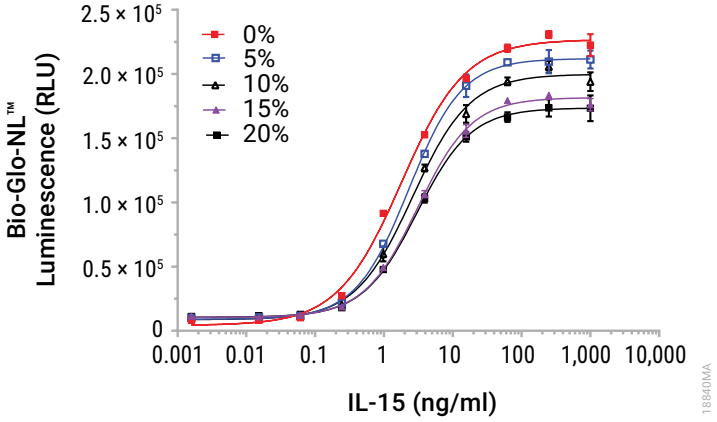
Figure 5. The IL-2Rβγ Bioassay indicates stability. Recombinant human IL-15 (15µg/ml with BSA carrier) was heat stressed at 53°C for 0–30 hours prior to being tested in the IL-2Rβγ Bioassay. Bio-Glo-NL™ Reagent was added and luminescence quantified using the GloMax® Discover System. Fold induction data were fitted to a 4PL curve using GraphPad Prism® software. Data were generated using thaw-and-use cells.



	IL-2	IL-15	IL-2 (384)	IL-15 (384)
EC_{50}	53.46	3.327	47.59	2.554

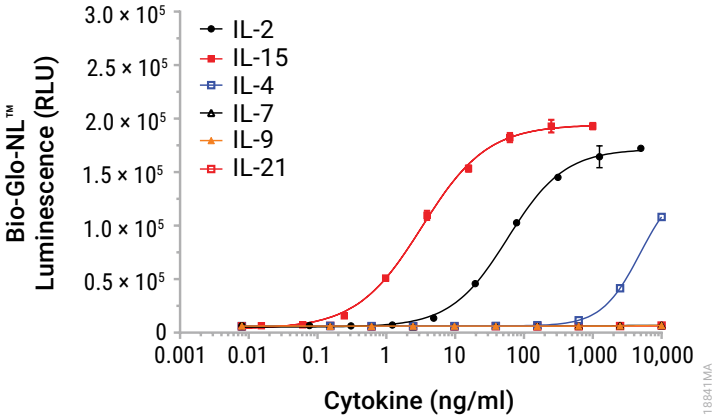
Figure 6. The IL-2Rβγ Bioassay is amenable to 384-well plate format. The IL-2Rβγ Bioassay was tested in 96- and 384-well formats. IL-2Rβγ Bioassay Cells were prepared and dispensed as 50µl (96-well) or 12.5µl (384-well) volumes. Serial fourfold dilutions of recombinant human IL-15 were prepared and added to cells (25µl/well in the 96-well format; 6.2µl/well in the 384-well format). After a 6-hour stimulation with recombinant IL-15, Bio-Glo-NL™ Reagent was added (75µl/well in the 96-well format; 18.7µl/well in the 384-well format) and luminescence quantified using the GloMax® Discover System. Data were fitted to a 4PL curve using GraphPad Prism® software. Data were generated using thaw-and-use cells. The IL-2 EC_{50} was approximately 54 (96-well format) and 48ng/ml (384-well format) as shown in the table. The IL-15 EC_{50} was approximately 3.3ng/ml (96-well) and 2.6ng/ml (384-well).

1. Description (continued)



	0%	5%	10%	15%	20%
EC_{50}	1.796	2.307	2.610	3.100	3.029

Figure 7. Human serum impact on the IL-2Rβγ Bioassay. IL-2Rβγ Bioassay Cells were tested with a dose-response of recombinant IL-15 in the absence or presence of increasing concentrations of pooled normal human serum, resulting in 0–20% human serum final assay concentrations. Bio-Glo-NL™ Reagent was added, and luminescence was quantified using the GloMax® Discover System. Data were fitted to a 4PL curve using GraphPad Prism® software. Data were generated using thaw-and-use cells.



