- LIFE SCIENCE INSTITUTE -

BIOLOG

c-diNMP Analogues

Second Messenger and Signal Transduction Research
High Purity Nucleotide & Nucleoside Analogues

- *Unique Collection of Cyclic Nucleotides*
- *Inhibitors and Activators of Protein Kinases A and G*
- *Specific Epac Modulators*
- *Widest Selection of NAD^+ and cADPR Analogues*
- *c-diGMP and c-diAMP, Derivatives and Metabolites*
- *Nucleoside Mono-, Di-, Tri- and Polyphosphates*
- *Fluorescent and Biotinylated Analogues*
- *Affinity Chromatography Gels*
- *Bulk and Custom Syntheses*

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Catalogue Content

Catalogue Number Index

BIOLOG Product List

c-diAMP Analogues and Metabolites

2'3'-cdiAMP (c[A(2',5')pA(3',5')p]) Analogue

c-diGMP Analogues and Metabolites

Preparation of Stock Solutions

Most BIOLOG products are sold in micromol quantities in order to assist customers with the preparation of stock solutions. In contrast to often troublesome calculations regarding molecular weight, salt form, water content and purity percentages, simply add certain volumes of solvent (mostly water or buffer) and end up already with stock solutions of defined concentrations.
The following table shows how to dissolve the content of a vial with water or buffer in order to obtain defined stock solutions:

Concentration of stock solution	**Content of vial**					
	0.1 µmol	**0.5 µmol**	**1 µmol**	**5 µmol**	**10 µmol**	**25 µmol**
	⇓	⇓	⇓	⇓	⇓	⇓
	Water or buffer volumes to be added to achieve stock concentrations on the left					
	⇓	⇓	⇓	⇓	⇓	⇓
100 mM (1 x 10^{-1} M)	1 µl	5 µl	10 µl	50 µl	100 µl	250 µl
50 mM (5 x 10^{-2} M)	2 µl	10 µl	20 µl	100 µl	200 µl	500 µl
20 mM (2 x 10^{-2} M)	5 µl	25 µl	50 µl	250 µl	500 µl	1.25 ml
10 mM (1 x 10^{-2} M)	10 µl	50 µl	100 µl	500 µl	1 ml	2.5 ml
5 mM (5 x 10^{-3} M)	20 µl	100 µl	200 µl	1 ml	2 ml	5 ml
1 mM (1 x 10^{-3} M)	100 µl	500 µl	1000 µl	5 ml	10 ml	25 ml
500 µM (5 x 10^{-4} M)	200 µl	1000 µl	2 ml	10 ml	20 ml	50 ml

If a typical dilution series (1 mM, 100 µM, 10 µM, 1 µM ...) is prepared, respective final end volumes will be 90% of the starting stock solution. For example: The content of a 0.1 µmol vial that has been dissolved in 100 µl of water to result in a 1 mM stock solution, yields 9 ml of each concentration level after dilution.

Interested in our experience with nucleotides?

Since we collect scientific data for most of the structures offered, we can assist you with many of your specific questions connected to nucleotide-related compounds.

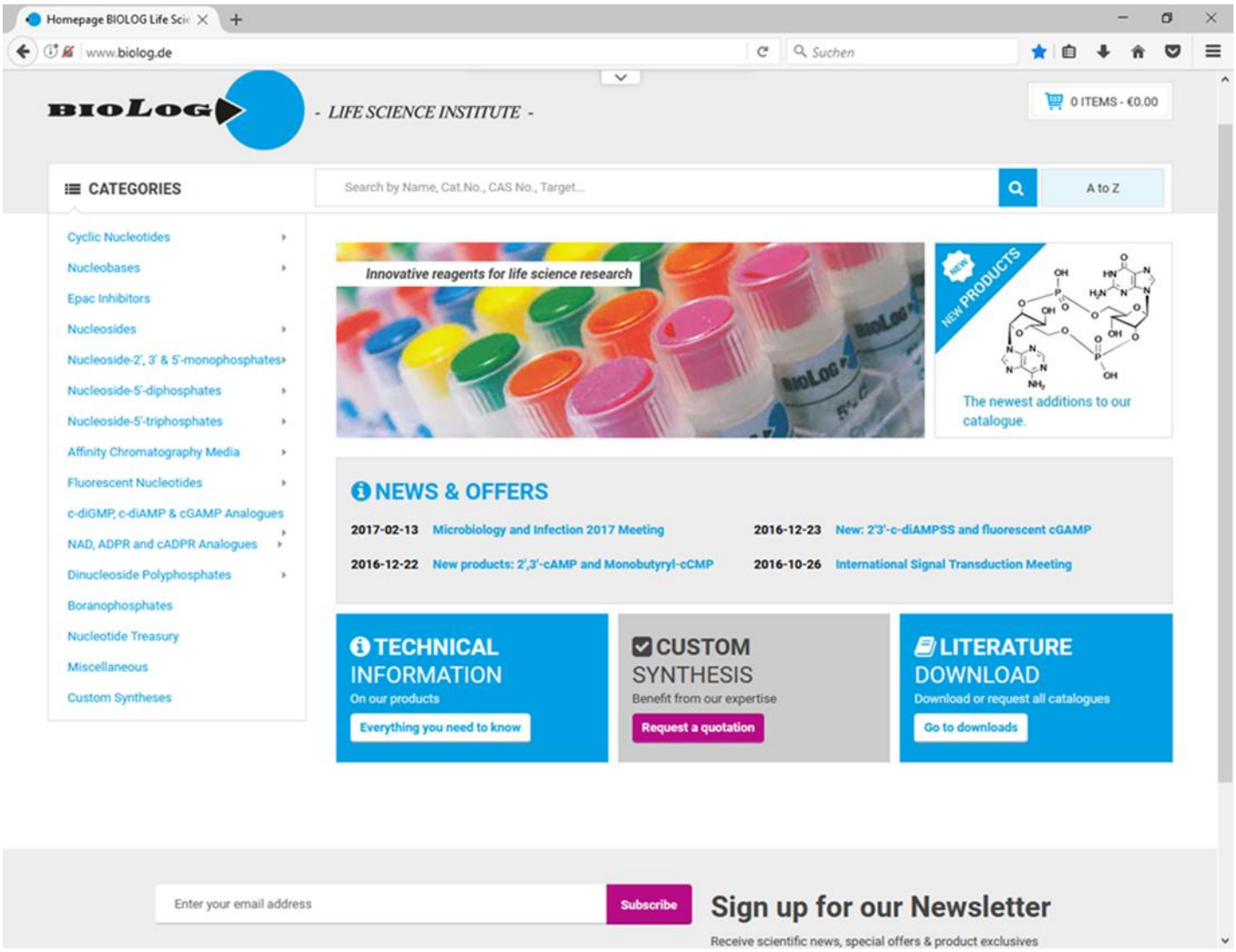
We invite your questions and appreciate hearing about your results and papers related to our products. Confidentiality regarding sensitive matters is, of course, assured. You are encouraged to take advantage of this service regardless whether or not you are already a customer.

**Our products are designed, developed and sold for research purposes only!
They are intended for *in vitro* and nonhuman *in vivo* laboratory applications.
Contents of vials are not sterile and have not been tested for endotoxins.**

Please visit Biolog's new website

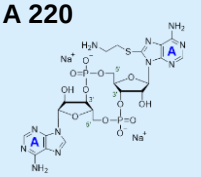
www.biolog.de

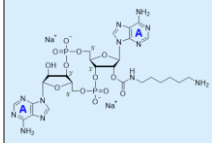
and discover a large variety of rare and sophisticated nucleotide analogues with interesting modifications and useful ligands connected, extended search functions and a convenient shop system

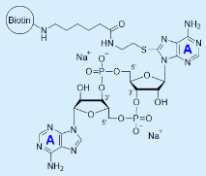


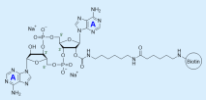
S 001 *New !*	**Determination and quantification of cyclic dinucleotides in biological systems**
	Biolog offers determination and quantification of the bacterial second messengers c-diAMP (Cat. No. C 088), c-diGMP (Cat. No. C 057) or 3'3'-cGAMP (Cat. No. C 117) as well as of the metazoan signalling nucleotide 2'3'-cGAMP (Cat. No. C 161) by HPLC-mass spectrometric analytics. Detectable concentrations depend on the matrix present, but can be as low as 4 ng/mL. References: Andrade et al., *Cell Host Microbe*, **20**, 49-59 (2016); Valentini et al., *PLoS Genet.*, **12**(10):e1006354 (2016). For a corresponding offer, please inquire with details of your biosystem.

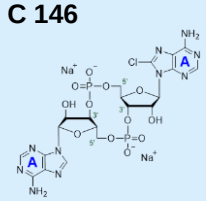
c-diAMP Analogues and Metabolites

A 220		**8- (2- Aminoethylthio)- cyclic diadenosine monophosphate (8-AET-c-diAMP)**
		$C_{22}H_{29}N_{11}O_{12}P_2S$; MW 733.6 (free acid); λ_{max} 267 nm; ε 22900; sodium salt; purity > 95% HPLC. For other salt forms please inquire. Analogue of the bacterial second messenger c-diAMP (Cat. No. C 088) which is suitable as a ligand in affinity chromatography or for coupling of various labelling structures including fluorophores. The 4 atom spacer is attached to position 8 of one of the two adenine nucleobases. Detailed technical information available.
0.1 µmol / ~73 µg € 164.- (A 220 - 001)		5 x 0.1 µmol € 734.- (A 220 - 005)

A 182		**2'- O- (6- Aminohexylcarbamoyl)- cyclic diadenosine monophosphate (2'-AHC-c-diAMP)**
		$C_{27}H_{38}N_{12}O_{13}P_2$; MW 800.6 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 95% HPLC. For other salt forms please inquire. Analogue of the bacterial second messenger c-diAMP (Cat. No. C 088) which is suitable as a ligand in affinity chromatography or for coupling of various labelling structures including fluorophores. Detailed technical information available.
0.1 µmol / ~80 µg € 164.- (A 182 - 001)		5 x 0.1 µmol € 734.- (A 182 - 005)

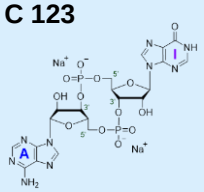
B 156		**8- (2- [Biotinyl]aminoethylthio)- cyclic diadenosine monophosphate (8-[Biotin]-AET-c-diAMP)**
		$C_{38}H_{54}N_{14}O_{15}P_2S_2$; MW 1073.0 (free acid); λ_{max} 267 nm; ε 22900; sodium salt; purity > 95% HPLC. For other salt forms please inquire. Biotinylated analogue of the bacterial second messenger c-diAMP (Cat. No. C 088), in which the biotin label is attached to position 8 of one of the two adenine nucleobases via an 11 atom spacer. Potential tracer in immunoassays, affinity chromatography or pull-down assays. Detailed technical information available. Reference: Gundlach et al., *J. Biol. Chem.*, **290**, 3069 – 3080 (2015).
0.1 µmol / ~0.1 mg € 190.- (B 156 - 001)		5 x 0.1 µmol € 857.- (B 156 - 005)

B 106		**2'- O- (6- [Biotinyl]aminohexylcarbamoyl)- cyclic diadenosine monophosphate (2'-[Biotin]-AHC-c-diAMP)**
		$C_{43}H_{63}N_{15}O_{16}P_2S$; MW 1140.1 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 95% HPLC. For other salt forms please inquire. 2'-[Biotin]-AHC-c-diAMP is an analogue of the bacterial second messenger c-diAMP (Cat. No. C 088), in which a biotin moiety has been attached to the 2'-hydroxy group of one ribose via a 16 atom spacer. Potential tracer in immunoassays, affinity chromatography or pull-down assays. Detailed technical information available. References: Corrigan et al., *Proc. Natl. Acad. Sci. USA*, **110**, 9084 - 9089 (2013); Bai et al., *J. Bacteriol.*, **195**, 5123 - 5132 (2013); Gundlach et al., *J. Biol. Chem.*, **290**, 3069 – 3080 (2015).
0.1 µmol / ~0.1 mg € 190.- (B 106 - 001)		5 x 0.1 µmol € 856.- (B 106 - 005)

C 146		**8- Chloro- cyclic diadenosine monophosphate (8-Cl-c-diAMP)**
		$C_{20}H_{23}ClN_{10}O_{12}P_2$; MW 692.9 (free acid); λ_{max} 262 nm; ε 28600; sodium salt; purity > 95% HPLC. For other salt forms please inquire. Analogue of the bacterial second messenger c-diAMP (Cat. No. C 088), useful for binding studies and precursor for further modifications with spacers or labels. Detailed technical information available.
0.1 µmol / ~70 µg € 164.- (C 146 - 001)		5 x 0.1 µmol € 734.- (C 146 - 005)

C 117	**Cyclic (adenosine monophosphate- guanosine monophosphate) (c-(ApGp))**
	Please find entry under "3',3'-cGAMP Analogues", p. 16.

