



## Related products

Product	Description/Application	Quantity	Cat. no.
E-Shot™ Cuvettes	For electroporation, 0.1 cm	50 per bag	P510-50
E-Shot™ Cuvettes	For electroporation, 0.2 cm	50 per bag	P520-50
Cuvettes	For electroporation, 0.4 cm	50 per bag	P460-50
MagicMedia™ <i>E. coli</i> Expression Medium	Simple, highly productive growth medium for increased expression levels	1 L	K6801
	powder SoluPouch™ format	5 × 1 L	K6802
	liquid format	1 L	K6803
SOC medium	Posttransformation recovery medium	10 × 10 ml	15544-034
Terrific Broth	Robust growth medium for increased plasmid yields	500 g	22711-022
imMedia™ Amp liquid	5 min preparation of LB liquid medium with ampicillin	20 pouches	Q600-20
imMedia™ Kan liquid	5 min preparation of LB liquid medium with kanamycin	20 pouches	Q610-20
imMedia™ Zeo liquid	5 min preparation of LB liquid medium with Zeocin™ selection agent	20 pouches	Q620-20
imMedia™ Amp Agar	5 min preparation of LB agar medium with ampicillin	20 pouches	Q601-20
imMedia™ Kan Agar	5 min preparation of LB agar medium with kanamycin	20 pouches	Q611-20
imMedia™ Zeo Agar	5 min preparation of LB agar medium with Zeocin™ selection agent	20 pouches	Q621-20
imMedia™ Amp Blue	5 min preparation of LB agar medium with ampicillin, IPTG, and X-gal	20 pouches	Q602-20
imMedia™ Kan Blue	5 min preparation of LB agar medium with kanamycin, IPTG, and X-gal	20 pouches	Q612-20
Zeocin™ Selection Agent	Selection for Zeo-resistant clones	1 g	R250-01
		5 g	R250-05
Ampicillin	Selection for Amp-resistant clones	20 mg	11593-019
X-gal	Chromogenic substrate for β-galactosidase	100 mg	15520-034
		1 g	15520-018
Bluo-gal	Chromogenic substrate for β-galactosidase	1 g	15519-028
IPTG	Inducer of β-galactosidase activity in bacteria	1 g	15529-019
0.8% E-Gel® 18-pak	Bufferless, precast agarose gels	18 gels	G5018-08
1.2% E-Gel® 18-pak	Bufferless, precast agarose gels	18 gels	G5018-01
2% E-Gel® 18-pak	Bufferless, precast agarose gels	18 gels	G5018-02
4% E-Gel® 18-pak	Bufferless, precast agarose gels	18 gels	G5018-04
E-Gel® PowerBase™ v.4	Base to run E-Gel® gels	1 base	G6200-04
1 Kb Plus DNA Ladder	DNA sizing	250 µg	10787-018
		1 mg	10787-026

Meet all your transformation needs here—efficiency, genotype, and packaging options

Electroporation and chemically competent *E. coli*



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T1 phage-resistant for additional protection



Electroporation-competent format

## Doing transformations? Find what you need for success here

### Electroporation-competent and chemically competent *E. coli*

- Innovative—advanced strains that grow faster, produce more colonies, and offer more protection against phage contamination and DNA recombination
- Reliable—years of proven performance and documented lot-to-lot consistency
- Flexible—available in a wide range of packaging formats and transformation efficiencies

Obtaining the right clone shouldn't be the time-intensive step in your research. That's why each *E. coli* strain from Invitrogen is specially engineered to keep you moving ahead. High transformation efficiencies—ranging from  $1 \times 10^6$  to  $3 \times 10^{10}$ —ensure that you produce representative cDNA and genomic libraries every time. You can screen clones faster and get your clone sooner with Mach1™ cells—the fastest-growing chemically competent strain available. While other competent cells claim resistance to T1 and T5 phages, Invitrogen strains have the *tonA* genotype, providing the best insurance against contamination. To make sure that each lot of cells consistently gives you the highest level of performance, stringent quality control standards must be met. The same quality principles are applied to cells designed for specialized applications, including cloning of unstable DNA and protein expression. If your research requires competent cells, you'll find what you need to succeed here.

# A complete selection of competent cells

Invitrogen offers competent cells for everything from cloning to expression. Table 1 summarizes the strains currently available. To learn more about a particular cell type, turn to the indicated page.

**Table 1—Competent cells are available for everything from cloning to protein expression.**

High-efficiency cloning (chemically competent)	High-efficiency cloning (electrocompetent)	High-throughput cloning	Fast growth	Routine cloning	cDNA and genomic library construction	Cloning unstable DNA	ssDNA production	Preparing unmethylated DNA	Recombinant baculovirus production	Propagating vectors with <i>ccdB</i> gene	Protein expression
One Shot® OmniMAX™ 2 T1 <sup>R</sup> pg. 11	MegaX DH10B™ T1 <sup>R</sup> Electrocomp™ pg. 14	MultiShot™ StripWell Mach1™ T1 <sup>R</sup> pg. 12	One Shot® Mach1™ T1 <sup>R</sup> pg. 12	One Shot® TOP10 pg. 13	MegaX DH10B™ T1 <sup>R</sup> Electrocomp™ pg. 14	ElectroMAX™ Stbl4™ pg. 18	ElectroMAX™ DH12S™ pg. 18	One Shot® INV110 pg. 18	MAX Efficiency® DH10Bac™ pg. 19	One Shot® <i>ccdB</i> Survival™ T1 <sup>R</sup> pg. 19	BL21 Star™(DE3) One Shot® pg. 20
One Shot® Mach1™ T1 <sup>R</sup> pg. 12	E-Shot™ DH10B™ T1 <sup>R</sup> Electrocomp™ pg. 14	MultiShot™ StripWell TOP10 pg. 13	MultiShot™ StripWell Mach1™ T1 <sup>R</sup> pg. 12	One Shot® TOP10F' pg. 13	E-Shot™ DH10B™ T1 <sup>R</sup> Electrocomp™ pg. 14	One Shot® Stbl3™ pg. 17	One Shot® TOP10F' pg. 13			Library Efficiency® DB3.1™ pg. 19	BL21-A1™ One Shot® pg. 22
One Shot® MAX Efficiency® DH10B™ T1 <sup>R</sup> pg. 12	ElectroMAX™ DH10B™ T1 <sup>R</sup> pg. 15	MultiShot™ TOP10 pg. 13		MAX Efficiency® DH5a™ pg. 13	One Shot® OmniMAX™ 2 T1 <sup>R</sup> pg. 11	MAX Efficiency® Stbl2™ pg. 17	One Shot® OmniMAX™ 2 T1 <sup>R</sup> pg. 11				BL21(DE3) One Shot® pg. 23
One Shot® MAX Efficiency® DH5a™ T1 <sup>R</sup> pg. 13	ElectroMAX™ DH5a-E™ pg. 16			Library Efficiency® DH5a™ pg. 13	ElectroMAX™ DH10B™ T1 <sup>R</sup> pg. 15		One Shot® INVaF' See <a href="http://www.invitrogen.com/compcells">www.invitrogen.com/compcells</a>				BL21(DE3)pLysS One Shot® pg. 23
One Shot® TOP10 pg. 13	ElectroMAX™ DH10B™ pg. 15			Subcloning Efficiency® DH5a™ pg. 13			MAX Efficiency DH5aF' IQ™ See <a href="http://www.invitrogen.com/compcells">www.invitrogen.com/compcells</a>				BL21(DE3)pLysE One Shot® pg. 23
One Shot® TOP10F' pg. 13	One Shot® TOP10 Electrocomp™ pg. 16										
MAX Efficiency® DH10B™ pg. 12	TOP10F' Electrocomp™ pg. 16										
MAX Efficiency® DH5a™ pg. 13	TOP10 Electrocomp™ pg. 16										

## Flexible packaging formats

Each project has its own unique requirements. To meet these different demands, many of Invitrogen's competent cells are offered in a variety of packaging formats (Table 2). Custom formats are also available.

Table 2—Competent cells are available in a variety of formats.

Format	Chemically competent	Electrocompetent	Single-use	High-throughput	Volume	Advantage
One Shot®	●	●	●		50 µl	Transformation and recovery in the same tube
E-Shot™		●	●		25 µl	Electroporation and recovery in the same cuvette
MultiShot™ StripWell	●			●	50 µl per well	12 strips of 8 tubes; do as many or as few reactions as needed
MultiShot™	●			●	15 µl per well	96-well plates fit automated format
Standard	●	●			100 µl, 200 µl, or 500 µl	Economical option

### Single-use One Shot® aliquots for unparalleled convenience

The unique One Shot® format provides 50 µl aliquots of chemically competent cells in single-use tubes. Transformation is performed directly in the tube, saving you time and effort. There are no extra pipetting steps, no extra tubes, and no loss of efficiency due to repeated freeze-thaw cycles. These kits come with SOC medium and pUC19 positive control (Figure 1).



