

# Rotifer Production Solutions



Rotifer (*Brachionus plicatilis*) grown using RotiGrow Plus

## Feed, Enrichment and Greenwater Products & Solutions

From the producers of **Nanno 3600** and **Pav-DHA**, introducing our new and improved microalgal feeds and solutions:

### RotiGrow

#### GROW-OUT FEEDS

- RotiGrow Plus
- RotiGrow Nanno

### N-Rich

#### ENRICHMENT FEEDS

- N-Rich High PRO
- N-Rich PL Plus
- N-Rich Ultra PL

### RotiGreen

#### GREENWATER FEEDS

- RotiGreen Nanno
- RotiGreen Iso
- RotiGreen Omega

### **100% of feed biomass from Microalgae**

#### **Best for rotifers**

Exceptionally clean  
High yield  
Fortifies your rotifers

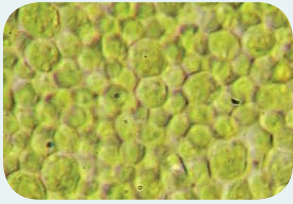
#### **Best for fish**

Complete HUFA enrichment  
"Whole Cell – Whole Food Nutrition"  
Broad-spectrum, high-protein, nutrient-rich feeds and enrichments

#### **Best for you!**

Frozen and refrigerator-stable products for better logistics and inventory control  
Easily dispersed – no mixing needed  
Clean feeds make system maintenance easy

***The most convenient and effective feeds available!***



Photomicrograph of RotiGrow Plus

## RotiGrow Feeds

*Solutions for grow-out and pre-enrichment include:*

- **RotiGrow Plus** A clean, effective, high-yield, microalgal blend rotifer feed that produces phospholipid-rich rotifers. It optimizes pre-enrichment levels of DHA, EPA and ARA. It can be used as a stand-alone feed or with other feeds and enrichments.
- **RotiGrow Nanno** A clean, effective, high-yield, single species (*Nannochloropsis*) rotifer feed that produces phospholipid-rich rotifers. It provides the highest biomass conversion rate of our products, with the least organic waste in the tank, and gives a high EPA and ARA pre-enrichment boost for use with high DHA-enrichment protocols.

# Feeds for Growing Rotifers

## Optimum Grow-Out and Pre-Enrichment

RotiGrow feeds are carefully formulated to produce healthy and vigorous rotifers despite high-density, stressful conditions. Our feeds balance building high-HUFA lipid membranes, gut loading, and achieving optimal nutritional profiles while limiting harmful bacteria. RotiGrow feeds create healthy, vigorous rotifers ready for the enrichment phase because they combine optimized nutritional profiles with 100 percent natural biomass from microalgae.

## Superior Nutrition for Rotifer Grow-Out

### Maximum value for larval fish

The ideal rotifer feed produces a vigorous and stable culture. Rotifers are exposed to tremendous stress from high-density culturing, enrichment, warm and cold storage, and transfer to the larval rearing tank. Rotifers grown using RotiGrow feeds emerge from this process with maximum health, vigor, cleanliness, and nutritional value for larval fish.

### Optimized for production

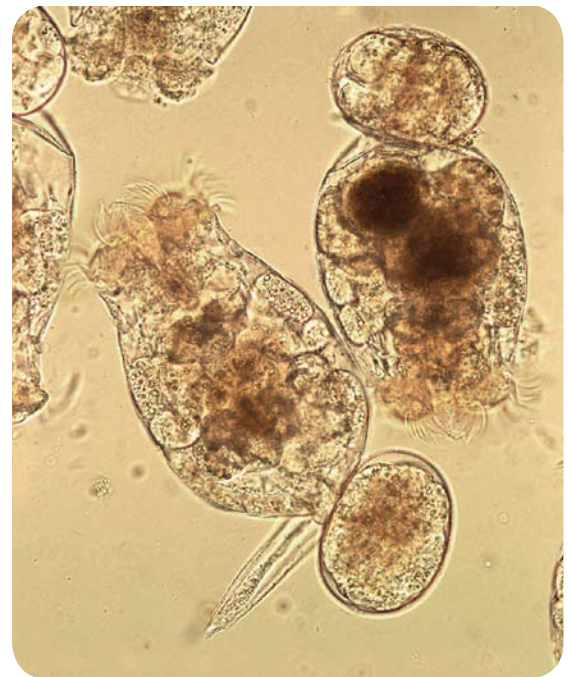
RotiGrow feeds allow high-density cultures with high harvest rates to thrive in minimal space, with minimal effort. Our feeds offer high biomass conversion from feed to rotifer, a key factor in efficient production.