C 123

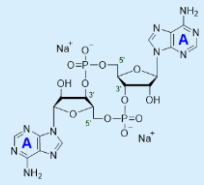


Cyclic (adenosine monophosphate- inosine monophosphate) (c-(ApIp))

$C_{20}H_{23}N_9O_{13}P_2$; MW 659.4 (free acid); λ_{max} 252 nm; ε 21600; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Hybrid cyclic dinucleotide containing both a 5'-AMP and a 5'-IMP unit. Detailed technical information available.

0.1 µmol / ~66 µg € 190.- (C 123 - 001)	5 x 0.1 µmol € 857.- (C 123 - 005)

C 088

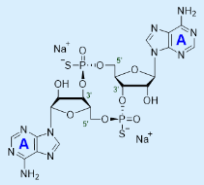


Cyclic diadenosine monophosphate (c-diAMP / cyclic bis (3' → 5') diadenylic acid)

[54447-84-6]; $C_{20}H_{24}N_{10}O_{12}P_2$; MW 658.4 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 98% HPLC (typically > 99%). For other salt forms please inquire.
c-diAMP was identified as a second messenger that signals DNA integrity in *Bacillus subtilis* during sporulation, and is considered to be an additional purine-based signalling nucleotide with a more general function in prokaryotes. Detailed technical information available.
The structurally related bacterial second messenger c-diGMP (Cat. No. C 057) is offered as well. References: Simm et al., *J. Bacteriol.*, **189**, 3613 - 3623 (2007); Witte et al., *Mol. Cell*, **30**, 167 - 178 (2008); Oppenheimer-Shaanan et al., *EMBO Rep.*, **12**, 594 - 601 (2011).

1 µmol / ~0.7 mg € 110.- (C 088 - 01)	5 x 1 µmol € 495.- (C 088 - 05)	**Inquiries for bulk quantities welcome!**

C 118

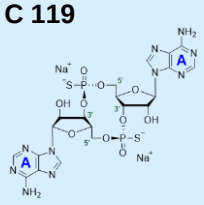


Cyclic diadenosine monophosphorodithioate, Rp- isomers (Rp,Rp-c-diAMPSS)

$C_{20}H_{24}N_{10}O_{10}P_2S_2$; MW 690.6 (free acid); λ_{max} 259 nm; ε 27350; sodium salt; purity > 95% HPLC. For other salt forms please inquire.
Sulfur-modified analogue of the bacterial second messenger c-diAMP (Cat. No. C 088, above) with increased metabolic stability. Rp,Rp-c-diAMPSS can be useful in studies on ligand-receptor interactions and was reported to enhance the anti-tumor activity of therapeutic vaccines. Detailed technical information available. Reference: Leong et al., *J. Immunother. Cancer*, **1** (Suppl. 1): O20 (2013).

0.1 µmol / ~69 µg € 190.- (C 118 - 001)	5 x 0.1 µmol € 857.- (C 118 - 005)

C 119

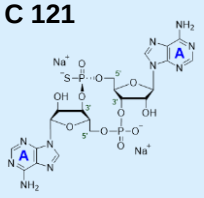


Cyclic diadenosine monophosphorodithioate, Rp- / Sp- isomers (Rp,Sp-c-diAMPSS)

$C_{20}H_{24}N_{10}O_{10}P_2S_2$; MW 690.6 (free acid); λ_{max} 259 nm; ε 27350; sodium salt; purity > 95% HPLC. For other salt forms please inquire.
Sulfur-modified analogue of the bacterial second messenger c-diAMP (Cat. No. C 088, above) with increased metabolic stability. Rp,Sp-c-diAMPSS can be useful in studies on ligand-receptor interactions. Detailed technical information available. Reference: Leong et al., *J. Immunother. Cancer*, **1** (Suppl. 1): O20 (2013).

0.1 µmol / ~69 µg € 190.- (C 119 - 001)	5 x 0.1 µmol € 857.- (C 119 - 005)

C 121

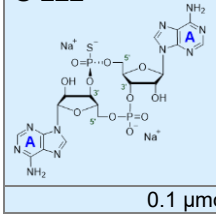


Cyclic diadenosine monophosphorothioate, Rp- isomer (Rp-c-diAMPS)

$C_{20}H_{24}N_{10}O_{11}P_2S$; MW 674.5 (free acid); λ_{max} 259 nm; ε 27200; sodium salt; purity > 95% HPLC. For other salt forms please inquire.
Sulfur-modified analogue of the bacterial second messenger c-diAMP (Cat. No. C 088, above). Sp-c-diAMPS is also offered (Cat. No. C 122, below). Detailed technical information available.

0.1 µmol / ~67 µg € 190.- (C 121 - 001)	5 x 0.1 µmol € 857.- (C 121 - 005)

C 122



Cyclic diadenosine monophosphorothioate, Sp- isomer (Sp-c-diAMPS)

$C_{20}H_{24}N_{10}O_{11}P_2S$; MW 674.5 (free acid); λ_{max} 259 nm; ε 27200; sodium salt; purity > 95% HPLC. For other salt forms please inquire.
Sulfur-modified analogue of the bacterial second messenger c-diAMP (Cat. No. C 088, above). Rp-c-diAMPS is also offered (Cat. No. C 121, above). Detailed technical information available.

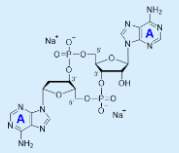
0.1 µmol / ~67 µg € 190.- (C 122 - 001)	5 x 0.1 µmol € 857.- (C 122 - 005)

C 105

Cyclic diinosine monophosphate (c-diIMP)

Please find entry under “c-diGMP Analogues”, p. 11

D 144

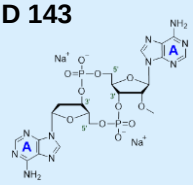


2'- Deoxy- cyclic diadenosine monophosphate (c-di-2'-dAMP / c-(2'-dApAp))

$C_{20}H_{24}N_{10}O_{11}P_2$; MW 642.4 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 95% HPLC. For other salt forms please inquire. c-di-2'-dAMP is an analogue of the bacterial second messenger c-diAMP (Cat. No. C 088). Detailed technical information available.

0.1 µmol / ~64 µg € 171.- (D 144 - 001)	5 x 0.1 µmol € 769.- (D 144 - 005)

D 143

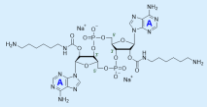


2'- Deoxy- 2''- O- methyl- cyclic diadenosine monophosphate (c-di-2'-d-2''-O-Me-AMP / c-(2'-dAp-2'-O-Me-Ap))

$C_{21}H_{26}N_{10}O_{11}P_2$; MW 656.5 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 95% HPLC. For other salt forms please inquire. c-di-2'-d-2''-O-Me-AMP is an analogue of the bacterial second messenger c-diAMP (Cat. No. C 088) with modified ribose 2'-hydroxy positions. Detailed technical information available.

0.1 µmol / ~66 µg € 171.- (D 143 - 001)	5 x 0.1 µmol € 769.- (D 143 - 005)

D 121

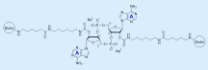


2'- , 2''- O- (Di- [6- aminohexylcarbamoyl])- cyclic diadenosine monophosphate (2',2''-Di-AHC-c-diAMP)

$C_{34}H_{52}N_{14}O_{14}P_2$; MW 942.8 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Analogue of the bacterial second messenger c-diAMP (Cat. No. C 088) which is suitable as a ligand in affinity chromatography or for coupling of various labelling structures including fluorophores. Detailed technical information available.

0.1 µmol / ~94 µg € 164.- (D 121 - 001)	5 x 0.1 µmol € 734.- (D 121 - 005)

D 122

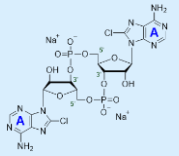


2', 2''- O- (Di- (6- [biotinyl]aminohexylcarbamoyl))- cyclic diadenosine monophosphate (2',2''-Di-[Biotin]-AHC-c-diAMP)

$C_{66}H_{102}N_{20}O_{20}P_2S_2$; MW 1621.8 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. 2',2''-Di-[Biotin]-AHC-c-diAMP is an analogue of the bacterial second messenger c-diAMP (Cat. No. C 088), in which biotin moieties have been attached to both ribose 2'-hydroxy groups via 16 atom spacers. Potential tracer in immunoassays, affinity chromatography or pull-down assays. Detailed technical information available.

0.1 µmol / ~0.2 mg € 190.- (D 122 - 001)	5 x 0.1 µmol € 856.- (D 122 - 005)

D 161 ***New !***

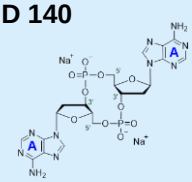


8-, 8'- Dichloro- cyclic diadenosine monophosphate (8,8'-Di-Cl-c-diAMP)

$C_{20}H_{22}Cl_2N_{10}O_{12}P_2S_2$; MW 727.3 (free acid); λ_{max} 262 nm; ε 30600; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Functionalized analogue of the bacterial second messenger c-diAMP (Cat. No. C 088) which can be useful for binding studies and for further modifications with spacers or labels. Detailed technical information available.

0.1 µmol / ~73 µg € 141.- (D 161 - 001)	5 x 0.1 µmol € 633.- (D 161 - 005)

D 140

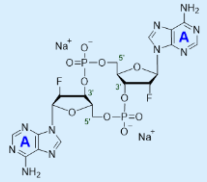


2'- , 2''- Dideoxy- cyclic diadenosine monophosphate (2',2''-Di-c-didAMP)

$C_{20}H_{24}N_{10}O_{10}P_2$; MW 626.4 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. 2',2''-Di-c-didAMP is an analogue of the bacterial second messenger c-diAMP (Cat. No. C 088) lacking both ribose 2'-hydroxy groups. Detailed technical information available. Reference: Blommers et al., *Biochemistry*, **27**, 8361 - 8369 (1988).