Figure 1—The single-use One Shot® Kits offer the highest level of convenience.

### E-Shot™ format for the most convenient electroporation

For convenient electroporation, the E-Shot™ format provides competent *E. coli* predisposed into single-use, 0.1 cm universal-fit cuvettes (Figure 2). Electroporation and cell recovery are both done directly in the cuvette.



Figure 2—The most convenient electroporation.

### MultiShot™ StripWell format for medium throughput

The MultiShot™ StripWell format provides strips of tubes in a 96-well plate format, each well containing 50 µl of chemically competent cells (Figure 3). This allows you to use as many or as few reactions as you want, without wasting reagents. Each kit includes 12 strips of eight tubes, SOC medium, and pUC19 positive control (not pictured).



Figure 3—MultiShot™ StripWell kits are designed for medium-throughput cloning.

### MultiShot™ format for the highest throughput

The MultiShot™ format provides 15 µl aliquots of chemically competent cells in each well of a 96-well plate. Kits are supplied with five 96-well plates, SOC medium, and pUC19 positive control (Figure 4).



Figure 4—MultiShot™ kits include competent cells predisposed into 96-well plates.

### Standard kits are the economical choice

Standard kits include competent cells in a bulk format. They are designed for scientists who perform more than one transformation at a time and for general use in a busy lab. Kits are available in 500 µl (5 × 100 µl), 1 ml (5 × 200 µl), and 2 ml (4 × 500 µl) quantities. These kits include SOC medium and pUC19 positive control (Figure 5).



Figure 5—Standard bulk format for an economical choice.

### Have it your way with a custom kit

Custom kits with any competent cell type can be packaged in any of the above formats to meet your particular needs. Custom-designed strains can also be made available. Contact your local account manager or send an email to [customcompcells@invitrogen.com](mailto:customcompcells@invitrogen.com) to learn more.



# Competent cells for cloning

Transformation efficiency. Genetic markers. Packaging formats that fit your workflow. These are the most important considerations when choosing competent cells for your cloning experiment. Each of these factors will directly impact the time and effort required for your project, as well as its success. That's why Invitrogen offers you a number of cell types and formats. The following pages discuss these factors and the attributes inherent in each cell line, helping you make the right choice so you can achieve your cloning goals.

### Transformation efficiencies for a variety of applications

The transformation efficiency you need will be largely determined by your application. To meet these different requirements, competent cells are available in a wide range of transformation efficiencies—from  $>1 \times 10^6$  to  $>3 \times 10^{10}$  cfu/ $\mu$ g (Figure 6).

If your DNA is very limited or if the number of clones is critical, as in cDNA library construction, choose the MegaX DH10B™ T1<sup>R</sup> Electrocomp™ cells, the most efficient competent *E. coli* available, at  $>3 \times 10^{10}$  cfu/ $\mu$ g. For routine cloning applications, a number of cell types are available with efficiencies ranging from  $>1 \times 10^6$  to  $>5 \times 10^9$  cfu/ $\mu$ g.

**Determining transformation efficiency**  
Usually the transformation efficiency of competent cells is measured by transforming them with subsaturating amounts of supercoiled pUC DNA (~10–500 pg). The results are expressed in number of transformants (or colony forming units) per microgram of plasmid DNA (cfu/ $\mu$ g).

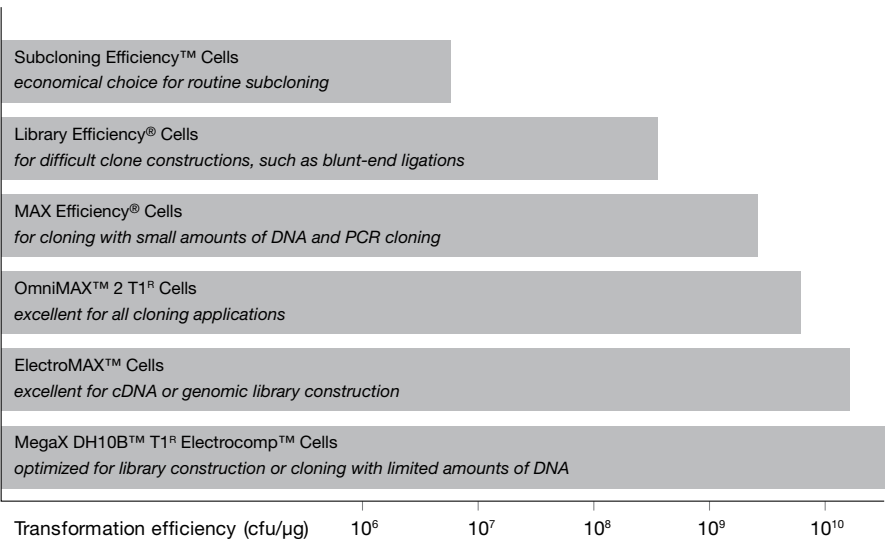


Figure 6—A range of transformation efficiencies are available to meet your application needs. One Shot® cells are generally provided at  $>1 \times 10^9$  or  $>1 \times 10^8$  cfu/ $\mu$ g.

### Genetic markers to consider when cloning

Several host strains offer distinct genetic advantages for use in a particular application. Generally, these genetic markers constitute host genes that have been mutated from the wild-type version, allowing the cell lines to be more easily manipulated and amenable to taking up foreign DNA. Here we discuss some important genotypes to look for when choosing a cell line for cloning.

#### *endA*

Endonuclease I deficiency ensures good quality of miniprep DNA (Figure 7).

#### F' episome

Needed for ssDNA production, the F' episome codes for strand-like structures called pili, which are found on the outer membrane of *E. coli*. M13 phage infect *E. coli* through these pili.

#### *lacI<sup>q</sup>*

Overproduction of the *lac* repressor negatively regulates transcription from the *lac* promoter. This repression is overcome by adding IPTG.

#### *lacZΔM15*

Partial deletion of the *lacZ* gene allows for  $\alpha$ -complementation, which is required for blue/white color selection when *E. coli* is plated on agar containing X-gal (Figure 8).

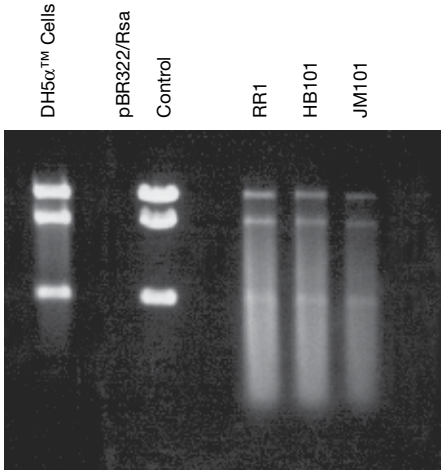


Figure 7—Cells with the *endA* genotype are better suited for minipreps. DH5a™ cells are *endA1* resulting in good quality minipreps. Strains such as HB101, JM101, and RR1 are *endA*<sup>+</sup>, making them unsuitable for miniprep analysis.



Figure 8—Easy visual screening. Blue/white color selection can be used to distinguish recombinant clones containing inserts (white) from non-recombinants (blue).



*mcrA, mcrBC, and mrr*

Mutations in these genes allow for the efficient cloning of methylated genomic DNA or methylated cDNA; strains with these markers don't restrict foreign DNA, resulting in libraries with greater representation.

*tonA*

Unlike some strains promoting T1/T5 phage resistance, Invitrogen's true *tonA* genotype prevents T1 and T5 phage infection and safeguards your clones.

*recA1*

This general recombination deficiency ensures insert stability and helps to prevent unwanted recombination between insert and host; inserts are more stable in *recA1* hosts than in *recA13* hosts.

Tips for improving your blue/white screening

- Use pUC or pUC-based vectors that contain the portion of the *lacZ* gene that allows for  $\alpha$ -complementation.
- Select an *E. coli* strain that carries the *lacZ* $\Delta$ M15 marker.
- Plate transformations on plates containing X-gal or Bluo-gal. Spread 50  $\mu$ l of 2% X-gal or 100  $\mu$ l of 2% Bluo-gal (both can be dissolved in dimethyl formamide or 50:50 DMSO:water) on the surface of a 100 mm plate and let dry. Alternatively, add the X-gal (to a final concentration of 50  $\mu$ g/ml) or Bluo-gal (to a final concentration of 300  $\mu$ g/ml) directly to cooled medium (~50°C) before pouring the plates. Plates are stable for four weeks at +4°C.
- If the strain used carries the *lacI*<sup>q</sup> marker, add IPTG to induce the *lac* promoter. Spread 30  $\mu$ l of 100 mM IPTG (in water) on 100 mm plates. Alternatively, add the IPTG, to a final concentration of 1 mM, directly to cooled medium (~50°C) before pouring the plates. Plates are stable for four weeks at +4°C.
- Do not plate *E. coli* on a glucose-containing medium if using X-gal or Bluo-gal for blue/white screening. Glucose competes as a substrate and prevents the colonies from turning blue.