	IL-2	IL-15
EC_{50}	58.37	3.304

Figure 8. IL-2Rβγ Bioassay cytokine specificity. IL-2Rβγ Bioassay cells were tested with a panel of related type 1 cytokines (IL-2, IL-15, IL-4, IL-7, IL-9 and IL-21). Bio-Glo-NL™ Reagent was added, and luminescence was quantified using the GloMax® Discover System. Data were fitted to a 4PL curve using GraphPad Prism® software. Some IL-4 response was detectable at high concentrations, but no signal was generated by IL-7, IL-9 or IL-21 in the assay. We could not calculate EC_{50} values for these related cytokines over the range of concentrations tested. Data were generated using thaw-and-use cells.

2. Product Components and Storage Conditions

PRODUCT	SIZE	CAT.#
IL-2Rβγ Bioassay	**1 each**	**JA5101**

Not for Medical Diagnostic Use. Each kit contains sufficient reagents for 120 assays using the inner 60 wells of two 96-well plates. Includes:

- 1 vial IL-2Rβγ Bioassay Cells, 1.6×10^7 cells/ml (0.6ml per vial)
- 36ml RPMI 1640 Medium
- 4ml Fetal Bovine Serum
- 1 vial Bio-Glo-NL™ Luciferase Assay Substrate
- 10ml Bio-Glo-NL™ Luciferase Assay Buffer

PRODUCT	SIZE	CAT.#
IL-2Rβγ Bioassay, 5X	**1 each**	**JA5105**

Not for Medical Diagnostic Use. Each kit contains sufficient reagents for 600 assays using the inner 60 wells of ten 96-well plates. Includes:

- 5 vials IL-2Rβγ Bioassay Cells, 1.6×10^7 cells/ml (0.6ml per vial)
- 5 × 36ml RPMI 1640 Medium
- 5 × 4ml Fetal Bovine Serum
- 5 vials Bio-Glo-NL™ Luciferase Assay Substrate
- 5 × 10ml Bio-Glo-NL™ Luciferase Assay Buffer

Note: IL-2Rβγ Bioassay components are shipped separately because of differing temperature requirements. The IL-2Rβγ Bioassay Cells are shipped on dry ice. The Bio-Glo-NL™ Luciferase Assay System and Fetal Bovine Serum are shipped on dry ice, separately from the cells. The RPMI 1640 Medium is shipped at ambient temperature.

Storage Conditions: Upon arrival, immediately transfer the cell vials to below –140°C (freezer or liquid nitrogen vapor phase) for long-term storage. Do not store cell vials submerged in liquid nitrogen. Do not store cell vials at –80°C because this will decrease cell viability and cell performance.

Store Bio-Glo-NL™ Luciferase Assay Substrate, Bio-Glo-NL™ Luciferase Assay Buffer and Fetal Bovine Serum at –30°C to –10°C. Avoid multiple freeze-thaw cycles of the serum. The Bio-Glo-NL™ Luciferase Assay Substrate remains liquid and does not freeze.

Store RPMI 1640 Medium at +2°C to +10°C protected from light.

3. Before You Begin

Please read through the entire protocol to become familiar with the components and the assay procedure before beginning.

Note the catalog number and lot number from the cell vial box label. This information can be used to download documents for the specified product, such as Certificate of Analysis, from **www.promega.com**

The IL-2Rβγ Bioassay is intended for use with user-provided biologics designed to activate or inhibit the IL-2Rβγ signaling pathway. The recommended cell plating density, induction time and assay buffer components described in Section 4 were established using research-grade recombinant human IL-2 and IL-15. You may need to adjust the parameters provided here and optimize assay conditions for other biologic samples. Data generated using these reagents is shown in Figure 2.

The IL-2Rβγ Bioassay produces a bioluminescent signal and requires a sensitive luminometer or multimode plate reader for detecting luminescence. Bioassay development and performance data included in this Technical Manual were generated using the GloMax® Discover System instrument. An integration time of 0.5 second/well was used for all readings. The bioassay is compatible with most other plate-reading luminometers; however, relative luminescence unit (RLU) readings may vary due to the sensitivity and settings of each instrument. The use of different instruments should not affect the measured relative potency of test samples.