0.1 µmol / ~63 µg € 171.- (D 140 - 001)	5 x 0.1 µmol € 769.- (D 140 - 005)

D 132

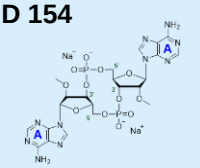


2'- , 2''- Dideoxy- 2'-, 2''- difluoro- cyclic diadenosine monophosphate (2',2''-Di-F-c-didAMP)

$C_{20}H_{22}F_2N_{10}O_{10}P_2$; MW 662.4 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Analogue of the bacterial second messenger c-diAMP (Cat. No. C 088) in which the ribose 2'-hydroxy groups have been replaced by fluorine atoms. 2',2''-Di-F-c-didAMP may be useful in studies on ligand-receptor interactions. Detailed technical information available.

0.1 µmol / ~66 µg € 171.- (D 132 - 001)	5 x 0.1 µmol € 769.- (D 132 - 005)

D 154

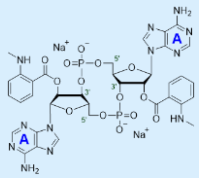


2'- , 2''- O- (Di- methyl)- cyclic diadenosine monophosphate (2',2''-Di-O-Me-c-diAMP)

$C_{22}H_{28}N_{10}O_{12}P_2$; MW 686.5 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Analogue of the bacterial second messenger c-diAMP (Cat. No. C 088) which can be useful in studies on ligand-receptor interactions. The mono-methylated c-diAMP analogue 2'-O-Me-c-diAMP (Cat. No. M 085) is also offered. Detailed technical information available.

0.1 µmol / ~69 µg € 171.- (D 154 - 001)	5 x 0.1 µmol € 769.- (D 154 - 005)

D 159



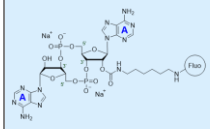
2'-, 2''- O- (Di- N'- methylanthraniloyl)- cyclic diadenosine monophosphate (Di-MANT-c-diAMP)

$C_{36}H_{38}N_{12}O_{14}P_2$; MW 924.7 (free acid); λ_{max} 256 nm; ε 40000 (pH 8); sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Fluorescent analogue of the bacterial second messenger c-diAMP (Cat. No. C 088). The MANT fluorophore (λ_{exc} 355 nm; λ_{em} 448 nm) has a certain sensitivity for its environment and can change its spectral properties upon binding. Compare: Hiratsuka, *Biochim. Biophys. Acta*, **742**, 496 - 503 (1983). Detailed technical information available.

Related product: Biolog also offers MANT-c-diAMP (Cat. No. M 103, below).

0.1 µmol / ~92 µg € 164.- (D 159 - 001)	5 x 0.1 µmol € 734.- (D 159 - 005)

F 011

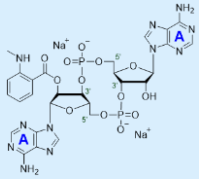


2'- O- (6- [Fluoresceinyl]aminohexylcarbamoyl)- cyclic diadenosine monophosphate (2'-Fluo-AHC-c-diAMP)

$C_{48}H_{48}N_{12}O_{19}P_2$; MW 1158.9 (free acid); λ_{max} 494 nm; ε 79000 (pH 9); sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Fluorescent analogue of the bacterial second messenger c-diAMP (Cat. No. C 088) with λ_{exc} 494 nm and λ_{em} 517 nm. Detailed technical information available.

0.1 µmol / ~0.1 mg € 217.- (F 011 - 001)	5 x 0.1 µmol € 978.- (F 011 - 005)

M 103



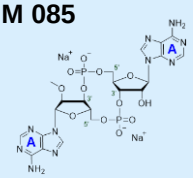
2'- O- (N'- methylanthraniloyl)- cyclic diadenosine monophosphate (MANT-c-diAMP)

$C_{28}H_{31}N_{11}O_{13}P_2$; MW 791.6 (free acid); λ_{max} 256 nm; ε 33500 (pH 8); sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Fluorescent analogue of the bacterial second messenger c-diAMP (Cat. No. C 088). The MANT fluorophore (λ_{exc} 355 nm; λ_{em} 448 nm) has a certain sensitivity for its environment and can change its spectral properties upon binding. Compare: Hiratsuka, *Biochim. Biophys. Acta*, **742**, 496 - 503 (1983). Detailed technical information available.

Related product: Biolog also offers Di-MANT-c-diAMP (Cat. No. D 159).

0.1 µmol / ~79 µg € 190.- (M 103 - 001)	5 x 0.1 µmol € 857.- (M 103 - 005)

M 085

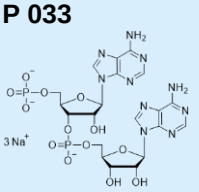


2'- O- Methyl- cyclic diadenosine monophosphate (2'-O-Me-c-diAMP / c-(2'-O-Me-ApAp))

$C_{21}H_{26}N_{10}O_{11}P_2$; MW 672.4 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Analogue of the bacterial second messenger c-diAMP (Cat. No. C 088). Detailed technical information available.

0.1 µmol / ~67 µg € 171.- (M 085 - 001)	5 x 0.1 µmol € 769.- (M 085 - 005)

P 033



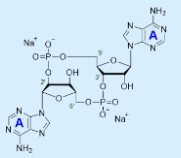
5'- Phosphoadenylyl- (3' → 5')- adenosine (pApA)

[3593-47-3]; $C_{20}H_{26}N_{10}O_{13}P_2$; MW 676.5 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Potential metabolic degradation product of c-diAMP (Cat. No. C 088).
c-diAMP is an additional purine-based signaling nucleotide in prokaryotes (Witte et al., *Mol. Cell*, **30**, 167 - 178 (2008)).
Detailed technical information available. References: Rao et al., *J. Biol. Chem.*, **285**, 473 - 482 (2010); Sureka et al., *Cell*, **158**, 1389 - 1401 (2014).

1 µmol / ~0.7 mg € 77.- (P 033 - 01)	5 x 1 µmol € 343.- (P 033 - 05)

2'3'-cdiAMP Analogues

C 187 *New !*

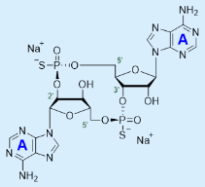


Cyclic (adenosine- (2' → 5')- monophosphate- adenosine- (3' → 5')- monophosphate) (c[A(2',5')pA(3',5')p] / 2'3'-c-diAMP / 2',5'-3',5'-c-diAMP)

$C_{20}H_{24}N_{10}O_{12}P_2$; MW 658.4 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 95% HPLC.
For other salt forms please inquire.
Cyclic dinucleotide structurally related to the bacterial second messenger c-diAMP (Cat. No. C 088). In contrast to 3',5'-linked c-diAMP, c[A(2',5')pA(3',5')p] contains two distinct phosphodiester linkages. Detailed technical information available.

0.5 µmol / ~329 µg € 155.- (C 187 - 005)	5 x 0.1 µmol € 699.- (C 187 - 025)

C 224 *New !*

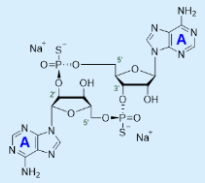


Cyclic (adenosine- (2' → 5')- monophosphorothioate [Rp]- adenosine- (3' → 5')- monophosphorothioate [Rp]) (c[A(2',5')pS[Rp]-A(3',5')pS[Rp]] / Rp,Rp-2'3'-c-diAMPSS)

[1638750-95-4], $C_{20}H_{24}N_{10}O_{10}P_2S_2$; MW 690.6 (free acid); λ_{max} 259 nm; ε 27350; sodium salt; purity > 95% HPLC. For other salt forms please inquire. c[A(2',5')pS[Rp]-A(3',5')pS[Rp]] is a synthetic cyclic dinucleotide with improved stability against degradation by phosphodiesterases. It has enhanced binding affinity to STING and activates mouse STING (mSTING) as well as all known human STING (hSTING) alleles. Compared to natural cyclic dinucleotides such as c-diGMP (Cat. No. C 057) or c[G(2',5')pA(3',5')p] (2'3'-cGAMP, Cat. No. C 161), c[A(2',5')pS[Rp]-A(3',5')pS[Rp]] shows higher potency in inducing interferons. In addition, it was found to generate anti-cancer effects in mouse models of solid tumors and acute myeloid leukemia (AML). Detailed technical information available. References: Corrales et al., *Cell Rep*., **11**, 1018 - 1030 (2015); Fu et al., *Sci. Transl. Med*., **7**, 283:283ra52 (2015); Curran et al., *Cell Rep*., **15**, 2357 - 2366 (2016).

0.1 µmol / ~69 µg € 184.- (C 224 - 001)	5 x 0.1 µmol € 828.- (C 224 - 005)

C 223 *New !*



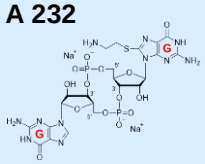
Cyclic (adenosine- (2' → 5')- monophosphorothioate [Sp]- adenosine- (3' → 5')- monophosphorothioate [Rp]) (c[A(2',5')pS[Sp]-A(3',5')pS[Rp]])

[1638242-31-5], $C_{20}H_{24}N_{10}O_{10}P_2S_2$; MW 690.6 (free acid); λ_{max} 259 nm; ε 27350; sodium salt; purity > 95% HPLC. For other salt forms please inquire.
c[A(2',5')pS[Sp]-A(3',5')pS[Rp]] is a synthetic di-thiophosphate analogue of c[A(2',5')pA(3',5')p] (2'3'-c-diAMP, Cat. No. C 187) with improved stability against degradation by phosphodiesterases. Detailed technical information available. References: Corrales et al., *Cell Rep*., **11**, 1018 - 1030 (2015); Fu et al., *Sci. Transl. Med*., **7**, 283:283ra52 (2015).

0.1 µmol / ~69 µg € 190.- (C 223 - 001)	5 x 0.1 µmol € 857.- (C 223 - 005)

c-diGMP Analogues and Metabolites

A 232

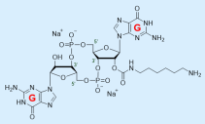


8- (2- Aminoethylthio)- cyclic diguanosine monophosphate (8-AET-c-diGMP)

$C_{22}H_{29}N_{11}O_{14}P_2S$; MW 765.6 (free acid); λ_{max} 271 nm; ε 18500; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Analogue of the bacterial second messenger c-diGMP (Cat. No. C 057) which is suitable as a ligand in affinity chromatography or for coupling of various labelling structures including fluorophores. The 4 atom spacer is attached to position 8 of one of the two guanine nucleobases. Detailed technical information available.

0.1 µmol / ~77 µg € 190.- (A 232 - 001)	5 x 0.1 µmol € 857.- (A 232 - 005)

A 151

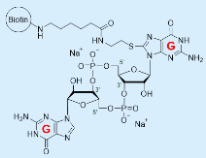


2'- O- (6- Aminohexylcarbamoyl)- cyclic diguanosine monophosphate (2'-AHC-c-diGMP)

[1422761-54-3]; $C_{27}H_{38}N_{12}O_{15}P_2$; MW 832.6 (free acid); λ_{max} 253 nm; ε 23700; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Analogue of the bacterial second messenger c-diGMP (Cat. No. C 057) which is suitable as a ligand in affinity chromatography or for coupling of various labelling structures including fluorophores. The spacer is connected to one of the two ribose 2'-hydroxy groups in c-diGMP. A corresponding analogue with two spacers is available as well (2',2''-Di-AHC-c-diGMP, Cat. No. D 112). Detailed technical information available. Reference: Düvel et al., *J. Microbiol. Methods*, **88**, 229 - 236 (2012).