# High-efficiency chemically competent cells for cloning and subcloning

## Highest-efficiency chemically competent cells in the One Shot® format



### OmniMAX™ 2 T1<sup>R</sup> Cells

The OmniMAX™ 2 T1<sup>R</sup> *E. coli* strain is an improved chemically competent cell line, perfect for use in all cloning applications, including Gateway® technology. It offers one of the highest transformation efficiencies of any chemically competent cell type available, with  $>5 \times 10^9$  cfu/ $\mu$ g pUC19 (Figure 9). Since OmniMAX™ 2 T1<sup>R</sup> cells lack the *E. coli* K12 restriction systems (*mcrA* (*mrr hsdRMS-mcrBC*)), they also provide efficient transformation of highly methylated DNA. In addition, the strain carries the *tonA* genotype for resistance to T1 and T5 phage infection, protecting your samples and minimizing the possibility of downtime in your lab due to phage contamination. These cells are available in the single-use One Shot® format.

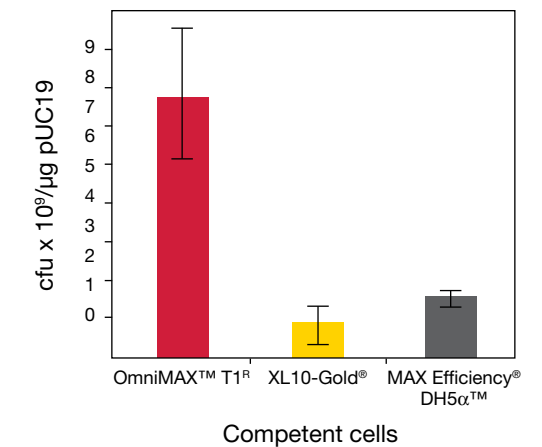


Figure 9—OmniMAX™ 2 T1<sup>R</sup> cells provide superior transformation efficiency. Transformation efficiency of One Shot® OmniMAX™ T1<sup>R</sup>, XL10-Gold® (Stratagene), and MAX Efficiency® DH5α™ cells was determined using 10 pg pUC19 plasmid. Transformations were performed according to manufacturers' protocols. Values shown are mean  $\pm$  SD of triplicate observations.

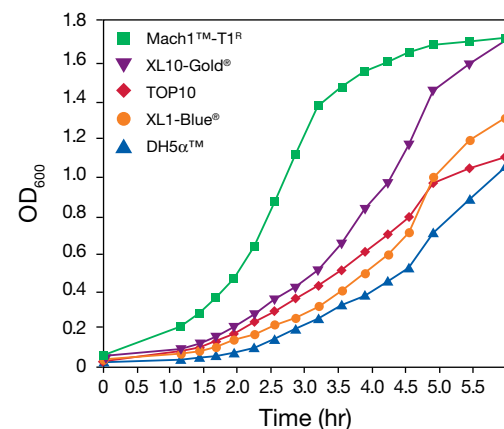
Product	Transformation efficiency	Quantity	Cat. no.
One Shot® OmniMAX™ 2 T1 <sup>R</sup> Cells	$>5 \times 10^9$ cfu/ $\mu$ g	20 x 50 $\mu$ l	C8540-03

### Fastest-growing cloning strain



#### Mach1™ T1<sup>R</sup> Cells

The Mach1™ T1<sup>R</sup> *E. coli* strain is the fastest-growing chemically competent strain currently available (Figure 10). Mach1™ T1<sup>R</sup> colonies are clearly visible within eight hours of plating the transformation (ampicillin selection only), enabling you to plate and pick colonies in the same day. From an overnight colony, minipreps can be performed after only four hours of growth. Mach1™ T1<sup>R</sup> cells also benefit from T1 phage resistance. These cells are available in the convenient single-use One Shot® and medium- to high-throughput MultiShot™ formats.



**Figure 10—Mach1™ T1<sup>R</sup> cells grow faster than standard cloning strains.** Mach1™ T1<sup>R</sup>, XL10-Gold® (Stratagene), TOP10, XL1-Blue® (Stratagene), and DH5α™ *E. coli* were transformed with pUC19 and grown overnight. Each culture was then inoculated 1:50 into 50 ml of LB ampicillin in 500 ml flasks. OD<sub>600</sub> was measured every 30 min for 6 hr. Mach1™ T1<sup>R</sup> cells reach a useful OD (e.g., for miniprep analysis) significantly faster (4 hr) than other strains.

Product	Transformation efficiency	Quantity	Cat. no.
One Shot® Mach1™ T1 <sup>R</sup> Cells	>1 × 10 <sup>9</sup> cfu/μg	20 × 50 μl	C8620-03
MultiShot™ StripWell Mach1™ T1 <sup>R</sup> Cells	>1 × 10 <sup>9</sup> cfu/μg	1 plate	C8696-01



#### DH10B™ T1<sup>R</sup> and DH10B™ Cells

DH10B™ T1<sup>R</sup> cells are the most frequently cited competent cell on the market. They offer the benefit of the *tonA* genotype for T1 and T5 phage resistance with the same genetic markers, growth properties, and transformation efficiencies as the original DH10B™

strain. DH10B™ T1<sup>R</sup> are available in the convenient single-use One Shot® format, while the original DH10B™ strain is available in bulk.

Product	Transformation efficiency	Quantity	Cat. no.
One Shot® MAX Efficiency® DH10B™ T1 <sup>R</sup> Cells	>1 × 10 <sup>9</sup> cfu/μg	20 × 50 μl	12331-013
MAX Efficiency® DH10B™ Cells	>1 × 10 <sup>9</sup> cfu/μg	5 × 200 μl, 100 μl per rxn	18297-010



#### DH5α™ T1<sup>R</sup> and DH5α™ Cells

DH5α™ cells are designed for general cloning procedures. They are provided in various transformation efficiencies and packaging formats.

Product	Transformation efficiency	Quantity	Cat. no.
One Shot® MAX Efficiency® DH5α™ T1 <sup>R</sup> Cells	>1 × 10 <sup>9</sup> cfu/μg	20 × 50 μl	12297-016
MAX Efficiency® DH5α™ T1 <sup>R</sup> Cells	>1 × 10 <sup>9</sup> cfu/μg	5 × 200 μl, 100 μl per rxn	12034-013
MAX Efficiency® DH5α™ Cells	>1 × 10 <sup>9</sup> cfu/μg	5 × 200 μl, 100 μl per rxn	18258-012
Library Efficiency® DH5α™ Cells	>1 × 10 <sup>8</sup> cfu/μg	5 × 200 μl, 100 μl per rxn	18263-012
Subcloning Efficiency™ DH5α™ Cells	>1 × 10 <sup>6</sup> cfu/μg	4 × 500 μl, 50 μl per rxn	18265-017

#### TOP10 Cells

TOP10 cells are genetically similar to the reliable DH10B™ strain and offer the added convenience of single-use One Shot® and high-throughput MultiShot™ formats. This versatile cloning strain is found in many TOPO® cloning and expression kits.

Product	Transformation efficiency	Quantity	Cat. no.
One Shot® TOP10 Cells	>1 × 10 <sup>9</sup> cfu/μg	10 × 50 μl	C4040-10
	>1 × 10 <sup>9</sup> cfu/μg	20 × 50 μl	C4040-03
	>1 × 10 <sup>9</sup> cfu/μg	40 × 50 μl	C4040-06
One Shot® TOP10F' Cells	>1 × 10 <sup>9</sup> cfu/μg	20 × 50 μl	C3030-03
	>1 × 10 <sup>9</sup> cfu/μg	40 × 50 μl	C4040-06
MultiShot™ StripWell TOP10 Cells (50 μl per rxn)	>1 × 10 <sup>8</sup> cfu/μg	1 plate	C4096-01
	>1 × 10 <sup>8</sup> cfu/μg	5 plates	C4096-05
	>1 × 10 <sup>8</sup> cfu/μg	10 plates	C4096-10
MultiShot™ TOP10 Cells (15 μl per rxn)	>1 × 10 <sup>8</sup> cfu/μg	5 plates	C400-05

# High-efficiency cloning using electroporation

## Highest-efficiency electrocompetent cells



MegaX DH10B™ T1<sup>R</sup> Electrocomp™ cells are the highest-efficiency electrocompetent cells available (Figure 11), with a guaranteed three-fold greater number of colonies per transformation (>3 × 10<sup>10</sup> cfu/μg of pUC DNA). They are ideal for highly demanding cloning and library construction applications. MegaX cells have the same genotype as the widely used DH10B™ T1<sup>R</sup> strain, including *tonA* to prevent T1 and T5 lytic phage infection and safeguard your valuable clones and libraries; however, they are manufactured using an improved process that results in a significantly higher transformation efficiency. Available in the bulk Electrocomp™ format.