### Clean and healthy rotifers

Rotifers must have minimal levels of harmful bacteria, both internal and external, to avoid digestive stress to the larval fish. The use of RotiGrow feeds results in clean, strong rotifers that remain vigorous in the larval rearing tank.

### Superior pre-enrichment

Enrichment is a stressful process by which rotifers transform their lipid membrane phospholipids with HUFA lipids, accumulate HUFA oils, and load their guts. RotiGrow feeds provide pre-enrichment in the grow-out stage that greatly enhances HUFA lipids and reduces the duration and stress of the enrichment process.



Enriched rotifers grown using RotiGrow Plus and enriched for 8 hours with N-Rich Standard.

## Summary

*RotiGrow feeds have been developed to provide:*

- Vigorous, healthy rotifers and stable cultures
- Maximum density and production in batch and continuous systems – densities up to 5,000 rotifers per ml easily achieved
- Maximum rotifer cleanliness and health
- Maximum levels of HUFA pre-enrichment
- Ease of use and labor savings
- Extended shelf-life for better logistics and inventory control

# Choosing the Right Feed

## RotiGrow Feeds and other **Instant Algae** Grow-Out Feeds

It is impossible to understate the importance of proper feeds and protocols in the growing of rotifers. Because each hatchery has unique needs, efficient production and the healthiest, most nutritious rotifers requires the very best-quality feeds. That is why Reed Mariculture has devoted countless hours to the optimized formulation and rigorous testing of the highest quality feeds to mimic nature's feeds as nearly as possible. We produce billions of rotifers every day, and back them up with our superior customer service. These easy-to-use feeds, our expert advice, and smooth logistics will enhance your operation's efficiency and productivity. We also offer custom feed blends to meet your operation's specific needs.

## Feed options and product advantages

### **RotiGrow Plus**

- **All-In-One Grow-Out and Enrichment** plus gut-loading for HUFA enrichment requirements up to 40 mg/g d.w. and DHA:EPA ratio of 1.6:1
- Produces phospholipid-rich rotifers
- Very clean and effective
- Provides high phospholipid DHA, EPA and ARA enrichment
- Allows use of enrichment feeds that are nutritionally balanced for healthier rotifers
- Allows for extremely high DHA enrichment – if desired
- Microalgal blend



High density rotifer culture growing on RotiGrow Plus. 24 hours since last cleaning.

## RotiGrow Nanno

- Has the highest biomass conversion rate and least organic waste in your rotifer tank of the feeds we offer
- Very clean and effective
- Produces phospholipid-rich rotifers
- Provides a high EPA and ARA pre-enrichment boost for use with high DHA enrichment protocols
- Single species *Nannochloropsis*

## Chlorella

- Super Fresh Chlorella V12
- Provides moderate DHA, EPA and ARA enrichment (25mg/g HUFA pre-enrichment)

## Nanno 3600

- Our original *Nannochloropsis* feed
- Very effective with established protocols
- Provides an EPA and ARA pre-enrichment boost for use with high DHA enrichment protocols

## Rotifer Diet

- Our original blended *Nannochloropsis* / *Tetraselmis* feed
- Very effective with established protocols
- Provides an EPA and ARA pre-enrichment boost for use with high DHA enrichment protocols

**All our feeds are comparably priced in terms of rotifer production allowing you to choose the feed that best suits your needs.**

### FEED COMPARISON

**Production efficiency** Rotifer harvest per liter of feed

	RotiGrow Plus	RotiGrow Nanno	Chlorella	Nanno 3600	Rotifer Diet
Rotifer Harvest – wet weight ( <i>g per liter of feed</i> )	310g	375g	265g	350g	355g
Rotifer Harvest – Millions ( <i>million rotifers per liter of feed*</i> )	263M	320M	225M	300M	305M
Biomass conversion ( <i>dry weight of rotifer harvest/dry weight of paste biomass</i> )	32.2%	35.6%	28.9%	30.0%	30.5%
Cost ( <i>per million rotifers</i> ) **	\$0.135	\$0.135	\$0.15	\$0.143	\$0.143

\* Using Reed Mariculture's "Mini-L160" ( L-Type *B. plicatilis* with a mean lorica length of 165 microns, dry weight = 0.18g per million rotifers)

\*\* Cost per million rotifers based on our 200 liter price, in USD, FOB San Francisco. Actual price will vary depending on location and advance purchase agreements.