0.1 µmol / ~83 µg € 164.- (A 151 - 001)	5 x 0.1 µmol € 734.- (A 151 - 005)

B 184

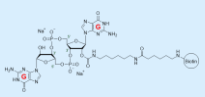


8- (2- [Biotinyl]aminoethylthio)- cyclic diguanosine monophosphate (8-[Biotin]-AET-c-diGMP)

$C_{38}H_{54}N_{14}O_{17}P_2S_2$; MW 1105.0 (free acid); λ_{max} 271 nm; ε 18500; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Biotinylated analogue of the bacterial second messenger c-diGMP (Cat. No. C 057), in which the biotin label is attached to position 8 of one of the two guanine nucleobases via an 11 atom spacer. Potential tracer in immunoassays, affinity chromatography or pull-down assays. Detailed technical information available.

0.1 µmol / ~0.1 mg € 219.- (B 184 - 001)	5 x 0.1 µmol € 973.- (B 184 - 005)

B 098

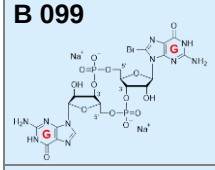


2'- O- (6- [Biotinyl]aminohexylcarbamoyl)- cyclic diguanosine monophosphate (2'-[Biotin]-AHC-c-diGMP)

$C_{43}H_{63}N_{15}O_{18}P_2S$; MW 1172.1 (free acid); λ_{max} 253 nm; ε 23700; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. The biotin label is connected to one of the two ribose 2'-hydroxy groups in c-diGMP (Cat. No. C 057) via a 16 atom spacer. Potential tracer in immunoassays, affinity chromatography or pull-down assays. The dibiotinylated analogue 2',2''-Di-[Biotin]-AHC-c-diGMP (Cat. No. D 111) is available as well. Detailed technical information available. Reference: Luo et al., *Mol. Biosyst.*, **8**, 772 - 778 (2012).

0.1 µmol / ~0.1 mg € 190.- (B 098 - 001)	5 x 0.1 µmol € 857.- (B 098 - 005)

B 099



8- Bromo- cyclic diguanosine monophosphate (8-Br-c-diGMP)

$C_{20}H_{23}BrN_{10}O_{14}P_2$; MW 769.3 (free acid); λ_{max} 257 nm; ε 25500; sodium salt; purity > 95% HPLC.
For other salt forms please inquire.
Mono-functionalized analogue of the bacterial second messenger c-diGMP (Cat. No. C 057, below), useful for binding studies and precursor for further modifications with spacers or labels. Detailed technical information available.

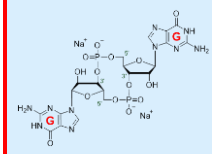
0.1 µmol / ~77 µg € 146.- (B 099 - 001)	5 x 0.1 µmol € 657.- (B 099 - 005)

C 117

Cyclic (adenosine monophosphate- guanosine monophosphate) (c-(ApGp))

Please find entry under "3',3'-cGAMP Analogues", p. 16.

C 057

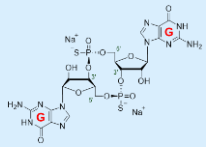


Cyclic diguanosine monophosphate (c-diGMP) / cyclic bis (3' → 5') diguanylic acid

[61093-23-0]; $C_{20}H_{24}N_{10}O_{14}P_2$; MW 690.4 (free acid); λ_{max} 253 nm; ε 23700; sodium salt; purity > 98% HPLC (typically > 99%). For other salt forms please inquire.
The metabolite pGpG (Cat. No. P 023) is available as well. Bacterial second messenger and STING ligand. Detailed technical information and references available. References: Ross et al., *Nature.*, **325,** 279 - 281 (1987); Jenal, *Curr. Opin. Microbiol.*, **7**, 185 - 191 (2004); Simm et al., *Mol. Microbiol.*, **53**, 1123 - 1134 (2004); Karaolis et al., *Biochem. Biophys. Res. Comm.*, **329**, 40 - 45 (2005); Méndez-Ortiz et al., *J. Biol. Chem.*, **281**, 8090 - 8099 (2006); Lee et al., *Science*, **329**, 845 - 848 (2010).

1 µmol / ~0.7 mg € 110.- (C 057 - 01)	5 x 1 µmol € 495.- (C 057 - 05)

C 129

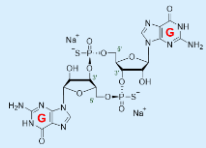


Cyclic diguanosine monophosphorodithioate, Rp- isomers (Rp,Rp-c-diGMPSS)

[1259875-41-6]; $C_{20}H_{24}N_{10}O_{12}P_2S_2$; MW 722.6 (free acid); λ_{max} 253 nm; ε 26100; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Sulfur-modified analogue of the bacterial second messenger c-diGMP (Cat. No. C 057, above) with increased metabolic stability. Rp,Rp-c-diGMPSS can be useful in studies on ligand-receptor interactions. Detailed technical information available. References: Yan et al., *Bioorg. Med. Chem. Lett.*, **18**, 5631 - 5634 (2008); Shanahan et al., *J. Am. Chem. Soc.*, **133**, 15578 - 15592 (2011); Shanahan et al., *Biochemistry*, **52**, 365 - 377 (2013).

0.1 µmol / ~72 µg € 190.- (C 129 - 001)	5 x 0.1 µmol € 857.- (C 129 - 005)

C 130

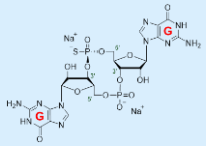


Cyclic diguanosine monophosphorodithioate, Rp- / Sp- isomers (Rp,Sp-c-diGMPSS)

[1259875-47-2]; $C_{20}H_{24}N_{10}O_{12}P_2S_2$; MW 722.6 (free acid); λ_{max} 253 nm; ε 26100; sodium salt; purity > 95% HPLC. For other salt forms please inquire. Sulfur-modified analogue of the bacterial second messenger c-diGMP (Cat. No. C 057, above) with increased metabolic stability. Rp,Sp-c-diGMPSS can be useful in studies on ligand-receptor interactions. Detailed technical information available. References: Yan et al., *Bioorg. Med. Chem. Lett.*, **18**, 5631 - 5634 (2008); Shanahan et al., *J. Am. Chem. Soc.*, **133**, 15578 - 15592 (2011); Shanahan et al., *Biochemistry*, **52**, 365 - 377 (2013).

0.1 µmol / ~72 µg € 190.- (C 130 - 001)	5 x 0.1 µmol € 857.- (C 130 - 005)

C 124

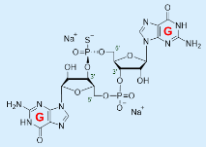


Cyclic diguanosine monophosphorothioate, Rp- isomer (Rp-c-diGMPS)

[1259875-32-5]; $C_{20}H_{24}N_{10}O_{13}P_2S$; MW 706.5 (free acid); λ_{max} 253 nm; ε 23700; sodium salt; purity > 95% HPLC. For other salt forms please inquire. Rp-isomer of the mono-thiophosphate analogue of the bacterial second messenger c-diGMP (Cat. No. C 057). It can be useful in studies on ligand-receptor interactions with c-diGMP and c-diAMP-binding proteins. Sp-c-diGMPS is also offered (Cat. No. C 125, below). Detailed technical information available. References: Shanahan et al., *J. Am. Chem. Soc.*, **133**, 15578 - 15592 (2011); Chen et al., *Vaccine*, **28**, 3080 - 3085 (2010).

0.1 µmol / ~71 µg € 190.- (C 124 - 001)	5 x 0.1 µmol € 857.- (C 124 - 005)

C 125

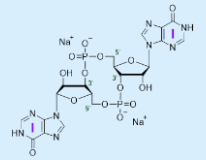


Cyclic diguanosine monophosphorothioate, Sp- isomer (Sp-c-diGMPS)

[1259875-39-2]; $C_{20}H_{24}N_{10}O_{13}P_2S$; MW 706.5 (free acid); λ_{max} 253 nm; ε 23700; sodium salt; purity > 95% HPLC. For other salt forms please inquire. Sp-isomer of the mono-thiophosphate analogue of the bacterial second messenger c-diGMP (Cat. No. C 057). It can be useful in studies on ligand-receptor interactions with c-diGMP and c-diAMP-binding proteins. Rp-c-diGMPS is also offered (Cat. No. C 124, above). Detailed technical information available. References: Shanahan et al., *J. Am. Chem. Soc.*, **133**, 15578 - 15592 (2011); Chen et al., *Vaccine*, **28**, 3080 - 3085 (2010).

0.1 µmol / ~71 µg € 190.- (C 125 - 001)	5 x 0.1 µmol € 857.- (C 125 - 005)

C 105

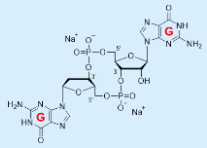


Cyclic diinosine monophosphate (c-diIMP)

[79940-41-3]; $C_{20}H_{22}N_8O_{14}P_2$; MW 660.4 (free acid); λ_{max} 249 nm; ε 21600; sodium salt; purity > 95% HPLC.
For other salt forms or analogues please inquire. Analogue of the bacterial second messengers c-diAMP and c-diGMP, respectively. Potential adjuvant for mucosal vaccination. Detailed technical information available. References: Ross et al., *J. Biol. Chem.*, **265**, 18933 - 18943 (1990); Libanova et al., *Vaccine*, **28**, 2249 - 2258 (2010); Sureka et al., *Cell*, **158**, 1389 - 1401 (2014).

1 µmol / ~0.7 mg € 171.- (C 105 - 01)	5 x 1 µmol € 769.- (C 105 - 05)

D 145

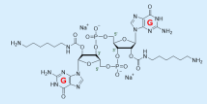


2'- Deoxy- cyclic diguanosine monophosphate (c-di-2'-dGMP / c-(2'-dGpGp) / c-dG-GMP)

$C_{20}H_{24}N_{10}O_{13}P_2$; MW 674.4 (free acid); λ_{max} 254 nm; ε 23700; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. c-di-2'-dGMP is an analogue of the bacterial second messenger c-di-GMP (Cat. No. C 057) which is useful in studies on ligand-receptor interactions. Detailed technical information available. References: Shanahan et al., *J. Am. Chem. Soc.*, **133**, 15578 - 15592 (2011); Mano et al., *ChemMedChem*, **2**, 1410 - 1413 (2007).

0.1 µmol / ~67 µg € 171.- (D 145 - 001)	5 x 0.1 µmol € 769.- (D 145 - 005)

D 112

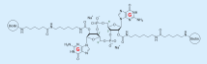


2'- , 2''- O- (Di- [6- aminohexylcarbamoyl])- cyclic diguanosine monophosphate (2',2''-Di-AHC-c-diGMP)

$C_{34}H_{52}N_{14}O_{16}P_2$; MW 974.8 (free acid); λ_{max} 253 nm; ε 23700; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Analogue of the bacterial second messenger c-diGMP (Cat. No. C 057) which is suitable as a ligand in affinity chromatography or for coupling of various labelling structures including fluorophores. Detailed technical information available.