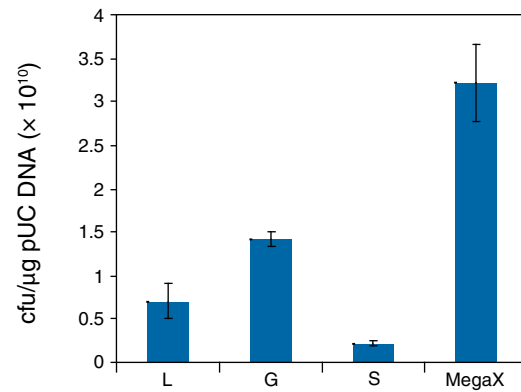


Figure 11—MegaX DH10B™ T1<sup>R</sup> Electrocomp™ cells consistently outperform the competition. L: *E. coli*® 10G SUPREME cells (Lucigen); G: GC10™ Thunderbolt™ cells (GeneChoice); S: ElectroTen-Blue® electroporation-competent cells (Stratagene).

Product	Transformation efficiency	Quantity	Cat. no.
MegaX DH10B™ T1 <sup>R</sup> Electrocomp™ Cells	>3 × 10 <sup>10</sup> cfu/μg	5 × 100 μl, 20 μl per rxn	C6400-03

## Highest-efficiency electrocompetent cells in One Shot® format



E-Shot™ DH10B™ T1<sup>R</sup> Electrocomp™ cells are competent *E. coli* pre-dispensed into convenient, single-use, 0.1 cm universal-fit cuvettes, ready for electroporation. Each cuvette contains enough cells for one transformation. The pre-dispensed format eliminates prepa-

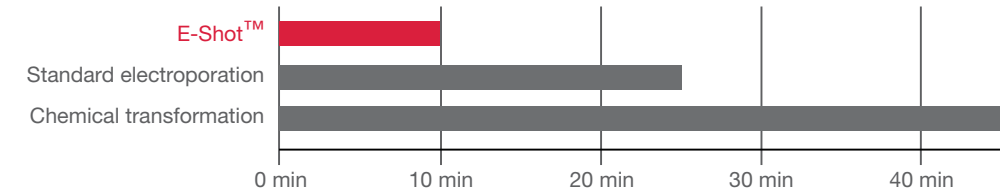
ration and aliquotting steps, saving time (Figure 12). The unique design of the cuvette chamber reduces the chance of introducing bubbles into the sample, helps distribute the contents evenly for optimal transformation efficiency, and allows for recovery of cells directly from the cuvette. The E-Shot™ format provides a convenient, single-use method for electroporation.

Product	Transformation efficiency	Quantity	Cat. no.
E-Shot™ DH10B™ T1 <sup>R</sup> Electrocomp™ Cells	>1 × 10 <sup>10</sup> cfu/μg	20 × 25 μl	C5100-03



ElectroMAX™ DH10B™ T1<sup>R</sup> competent *E. coli* are high-efficiency electrocompetent cells derived from the widely used DH10B™ strain. It includes the *tonA* genotype, which prevents T1 infection and safeguards your valuable clones and libraries. These highly competent cells are available in a bulk format.

Product	Transformation efficiency	Quantity	Cat. no.
ElectroMAX™ DH10B™ T1 <sup>R</sup> Cells	>1 × 10 <sup>10</sup> cfu/μg	5 × 100 μl, 20 μl per rxn	12033-015
ElectroMAX™ DH10B™ Cells	>1 × 10 <sup>10</sup> cfu/μg	5 × 100 μl, 20 μl per rxn	18290-015



### E-Shot™ format (10 min)

1. Thaw cells in electroporation cuvette, 5 min
2. Add DNA
3. Electroporate
4. Add SOC medium
5. Recover, in cuvette

### Standard electroporation (25 min)

1. Thaw cells, 5 min
2. Chill a separately packaged cuvette on ice, 15 min
3. Transfer thawed cells to cuvette
4. Refreeze unused cells
5. Add DNA
6. Electroporate
7. Transfer to recovery tube
8. Add SOC medium
9. Recover

### Chemical transformation (45 min)

1. Thaw cells, 5 min
2. Pipet desired cell volume
3. Refreeze unused cells
4. Incubate on ice for 30 min
5. Add DNA
6. Heat shock 30–45 sec
7. Transfer to recovery tube
8. Add SOC medium
9. Recover

Figure 12—Faster electroporation with E-Shot™ cells.



### ElectroMAX™ DH5α-E™ Cells

ElectroMAX™ DH5α-E™ cells are derived from the DH5α™ strain and are suitable for transformation by electroporation. They may be used in procedures requiring high transformation efficiencies,

such as generation of cDNA libraries or transformations with limited input DNA. These are available in a bulk format.

Product	Transformation efficiency	Quantity	Cat. no.
ElectroMAX™ DH5α-E™ Cells	>1 × 10 <sup>10</sup> cfu/μg	5 × 100 μl, 20 μl per rxn	11319-019

### TOP10 Electrocomp™ Cells

The TOP10 cell strain is genetically similar to the reliable DH10B™ *E. coli* and offers the added convenience of single-use One Shot®

and high-throughput MultiShot™ formats. This versatile cloning strain is found in many TOPO® cloning and expression kits.

Product	Transformation efficiency	Quantity	Cat. no.
One Shot® TOP10 Electrocomp™ Cells	>1 × 10 <sup>9</sup> cfu/μg	20 × 50 μl	C4040-52
TOP10 Electrocomp™ Cells	>1 × 10 <sup>9</sup> cfu/μg	5 × 80 μl	C664-55
	>1 × 10 <sup>9</sup> cfu/μg	10 × 80 μl	C664-11
	>1 × 10 <sup>9</sup> cfu/μg	30 × 80 μl	C664-24
TOP10F' Electrocomp™ Cells	>1 × 10 <sup>9</sup> cfu/μg	5 × 80 μl	C665-55
	>1 × 10 <sup>9</sup> cfu/μg	10 × 80 μl	C665-11

## Competent cells for specialized applications

In addition to cells for cloning, Invitrogen offers a number of cell lines devoted to specific applications. Each of the following cell

types has been optimized to achieve the highest performance in its noted application.

### Cloning unstable DNA

#### Stbl3™ Cells

The Stbl3™ *E. coli* strain is designed for cloning direct repeats found in lentiviral expression vectors. These cells reduce the frequency of unwanted homologous recombination between

long terminal repeats (LTRs) found in ViraPower™ Lentiviral and other retroviral vectors. These are available in the convenient single-use One Shot® format.

Product	Transformation efficiency	Quantity	Cat. no.
One Shot® Stbl3™ Chemically Competent Cells	>1 × 10 <sup>8</sup> cfu/μg	20 × 50 μl	C7373-03

#### Stbl2™ Cells

MAX Efficiency® Stbl2™ cells are high-efficiency chemically competent cells specifically designed for cloning unstable inserts. In addition to *recA1*, a unique set of genetic markers allows for stable

cloning of direct-repeat and retroviral sequences and tandem-array genes. These cells are available in bulk format.

Product	Transformation efficiency	Quantity	Cat. no.
MAX Efficiency® Stbl2™ Chemically Competent Cells	>1 × 10 <sup>9</sup> cfu/μg	5 × 200 μl, 100 μl per rxn	10268-019



# Competent Cells



## Stbl4™ Cells

ElectroMAX™ Stbl4™ cells are suitable for transformation by electroporation and are specifically designed for cloning unstable inserts. In addition to *recA1*, a unique set of genetic markers allows for stable cloning of direct-repeat and retroviral sequences and tandem-array genes. They can be used for procedures requiring

high transformation efficiencies, such as generating cDNA and genomic libraries. ElectroMAX™ Stbl4™ competent cells are able to take up and maintain large plasmids (e.g., 50 kb cosmids and 100–200 kb P1 clones). These cells are available in bulk format.