### Typical HUFA pre-enrichment of rotifers harvested from Grow-out tank

	RotiGrow Plus	RotiGrow Nanno	Chlorella	Nanno 3600	Rotifer Diet	Marine fish egg*
DHA <sup>1</sup>	19	0.0	12.6	0.0	0.0	33.0
EPA <sup>1</sup>	12	20	5.2	16	15	18.6
ARA <sup>1</sup>	1.9	2.8	0.5	2.0	2.0	2.2
HUFA <sup>1</sup>	45	32	26	30	30	56.2
Total Fatty Acids <sup>2</sup>	10.5%	8.9%	8.2%	7.8%	7.8%	13.2%
Polar Membrane Lipid <sup>3</sup>	54%	—	Not Published	—	—	71%
Sterol <sup>3</sup>	4.9%	—	Not Published	—	—	9.8%
Free Fatty Acid <sup>3</sup>	5.1%	—	Not Published	—	—	5.4%
Triglyceride (oil) <sup>3</sup>	36%	—	Not Published	—	—	12.5%

\* Cod fatty acid numbers from Sargent and Toucher 1984

<sup>1</sup> mg/g dry weight

<sup>2</sup> Percent of dry weight as triglyceride

<sup>3</sup> Percent of Lipids

## Enrichment & Greenwater Formulated for Optimum Enrichment & Rotifer Health

N-Rich feeds are exceptionally clean, effective, and easy to use. They offer full fatty-acid nutrition without stressing rotifers. With Whole Cell-Whole Food microalgal nutrition, astaxanthin and Stay-C® added, N-Rich products provide broad-spectrum tissue enrichment, health and nutritional maintenance during both cold and warm storage, and gut loading. These superior feeds can achieve the highest level of performance because *all N-Rich biomass is from microalgae*.

### The Ideal Rotifer and Larval Nutrition

#### Optimal soft tissue and gut loading

Rotifers are nutrition-delivery devices. Their nutritional value comes from both enriched rotifer tissue and the feed loaded into the rotifer's gut. Soft tissue and gut contents are squeezed out of the rotifer by the larval fish when the rotifer



Dense culture after 8 hours of enrichment. The N-Rich family of enrichment feeds produces ultra-clean and vigorous rotifers

is consumed. The external shell (lorica) and eggs of the rotifers often pass undigested. Thus gut contents and soft tissue must offer the highest possible nutritional value.

#### Balanced nutrition

The N-Rich family of feeds assures that the rotifer's soft tissue and gut contain the highest level of proteins and lipids rich in phospholipid HUFAs as well as a host of carotenoids, sterols, vitamins, enzymes, and other key nutrients.

#### Healthy rotifers for healthy finfish larvae

In order for larval fish to thrive they must be fed the cleanest and healthiest rotifers possible. Protein and nutrient-rich enrichment feeds and

greenwater are essential to maintaining healthy rotifers with maximum vigor and minimal levels of harmful bacteria. Healthy rotifers avoid digestive stress and deliver maximum nutrition.

### N-Rich Feeds

The N-Rich family of enrichment feeds include:

- **N-Rich High PRO** provides a gentle, high-protein enrichment. Also used for cold and warm storage and enrichment maintenance and gut-loading. Lipid to protein ratio = 0.9 : 1
- **N-Rich PL Plus** for rapid enrichment and high DHA/HUFA enrichment. Lipid to protein ratio = 1.4 : 1
- **N-Rich PL Extreme** for very high DHA/HUFA enrichment required by some fish species. Lipid to protein ratio = 3.7 : 1
- **N-Rich specialty blends** Custom blends can be designed for slow enrichment, fast enrichment, and achievement of HUFA levels above 8% dry-weight rotifer biomass.

