

## **DIVERSA mRNA DELIVERY NANOPARTICLES**

DIVERSA lipid nanoparticles for promoting effective intracellular transfection of mRNA.

---

### **USER PROTOCOL – #DIV053**

<b>ABOUT THE NANOPARTICLES .....</b>	<b>1</b>
OVERVIEW .....	1
COMPONENTS .....	1
STORAGE.....	1
EQUIPMENT AND MATERIALS REQUIRED BUT NOT SUPPLIED .....	2
CONSIDERATIONS BEFORE STARTING.....	3
<b>DIVERSA MRNA DELIVERY NANOPARTICLES.....</b>	<b>4</b>
PROTOCOL for the encapsulation of 5 µg of mRNA.....	4
PROTOCOL for the encapsulation of 1 µg of mRNA.....	6
CONCENTRATION PROTOCOL .....	7
<b>TRANSFECTION ASSAY .....</b>	<b>9</b>
EXAMPLE PROTOCOL.....	9
<b>TABLES AND TECHNICAL NOTES .....</b>	<b>10</b>
<b>FREQUENTLY ASKED QUESTIONS.....</b>	<b>12</b>
<b>ONLINE RESOURCES .....</b>	<b>13</b>
<b>CHANGELOG .....</b>	<b>13</b>

## ABOUT THE NANOPARTICLES

### OVERVIEW

---

**DIVERSA**'s nanoparticles are a biocompatible, biodegradable, and cell-friendly technology designed to enhance the intracellular delivery of nucleic acids, paving the way for clinical translation.

**DIVERSA**'s nanoparticles demonstrate exceptional efficacy, ensuring safe mRNA delivery while maintaining cell integrity, standing out from viral and cationic-based transfection methods. They can accommodate a wide range of mRNA sizes (900 – 4500 nt), expanding research possibilities. For different size requirements, additional information is available in our [FAQs](#).

**DIVERSA**'s nanoparticles are easily internalized by cells and can penetrate more complex structures, such as 3D cell cultures and organoids. Additionally, they can be adapted to various routes of administration for evaluation in animal models, maximizing targeted biodistribution and enhancing their therapeutic effect. Contact [DIVERSA](#) for specific recommendations for *in vivo* experiments.

### COMPONENTS

---

- 4x **DIV053** vial for reconstitution.
- 4x **DIVTECH** vial for preparation of **DIVERSA**'s nanoparticles.
- 4x sterile, non-toxic, pyrogenic-free polypropylene 1 mL syringes.
- 4x 21G ½ sterile needles (0.8 x 38 mm).

### STORAGE

---

Before formulating, store the vials at -20 °C. Once formulated, the mRNA-loaded nanoparticles should be storage at 2-8 °C.

---

Shipping temperature may differ from storage temperature. This does not alter the performance of the product.

**DIVERSA TECHNOLOGIES S.L.** | Edificio Emprendia, Campus Sur, 15782 Santiago de Compostela, Spain.

Technical support: email: [support@diversatechnologies.com](mailto:support@diversatechnologies.com) | [www.diversatechnologies.com](http://www.diversatechnologies.com)

**FOR RESEARCH USE ONLY.** Not for use in humans. Purchase of this product does not include any right to resell or transfer, either as a stand-alone product or as a component of another product. Any use of this Product for purposes other than research is strictly prohibited.

## EQUIPMENT AND MATERIALS REQUIRED BUT NOT SUPPLIED

---

- 1.5 mL sterile RNase-free microtubes
- 0.6 mL sterile RNase-free microtubes
- 2 mL sterile RNase-free microtubes
- 15 mL sterile RNase-free tube
- Amicon Ultra Centrifugal Filter
- 0.22 µm filter of PES membrane
- RNase contamination remover (e.g. RNaseZAP or RNase AWAY Surface Decontaminant)
- RNase-free water (Molecular Grade)
- Dulbecco's phosphate-buffered saline 1X (DPBS) (without calcium and magnesium)
- Ethanol (EtOH) 96%
- mRNA of interest
- Citrate buffer 10 mM at pH3 (10 mL):
  - Weight 2.8 mg of Sodium Citrate Tribasic Dihydrate (CAS No: 6132-04-3) and 17.4 mg of Citric Acid Monohydrate (CAS No: 5949-29-1).
  - Dissolve both components in 8 mL of RNase-free water (Molecular Grade).
  - Measure the pH and, if necessary, adjust to pH 3. Clean the sensor to avoid contamination by RNases.
  - Adjust the final volume to 10 mL with RNase-free water.
  - Store at 2-8 °C in an RNase-free container.