3.A. Materials to Be Supplied By the User

Composition of Buffers and Solutions is provided in Section 7.A.

Reagents

- Recombinant human IL-15 (e.g., PeproTech Cat.# 200-15) or Human IL-2 (e.g., PeproTech Cat.# 200-02 or Miltenyi Cat.# 130-097-742)
- user-defined biologics samples

Note: The IL-2Rβγ Bioassay uses the Bio-Glo-NL™ Luciferase Assay System (Cat.# J3081, J3082, J3083) for detection. **Do not** use the Bio-Glo™ Luciferase Assay System (Cat.# G7940, G7941).

Supplies and Equipment

- white, flat-bottom 96-well assay plate (e.g., Corning® Cat.# 3917)
- sterile clear 96-well plate with lid (e.g., Corning® Cat.# 3370 or Falcon Cat.# 353077) for preparing sample dilutions
- pipettes (single-channel and 12-channel)
- sterile 15ml and 50ml conical tubes
- sterile reagent reservoirs (e.g., Corning® Cat.# 4870)
- humidified 37°C, 5% CO_2 incubator
- 37°C water bath
- plate reader that measures glow luminescence (e.g., GloMax® Discover System)

4. Assay Protocol

The IL-2Rβγ Bioassay can be used to test IL-2- and IL-15-type biological samples that are known to bind and stimulate the IL-2Rβγ receptor. Recombinant human IL-2 or IL-15 can be used. This protocol illustrates the use of the IL-2Rβγ Bioassay to examine two test samples against a reference sample in a single assay run. Each test and reference sample is run in triplicate, in a ten-point dilution series, in a single 96-well assay plate using the inner 60 wells. Other experimental and plate layouts are possible but may require further optimization.

Notes:

a. When preparing test and reference samples, choose an appropriate starting concentration and dilution scheme to achieve a full dose-response curve with proper upper and lower asymptotes and sufficient points on the slope. For reference, we use 0–1µg/ml of recombinant human IL-15 (PeproTech Cat.# 200-15) or 0–5µg/ml of recombinant human IL-2 (PeproTech Cat.# 200-02) as a sample range with serial fourfold dilutions to achieve full dose curves as ten-point series. Concentration ranges and dilution schemes may need to be optimized for your samples.

b. The thaw-and-use cells are for single use only and cannot be cultured or refrozen for second use. Please plan your experiments accordingly to optimize the use of the thaw-and-use cells.