0.1 µmol / ~97 µg € 164.- (D 112 - 001)	5 x 0.1 µmol € 734.- (D 112 - 005)

D 111

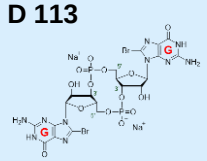


2'-, 2''- O- (Di- 6- [biotinyl]aminohexylcarbamoyl)- cyclic diguanosine monophosphate (2',2''-Di-[Biotin]-AHC-c-diGMP)

$C_{66}H_{102}N_{20}O_{22}P_2S_2$; MW 1653.7 (free acid); λ_{max} 253 nm; ε 23700; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. The biotin labels are connected to both ribose 2'-hydroxy groups of c-diGMP (Cat. No. C 057) via 16 atom spacers. The monobiotinylated analogue 2'-[Biotin]-AHC-c-diGMP (Cat. No. B 098) is available as well. Detailed technical information available.

0.1 µmol / ~0.2 mg € 190.- (D 111 - 001)	5 x 0.1 µmol € 857.- (D 111 - 005)

D 113

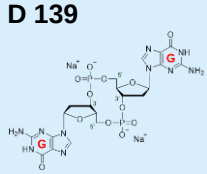


8-, 8'- Dibromo- cyclic diguanosine monophosphate (8,8'-Di-Br-c-diGMP)

[1357147-61-5]; $C_{20}H_{22}Br_2N_{10}O_{14}P_2$; MW 848.2 (free acid); λ_{max} 263 nm; ε 32800; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Functionalized analogue of the bacterial second messenger c-diGMP (Cat. No. C 057), useful for binding studies and for further modifications with spacers or labels. Detailed technical information available. Reference: Veliath et al., *Nucleos. Nucleot. Nucl.*, **30**, 961 - 978 (2011).

0.1 µmol / ~85 µg € 126.- (D 113 - 001)	5 x 0.1 µmol € 568.- (D 113 - 005)

D 139

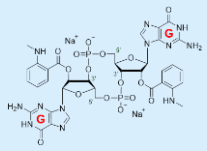


2'- , 2''- Dideoxy- cyclic diguanosine monophosphate (2',2''-Di-c-didGMP)

[60307-63-3]; $C_{20}H_{24}N_{10}O_{12}P_2$; MW 658.4 (free acid); λ_{max} 253 nm; ε 23700; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. 2',2''-Di-c-didGMP is an analogue of the bacterial second messenger c-diGMP (Cat. No. C 057) which selectively binds the c-diGMP class II riboswitch over the class I riboswitch. It may be useful for discriminating between these two classes of c-diGMP-binding RNAs and for studying RNA-based c-diGMP signalling. Detailed technical information available. Reference: Shanahan et al., *Biochemistry*, **52**, 365 - 377 (2013).

0.1 µmol / ~66 µg € 171.- (D 139 - 001)	5 x 0.1 µmol € 769.- (D 139 - 005)

D 101

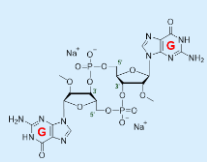


2'-, 2''- O- (Di- N'- methylanthraniloyl)- cyclic diguanosine monophosphate (Di-MANT-c-diGMP)

$C_{36}H_{38}N_{12}O_{16}P_2$; MW 956.7 (free acid); λ_{max} 253 nm; ε 38700 (pH 8); sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Membrane permeant, fluorescent analogue of the bacterial second messenger c-diGMP (Cat. No. C 057). The MANT fluorophore (λ_{exc} 355 nm; λ_{em} 448 nm) has a certain sensitivity for its environment and can change its spectral properties upon binding. Compare: Hiratsuka, *Biochim. Biophys. Acta*, **742**, 496 - 503 (1983). Detailed technical information available. Reference: Abdul-Sater et al., *Microbes Infect.*, **14**, 188 - 197 (2012).

0.1 µmol / ~96 µg € 164.- (D 101 - 001)	5 x 0.1 µmol € 734.- (D 101 - 005)

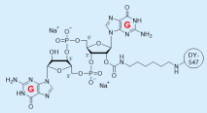
D 136

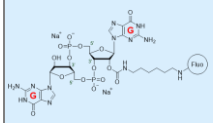


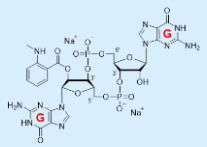
2'- , 2''- O- (Di- methyl)- cyclic diguanosine monophosphate (2',2''-Di-O-Me-c-diGMP)

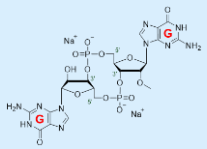
[849214-02-4]; $C_{22}H_{28}N_{10}O_{14}P_2$; MW 718.5 (free acid); λ_{max} 253 nm; ε 23700; sodium salt; purity > 95% HPLC.
For other salt forms please inquire.
2',2''-Di-O-Me-c-diGMP is an analogue of the bacterial second messenger c-diGMP (Cat. No. C 057) which selectively binds the c-diGMP class II riboswitch over the class I riboswitch. It may be useful for discriminating between these two classes of c-diGMP-binding RNAs and for studying RNA-based c-diGMP signalling. Detailed technical information available. Reference: Shanahan et al., *Biochemistry*, **52**, 365 - 377 (2013).

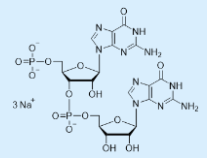
0.1 µmol / ~72 µg € 171.- (D 136 - 001)	5 x 0.1 µmol € 769.- (D 136 - 005)

D 116 	**2'- O- (6- [DY-547]- aminohexylcarbamoyl)- cyclic diguanosine monophosphate (2'-[DY-547]-AHC-c-diGMP)** $C_{57}H_{71}N_{14}O_{22}P_2S_2 \cdot Na$; MW 1453.3 (free acid nucleotide); λ_{max} 559 nm; ε 150000 (EtOH); sodium salt; purity > 95% HPLC. For other salt forms please inquire. Fluorescent analogue of the bacterial second messenger c-diGMP (Cat. No. C 057); λ_{exc} 557 nm, λ_{em} 574 nm. The DY-547 dye is connected to one of the ribose 2'-hydroxy groups of c-diGMP via a 9 atom spacer. Detailed technical information available. Reference: Hanson et al., *J. Clin. Invest*., **125**, 2532 - 2546 (2015).	
0.1 µmol / ~0.1 mg € 217.- (D 116 - 001)		5 x 0.1 µmol € 978.- (D 116 - 005)

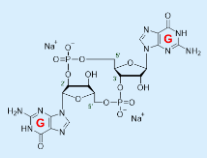
F 009 	**2'- O- (6- [Fluoresceinyl]aminohexylcarbamoyl)- cyclic diguanosine monophosphate (2'-Fluo-AHC-c-diGMP)** [1422761-55-4]; $C_{48}H_{48}N_{12}O_{21}P_2$; MW 1190.9 (free acid); λ_{max} 494 nm; ε 79000 (pH 9); sodium salt; purity > 95% HPLC. For other salt forms please inquire. Fluorescent analogue of the bacterial second messenger c-diGMP (Cat. No. C 057) with λ_{exc} 494 nm and λ_{em} 517 nm. The dye is conjugated via a 9 atom spacer to one of the 2'-hydroxy groups. Detailed technical information available. References: Düvel et al., *J. Microbiol. Methods*, **88**, 229 - 236 (2012); Sundriyal et al., *J. Biol. Chem*., **289**, 6978 - 6990 (2014).	
0.1 µmol / ~0.1 mg € 217.- (F 009 - 001)		5 x 0.1 µmol € 978.- (F 009 - 005)

M 102 	**2'- O- (N'- methylanthraniloyl)- cyclic diguanosine monophosphate (MANT-c-diGMP)** [1384529-33-2]; $C_{28}H_{31}N_{11}O_{15}P_2$; MW 823.6 (free acid); λ_{max} 252 nm; ε 31500 (pH 8); sodium salt; purity > 95% HPLC. For other salt forms please inquire. Fluorescent analogue of the bacterial second messenger c-diGMP (Cat. No. C 057). The MANT fluorophore (λ_{exc} 355 nm; λ_{em} 448 nm) has a certain sensitivity for its environment and can change its spectral properties upon binding. Compare: Hiratsuka, *Biochim. Biophys. Acta*, **742**, 496 - 503 (1983). Detailed technical information available. Reference: Sharma et al., *Biochemistry*, **51**, 5443 – 5453 (2012). Related product: Biolog also offers Di-MANT-c-diGMP (Cat. No. D 101).	
0.1 µmol / ~82 µg € 190.- (M 102 - 001)		5 x 0.1 µmol € 857.- (M 102 - 005)

M 086 	**2'- O- Methyl- cyclic diguanosine monophosphate (2'-O-Me-c-diGMP)** [849214-01-3]; $C_{21}H_{26}N_{10}O_{14}P_2$; MW 704.4 (free acid); λ_{max} 253 nm; ε 23700; sodium salt; purity > 95% HPLC. For other salt forms please inquire. Analogue of the bacterial second messenger c-diGMP (Cat. No. C 057). Detailed technical information available. Reference: Shanahan et al., *J. Amer. Chem. Soc.*, **133**, 15578 - 15592 (2011).	
0.1 µmol / ~70 µg € 171.- (M 086 - 001)		5 x 0.1 µmol € 769.- (M 086 - 005)

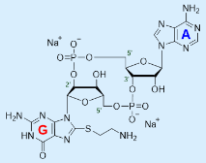
P 023 	**5'- Phosphoguanylyl- (3' → 5')- guanosine (pGpG)** [33008-99-0]; $C_{20}H_{26}N_{10}O_{15}P_2$; MW 708.4 (free acid); λ_{max} 253 nm; ε 23000; sodium salt; purity > 95% HPLC. For other salt forms please inquire. First metabolic degradation product of the bacterial second messenger c-diGMP (Cat. No. C 057). Detailed technical information available. Reference: Christen et al., *Proc. Nat. Acad. Sci. USA*, **104**, 4112 - 4117 (2007); Rao et al., *J. Biol. Chem*., **285**, 473 - 482 (2010); Stelitano et al., *PLos ONE*, **8**, e74920 (2013).	
1 µmol / ~0.7 mg € 77.- (P 023 - 01)		5 x 1 µmol € 343.- (P 023 - 05)

2'3'-cdiGMP Analogue (c[G(2',5')pG(3',5')p])

C 182 *New !* 	**Cyclic (guanosine- (2' → 5')- monophosphate- guanosine- (3' → 5')- monophosphate) (c[G(2',5')pG(3',5')p] / 2'3'-c-diGMP / 2',5'-3',5'-c-diGMP)** $C_{20}H_{24}N_{10}O_{14}P_2$; MW 690.4 (free acid); λ_{max} 253 nm; ε 23700; sodium salt; purity > 95% HPLC. For other salt forms please inquire. Cyclic dinucleotide structurally related to the bacterial second messenger c-diGMP (Cat. No. C 057). In contrast to 3',5'-linked c-diGMP, c[G(2',5')pG(3',5')p] contains two distinct phosphodiester linkages. Detailed technical information available.	
0.5 µmol / ~345 µg € 155.- (C 182 - 005)		5 x 0.5 µmol € 699.- (C 182 - 025)

2'3'-cGAMP Analogues (c[G(2',5')pA(3',5')p])

C 175

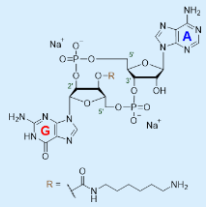


Cyclic (8- (2- aminoethylthio)guanosine- (2' → 5')- monophosphate- adenosine- (3' → 5')- monophosphate) (c[8-AET-G(2',5')pA(3',5')p])

$C_{22}H_{29}N_{11}O_{13}P_2S$; MW 749.6 (free acid); λ_{max} 265 nm; ε 23500; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Analogue of the metazoan cyclic dinucleotide second messenger and STING activator c[G(2',5')pA(3',5')p] (*aka* cGAMP(2'-5') or 2'3'-cGAMP, Cat. No. C 161) which is suitable as a ligand in affinity chromatography or for coupling of various labelling structures including fluorophores. c[G(2',5')pA(3',5')p] was found to be the metazoan second messenger produced by the mammalian innate immune DNA sensor cGAMP synthase (cGAS). Detailed technical information available. References: Gao et al., *Cell*, **153**, 1094 - 1107 (2013); Ablasser et al., *Nature*, **498**, 380 - 384 (2013); Zhang et al., *Mol. Cell*, **51**, 226 - 235 (2013); Diner et al., *Cell Rep.*, **3**, 1355 - 1361 (2013).