---

Shipping temperature may differ from storage temperature. This does not alter the performance of the product.

**DIVERSA TECHNOLOGIES S.L.** | Edificio Emprendia, Campus Sur, 15782 Santiago de Compostela, Spain.

Technical support: email: [support@diversatechnologies.com](mailto:support@diversatechnologies.com) | [www.diversatechnologies.com](http://www.diversatechnologies.com)

**FOR RESEARCH USE ONLY.** Not for use in humans. Purchase of this product does not include any right to resell or transfer, either as a stand-alone product or as a component of another product. Any use of this Product for purposes other than research is strictly prohibited.

## CONSIDERATIONS BEFORE STARTING

---

- The following protocol is optimized for the formulation of 5 µg of mRNA, starting from one **DIV053** vial. A protocol for the formulation of 1 µg of mRNA is also provided. The box contains four **DIV053** vials, allowing four separate nanoparticle preparations.
- **DIVERSA** cannot guarantee optimal formulation performance if any modifications are made to the protocol.
- It is recommended to use **DIVERSA**'s nanoparticles within 48 hours of preparation for optimal performance.
- Transfection with **DIVERSA**'s nanoparticles is stable in supplemented cell culture media for at least 24 h at 37 °C.
- Do not use any buffer solution containing Triton-X, SDS, or Tween-20 for the preparation of **DIVERSA**'s nanoparticles.
- Once formulated, do NOT freeze **DIVERSA**'s nanoparticles.
- Do NOT heat over 90°C **DIVERSA**'s nanoparticles.

---

Shipping temperature may differ from storage temperature. This does not alter the performance of the product.

**DIVERSA TECHNOLOGIES S.L.** | Edificio Emprendia, Campus Sur, 15782 Santiago de Compostela, Spain.

Technical support: email: [support@diversatechnologies.com](mailto:support@diversatechnologies.com) | [www.diversatechnologies.com](http://www.diversatechnologies.com)

**FOR RESEARCH USE ONLY.** Not for use in humans. Purchase of this product does not include any right to resell or transfer, either as a stand-alone product or as a component of another product. Any use of this Product for purposes other than research is strictly prohibited.

## DIVERSA mRNA DELIVERY NANOPARTICLES

### PROTOCOL for the encapsulation of 5 µg of mRNA

Click [here](#) to view the video on the preparation of **DIVERSA mRNA DELIVERY NANOPARTICLES**.

Clean the workspace and micropipettes before starting with 70% EtOH, followed by RNase contamination remover solution.

1. Add 300 µL of EtOH into the **DIV053** by inserting the needle through the septum using the provided syringe and needle. Then vortex the vial.

**Note<sub>1</sub>:** DO NOT remove the metal cap from the vial to avoid spilling.

**Note<sub>2</sub>:** You will need the same syringe and needle for step 4. Do not discard them.

2. Add 895 µL of 10 mM Citrate Buffer (pH 3) and 5 µL of mRNA to the **DIVTECH** vial.

**Note<sub>1</sub>:** Prepare just a prior injection and avoid leaving the mRNA citrate phase at RT.

**Note<sub>2</sub>:** The specified volumes are based on an mRNA stock concentration of 1 mg/mL. Please adjust accordingly for different stock concentrations.

3. Remove the metal cap from the **DIV053**. Take the volume from the **DIV053** vial reusing the same syringe and needle from step 1. Before injection, ensure an approximately 0.3 mL air gap in the syringe. Then, inject the volume into the **DIVTECH** vial containing the mRNA with a sudden, vigorous downward motion, resulting in a final volume of 1.2 mL of **DIVERSA**'s nanoparticles.

4. Leave the **DIVTECH** vial open for 35 min at room temperature (RT), protected from light.

5. Transfer the 1.2 mL of **DIVERSA**'s nanoparticles from the **DIVTECH** vial to a 15 mL sterile RNase-free tube containing 6 mL of DPBS 1X at 4 °C.

Subsequently, either proceed with the [CONCENTRATION PROTOCOL](#) or store the diluted formulation at 4 °C for later use.