### RotiGreen Feeds

The RotiGreen family of greenwater feeds includes:

- **RotiGreen Nanno** – *Nannochloropsis* greenwater
- **RotiGreen Iso** – *Isochrysis* greenwater
- **RotiGreen Omega** – Algal blend with a high HUFA blend of DHA, ARA and EPA
- **Nanno 3600** and **Isochrysis 1800** are also available for greenwater.

# Superior Enrichment & Best Practices

## N-Rich Feeds and Protocols

Rigorous testing, observation, and customer feedback on our N-Rich products have resulted in a complete line of feeds that produce outstanding results when used according to our protocols. This is all part of our unwavering commitment to our customer's success.

## N-Rich feeds in detail:

*Enrichment and gut-load from 5 Whole-Cell microalgae.*

### Nutrition includes:

- 20% to 41% protein (depending on blend)
- 8% to 21% carbohydrates (depending on blend)
- 150ppm astaxanthin from *Haematococcus* microalgae
- 1,000mg/Kg Stay-C® stabilized Vitamin C
- A host of nutrients typical of *Isochrysis*, *Pavlova*, *Tetraselmis*, and *Thalassiosira* including carotenoids, enzymes, and sterols

### Full DHA, EPA and ARA enrichment when used with RotiGrow Plus and RotiGrow Nanno

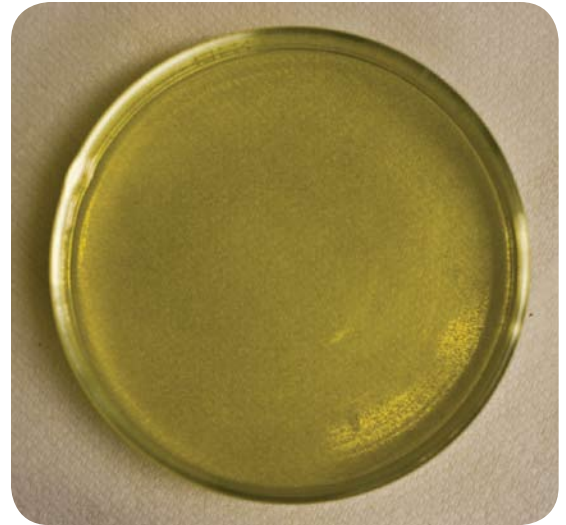
- Enriched rotifers contain more than 33mg/g DHA, 16mg/g EPA and 2.5 mg/g ARA in as little as 2 hours of enrichment. Still higher levels can be achieved

### Rotifers have optimized lipid-class ratios

- 15-18% lipids with high levels of phospholipids and other cell membrane lipids necessary for larval cellular development
- 12-20% lipids as a percent of biomass, depending on enrichment protocol
- Lipid : Protein ratio from 1:5 to 1:2.8 depending on protocol
- 60% Membrane lipids (56% Phospholipids and Glycolipids)
- 4.5% Sterols
- 4.9% Free Fatty Acids
- Only 35% Triglyceride lipids

### Superior Rotifer Nutrition

- High protein and carbohydrate content maintains rotifer health throughout the enrichment process



Using our feeds and following the protocols results in ultra-clean rotifers

### Easy to Use

- Concentrated, clean, liquid form
- No special preparation required
- Easy to measure and disperse
- Extremely clean – minimal foaming and minimal fouling. No need to rinse the rotifers.

### Clean, Healthy and Energetic Rotifers

- Rotifers look as good after enrichment as they did before enrichment
- Minimal fouling and reduced bacteria-loads
- Plump rotifers with minimal stress and wasting
- Vigorous movement

## RotiGreen

A new greenwater formulation that provides nutrition directly to larval fish, maintains rotifer nutritional profile and gut load, and performs all other greenwater functions with minimal settling or fouling of the larval tank

- DHA, EPA, and ARA-balanced microalgal greenwater
- Clean, non-settling, non-fouling
- Greenwater nutrition for gill-feeding larval fish
- Greenwater nutrition for rotifers
- Maintains rotifer HUFA profile

## BEST PRACTICES

### Demonstrated Enrichment Protocols – Four Example Enrichments

Using a small “Cayman-like” L-strain rotifer (165micron, 0.18g/million dry weight)