0.1 µmol / ~75 µg € 164.- (C 175 - 001)	5 x 0.1 µmol € 734.- (C 175 - 005)

C 191

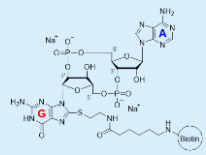


Cyclic (3'- O- (6- aminohexylcarbamoyl)guanosine- (2' → 5')- monophosphate- adenosine- (3' → 5')- monophosphate) (c[3'-AHC-G(2',5')pA(3',5')p])

$C_{27}H_{38}N_{12}O_{14}P_2$; MW 816.6 (free acid); λ_{max} 258 nm; ε 25050; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Analogue of the metazoan cyclic dinucleotide second messenger and STING activator c[G(2',5')pA(3',5')p] (aka cGAMP(2'-5') or 2'3'-cGAMP, Cat. No. C 161) which is suitable as a ligand in affinity chromatography or for coupling of various labelling structures including fluorophores. The spacer is connected to the ribose 3'-hydroxy group of the guanosine part. Detailed technical information available.

0.1 µmol / ~82 µg € 164.- (C 191 - 001)	5 x 0.1 µmol € 734.- (C 191 - 005)

C 176

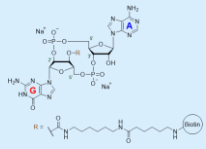


Cyclic (8- (2- [biotinyl]aminoethylthio)- guanosine- (2' → 5')- monophosphate- adenosine- (3' → 5')- monophosphate) (c[8-[Biotin]-AET-G(2',5')pA(3',5')p])

$C_{38}H_{54}N_{14}O_{16}P_2S_2$; MW 1089.0 (free acid); λ_{max} 266 nm; ε 23500; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Biotinylated analogue of the metazoan cyclic dinucleotide second messenger and STING activator c[G(2',5')pA(3',5')p] (*aka* cGAMP(2'-5') or 2'3'-cGAMP, Cat. No. C 161) in which the biotin label is attached to position 8 of the guanine nucleobase via a 11 atom spacer. Potential tracer in immunoassays, affinity chromatography or pull-down assays. c[G(2',5')pA(3',5')p] was found to be the metazoan second messenger produced by the mammalian innate immune DNA sensor cGAMP synthase (cGAS). Detailed technical information available. Reference: Bridgeman et al., *Science*, **349**, 1228 - 1232 (2015).

0.1 µmol / ~0.1 mg € 190.- (C 176 - 001)	5 x 0.1 µmol € 857.- (C 176 - 005)

C 196

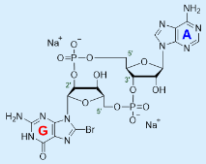


Cyclic (3'- O- (6- [biotinyl]aminohexylcarbamoyl)guanosine- (2' → 5')- monophosphate- adenosine- (3' → 5')- monophosphate) (c[3'-[Biotin]-AHC-G(2',5')pA(3',5')p])

$C_{43}H_{63}N_{15}O_{17}P_2S$; MW 1156.1 (free acid); λ_{max} 258 nm; ε 25050; sodium salt; purity > 95% HPLC.
For other salt forms please inquire.
Biotinylated analogue of the metazoan cyclic dinucleotide second messenger and STING activator c[G(2',5')pA(3',5')p] (aka cGAMP(2'-5') or 2'3'-cGAMP, Cat. No. C 161) in which the biotin label is attached to the 3'-hydroxy group of the guanosine via a 16-atom spacer. Potential tracer in immunoassays, for affinity chromatography or pull-down assays. c[G(2',5')pA(3',5')p] was found to be the metazoan second messenger produced by the mammalian innate immune DNA sensor cGAMP synthase (cGAS).
Detailed technical information available. References for c[G(2',5')pA(3',5')p]: Gao et al., *Cell*, **153**, 1094 - 1107 (2013); Ablasser et al., *Nature*, **498**, 380 - 384 (2013); Zhang et al., *Mol. Cell*, **51**, 226 - 235 (2013); Diner et al., *Cell Rep*., **3**, 1355 - 1361 (2013). Reference for the related product with the catalogue number C 176: Bridgeman et al., *Science*, **349**, 1228 - 1232 (2015).

0.1 µmol / ~0.1 mg € 190.- (C 196 - 001)	5 x 0.1 µmol € 857.- (C 196 - 005)

C 172

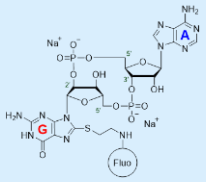


Cyclic (8- bromoguanosine- (2' → 5')- monophosphate- adenosine- (3' → 5')- monophosphate) (c[8-Br-G(2',5')pA(3',5')p])

$C_{20}H_{23}BrN_{10}O_{13}P_2$; MW 753.3 (free acid); λ_{max} 262 nm; ε 27800; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Analogue of the metazoan cyclic dinucleotide second messenger and STING activator c[G(2',5')pA(3',5')p] (*aka* cGAMP(2'-5') or 2'3'-cGAMP, Cat. No. C 161) which may be useful for binding studies and as precursor for further modifications with spacers or labels. c[G(2',5')pA(3',5')p] was found to be the metazoan second messenger produced by the mammalian innate immune DNA sensor cGAMP synthase (cGAS). Detailed technical information available. References for c[G(2',5')pA(3',5')p]: Gao et al., *Cell*, **153**, 1094 - 1107 (2013); Ablasser et al., *Nature*, **498**, 380- 384 (2013); Zhang et al., *Mol. Cell*, **51**, 226 - 235 (2013); Diner et al., *Cell Rep.*, **3**, 1355 - 1361 (2013).

0.1 µmol / ~75 µg € 164.- (C 172 - 001)	5 x 0.1 µmol € 734.- (C 172 - 005)

C 178

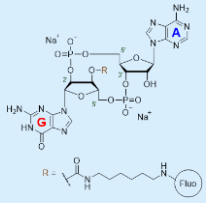


Cyclic (8- (2- [fluoresceinyl]aminoethylthio)- guanosine- (2' → 5')- monophosphate- adenosine- (3' → 5')- monophosphate) (c[8-Fluo-AET-G(2',5')pA(3',5')p] / 8-Fluo-AET-cGAMP(2'-5'))

$C_{43}H_{39}N_{11}O_{19}P_2S$; MW 1107.9 (free acid); λ_{max} 494 nm; ε 79000 (pH 9); sodium salt; purity > 95% HPLC. For other salt forms please inquire. Fluorescent analogue of the metazoan cyclic dinucleotide second messenger and STING activator c[G(2',5')pA(3',5')p] (*aka* cGAMP(2'-5') or 2'3'-cGAMP, Cat. No. C 161) with λ_{exc} 494 nm and λ_{em} 517 nm. c[G(2',5')pA(3',5')p] was found to be the metazoan second messenger produced by the mammalian innate immune DNA sensor cGAMP synthase (cGAS). Detailed technical information available.
References for c[G(2',5')pA(3',5')p]: Gao et al., *Cell*, **153**, 1094 - 1107 (2013); Ablasser et al., *Nature*, **498**, 380- 384 (2013); Zhang et al., *Mol. Cell*, **51**, 226 - 235 (2013); Diner et al., *Cell Rep.*, **3**, 1355 - 1361 (2013). Related products: Biolog also offers a fluorescent version of the potential bacterial second messenger c[G(3',5')pA(3',5')p] (c-(Ap-8-Fluo-AET-Gp), Cat. No. C 159.

0.1 µmol / ~0.1 mg € 219.- (C 178 - 001)	5 x 0.1 µmol € 973.- (C 178 - 005)

C 194

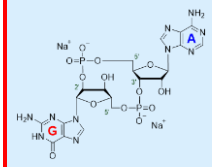


Cyclic (3'- O- (6- [fluoresceinyl]aminohexylcarbamoyl)guanosine- (2' → 5')- monophosphate- adenosine- (3' → 5')- monophosphate) (c[3'-Fluo-AHC-G(2',5')pA(3',5')p])

$C_{48}H_{48}N_{12}O_{20}P_2$; MW 1174.9 (free acid); λ_{max} 494 nm; ε 79000 (pH 9); sodium salt; purity > 95% HPLC. For other salt forms please inquire.
Fluorescent analogue of the metazoan cyclic dinucleotide second messenger and STING activator c[G(2',5')pA(3',5')p] (aka cGAMP(2'-5') or 2'3'-cGAMP, Cat. No. C 161) with λ_{exc} 494 nm and λ_{em} 517 nm. c[G(2',5')pA(3',5')p] was found to be the metazoan second messenger produced by the mammalian innate immune DNA sensor cGAMP synthase (cGAS). Detailed technical information available. References for c[G(2',5')pA(3',5')p]: Gao et al., *Cell*, **153**, 1094 - 1107 (2013); Ablasser et al., *Nature*, **498**, 380 - 384 (2013); Zhang et al., *Mol. Cell*, **51**, 226 - 235 (2013); Diner et al., *Cell Rep.*, **3**, 1355 - 1361 (2013).

0.1 µmol / ~0.1 mg € 219.- (C 194 - 001)	5 x 0.1 µmol € 973.- (C 194 - 005)

C 161 *New !*

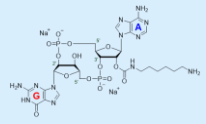


Cyclic (guanosine- (2' → 5')- monophosphate- adenosine- (3' → 5')- monophosphate) (c[G(2',5')pA(3',5')p] / cGAMP(2'-5') / 2'3'-cGAMP / 2',5'-3',5'-cGAMP)

[1441190-66-4]; $C_{20}H_{24}N_{10}O_{13}P_2$; MW 674.4 (free acid); λ_{max} 256 nm; ε 25050; sodium salt; purity > 98% HPLC.
For other salt forms please inquire. c[G(2',5')pA(3',5')p] was found to be the metazoan second messenger produced by the mammalian innate immune DNA sensor cGAMP synthase (cGAS). It has also been reported to exert potent activation of the immune signalling protein STING.
Detailed technical information available.
References: Gao et al., *Cell*, **153**, 1094 - 1107 (2013); Ablasser et al., *Nature*, **498**, 380- 384 (2013); Zhang et al., *Mol. Cell*, **51**, 226 - 235 (2013); Diner et al., *Cell Rep.*, **3**, 1355 - 1361 (2013). Related product: Biolog also offers the potential bacterial second messenger c[G(3',5')pA(3',5')p] (c-(ApGp), Cat. No. C 117.