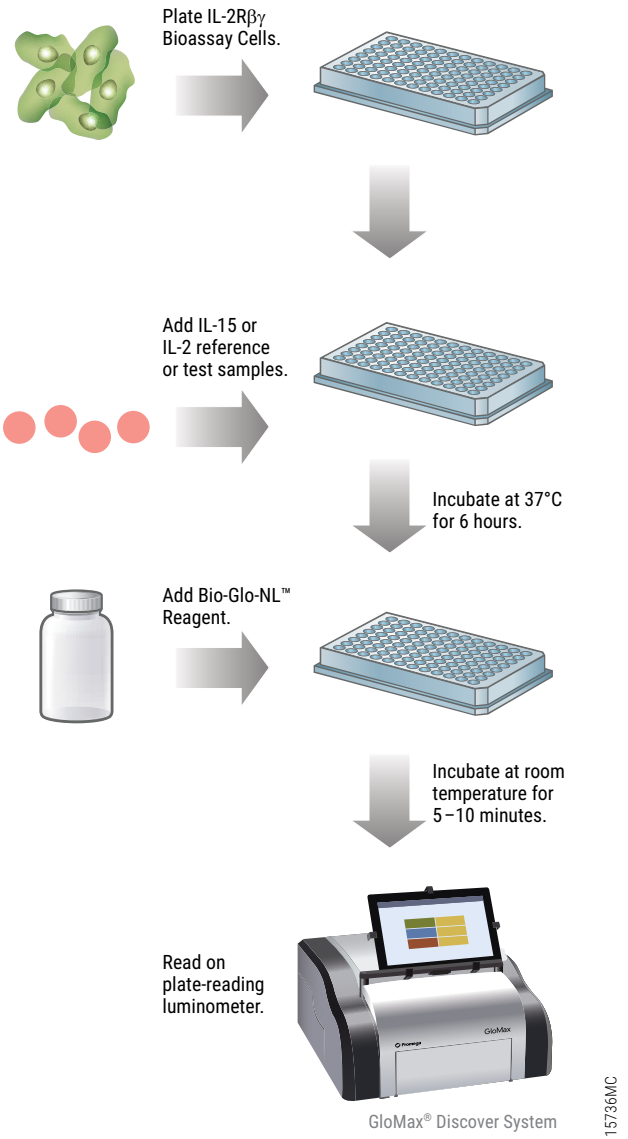


Figure 9. IL-2Rβγ Bioassay schematic protocol.

4.A. Plate Layout Design

For the protocol described here, use the plate layout illustrated in Figure 10 as a guide. The protocol describes serial replicate dilutions (n = 3) of test and reference samples to generate two ten-point dose-response curves for each plate.

Recommended Plate Layout Design													
	1	2	3	4	5	6	7	8	9	10	11	12	
A	B	B	B	B	B	B	B	B	B	B	B	B	Assay Buffer (B)
B	B	no drug	dilu9	dilu8	dilu7	dilu6	dilu5	dilu4	dilu3	dilu2	dilu1	B	Reference Replicate 1
C	B	no drug	dilu9	dilu8	dilu7	dilu6	dilu5	dilu4	dilu3	dilu2	dilu1	B	Test Replicate 1
D	B	no drug	dilu9	dilu8	dilu7	dilu6	dilu5	dilu4	dilu3	dilu2	dilu1	B	Reference Replicate 2
E	B	no drug	dilu9	dilu8	dilu7	dilu6	dilu5	dilu4	dilu3	dilu2	dilu1	B	Test Replicate 2
F	B	no drug	dilu9	dilu8	dilu7	dilu6	dilu5	dilu4	dilu3	dilu2	dilu1	B	Reference Replicate 3
G	B	no drug	dilu9	dilu8	dilu7	dilu6	dilu5	dilu4	dilu3	dilu2	dilu1	B	Test Replicate 3
H	B	B	B	B	B	B	B	B	B	B	B	B	Assay Buffer (B)

Figure 10. Example plate layout. This suggested layout shows nonclustered locations for three replicates of each test and reference sample dilution series (dilu1–dilu9) and wells containing assay buffer (denoted by "B") alone.

4.B. Preparing Reagents, Test and Reference Samples

Prepare the following reagents before starting the assay.

Bio-Glo-NL™ Luciferase Assay Reagent: For reference, 10ml of Bio-Glo-NL™ Reagent is sufficient to assay 120 wells in a 96-well assay format. Store Bio-Glo-NL™ Luciferase Assay Substrate at –30°C to –10°C. Thaw the Bio-Glo-NL™ Luciferase Assay Buffer at room temperature (do not exceed 25°C) during the 6-hour assay induction period. We recommend preparing the reconstituted Bio-Glo-NL™ Reagent immediately before use. Do not store the reconstituted reagent. Once reconstituted, Bio-Glo-NL™ Reagent will lose 10% activity in approximately 8 hours at room temperature. For instructions on use of the Bio-Glo-NL™ Luciferase Assay System, please refer to the *Bio-Glo-NL™ Luciferase Assay System Quick Protocol*, #FB227.

Note: The IL-2Rβγ Bioassay is compatible only with Bio-Glo-NL™ Luciferase Assay Reagent. **Do not** use Bio-Glo™ Luciferase Assay Reagent with the IL-2Rβγ Bioassay.

Assay Buffer: Ensure that an appropriate amount of assay buffer is prepared for the assay. Thaw the fetal bovine serum (FBS) overnight at 4°C or in a 37°C water bath, taking care not to overheat it. To make 36ml of assay buffer, add 1.8ml of FBS to 34.2ml of RPMI 1640 medium to yield 95% RPMI 1640/5% FBS (see Section 7.A). Mix well and warm to 37°C prior to use. For reference, 36ml of assay buffer is typically sufficient for 120 wells in a 96-well assay format using the inner 60 wells.