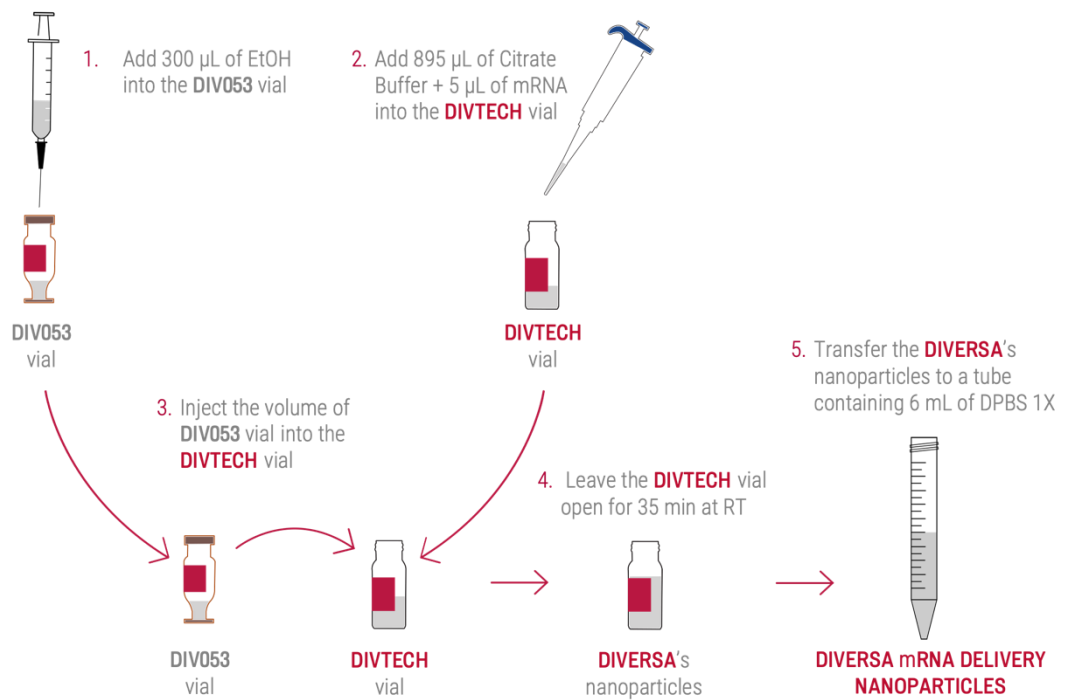
---

Shipping temperature may differ from storage temperature. This does not alter the performance of the product.

**DIVERSA TECHNOLOGIES S.L.** | Edificio Emprendia, Campus Sur, 15782 Santiago de Compostela, Spain.

Technical support: email: [support@diversatechnologies.com](mailto:support@diversatechnologies.com) | [www.diversatechnologies.com](http://www.diversatechnologies.com)

**FOR RESEARCH USE ONLY.** Not for use in humans. Purchase of this product does not include any right to resell or transfer, either as a stand-alone product or as a component of another product. Any use of this Product for purposes other than research is strictly prohibited.



**Figure 1. DIVERSA mRNA DELIVERY NANOPARTICLES.** Formulation protocol.

Shipping temperature may differ from storage temperature. This does not alter the performance of the product.

**DIVERSA TECHNOLOGIES S.L.** | Edificio Emprendia, Campus Sur, 15782 Santiago de Compostela, Spain.

Technical support: email: [support@diversatechnologies.com](mailto:support@diversatechnologies.com) | [www.diversatechnologies.com](http://www.diversatechnologies.com)

**FOR RESEARCH USE ONLY.** Not for use in humans. Purchase of this product does not include any right to resell or transfer, either as a stand-alone product or as a component of another product. Any use of this Product for purposes other than research is strictly prohibited.

## PROTOCOL for the encapsulation of 1 µg of mRNA

Please note that the variability in the formulation increases when working with smaller mRNA quantities. Ensure careful handling to maintain consistency in nanoparticle formation and performance.

1. Inject 310 µL of EtOH into the **DIV053** by inserting the needle through the septum using the provided syringe and needle. Then vortex the vial.