0.5 µmol / ~0.3 mg € 150.- (C 161 - 005)	5 x 0.5 µmol € 675.- (C 161 - 025)

C 192

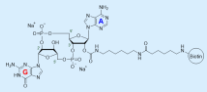


Cyclic (guanosine- (2' → 5')- monophosphate- 2'- O- (6- aminohexylcarbamoyl)adenosine- (3' → 5')- monophosphate) (c[G(2',5')p-2'-AHC-A(3',5')p])

$C_{27}H_{38}N_{12}O_{14}P_2$; MW 816.6 (free acid); λ_{max} 258 nm; ε 25050; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Analogue of the metazoan cyclic dinucleotide second messenger and STING activator c[G(2',5')pA(3',5')p] (aka cGAMP(2'-5') or 2'3'-cGAMP, Cat. No. C 161, above) which is suitable as a ligand in affinity chromatography or for coupling of various labelling structures including fluorophores. The spacer is connected to the ribose 2'-hydroxy group of the adenosine part. Detailed technical information available.

0.1 µmol / ~75 µg € 164.- (C 192 - 001)	5 x 0.1 µmol € 734.- (C 192 - 005)

C 197

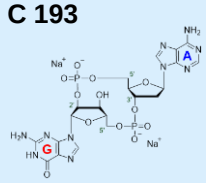


Cyclic (guanosine- (2' → 5')- monophosphate- 2'- O- (6- [biotinyl]aminohexylcarbamoyl)- adenosine- (3' → 5')- monophosphate) (c[G(2',5')p-2'-[Biotin]-AHC-A(3',5')p])

$C_{43}H_{63}N_{15}O_{17}P_2S$; MW 1156.1 (free acid); λ_{max} 258 nm; ε 25050; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Biotinylated analogue of the metazoan cyclic dinucleotide second messenger and STING activator c[G(2',5')pA(3',5')p] (aka cGAMP(2'-5') or 2'3'-cGAMP, Cat. No. C 161) in which the biotin label is attached to the 2'-hydroxy group of the adenosine via a 16-atom spacer. Potential tracer in immunoassays, for affinity chromatography or pull-down assays. c[G(2',5')pA(3',5')p] was found to be the metazoan second messenger produced by the mammalian innate immune DNA sensor cGAMP synthase (cGAS).
Detailed technical information available. References for c[G(2',5')pA(3',5')p]: Gao et al., *Cell*, **153**, 1094 - 1107 (2013); Ablasser et al., *Nature*, **498**, 380 - 384 (2013); Zhang et al., *Mol. Cell*, **51**, 226 - 235 (2013); Diner et al., *Cell Rep.*, **3**, 1355 - 1361 (2013).

0.1 µmol / ~0.1 mg € 190.- (C 197 - 001)	5 x 0.1 µmol € 857.- (C 197 - 005)

C 193

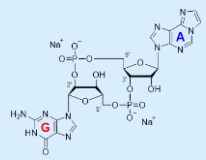


Cyclic (guanosine- (2' → 5')- monophosphate- 2'- deoxyadenosine- (3' → 5')- monophosphate) (c[G(2',5')p-2'-dA(3',5')p])

$C_{20}H_{24}N_{10}O_{12}P_2$; MW 658.4 (free acid); λ_{max} 256 nm; ε 25050; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. c[G(2',5')p-2'-dA(3',5')p] is a 2'-deoxy analogue of the metazoan cyclic dinucleotide second messenger and STING activator c[G(2',5')pA(3',5')p] (aka cGAMP(2'-5') or 2'3'-cGAMP, Cat. No. C 161, above) which can be useful in studies on ligand-receptor interactions. Detailed technical information available.

0.1 µmol / ~66 µg € 171.- (C 193 - 001)	5 x 0.1 µmol € 769.- (C 193 - 005)

C 225 *New !*

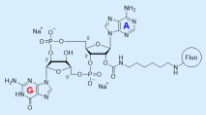


Cyclic (guanosine- (2' → 5')- monophosphate- 1, N⁶- ethenoadenosine- (3' → 5')- monophosphate (c[G(2',5')p-ε-A(3',5')p] / ε-cGAMP(2'-5') / ε-2'3'-cGAMP)

$C_{22}H_{24}N_{10}O_{13}P_2$; MW 698.4 (free acid); λ_{max} 257 nm; ε 16000; sodium salt; purity > 95% HPLC.
For other salt forms please inquire.
Fluorescent analogue of c[G(2',5')pA(3',5')p] (2'3'-cGAMP, Cat. No. C 161, above); λ_{exc} 300 nm, λ_{em} 408 nm. Detailed technical information available.

0.1 µmol / ~70 µg € 164.- (C 225 - 001)	5 x 0.1 µmol € 734.- (C 225 - 005)

C 195

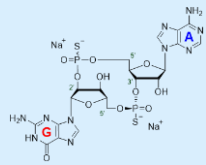


Cyclic (guanosine- (2' → 5')- monophosphate- 2'- O- (6- [fluoresceinyl]aminohexyl- carbamoyl)adenosine- (3' → 5')- monophosphate) (c[G(2',5')p-2'-Fluo-AHC-A(3',5')p])

$C_{48}H_{48}N_{12}O_{20}P_2$; MW 1174.9 (free acid); λ_{max} ~494 nm; ε 79000 (pH 9); sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Fluorescent analogue of the metazoan cyclic dinucleotide second messenger and STING activator c[G(2',5')pA(3',5')p] (aka cGAMP(2'-5') or 2'3'-cGAMP, Cat. No. C 161) with λ_{exc} 494 nm and λ_{em} 517 nm. c[G(2',5')pA(3',5')p] was found to be the metazoan second messenger produced by the mammalian innate immune DNA sensor cGAMP synthase (cGAS). Detailed technical information available. References for c[G(2',5')pA(3',5')p]: Gao et al., *Cell*, **153**, 1094 - 1107 (2013); Ablasser et al., *Nature*, **498**, 380 - 384 (2013); Zhang et al., *Mol. Cell*, **51**, 226 - 235 (2013); Diner et al., *Cell Rep*., **3**, 1355 - 1361 (2013).

0.1 µmol / ~0.1 mg € 219.- (C 195 - 001)	5 x 0.1 µmol € 973.- (C 195 - 005)

Set 101 *New !*

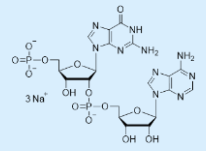


Cyclic (guanosine- (2' → 5')- monophosphorothioate- adenosine- (3' → 5')- monophosphorothioate) (c[G(2',5')pS-A(3',5')pS] / 2'3'-cGAMPSS / 2'3'-cGsAsMP); set of 2 isomers

[1638242-56-4]/[1638243-00-1]; $C_{20}H_{24}N_{10}O_{11}P_2S_2$; MW 706.6 (free acid); λ_{max} 256 nm; ε 25400 (pH 9); sodium salt; purity > 95% HPLC. For other salt forms please inquire.
This set contains 0.1 µmol each of c[G(2',5')pS-A(3',5')pS], isomer 1 and c[G(2',5')pS-A(3',5')pS], isomer 2 which are isomeric di-thiophosphate analogues of the metazoan cyclic dinucleotide second messenger c[G(2',5')pA(3',5')p] (aka 2'3'-cGAMP, Cat. No. C 161). c[G(2',5')pS-A(3',5')pS] is resistant towards the 2'3'-cGAMP hydrolysing enzyme ENPP1 and shows higher potency than natural 2'3'-cGAMP in inducing IFN-β secretion from human THP1 monocytes. Detailed technical information available. Reference: Li et al., *Nat. Chem. Biol*., **10**, 1043 - 1048 (2014).

2 x 0.1 µmol / ~71 µg € 190.- (Set 101)	

P 081 *New !*



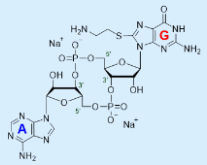
5'- Phosphoguanylyl- (2' –> 5')- adenosine (pG(2',5')pA / 5'-p(rG)(2',5')p(rA))

[55779-55-0]; $C_{20}H_{26}N_{10}O_{14}P_2$; MW 692.4 (free acid); λ_{max} 256 nm; ε 25050; sodium salt; purity > 95% HPLC. For other salt forms please inquire. pG(2',5')pA is a linear dinucleotide and potential degradation product of the metazoan cyclic dinucleotide second messenger 2'3'-cGAMP (c[G(2',5')pA(3',5')p], our Cat. No. C 161). Detailed technical information available. Reference: Gao et al., *Cell*, **153**, 1094 - 1107 (2013).

1 µmol / ~0.7 mg € 77.- (P 081 - 01)	5 x 1 µmol € 343.- (P 081 - 05)

3’3’-cGAMP (c-ApGp) Analogues

C 149

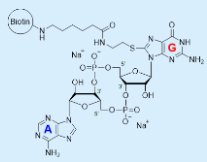


Cyclic (adenosine monophosphate- 8- (2- aminoethylthio)guanosine monophosphate) (c-(Ap-8-AET-Gp) / 8-AET-cGAMP)

$C_{22}H_{29}N_{11}O_{13}P_2S$; MW 749.6 (free acid); λ_{max} 265 nm; ε 23500; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Analogue of the bacterial second messenger c-(ApGp) (*aka* cGAMP, Cat. No. C 117) which is suitable as a ligand in affinity chromatography or for coupling of various labelling structures including fluorophores. c-(ApGp) is considered to play a role in *Vibrio cholerae* pathogenesis and was also reported to stimulate the production of interferon via STING. Detailed technical information available. References for c-(ApGp): Davies et al., *Cell*, **149**, 358 - 370 (2012); Wu et al., *Science*, **339**, 826 - 830 (2013).

0.1 µmol / ~75 µg € 164.- (C 149 - 001)	5 x 0.1 µmol € 734.- (C 149 - 005)

C 157

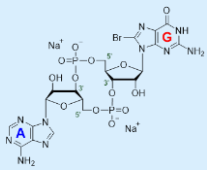


Cyclic (adenosine monophosphate- 8- (2- [biotinyl]aminoethylthio)guanosine mono-phosphate) (c-(Ap-8-[Biotin]-AET-Gp) / 8-[Biotin]-AET-cGAMP)

$C_{38}H_{54}N_{14}O_{16}P_2S_2$; MW 1089.0 (free acid); λ_{max} 266 nm; ε 23500; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Biotinylated analogue of the bacterial second messenger c-(ApGp) (*aka* cGAMP, Cat. No. C 117) in which the biotin label is attached to position 8 of the guanine nucleobase via an 11 atom spacer. Potential tracer in immunoassays, for affinity chromatography or pull-down assays. c-(ApGp) is considered to play a role in *Vibrio cholerae* pathogenesis and was also reported to stimulate the production of interferon via STING. Detailed technical information available. References for c-(ApGp): Davies et al., *Cell*, **149**, 358 - 370 (2012); Wu et al., *Science*, **339**, 826 - 830 (2013).