Test and Reference Samples: Prepare starting dilutions (denoted as dilu1, 3X final concentration) of test and reference samples (see Figures 10 and 11). Using assay buffer as the diluent, prepare 360µl of reference sample starting dilution and 180µl of each test sample starting dilution in 1.5ml tubes. Store the tubes containing starting dilutions appropriately before making serial dilutions.

4.C. Preparing and Plating IL-2Rβγ Bioassay Cells

The thaw-and-use IL-2Rβγ Bioassay Cells included in this kit are sensitive; carefully follow the cell thawing and plating procedures exactly as described. Do not overmix or overwarm the cell reagents. No additional cell culture or manipulation is required. We recommend that you thaw and dilute a maximum of two vials of thaw-and-use cells at a time.

Follow institutional guidelines for handling, including use of personal protective equipment (PPE) and waste disposal for biohazardous material.

1. Remove one vial of IL-2Rβγ Bioassay Cells from storage at –140°C and transfer to the bench on dry ice.
2. Add 7.7ml of prewarmed (37°C) assay buffer to a 15ml conical tube.
3. Warm the cells in a 37°C water bath until just thawed (about 2 minutes). While thawing, gently agitate and visually inspect. Try not to submerge the vial completely. Do not invert.
4. Gently mix the cell suspension by pipetting, then transfer 0.55ml of the cells to the 15ml conical tube containing 7.7ml of assay buffer. Mix well by gently pipetting or inverting 5 times.
5. Transfer the cell suspension to a sterile reagent reservoir.
6. Using a multichannel pipette, immediately dispense 50µl of the cell suspension to each of the inner 60 wells of two 96-well assay plates. Optimal results depend on gently keeping the cells evenly resuspended during plating.

4.C. Preparing and Plating IL-2Rβγ Bioassay Cells (continued)

7. Add 75µl/well of warm assay buffer to the outer 36 wells of each plate.
8. Cover each assay plate with a lid and incubate in a humidified 37°C, 5% CO_2 incubator while preparing samples and dilutions.

4.D. Preparing Serial Dilutions

Prepare serial dilutions on the day of the assay.

The instructions described here are for preparing a single stock of fourfold serial dilutions of a single sample for analysis in triplicate (135µl of each dilution provides a sufficient volume for analysis in triplicate). Alternatively, prepare three independent stocks of serial dilutions to generate triplicate samples. To prepare fourfold serial dilutions, you will need a total of 360µl of a reference sample at 3X the highest concentration in your dose-response curve. You will need 180µl of each test sample at 3X the highest concentration in each of the test sample dose-response curves. For other dilution schemes, adjust the volumes accordingly.

Note: For IL-15 stimulation using recombinant human IL-15 as your reference sample (PeproTech IL-15, Cat.# 200-15), we recommend starting with a 3X concentration of 3µg/ml and performing serial fourfold dilutions. When using other reference sources of IL-15, the starting concentration may need to be adjusted.

1. To a sterile clear 96-well plate, add 180µl of reference sample starting dilution (dilu1, 3X final concentration) to wells A11 and B11 (see Figure 11).
2. Add 180µl of test samples 1 and 2 starting dilution (dilu1, 3X final concentration) to wells C11 and D11, respectively.
3. Add 135µl of assay buffer to other wells in these four rows, from column 10 to column 2.
4. Transfer 45µl of the sample starting dilutions from column 11 into column 10. Mix well by pipetting. Avoid creating bubbles.
5. Repeat equivalent fourfold serial dilutions across the columns from right to left until you reach column 3. Remove 45µl from column 3 so all wells have 135µl volume. Do not dilute into column 2.
6. Cover the plate with a lid and set aside.

Recommended Plate Layout for Sample Dilutions Prepared from a Single Sample Stock													
	1	2	3	4	5	6	7	8	9	10	11	12	
A		no drug	dilu9	dilu8	dilu7	dilu6	dilu5	dilu4	dilu3	dilu2	dilu1		Reference sample
B		no drug	dilu9	dilu8	dilu7	dilu6	dilu5	dilu4	dilu3	dilu2	dilu1		Reference sample
C		no drug	dilu9	dilu8	dilu7	dilu6	dilu5	dilu4	dilu3	dilu2	dilu1		Test sample 1
D		no drug	dilu9	dilu8	dilu7	dilu6	dilu5	dilu4	dilu3	dilu2	dilu1		Test sample 2
E													
F													
G													
H													

Figure 11. Example plate layout showing reference and test sample serial dilutions. Wells A2, B2, C2 and D2 contain 135µl of assay buffer without sample as a negative control.