Product	Transformation efficiency	Quantity	Cat. no.
ElectroMAX™ Stbl4™ Electrocomp™ Cells	>5 × 10 <sup>9</sup> cfu/μg	5 × 100 μl, 20 μl per rxn	11635-018

## Single-stranded DNA (ssDNA) production



## DH12S™ Cells

Highly purified ssDNA is used for DNA sequencing, preparation of strand-specific probes, *in vitro* mutagenesis, and subtraction library applications. For optimal ssDNA production, you need a host

strain like ElectroMAX™ DH12S™ *E. coli* that carries the F' episome and *endA1* genotype, since double-stranded DNA is degraded in *endA*<sup>+</sup> strains. These cells are available in bulk format.

Product	Transformation efficiency	Quantity	Cat. no.
ElectroMAX™ DH12S™ Electrocomp™ Cells	>1 × 10 <sup>10</sup> cfu/μg	5 × 100 μl, 20 μl per rxn	18312-017

## Propagating unmethylated DNA

### INV110 Cells

Certain applications require the production of unmethylated DNA. For example, a number of restriction enzymes are sensitive to *dam* and *dcm* methylation at their recognition sites (Table 3) and will fail to cut unless the target DNA has been propagated in

a *dam/dcm*-deficient strain, such as One Shot® INV110 cells. These cells are also *endA1* to ensure high-quality miniprep DNA. They are available in the convenient single-use One Shot® format.

Product	Transformation efficiency	Quantity	Cat. no.
One Shot® INV110 Cells	>1 × 10 <sup>6</sup> cfu/μg	20 × 50 μl	C7171-03

Table 3—Restriction endonuclease inhibited by *dam* and *dcm* methylation.

Restriction endonucleases sensitive to <i>dam</i> methylation			Restriction endonucleases sensitive to <i>dcm</i> methylation		
<i>Acc</i> III	<i>Bcl</i> I	<i>Bpm</i> I	<i>Aat</i> II	<i>Aha</i> II	<i>Apa</i> II
<i>Bsa</i> B I	<i>Bsh</i> 1365 I	<i>Bsp</i> 106 I	<i>Asp</i> 718 I	<i>Ava</i> II	<i>Bal</i> I
<i>Bsp</i> H I	<i>Cla</i> I	<i>Dsa</i> I	<i>Cfr</i> I	<i>Dra</i> II	<i>Eae</i> I
<i>Dpn</i> II	<i>Hph</i> I	<i>Mbo</i> I	<i>Eco</i> 24 I	<i>Eco</i> 0109 I	<i>Eco</i> R II
<i>Mbo</i> II	<i>Mfl</i> I	<i>Nde</i> II	<i>Fok</i> I	<i>Kpn</i> I	<i>Msc</i> I
<i>Nru</i> I	<i>Taq</i> I	<i>Xba</i> I	<i>Mls</i> I	<i>Sau</i> 96 I	<i>Scr</i> F I
<i>Xor</i> II			<i>Sfi</i> I	<i>Stu</i> I	

## Propagating vectors with the *ccdB* gene

### *ccdB* Survival™ T1<sup>R</sup> Cells

One Shot® *ccdB* Survival™ T1<sup>R</sup> chemically competent *E. coli* are suitable for propagation of plasmids containing the *ccdB* gene. They are designed for use with the Gateway® Vector Conversion

System and for propagating Gateway® destination, donor, and supercoiled entry vectors. These cells are available in the convenient single-use One Shot® format.

Product	Transformation efficiency	Quantity	Cat. no.
One Shot® <i>ccdB</i> Survival™ T1 <sup>R</sup> Cells	>5 × 10 <sup>8</sup> cfu/μg	10 × 50 μl	C7510-03

## DB3.1™ Cells

The Gateway® universal cloning and expression platform is based on the well-characterized lambda phage site-specific recombination system that relies on the strong negative selection marker *ccdB*. Expression of this gene in a standard *E. coli* host results in cell

death. In order to propagate vectors containing the *ccdB* gene, a special strain, Library Efficiency® DB3.1™ cells, was developed. Use this strain for growing nonrecombinant Gateway® destination and donor vectors. These cells are available in bulk format.

Product	Transformation efficiency	Quantity	Cat. no.
Library Efficiency® DB3.1™ Chemically Competent Cells	>1 × 10 <sup>8</sup> cfu/μg	5 × 200 μl, 100 μl per rxn	11782-018

## Recombinant baculovirus production

### DH10Bac™ Cells

MAX Efficiency® DH10Bac™ competent cells are used for production of a recombinant bacmid in the Bac-to-Bac® Baculovirus Expression System. The DH10Bac™ *E. coli* strain contains a parent bacmid that recombines with the donor plasmid, pFastBac™, to

create an expression bacmid containing the gene of interest. The expression bacmid can then be used for production of recombinant baculovirus. These cells are available in bulk format.

Product	Transformation efficiency	Quantity	Cat. no.
MAX Efficiency® DH10Bac™ Chemically Competent Cells	1 × 10 <sup>8</sup> cfu/μg	5 × 100 μl	10361-012

# Competent cells for protein expression

*E. coli* is one of the most popular hosts for overexpression of recombinant proteins because it grows fast, is inexpensive to use, and yields high levels of protein. The most popular strains for recombinant protein expression from T7 expression systems are BL21 and its derivatives (Table 4). These strains are descended from the *E. coli* B strain and have been specifically constructed for high-level expression of recombinant proteins. Invitrogen's BL21 strains are optimized for protein induction and possess additional genetic markers that stabilize high levels of protein expression (Table 5). Protein expression in these strains can be induced with IPTG, MagicMedia™ *E. coli* Expression Medium, or L-arabinose (BL21-AI™ strain). This inducibility helps to minimize the toxic effects of some recombinant proteins. L-arabinose induction may also aid in optimizing solubility, as its induction is titratable.

## Extremely high expression of nontoxic recombinant proteins

### BL21 Star™(DE3) Cells

BL21 Star™(DE3) *E. coli* is a unique strain designed for high-level recombinant protein expression. BL21 Star™(DE3) cells offer enhanced mRNA stability so that abundant mRNA is available for protein production. This enhanced stability is due to a mutation in the RNase E gene, which codes for a key component of the degradosome responsible for RNA degradation. Proteins are expressed at two- to ten-fold higher levels in BL21 Star™(DE3) *E. coli* than in a standard BL21 strain (Figures 13 and 14). Use BL21 Star™(DE3) *E. coli* with any T7 promoter-containing bacterial expression vector. These cells are available in the convenient single-use One Shot® format.

Product	Transformation efficiency	Quantity	Cat. no.
BL21 Star™(DE3) One Shot® Cells	>1 × 10 <sup>8</sup> cfu/μg	20 × 50 μl	C6010-03

Table 4—Competent cells commonly used for protein expression from T7 promoter-containing vectors.

Product	Application	Efficiency (cfu/μg)	Quantity	Cat. no.
BL21 Star™(DE3) One Shot® Cells	Extremely high expression of nontoxic proteins	>1 × 10 <sup>8</sup>	20 × 50 μl	C6010-03
BL21-AI™ One Shot® Cells	Tight regulation and strong expression of toxic proteins	>1 × 10 <sup>8</sup>	20 × 50 μl	C6070-03
BL21(DE3) One Shot® Cells	Expression of nontoxic proteins	>1 × 10 <sup>8</sup>	20 × 50 μl	C6000-03
BL21(DE3)pLysS One Shot® Cells	Expression of toxic or insoluble proteins	>1 × 10 <sup>8</sup>	20 × 50 μl	C6060-03
BL21(DE3)pLysE One Shot® Cells	Expression of toxic or very insoluble proteins	>1 × 10 <sup>7</sup>	20 × 50 μl	C6565-03

Table 5—Key genetic markers for protein expression.