**Note:** DO NOT remove the metal cap from the vial to avoid spilling.

2. Remove the metal cap from the **DIV053**. Divide the volume of **DIV053** vial into 5 aliquots of 60 µL in 0.6 mL sterile RNase-free microtubes.

**Note:** Unused **DIV053** aliquots can be stored at 4°C for up to 2 weeks. Ensure the microtubes are tightly closed to prevent evaporation of ethanol.

3. Add 175 µL of 10 mM Citrate Buffer (pH 3) and 5 µL of mRNA in 0.6 mL sterile RNase-free microtubes.

**Note<sub>1</sub>:** Prepare just a prior injection and avoid leaving the mRNA citrate phase at RT.

**Note<sub>2</sub>:** The specified volumes are based on an mRNA stock concentration of 0.2 mg/mL. Please adjust accordingly for different stock concentrations.

4. Using a 200 µL micropipette, add 60 µL from the previously reconstituted **DIV053** vial into the 0.6 mL sterile RNase-free microtube containing the citrate buffer solution and the mRNA, resulting in a final volume of 240 µL of **DIVERSA**'s nanoparticles.

**Note:** Before adding the volume from the **DIV053** vial into the microtube, set the micropipette at the maximum volume and add the solution with a sudden, vigorous downward motion. Pipette up and down several times with confidence to ensure proper mixing and nanoparticle formation.

5. Leave the microtube containing the **DIVERSA**'s nanoparticles open for 35 min at room temperature (RT), protected from light.
6. Transfer the 240 µL of **DIVERSA**'s nanoparticles to a 2 mL sterile RNase-free microtube containing 1.760 mL of DPBS 1X at 4 °C.

Subsequently, either proceed with the **CONCENTRATION PROTOCOL** or store the diluted formulation at 4 °C for later use.

---

Shipping temperature may differ from storage temperature. This does not alter the performance of the product.

**DIVERSA TECHNOLOGIES S.L.** | Edificio Emprendia, Campus Sur, 15782 Santiago de Compostela, Spain.

Technical support: email: [support@diversatechnologies.com](mailto:support@diversatechnologies.com) | [www.diversatechnologies.com](http://www.diversatechnologies.com)

**FOR RESEARCH USE ONLY.** Not for use in humans. Purchase of this product does not include any right to resell or transfer, either as a stand-alone product or as a component of another product. Any use of this Product for purposes other than research is strictly prohibited.

## CONCENTRATION PROTOCOL

Select the most appropriate Amicon Ultra Centrifugal Filter.

**Note:** A molecular weight cut-off (MWCO) between 10 kDa and 100 kDa is preferred. The total volume of the diluted formulation will depend on the selected formulation protocol.

- **PROTOCOL for the encapsulation of 5 µg of mRNA.** If possible, select a filter with a capacity greater than 7.2 mL. If the capacity is lower, the diluted formulation (from step 5, **FORMULATION PROTOCOL**) can be added in multiple steps. In such cases, the formulation must always be kept at 4°C during the waiting period.
- **PROTOCOL for the encapsulation of 1 µg of mRNA.** If possible, select a filter with a capacity greater than 2 mL. If the capacity is lower, the diluted formulation (from step 6, **FORMULATION PROTOCOL**) can be added in multiple steps. In such cases, the formulation must always be kept at 4°C during the waiting period.

1. Equilibrate the membrane of the Amicon Ultra Centrifugal Filter by adding 1X DPBS at 4 °C, ensuring the membrane is fully covered. Centrifuge at 2,500 RCF at 4 °C (5-10 min) and discard the flow-through.
2. Add the diluted formulation and centrifuge at 2,500 RCF at 4 °C.

**Note<sub>1</sub>:** Please check [Table 1](#) for recommendations on final working concentrations.

**Note<sub>2</sub>:** The centrifugation time may vary depending on the molecular weight (MW) of the mRNA and the characteristics of the Amicon Ultra Centrifugal Filter, so adjust the centrifugation time accordingly.

As a reference, **DIVERSA**'s nanoparticles loaded with an mRNA of 1922 nt using an Amicon Ultra Centrifugal Filter (15 mL-30 kDa) and centrifuged for 35 min resulted in approximately 200 µL.

**Note<sub>3</sub>:** Ensure that the **DIVERSA**'s nanoparticles remain in suspension, and DO NOT allow them to dry completely.