4.E. IL-15 Stimulation Assay

1. Using a multichannel pipette, dispense 25µl of each sample to the 50µl of preplated cells according to the plate layout in Figure 10.
2. Cover each assay plate with a lid and incubate in a humidified 37°C, 5% CO_2 incubator for 6 hours.
3. After a 6-hour incubation, proceed to Section 4.F.

4.F. Preparing and Adding Bio-Glo-NL™ Reagent

We recommend preparing the Bio-Glo-NL™ Luciferase Assay Reagent immediately before use. Ensure that the Bio-Glo-NL™ Luciferase Assay Buffer is equilibrated to room temperature (do not exceed 25°C) before reconstituting the reagent. Do not store the reconstituted reagent. Once reconstituted, Bio-Glo-NL™ Reagent will lose 10% activity in approximately 8 hours at room temperature.

1. Remove the Bio-Glo-NL™ Luciferase Assay Substrate from –30°C to –10°C storage. Briefly centrifuge the tubes if the substrate has collected in the cap or on the sides of the tubes.
2. Prepare the desired amount of reconstituted Bio-Glo-NL™ Reagent by combining one volume of substrate with 50 volumes of buffer. For example, if the experiment requires 10ml of reagent, add 200µl of substrate to 10ml of buffer. Ten milliliters (10ml) of Bio-Glo-NL™ Reagent is sufficient for 120 wells (two assay plates, using the inner 60 wells of each plate).
3. Remove the assay plates from the incubator, remove the plate lid, and equilibrate to ambient temperature for 15 minutes.
4. Using a multichannel pipette, add 75µl of Bio-Glo-NL™ Reagent to the inner 60 wells of the assay plates, taking care not to create bubbles.
5. Add 75µl of Bio-Glo-NL™ Reagent to wells B1, C1 and D1 of each assay plate to measure the background signal.
6. Incubate at ambient temperature for 5–10 minutes.

   Note: Varying the incubation time will affect the raw RLU values but should not significantly change the EC_{50} value and fold induction.
7. Measure luminescence using a luminometer or luminescence plate reader.

4.G. Data Analysis

1. Measure plate background by calculating the average relative light units (RLU) from wells B1, C1 and D1.
2. Calculate fold induction:

$$\text{Fold induction} = \frac{\text{RLU (sample–background)}}{\text{RLU (no drug control–background)}}$$

   Note: When calculating fold induction, if the no drug control sample RLU values are at least 100X the plate background RLU values, there is no need to subtract plate background from sample RLU.
3. Graph data as RLU versus Log_{10}[sample] and fold induction versus Log_{10}[sample]. Fit curves and determine the EC_{50} value of response using appropriate curve fitting software (such as GraphPad Prism®).

5. Troubleshooting

For questions not addressed here, please contact your local Promega Branch Office or Distributor. Contact information available at: **www.promega.com**. Email: **techserv@promega.com**

Symptoms	Causes and Comments
Low luminescence measurements (RLU readout)	Choose an instrument designed for plate-reading luminescence detection. Instruments designed primarily for fluorescence detection are not recommended. Luminometers measure and report luminescence as relative values, and actual RLU values will vary between instruments. If using a reader with an adjustable gain, we recommend a high-gain setting.
	Insufficient cells per well can lead to low RLU. Handle and plate the cells according to the instructions to ensure a sufficient number of viable cells per well.
	Low activity of Bio-Glo-NL™ Reagent leads to low RLU. Store and handle the Bio-Glo-NL™ Reagent according to the instructions.
	Ensure that you are using Bio-Glo-NL™ Reagent, which is designed for NanoLuc® Luciferase reporter bioassays. IL-2Rβγ Bioassay Cells are not compatible with Bio-Glo™ Reagent, which is designed for firefly luciferase reporter bioassays.
Variability in assay performance	Ensure that incubation times and cytokine dilutions series are consistent between assays.
Weak assay response (low fold induction)	Optimize the concentration range of your test sample(s) to achieve a full dose response with complete upper and lower asymptotes.
	If untreated control RLU is less than 100-fold above plate reader background RLU, subtract plate reader background RLU from all samples prior to calculating fold induction.