#### Some Enrichments for Rotifers Grown with RotiGrow Plus or Super Fresh Chlorella V12

#### 1 Gentle 3-8 hour enrichment

**DOSE:** Moderate

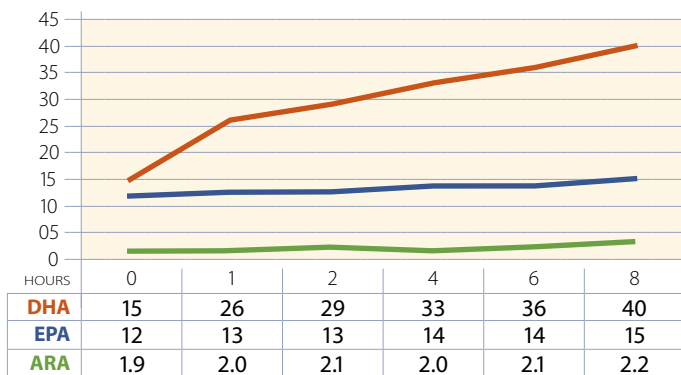
**ROTIFER GROW-OUT FEED:** RotiGrow Plus

**ENRICHMENT:** N-Rich High PRO (high protein algal blend)

**DIRECTIONS FOR 6 HOUR ENRICHMENT:** Feed 0.35ml N-Rich High PRO per liter every 3 hours at a density of 1000 Rotifers per ml.

**CONTINUOUS FEEDING DIRECTIONS (PREFERRED METHOD):** Feed 0.12ml N-Rich High PRO per liter per hour at 1000 rotifers per ml. Maximum enrichment density is 5000/ml. Increase feed proportionally to rotifer density. Maintain dissolved oxygen near saturation.

MG/G DRY WEIGHT



#### 2 Quick 2-3 hour enrichment

**DOSE:** Strong

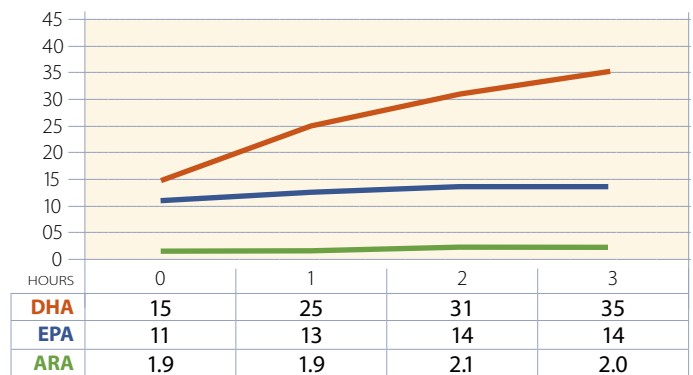
**ROTIFER GROW-OUT FEED:** RotiGrow Plus

**ENRICHMENT:** N-Rich PL Plus (balanced phospholipid and protein algal blend)

**DIRECTIONS FOR 2-3 HOUR ENRICHMENT:** Feed 0.6 ml N-Rich PL Plus per liter at a density of 1000 Rotifers per ml.

**CONTINUOUS FEEDING DIRECTIONS (PREFERRED METHOD):** Feed 0.2ml N-Rich PL Plus per liter per hour at 1000 rotifers per ml. Maximum enrichment density is 5000/ml. Increase feed proportionally to rotifer density. Maintain dissolved oxygen near saturation.

MG/G DRY WEIGHT



#### Some Enrichments for Rotifers Grown with RotiGrow Nanno, Nanno 3600 and Rotifer Diet I

#### 3 Strong enrichment from Nannochloropsis base

**DOSE:** Strong

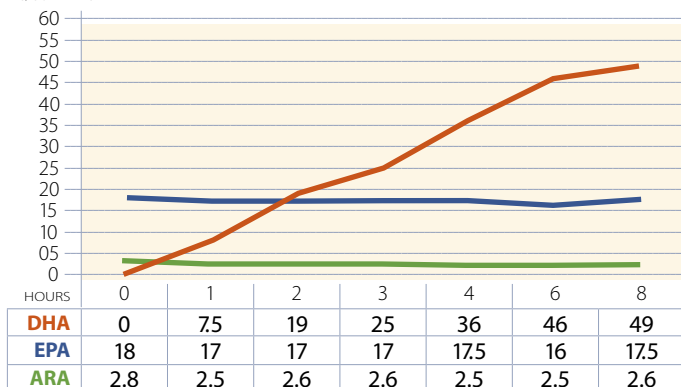
**ROTIFER GROW-OUT FEED:** RotiGrow Nanno, Nanno 3600 or Rotifer Diet I

**ENRICHMENT:** N-Rich PL Plus (balanced phospholipid and protein algal blend)

**DIRECTIONS FOR 3-8 HOUR ENRICHMENT:** Feed 0.6 ml N-Rich PL Plus per liter every 3 hours at a density of 1000 Rotifers per ml. If enriching for 8 hours add 0.2ml N-Rich PL Plus at hour 6.