3. Discard the flow-through and collect the **DIVERSA**'s nanoparticles from the upper part of the Amicon Ultra Centrifugal Filter.
4. Transfer the **DIVERSA**'s nanoparticles to a 0.6 mL sterile RNase-free microtube and store at 4 °C until use.

---

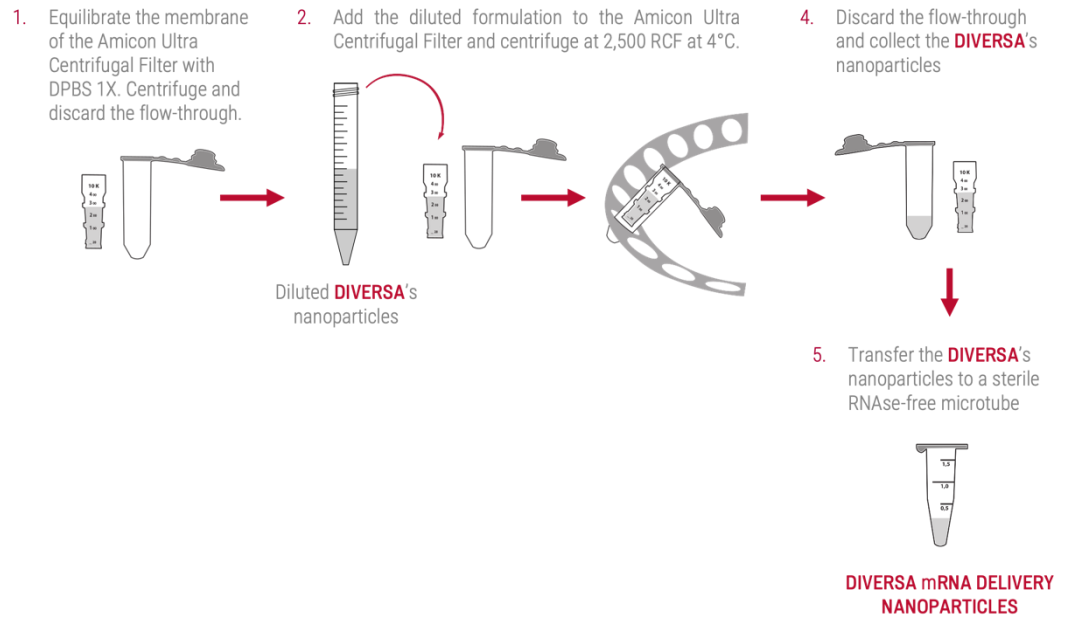
Shipping temperature may differ from storage temperature. This does not alter the performance of the product.

**DIVERSA TECHNOLOGIES S.L.** | Edificio Emprendia, Campus Sur, 15782 Santiago de Compostela, Spain.

Technical support: email: [support@diversatechnologies.com](mailto:support@diversatechnologies.com) | [www.diversatechnologies.com](http://www.diversatechnologies.com)

**FOR RESEARCH USE ONLY.** Not for use in humans. Purchase of this product does not include any right to resell or transfer, either as a stand-alone product or as a component of another product. Any use of this Product for purposes other than research is strictly prohibited.





**Figure 2. DIVERSA mRNA DELIVERY NANOPARTICLES.** Concentration protocol

Shipping temperature may differ from storage temperature. This does not alter the performance of the product.

**DIVERSA TECHNOLOGIES S.L.** | Edificio Emprendia, Campus Sur, 15782 Santiago de Compostela, Spain.

Technical support: email: [support@diversatechnologies.com](mailto:support@diversatechnologies.com) | [www.diversatechnologies.com](http://www.diversatechnologies.com)

**FOR RESEARCH USE ONLY.** Not for use in humans. Purchase of this product does not include any right to resell or transfer, either as a stand-alone product or as a component of another product. Any use of this Product for purposes other than research is strictly prohibited.

## TRANSFECTION ASSAY

### EXAMPLE PROTOCOL

---

1. Seed the recommended number of the cells in a 96-well plate with 100  $\mu$ L of supplemented medium the day before the transfection assay.

**Note:** Optimizations should be performed depending on the cell type and the length of the experiment.

2. Prepare the **DIVERSA's** nanoparticles for 5  $\mu$ g of mRNA according to the provided **FORMULATION PROTOCOL**. Concentrate it up to 250  $\mu$ L for a final mRNA concentration of 20  $\mu$ g/mL.