6. References

1. Hernandez, R. *et al.* (2022) Engineering IL-2 for immunotherapy of autoimmunity and cancer. *Nat. Rev. Immunol.* **22**, 614–28.
2. Harris, K.E. *et al.* (2021) A bispecific antibody agonist of the IL-2 heterodimeric receptor preferentially promotes in vivo expansion of CD8 and NK cells. *Sci. Rep.* **11**, 10592.
3. Castillo, E.F. and Schluns, K.S. (2012) Regulating the immune system via IL-15 transpresentation. *Cytokine* **59**, 479–90.
4. Stonier, S.W. and Schluns, K.S. (2010) Trans-presentation: a novel mechanism regulating IL-15 delivery and responses. *Immunol. Lett.* **127**, 85–92.
5. Bergamaschi, C. *et al.* (2012) Circulating IL-15 exists as heterodimeric complex with soluble IL-15Rα in human and mouse serum. *Blood* **120**, e1–8.
6. Giri, J.G. *et al.* (1994) Utilization of the beta and gamma chains of the IL-2 receptor by the novel cytokine IL-15. *EMBO J.* **13**, 2822–30.

7. Appendix

7.A. Composition of Buffers

assay buffer

95%	RPMI 1640 medium
5%	fetal bovine serum

Prepare and use within 5 days. Store at 4°C.

8. Summary of Changes

The following changes were made to the 7/26 revision of this document:

1. Removed Section 7.B, Related Products.
2. Made minor text edits.

[a]NOT FOR MEDICAL DIAGNOSTIC USE. FOR IN VITRO USE ONLY. BY USE OF THIS PRODUCT, RECIPIENT AGREES TO BE BOUND BY THE TERMS OF THIS LIMITED USE STATEMENT. If the recipient is not willing to accept the conditions of this limited use statement, and the product is unused, Promega will accept return of the unused product and provide the recipient with a full refund. This product may not be further sold or transferred by the recipient and may be used only by the recipient, and then only for (1) research use; (2) discovery, development and monitoring of biologic drugs and vaccines; (3) quality assurance testing of biologic drugs and vaccines; and (4) product release assays for biologic drugs and vaccines. No other commercial use is allowed. "Commercial use" means any and all uses of this product by recipient for monetary or other consideration, including providing a service, information or data to unaffiliated third parties, and resale of this product for any use. Recipient has no right to propagate, modify, derivatize, genetically engineer or otherwise create variations of the cells or genes stably transfected within the cells. In addition, recipient must use Bio-Glo-NL™ Luciferase Assay System purchased from Promega Corporation for all luminescence assays using this product or contact Promega to obtain a license for use of this product with reagents other than Promega's. PROMEGA MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING AS TO MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH REGARDS TO THIS PRODUCT. The terms of this agreement shall be governed under the laws of the State of Wisconsin, USA.

[b]U.S. Pat. Nos. 8,557,970, 8,669,103, 9,777,311, 9,840,730, 9,951,373, 10,233,485, 10,633,690, 10,774,364, 10,844,422, 11,365,436, 11,661,623, 11,667,950; European Pat. Nos. 2456864, 2635595, 2990478, 3181687, 3409764; Japanese Pat. Nos. 6038649, 6155424, 6227615, 6374420, 6539689; and other patents and patents pending.

© 2024–2026 Promega Corporation. All Rights Reserved.

GloMax and Lumit are registered trademarks of Promega Corporation. Bio-Glo and Bio-Glo-NL are trademarks of Promega Corporation.

GraphPad Prism is a registered trademark of GraphPad Software, Inc. JMP is a registered trademark of SAS Institute, Inc. Proleukin is a registered trademark of CLINIGEN HOLDINGS LIMITED.

Products may be covered by pending or issued patents or may have certain limitations. Please visit our website for more information.

All prices and specifications are subject to change without prior notice.

Product claims are subject to change. Please contact Promega Technical Services or access the Promega online catalog for the most up-to-date information on Promega products.