**CONTINUOUS FEEDING DIRECTIONS (PREFERRED METHOD):** Feed 0.2ml N-Rich PL Plus per liter per hour at 1000 rotifers per ml. Maximum enrichment density is 5000/ml. Increase feed proportionally to rotifer density. Maintain dissolved oxygen near saturation.

MG/G DRY WEIGHT



#### 4 Extreme HUFA enrichment from Nannochloropsis base

**DOSE:** Moderate

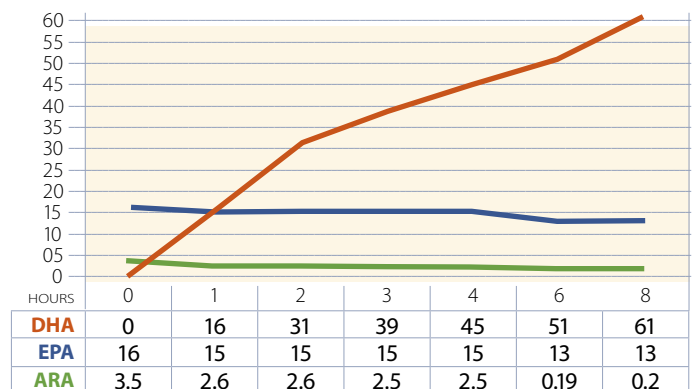
**ROTIFER GROW-OUT FEED:** RotiGrow Nanno, Nanno 3600 or Rotifer Diet I

**ENRICHMENT:** N-Rich Ultra PL (high phospholipid algae)

**DIRECTIONS FOR 6 HOUR ENRICHMENT:** Feed 0.4 ml N-Rich Ultra PL per liter at a density of 1000 Rotifers per ml. Feed 1/2 of the feed at the beginning and 1/2 at 3 hours.

**CONTINUOUS FEEDING DIRECTIONS (PREFERRED METHOD):** Feed 0.13ml N-Rich Ultra PL per liter per hour at 1000 rotifers per ml. Maximum enrichment density is 5000/ml. Increase feed proportionally to rotifer density. Maintain dissolved oxygen near saturation.

MG/G DRY WEIGHT



Instant Algae Packaging

1 Quart Bottle



1 Liter Bag



10 Liter Cubitainer®



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# More Products & Services

## Live Rotifer Cultures

### The RMI "Mini-L 160" small L-Type 165-micron rotifer!

- *Brachionus plicatilis* similar to the "Cayman" biotype
- Median lorica length = 165 microns
- Mean rotifer dry weight biomass = 180mg per million rotifers
- Acclimated to 15-20 ppt., best growth at 20-25 °C

**Live rotifers** – 1 million to 2 billion rotifers per shipment

*Clean robust rotifers for use as:*

- Starter cultures
- Supplemental feed
- Primary feed

## Supplies:

- ClorAm-X ammonia and chlorine neutralizer
- Peristaltic pumps
- Rotifer filter floss

## Otohime Weaning Diets:

- Superior to any other weaning diet available

## Service-first customer support

- **Easy world-wide logistics**
- Factory-direct and distributor sales available

### *Our job is to make your job easier!*

- Knowledgeable staff willing to help any way we can
- Years of experience with continuous-growth rotifer systems
- Free fatty acid analytical services available to help operations optimize enrichment practices

## Company Information

Reed Mariculture is the world's largest producer of marine microalgae concentrates. Our *Instant Algae*® larviculture feeds are used by over 500 hatcheries, universities, and marine ornamental operations in more than 80 countries around the world. We also offer zooplankton, copepods, and weaning feeds.

For more rotifer information, visit [www.rotifersolutions.com](http://www.rotifersolutions.com)

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