3. Add the **DIVERSA's** nanoparticles at the desired transfection concentration in, at least, triplicate (e.g., 5  $\mu$ L of nanoparticles in a final volume of 100  $\mu$ L, achieving a final concentration in the well of 1  $\mu$ g/mL of mRNA encapsulated in **DIVERSA's** nanoparticles).

**Note:** This concentration can be modified depending on the type of mRNA and the specific cells of interest, but a minimum amount of 1  $\mu$ g/mL of mRNA is recommended for the first set of experiments.

4. The read out can be performed after different incubation times depending on the mRNA of interest.

For example:

- HEK293 cells transfected with 1  $\mu$ g/mL FLuc mRNA encapsulated in **DIVERSA's** nanoparticles can be analyzed 24 h post-transfection with the ONE-Glo™ Luciferase Assay (Promega (Ref.: E6120)).
- HEK293 cells transfected with 1  $\mu$ g/mL GFP mRNA encapsulated in **DIVERSA's** nanoparticles can be analyzed 24 h post-transfection by Flow Cytometry Analysis, fluorescence or confocal microscopy.

---

Shipping temperature may differ from storage temperature. This does not alter the performance of the product.

**DIVERSA TECHNOLOGIES S.L.** | Edificio Emprendia, Campus Sur, 15782 Santiago de Compostela, Spain.

Technical support: email: [support@diversatechnologies.com](mailto:support@diversatechnologies.com) | [www.diversatechnologies.com](http://www.diversatechnologies.com)

**FOR RESEARCH USE ONLY.** Not for use in humans. Purchase of this product does not include any right to resell or transfer, either as a stand-alone product or as a component of another product. Any use of this Product for purposes other than research is strictly prohibited.

## TABLES AND TECHNICAL NOTES

**Table 1.** Recommended volume of **DIVERSA's** formulation to transfect 100 ng of mRNA in 100  $\mu$ L using a 96-well plate.

Final volume of <b>DIVERSA's</b> nanoparticles	<b>500 <math>\mu</math>L</b>	<b>250 <math>\mu</math>L</b>	<b>100 <math>\mu</math>L</b>
Amount of mRNA in <b>DIVERSA's</b> nanoparticles	5 $\mu$ g		
mRNA concentration in <b>DIVERSA's</b> nanoparticles	10 ng/ $\mu$ L	20 ng/ $\mu$ L	50 ng/ $\mu$ L
Volume of mRNA loaded <b>DIVERSA's</b> nanoparticles to transfect 100 ng	<b>10 <math>\mu</math>L</b>	<b>5 <math>\mu</math>L</b>	<b>2 <math>\mu</math>L</b>

**Table 2.** Recommended volumes for cell culture transfection to achieve a final mRNA concentration in the well of 1  $\mu$ g/mL, starting from a mRNA concentration in **DIVERSA's** nanoparticles of 20  $\mu$ g/mL.

Cell culture vessel	Amount of mRNA/well	Volume of <b>DIVERSA's</b> nanoparticles*	Volume of medium/ well*	Total volume/well*
100 cm	5000 ng	250 $\mu$ L	4,75 mL	5 mL
6-well	1000 ng	50 $\mu$ L	950 $\mu$ L	1 mL
12-well	500 ng	25 $\mu$ L	475 $\mu$ L	500 $\mu$ L
24-well	250 ng	12.5 $\mu$ L	237.5 $\mu$ L	250 $\mu$ L
96-well	100 ng	5 $\mu$ L	95 $\mu$ L	100 $\mu$ L

\* These volumes are recommended for an incubation time of 4 hours. If **DIVERSA's** nanoparticles are incubated for longer than 4 hours, it is recommended to double the volumes of both the nanoparticles and the medium.

Shipping temperature may differ from storage temperature. This does not alter the performance of the product.

**DIVERSA TECHNOLOGIES S.L.** | Edificio Emprendia, Campus Sur, 15782 Santiago de Compostela, Spain.

Technical support: email: [support@diversatechnologies.com](mailto:support@diversatechnologies.com) | [www.diversatechnologies.com](http://www.diversatechnologies.com)

**FOR RESEARCH USE ONLY.** Not for use in humans. Purchase of this product does not include any right to resell or transfer, either as a stand-alone product or as a component of another product. Any use of this Product for purposes other than research is strictly prohibited.