Genetic marker	Description/effect
<i>lon</i>	Mutation in gene coding for Lon protease; helps prevent recombinant protein degradation
<i>ompT</i>	Mutation in gene coding for OmpT outer membrane protease; helps prevent recombinant protein degradation
<i>rne131</i>	Mutation in this gene causes production of defective RNase E; helps prevent mRNA degradation, a common cause of low levels of recombinant protein expression. Found only in BL21 Star™ <i>E. coli</i>

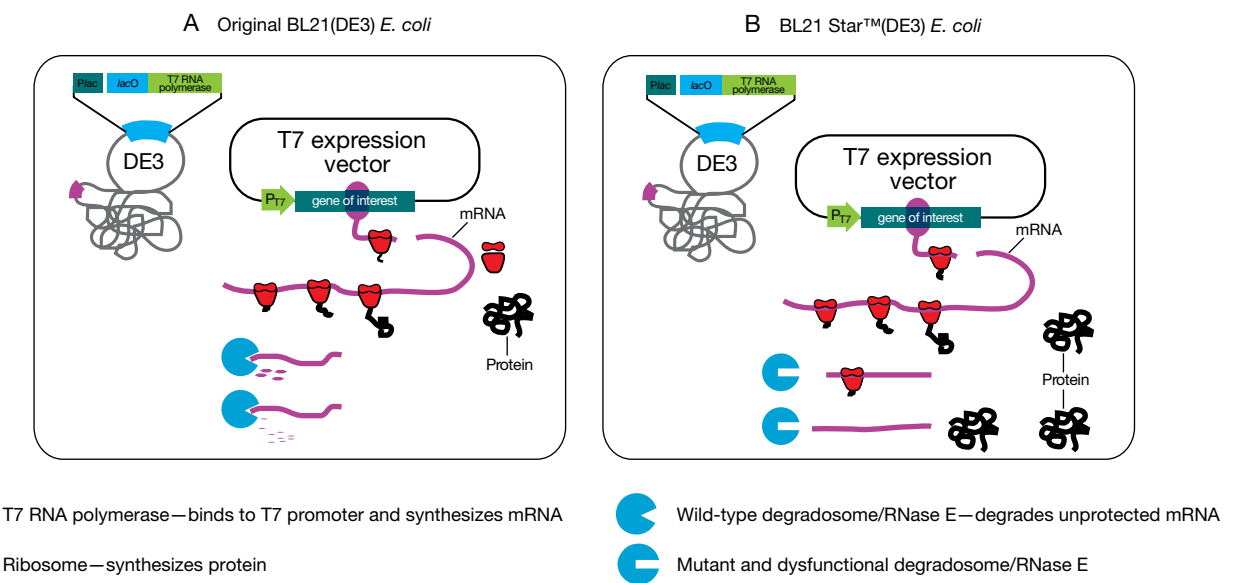


Figure 13—Improved stability of recombinant proteins in BL21 Star™(DE3) cells.

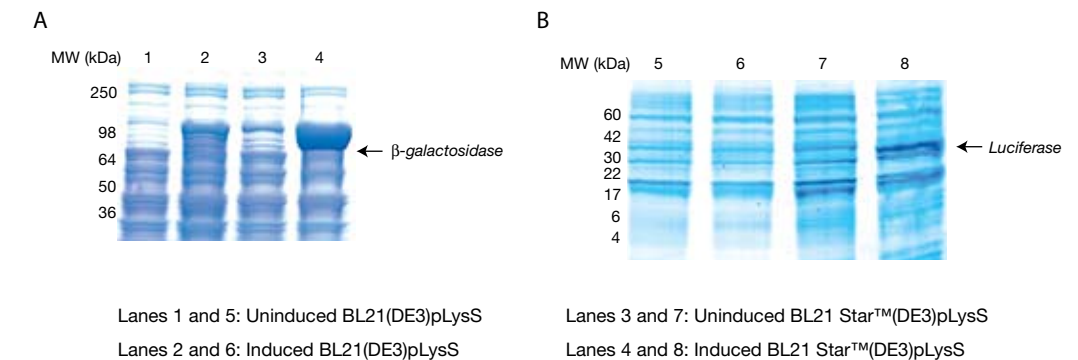


Figure 14—BL21 Star™(DE3) cells demonstrate superior protein expression. BL21(DE3)pLysS and BL21 Star™(DE3)pLysS *E. coli* were transformed with plasmids pCR®T7/CT/lacZ (A) and pET28/luciferase (B). A single colony from each transformation was used to inoculate 20 ml of LB medium supplemented with 100 μg/ml ampicillin. Induction with IPTG was initiated at OD<sub>600</sub> = 0.5. Two and a half hours postinduction, cells were harvested by centrifugation. Pellets from 1.5 ml of each culture were resuspended in 400 μl of NuPAGE® protein sample buffer. Ten microliters of each sample was loaded for SDS-PAGE analysis.

## High expression of toxic proteins

### BL21-AI™ Cells

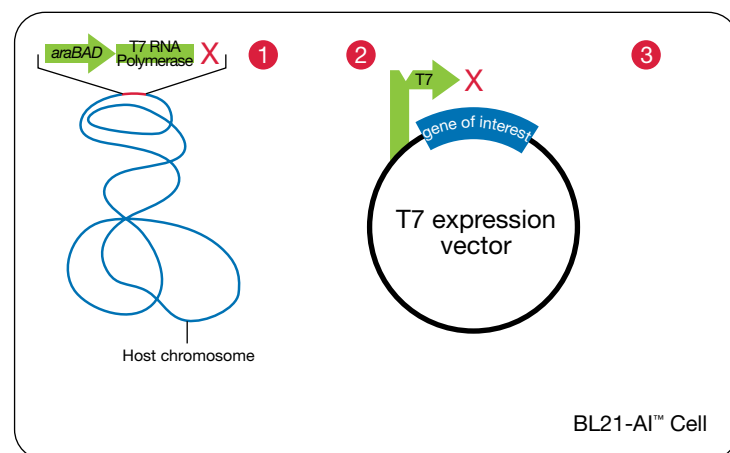
For high-level expression of toxic proteins, use BL21-AI™ *E. coli*, an arabinose-inducible strain that allows tight regulation and strong expression of recombinant proteins. BL21-AI™ *E. coli* was constructed by cloning the exceptionally tight arabinose-inducible promoter, *araBAD*, upstream of the T7 RNA polymerase gene in the BL21 host genome. When L-arabinose is added to the growth

medium, T7 RNA polymerase is produced and binds to the T7 promoter of your expression construct, inducing expression (Figure 15). Use BL21-AI™ *E. coli* with any T7 promoter-containing bacterial expression vector. These cells are available in the convenient single-use One Shot® format.

Product	Transformation efficiency	Quantity	Cat. no.
BL21-AI™ One Shot® Cells	>1 × 10 <sup>8</sup> cfu/μg	20 × 50 μl	C6070-03

#### Uninduced

1. No T7 RNA polymerase expressed.
2. T7 promoter is off.
3. No protein expressed.



#### Induced

1. T7 RNA polymerase expressed.
2. Binds to T7 promoter.
3. T7 promoter turned on.
4. Protein expressed.

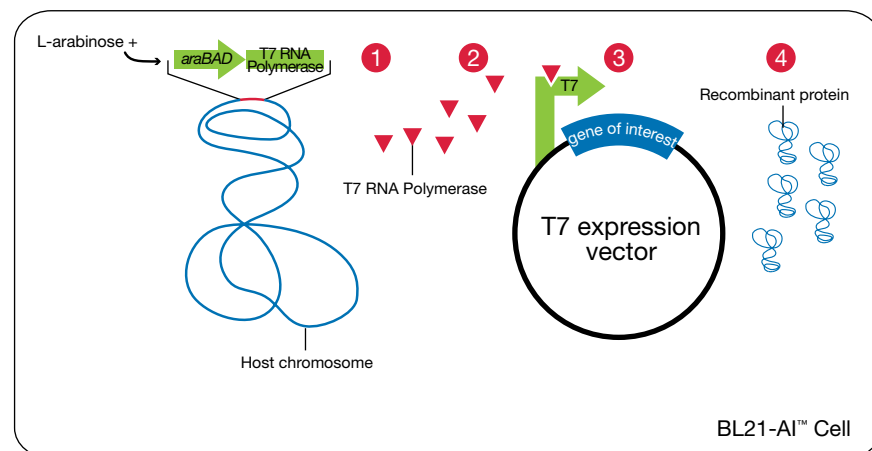


Figure 15—Inducible expression in BL21-AI™ *E. coli*.

### BL21(DE3) Cells

The BL21(DE3) strain, designed for high-level recombinant protein expression, contains the λDE3 lysogen that carries the gene for T7 RNA polymerase under control of the *lacUV5* promoter. Its lack of the Lon protease and the OmpT outer membrane protease reduces

degradation of heterologous proteins expressed in the strains. These cells are available in the convenient single-use One Shot® format.

Product	Transformation efficiency	Quantity	Cat. no.
BL21(DE3) One Shot® Cells	>1 × 10 <sup>8</sup> cfu/μg	20 × 50 μl	C6000-03

### BL21(DE3)pLysS Cells

The pLysS plasmid carried by the BL21(DE3)pLysS strain produces T7 lysozyme to reduce basal-level expression of the gene of interest. pLysS confers resistance to chloramphenicol (Cm<sup>R</sup>) and con-

tains the p15A origin for compatibility with plasmids containing the ColE1 or pMB1 origin (i.e., pUC- or pBR322-derived plasmids).

Product	Transformation efficiency	Quantity	Cat. no.
BL21(DE3)pLysS One Shot® Cells	>1 × 10 <sup>8</sup> cfu/μg	20 × 50 μl	C6060-03

### BL21(DE3)pLysE Cells

The pLysE plasmid carried by the BL21(DE3)pLysE strain produces higher amounts of T7 lysozyme than pLysS, to further reduce basal-level expression of the gene of interest. Like pLysS, pLysE

confers resistance to chloramphenicol (Cm<sup>R</sup>) and contains the p15A origin for compatibility with plasmids containing the ColE1 or pMB1 origin.