**Table 3.** Example of cells successfully transfected using **DIVERSA**'s formulation.

Immortalized Cells	Embryonic kidney cells (HEK293) Epithelial breast cancer cells (MDA-MB-231) Epithelial lung cancer cells (A549) Human monocytes (THP-1) Mouse macrophages (RAW264) Mouse fibroblasts (NIH/3T3) Mouse cardiomyocytes (HL-1) Human cardiomyocytes (AC10) Human fibroblasts (HFF-1)
Primary cells	Human primary monocytes-derived macrophages Cortical neurons Human primary monocytes-derived macrophages Cortical neurons
Organoids	From brain cells

Shipping temperature may differ from storage temperature. This does not alter the performance of the product.

**DIVERSA TECHNOLOGIES S.L.** | Edificio Emprendia, Campus Sur, 15782 Santiago de Compostela, Spain.

Technical support: email: [support@diversatechnologies.com](mailto:support@diversatechnologies.com) | [www.diversatechnologies.com](http://www.diversatechnologies.com)

**FOR RESEARCH USE ONLY.** Not for use in humans. Purchase of this product does not include any right to resell or transfer, either as a stand-alone product or as a component of another product. Any use of this Product for purposes other than research is strictly prohibited.

## FREQUENTLY ASKED QUESTIONS

QUESTION	ANSWER
Can I use mRNA to encode any protein?	Yes, <b>DIVERSA</b> 's nanoparticles can be loaded with mRNAs encoding for any protein of interest.
<b>DIVERSA</b> 's nanoparticles can be used for other types of nucleic acids?	No, <b>DIVERSA</b> can provide customized formulations for other types of nucleic acid.
What is the maximum amount of mRNA to encapsulate in <b>DIVERSA</b> 's nanoparticles?	The maximum amount of mRNA to encapsulate is 5 µg per <b>DIV053</b> vial. However, higher amounts can be achieved as a customized formulation. Contact <b>DIVERSA</b> .
What is the amount of the fluorophore in <b>DIV053</b> ?	The fluorophore amount is 5 µg per vial.
Can I filter the formulation?	Yes, if necessary, <b>DIVERSA</b> 's nanoparticles can be filtered using small 0.22 µm PES membrane filters.
How can I measure the size of the final formulation?	Diameter size can be measured by an equipment as Dynamic Light Scattering (DLS) analysis.
Can I use <b>DIVERSA</b> 's nanoparticles for <i>in vivo</i> studies?	<b>DIVERSA</b> 's nanoparticles can be used <i>in vivo</i> . Contact <b>DIVERSA</b> for specific recommendations for <i>in vivo</i> experiments.

Shipping temperature may differ from storage temperature. This does not alter the performance of the product.

**DIVERSA TECHNOLOGIES S.L.** | Edificio Emprendia, Campus Sur, 15782 Santiago de Compostela, Spain.

Technical support: email: [support@diversatechnologies.com](mailto:support@diversatechnologies.com) | [www.diversatechnologies.com](http://www.diversatechnologies.com)

**FOR RESEARCH USE ONLY.** Not for use in humans. Purchase of this product does not include any right to resell or transfer, either as a stand-alone product or as a component of another product. Any use of this Product for purposes other than research is strictly prohibited.

## ONLINE RESOURCES

---

Visit our website [www.diversatechnologies.com](http://www.diversatechnologies.com) for further information.

## CHANGELOG

---

Version	Date	Change Description
1.0	1 APR 2024	Initial release of the protocol.
2.0	8 NOV 2024	Clarified protocol steps for preparing <b>DIVERSA's</b> nanoparticles; added recommendations.

---

Shipping temperature may differ from storage temperature. This does not alter the performance of the product.

**DIVERSA TECHNOLOGIES S.L.** | Edificio Emprendia, Campus Sur, 15782 Santiago de Compostela, Spain.

Technical support: email: [support@diversatechnologies.com](mailto:support@diversatechnologies.com) | [www.diversatechnologies.com](http://www.diversatechnologies.com)

**FOR RESEARCH USE ONLY.** Not for use in humans. Purchase of this product does not include any right to resell or transfer, either as a stand-alone product or as a component of another product. Any use of this Product for purposes other than research is strictly prohibited.