Product	Transformation efficiency	Quantity	Cat. no.
BL21(DE3)pLysE One Shot® Cells	>1 × 10 <sup>7</sup> cfu/μg	20 × 50 μl	C6565-03



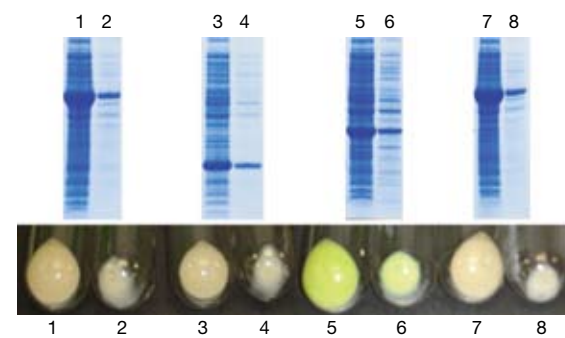
### 10X the protein yield from your T7 promoter–based expression vectors

#### MagicMedia™ *E. coli* Expression Medium

MagicMedia™ *E. coli* Expression Medium is specifically designed to dramatically increase the yield of recombinant proteins in T7 *E. coli* expression systems without the need to monitor optical density (OD) or add inducer. This proprietary formulation allows *E. coli* growth to reach culture densities 3–10-fold higher than traditional LB + IPTG methods, allowing you to achieve 3–10 times higher protein yields (Figure 16) with much less hands-on time. Time-consuming OD monitoring steps are eliminated—simply inoculate prepared MagicMedia™ medium, grow the culture overnight, and harvest—and culture volume is reduced to simplify handling and scale-up. In addition, MagicMedia™ Medium is ideal for simultaneous expression of multiple clones for high-throughput applications.

1. Champion™ pET300/NT Jnk2β2 MagicMedia™
2. Champion™ pET300/NT Jnk2β2 LB+IPTG
3. Champion™ pET300/NT Fatty Acid BP MagicMedia™
4. Champion™ pET300/NT Fatty Acid BP LB+IPTG

5. Champion™ pET302/NT-His GFP
6. Champion™ pET302/NT-His GFP LB+IPTG
7. Champion™ pET302/NT-His Jnk2β2 MagicMedia™
8. Champion™ pET302/NT-His Jnk2β2 LB+IPTG



**Figure 16—Higher protein yields achieved with MagicMedia™ *E. coli* Medium.** Four different human ORFs were cloned into either the Champion™ pET300/NT-DEST vector using Gateway® cloning or the Champion™ pET302/NT-His vector, by restriction enzyme digestion and ligation. Positive clones were transformed into BL21(DE3) *E. coli*. The clones were grown in ready-to-use liquid MagicMedia™ Medium (lanes 1, 3, 5, and 7) or LB + IPTG (lanes 2, 4, 6, and 8). Whole-cell lysates were analyzed on Coomassie®-stained NuPAGE® Novex® 4–12% Bis-Tris gels, shown above the corresponding cell pellets.

#### Tips for improving protein solubility

- Lower the induction temperature to 30°C to reduce the formation of inclusion bodies.
- Use a low copy-number plasmid.
- If the protein requires a cofactor (e.g., a metal), add the cofactor to the medium.

#### Tips for improving recombinant protein yield

- Use MagicMedia™ *E. coli* Expression Medium.
- Use BL21 Star™(DE3) *E. coli*.
- Check the codon usage in the recombinant protein sequence for infrequently used codons. Replacing the rare codons with more commonly used codons can significantly increase expression levels. For example, the arginine codons AGG and AGA are used infrequently by *E. coli*, so the level of tRNAs for these codons is low.
- Add protease inhibitors, such as PMSF, to buffers during protein purification. Use freshly made PMSF, since PMSF loses effectiveness within 30 min of dilution into an aqueous solution.
- Inoculate from fresh bacterial cultures, since higher protein yields are generally obtained from a fresh bacterial colony.

### Genotype listing

Strain	Genotype
BL21-A1™	F <sup>-</sup> ompT hsdS <sub>B</sub> (r <sub>B</sub> <sup>-</sup> , m <sub>B</sub> <sup>-</sup> ) gal dcm araB::T7RNAP-tetA
BL21(DE3)	F <sup>-</sup> ompT hsdS <sub>B</sub> (r <sub>B</sub> <sup>-</sup> , m <sub>B</sub> <sup>-</sup> ) gal dcm (DE3)
BL21(DE3)pLysS	F <sup>-</sup> ompT hsdS <sub>B</sub> (r <sub>B</sub> <sup>-</sup> , m <sub>B</sub> <sup>-</sup> ) gal dcm (DE3) pLysS (Cam <sup>R</sup> )
BL21(DE3)pLysE	F <sup>-</sup> ompT hsdS <sub>B</sub> (r <sub>B</sub> <sup>-</sup> , m <sub>B</sub> <sup>-</sup> ) gal dcm (DE3) pLysE (Cam <sup>R</sup> )
BL21 Star™(DE3)	F <sup>-</sup> ompT hsdS <sub>B</sub> (r <sub>B</sub> <sup>-</sup> , m <sub>B</sub> <sup>-</sup> ) gal dcm rne131 (DE3)
BL21 Star™ (DE3)pLysS	F <sup>-</sup> ompT hsdS <sub>B</sub> (r <sub>B</sub> <sup>-</sup> , m <sub>B</sub> <sup>-</sup> ) gal dcm rne131 (DE3) pLysS (Cam <sup>R</sup> )
ccdB Survival™ T1 <sup>R</sup>	F <sup>-</sup> mcrA Δ(mrr-hsdRMS-mcrBC) Φ80lacZΔM15 ΔlacX74 recA1 araD139 Δ(ara-leu)7697 galU galK rpsL (Str <sup>R</sup> ) endA1 nupG tonA::Ptrc-ccdA
DB3.1™	F <sup>-</sup> gyrA462 endA1 Δ(sr1-recA) mcrB mrr hsdS20(r <sub>B</sub> <sup>-</sup> , m <sub>B</sub> <sup>-</sup> ) supE44 ara-14 galk2 lacY1 proA2 rpsL20(Sm <sup>R</sup> ) xyl-5 λ <sup>-</sup> leu mtl1
DH5α™	F <sup>-</sup> Φ80lacZΔM15 Δ(lacZYA-argF) U169 recA1 endA1 hsdR17 (r <sub>K</sub> <sup>-</sup> , m <sub>K</sub> <sup>+</sup> ) phoA supE44 λ <sup>-</sup> thi-1 gyrA96 relA1
DH5α™ T1 <sup>R</sup>	F <sup>-</sup> Φ80lacZΔM15 Δ(lacZYA-argF)U169 recA1 endA1 hsdR17 (r <sub>K</sub> <sup>-</sup> , m <sub>K</sub> <sup>+</sup> ) phoA supE44 thi-1 gyrA96 relA1 tonA
DH10B™	F <sup>-</sup> mcrA Δ(mrr-hsdRMS-mcrBC) Φ80dlacZΔM15 ΔlacX74 recA1 endA1 araD139 Δ(ara leu) 7697 galU galK rpsL nupG λ <sup>-</sup>
DH10B™ T1 <sup>R</sup>	F <sup>-</sup> mcrA Δ(mrr-hsdRMS-mcrBC) Φ80dlacZΔM15 ΔlacX74 recA1 endA1 araD139 Δ(ara leu) 7697 galU galK rpsL nupG λ <sup>-</sup> tonA
DH10Bac™	F <sup>-</sup> mcrA Δ(mrr-hsdRMS-mcrBC) Φ80lacZΔM15 ΔlacX74 recA1 endA1 araD139 Δ(ara leu) 7697 galU galK λ <sup>-</sup> rpsL nupG/pMON14272/pMON7124
DH12S™	Φ80dlacZΔM15 mcrA Δ(mrr-hsdRMS-mcrBC) araD139 Δ(ara leu) 7697 Δ(lacX74 galU galK rpsL (Str <sup>R</sup> ) nupG recA1/F' proAB+ lacI <sup>q</sup> Δ M15 Tn10 (Tet <sup>R</sup> )
INV110	F' {traΔ36 proAB lacI <sup>q</sup> lacZΔM15} rpsL (Str <sup>R</sup> ) thr leu endA thi-1 lacY galK galT ara tonA tsx dam dcm supE44 Δ(lac-proAB) Δ(mcrC-mrr)102::Tn10 (Tet <sup>R</sup> )
Mach1™ T1 <sup>R</sup>	F <sup>-</sup> Φ80lacZΔM15 ΔlacX74 hsdR(r <sub>K</sub> <sup>-</sup> , m <sub>K</sub> <sup>+</sup> ) ΔrecA1398 endA1 tonA
MegaX DH10B™ T1 <sup>R</sup>	F <sup>-</sup> mcrA Δ(mrr-hsdRMS-mcrBC) Φ80lacZΔM15 ΔlacX74 recA1 endA1 araD139 Δ(ara leu)7697 galU galK λ <sup>-</sup> rpsL nupG tonA
OmniMAX™ 2 T1 <sup>R</sup>	F' {proAB+ lacI <sup>q</sup> lacZΔM15 Tn10(Tet <sup>R</sup> ) Δ(ccdAB)} mcrA Δ(mrr-hsdRMS-mcrBC) Φ80lacZΔM15 Δ(lacZYA-argF) U169 endA1 recA1 supE44 thi-1 gyrA96 relA1 tonA panD
Stbl2™	F <sup>-</sup> mcrA Δ(mcrBC-hsdRMS-mrr) recA1 endA1 lon gyrA96 thi supE44 relA1 λ <sup>-</sup> Δ(lac-proAB)
Stbl3™	F <sup>-</sup> mcrB mrr hsdS20 (r <sub>B</sub> <sup>-</sup> , m <sub>B</sub> <sup>-</sup> ) recA13 supE44 ara-14 galk2 lacY1 proA2 rpsL20 (Str <sup>R</sup> ) xyl-5 λ <sup>-</sup> leu mtl-1
Stbl4™	mcrA Δ(mcrBC-hsdRMS-mrr) recA1 endA1 gyrA96 gal- thi-1 supE44 λ <sup>-</sup> relA1 Δ(lac-proAB)/F' proAB+ lacI <sup>q</sup> ΔM15 Tn10 (Tet <sup>R</sup> )
TOP10	F <sup>-</sup> mcrA Δ(mrr-hsdRMS-mcrBC) Φ80lacZΔM15 ΔlacX74 recA1 araD139 Δ(ara leu) 7697 galU galK rpsL (Str <sup>R</sup> ) endA1 nupG



## Ordering information

Invitrogen leads the way in competent cell technology, pushing forward the frontiers of transformation efficiency and strain development. With the highest efficiencies—ranging from  $>1 \times 10^6$  to  $>3 \times 10^{10}$  cfu/ $\mu\text{g}$ —and the widest selection available, you're sure to find the right competent cell for your cloning and protein expression experiments. To learn more, visit [www.invitrogen.com/compcells](http://www.invitrogen.com/compcells).

Product	Transformation efficiency (cfu/ $\mu\text{g}$ )	Quantity	Cat. no.
<b>High-efficiency cloning, routine cloning, and subcloning</b>			
One Shot® OmniMAX™ 2 T1 <sup>R</sup> Cells	$>5 \times 10^9$	20 × 50 $\mu\text{l}$	C8540-03
One Shot® Mach1™ T1 <sup>R</sup> Cells	$>1 \times 10^9$	20 × 50 $\mu\text{l}$	C8620-03
One Shot® TOP10 Chemically Competent Cells	$>1 \times 10^9$	10 × 50 $\mu\text{l}$ 20 × 50 $\mu\text{l}$ 40 × 50 $\mu\text{l}$	C4040-10 C4040-03 C4040-06
One Shot® MAX Efficiency® DH10B™ T1 <sup>R</sup> Chemically Competent Cells	$>1 \times 10^9$	20 × 50 $\mu\text{l}$	12331-013
One Shot® MAX Efficiency® DH5 $\alpha$ ™ T1 <sup>R</sup> Chemically Competent Cells	$>1 \times 10^9$	20 × 50 $\mu\text{l}$	12297-016
MAX Efficiency® DH5 $\alpha$ ™ Chemically Competent Cells	$>1 \times 10^9$	5 × 200 $\mu\text{l}$	18258-012
Library Efficiency® DH5 $\alpha$ ™ Chemically Competent Cells	$>1 \times 10^8$	5 × 200 $\mu\text{l}$	18263-012
Subcloning Efficiency™ DH5 $\alpha$ ™ Chemically Competent Cells	$>1 \times 10^6$	4 × 500 $\mu\text{l}$	18265-017
<b>cDNA or genomic library construction using electroporation</b>			
MegaX DH10B™ T1 <sup>R</sup> Electrocomp™ Cells	$>3 \times 10^{10}$	25 × 50 $\mu\text{l}$	C6400-03
E-Shot™ DH10B™ T1 <sup>R</sup> Electrocomp™ Cells	$>1 \times 10^{10}$	20 × 25 $\mu\text{l}$	C5100-03
ElectroMAX™ DH10B™ T1 <sup>R</sup> Electrocomp™ Cells	$>1 \times 10^{10}$	5 × 100 $\mu\text{l}$	12033-015
ElectroMAX™ DH10B™ Electrocomp™ Cells	$>1 \times 10^{10}$	5 × 100 $\mu\text{l}$	18290-015
ElectroMAX™ Stbl4™ Electrocomp™ Cells	$>5 \times 10^9$	5 × 100 $\mu\text{l}$	11635-018
<b>Genomic and cDNA library construction using chemically competent cells</b>			
One Shot® OmniMAX™ 2 T1 <sup>R</sup> Cells	$>5 \times 10^9$	20 × 50 $\mu\text{l}$	C8540-03
<b>High-throughput cloning</b>			
MultiShot™ StripWell Mach1™ T1 <sup>R</sup> Cells	$>1 \times 10^9$	1 plate	C8696-01
MultiShot™ StripWell TOP10 Chemically Competent Cells	$>1 \times 10^9$	1 plate 5 plates	C4096-01 C400-05
MultiShot™ TOP10 Chemically Competent Cells	$>1 \times 10^9$	5 plates	C400-05

Product	Transformation efficiency (cfu/ $\mu\text{g}$ )	Quantity	Cat. no.
<b>Cloning unstable DNA</b>			
ElectroMAX™ Stbl4™ Electrocomp™ Cells	$>5 \times 10^9$	5 × 100 $\mu\text{l}$	11635-018
One Shot® Stbl3™ Chemically Competent Cells	$>1 \times 10^8$	20 × 50 $\mu\text{l}$	C7373-03
MAX Efficiency® Stbl2™ Chemically Competent Cells	$>1 \times 10^9$	5 × 200 $\mu\text{l}$	10268-019
<b>Single-stranded DNA production</b>			
ElectroMAX™ DH12S™ Electrocomp™ Cells	$>1 \times 10^{10}$	5 × 100 $\mu\text{l}$	18312-017
MAX Efficiency® DH5 $\alpha$ F' IQ™ Chemically Competent Cells	$>1 \times 10^8$	5 × 200 $\mu\text{l}$	18288-019
<b>Propagating unmethylated DNA</b>			
One Shot® INV110 Chemically Competent Cells	$>1 \times 10^6$	20 × 50 $\mu\text{l}$	C7171-03
<b>Propagating vectors with the ccdB gene vectors</b>			
One Shot® ccdB Survival™ T1 <sup>R</sup> Cells	$>5 \times 10^8$	10 × 50 $\mu\text{l}$	C7510-03
Library Efficiency® DB3.1™ Chemically Competent Cells	$>1 \times 10^8$	5 × 200 $\mu\text{l}$	11782-018
<b>Recombinant baculovirus production</b>			
MAX Efficiency® DH10Bac™ Competent Cells	$>1 \times 10^8$	5 × 100 $\mu\text{l}$	10361-012
<b>Protein expression</b>			
BL21-AI™ One Shot® Chemically Competent Cells	$>1 \times 10^8$	20 × 50 $\mu\text{l}$	C6070-03
BL21 Star™(DE3) One Shot® Chemically Competent Cells	$>1 \times 10^8$	20 × 50 $\mu\text{l}$	C6010-03
BL21 Star™(DE3)pLysS One Shot® Chemically Competent Cells	$>1 \times 10^8$	20 × 50 $\mu\text{l}$	C6020-03
One Shot® BL21 (DE3) Cells	$>1 \times 10^8$	20 × 50 $\mu\text{l}$	C6000-03
One Shot® BL21 (DE3)pLysS Cells	$>1 \times 10^8$	10 × 50 $\mu\text{l}$	C6060-10
One Shot® BL21 (DE3)pLysS Cells	$>1 \times 10^8$	20 × 50 $\mu\text{l}$	C6060-03
One Shot® BL21 (DE3)pLysE Cells	$>1 \times 10^7$	20 × 50 $\mu\text{l}$	C6565-03