0.1 µmol / ~0.1 mg € 190.- (C 157 - 001)	5 x 0.1 µmol € 857.- (C 157 - 005)

C 145

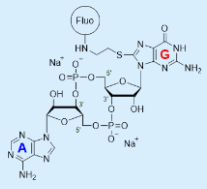


Cyclic (adenosine monophosphate- 8- bromoguanosine monophosphate) (c-(Ap-8-Br-Gp))

$C_{20}H_{23}BrN_{10}O_{13}P_2$; MW 753.3 (free acid); λ_{max} 262 nm; ε 27800; sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Halogenated analogue of the bacterial second messenger c-(ApGp) (*aka* cGAMP, Cat. No. C 117), which is useful for binding studies and as precursor for further modifications with spacers or labels. c-(ApGp) is considered to play a role in *Vibrio cholerae* pathogenesis and was also reported to stimulate the production of interferon via STING. Detailed technical information available. References for c-(ApGp): Davies et al., *Cell*, **149**, 358 - 370 (2012); Wu et al., *Science*, **339**, 826 - 830 (2013).

0.1 µmol / ~75 µg € 164.- (C 145 - 001)	5 x 0.1 µmol € 734.- (C 145 - 005)

C 159

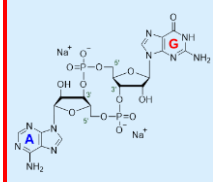


Cyclic (adenosine monophosphate- 8- (2- [fluoresceinyl]aminoethylthio)guanosine monophosphate) (c-(Ap-8-Fluo-AET-Gp) / 8-Fluo-AET-cGAMP)

$C_{43}H_{39}N_{11}O_{19}P_2S$; MW 1107.9 (free acid); λ_{max} 494 nm; ε 79000 (pH 9); sodium salt; purity > 95% HPLC.
For other salt forms please inquire. Fluorescent analogue of the bacterial second messenger c-(ApGp) (*aka* cGAMP, Cat. No. C 117) with λ_{exc} 494 nm and λ_{em} 517 nm. c-(ApGp) is considered to play a role in *Vibrio cholerae* pathogenesis and was also reported to stimulate the production of interferon via STING. Detailed technical information available. References for c-(ApGp): Davies et al., *Cell*, **149**, 358 - 370 (2012); Wu et al., *Science*, **339**, 826 - 830 (2013).

0.1 µmol / ~0.1 mg € 190.- (C 159 - 001)	5 x 0.1 µmol € 857.- (C 159 - 005)

C 117

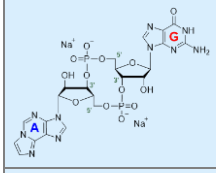


Cyclic (adenosine monophosphate- guanosine monophosphate) (c-(ApGp) / cGAMP)

[849214-04-6]; $C_{20}H_{24}N_{10}O_{13}P_2$; MW 674.4 (free acid); λ_{max} 256 nm; ε 25050; sodium salt; purity > 98% HPLC (typically > 99%). For other salt forms please inquire. Analogue of the bacterial second messengers c-diAMP (Cat. No. C 088) and c-diGMP (Cat. No. C 057). cGAMP is considered to play a role in *Vibrio cholerae* pathogenesis and was also reported to stimulate the production of interferon via STING. Detailed technical information available. References: Davies et al., *Cell*, **149**, 358 - 370 (2012); Wu et al., *Science*, **339**, 826 - 830 (2013); Hallberg et al., *Proc. Natl. Acad. Sci. USA*, **113**, 1790 – 1795 (2016).

0.5 µmol / ~0.3 mg € 110.- (C 117 - 005)	5 x 0.5 µmol € 495.- (C 117 - 025)

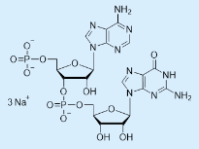
C 226 *New !*



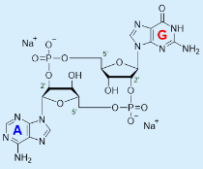
Cyclic (1, N⁶- ethenoadenosine monophosphate- guanosine monophosphate) (c-(ε-ApGp) / ε-3'3'-cGAMP / c[ε-A(3',5')pG(3',5')p] / c[G(3',5')p-ε-A(3',5')p])

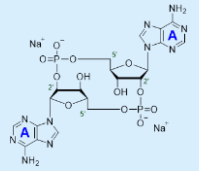
$C_{22}H_{24}N_{10}O_{13}P_2$; MW 698.4 (free acid); λ_{max} 257 nm; ε 16000; sodium salt; purity > 95% HPLC. For other salt forms please inquire.
Fluorescent analogue of c-(ApGp) (3'3'-cGAMP, Cat. No. C 117); λ_{ex} 300 nm, λ_{em} 408 nm. Detailed technical information available.

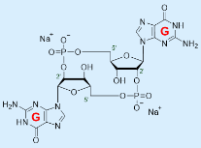
0.1 µmol / ~70 µg € 164.- (C 226 - 001)	5 x 0.1 µmol € 734.- (C 226 - 005)

P 082 *New !*	**5'- Phosphoadenylyl- (3' → 5')- guanosine (pApG / 5'-p(rA)p(rG))**
	[5064-50-6]; $C_{20}H_{26}N_{10}O_{14}P_2$; MW 692.4 (free acid); λ_{max} 256 nm; ε 25050; sodium salt; purity > 95% HLC. For other salt forms please inquire. pApG is a linear dinucleotide which was found to be a degradation product of the bacterial second messenger 3'3'-cGAMP (c-(ApGp), Cat. No. C 117), generated by specific PDEs in Vibrio cholerae (Gao et al. 2015). pApG does not bind to the c-diGMP-I riboswitch (Smith et al. 2012). Detailed technical information available. References: Gao et al., *Cell Res*., **25**, 539 - 550 (2015); Smith et al., *Biochemistry*, **51**, 425 - 432 (2012).
1 µmol / ~0.7 mg € 77.- (P 082 - 01)	5 x 1 µmol € 343.- (P 082 - 05)

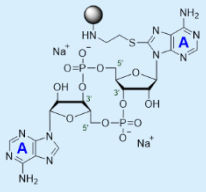
2’2’-cdiNMP Analogues

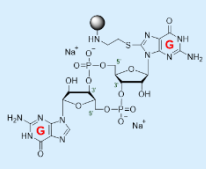
C 210 *New !*	**Cyclic (adenosine- (2' → 5')- monophosphate- guanosine- (2' → 5')- monophosphate) (c[A(2',5')pG(2',5')p] / 2'2'-cGAMP / 2',5'-2',5'-cGAMP)**
	[1465774-27-9]; $C_{20}H_{24}N_{10}O_{13}P_2$; MW 674.4 (free acid); λ_{max} 256 nm; ε 25050; sodium salt; purity > 95% HPLC. For other salt forms please inquire. c[A(2',5')pG(2',5')p] is a cyclic dinucleotide structurally related to the metazoan second messenger and STING activator c[G(2',5')pA(3',5')p] (2'3'-cGAMP, Cat. No. C 161). Similar to natural c[G(2',5')pA(3',5')p], c[A(2',5')pG(2',5')p] binds the signalling protein STING and subsequently induces type I interferons. Detailed technical information available. References: Gao et al., *Cell*, **154**, 748 - 762 (2013); Zhang et al., *Mol. Cell*, **51**, 226 - 235 (2013); Zhang et al., *Sci. Rep*., **5**, #18035 (2015) doi:10.1038/srep18035
0.5 µmol / ~337 µg € 155.- (C 210 - 005)	5 x 0.5 µmol € 699.- (C 210 - 025)

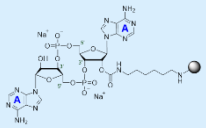
C 188 *New !*	**Cyclic diadenosine- (2' → 5')- monophosphate / cyclic bis (2' → 5') diadenylic acid (c[A(2',5')pA(2',5')p] / 2'2'-c-diAMP / 2',5'-2',5'-c-diAMP / c-diAMP(2'-5'))**
	$C_{20}H_{24}N_{10}O_{12}P_2$; MW 658.4 (free acid); λ_{max} 259 nm; ε 27000; sodium salt; purity > 95% HPLC. For other salt forms please inquire. Cyclic dinucleotide structurally related to the bacterial second messenger c-diAMP (Cat. No. C 088). In contrast to 3',5'-linked c-diAMP, c[A(2',5')pA(2',5')p] contains two 2',5' phosphodiester linkages. Detailed technical information available.
0.5 µmol / ~329 µg € 155.- (C 188 - 005)	5 x 0.5 µmol € 699.- (C 188 - 025)

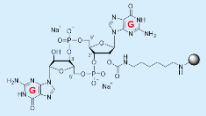
C 162	**Cyclic diguanosine- (2' → 5')- monophosphate / cyclic bis (2' → 5') diguanylic acid (c[G(2',5')pG(2',5')p] / 2',5'-2',5'-c-diGMP / c-diGMP(2'-5'))**
	[389873-75-0]; $C_{20}H_{24}N_{10}O_{14}P_2$; MW 690.4 (free acid); λ_{max} 253 nm; ε 23700; sodium salt; purity > 95% HPLC. For other salt forms please inquire. Cyclic dinucleotide structurally related to the bacterial second messenger c-diGMP (Cat. No. C 057). In contrast to 3',5'-linked c-diGMP, c[G(2',5')pG(2',5')p] contains two non-canonical 2',5' phosphodiester linkages. Detailed technical information available.
0.5 µmol / ~345 µg € 155.- (C 162 - 005)	5 x 0.5 µmol € 699.- (C 162 - 025)

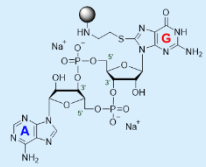
Gels for Affinity Chromatography

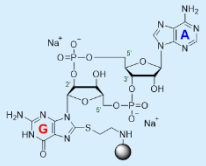
A 234	**8- (2- Aminoethylthio)- cyclic diadenosine monophosphate, immobilized on agarose gel (8-AET-c-diAMP-Agarose)**
	The bacterial second messenger c-diAMP (Cat. No. C 088) immobilized on agarose by an aminoethylthio spacer attached to position 8 of one of the two adenine nucleobases of the ligand. The gel may be useful for affinity chromatography of various c-diAMP-responsive proteins. Free 8-AET-c-diAMP is offered as well (Cat. No. A 220). Detailed technical information available. *Normally all affinity gels are supplied in pre-packed columns. The free beads without a column are available upon request. Corresponding negative control gel without nucleotide modification: Cat. No. E 010.*
Columns:	0.6 ml € 311.- (A 234 - 06) | 2.5 ml € 938.- (A 234 - 25) | 6 ml € 1,890.- (A 234 - 60)

A 235	**8- (2- Aminoethylthio)- cyclic diguanosine monophosphate, immobilized on agarose gel (8-AET-c-diGMP-Agarose)**
	The bacterial second messenger c-diGMP (Cat. No. C 057) immobilized on agarose by an aminoethylthio spacer attached to position 8 of one of the two guanine nucleobases of the ligand. The gel may be useful for affinity chromatography of various c-diGMP-responsive proteins. Free 8-AET-c-diGMP is offered as well (Cat. No. A 232). Detailed technical information available. *Normally all affinity gels are supplied in pre-packed columns. The free beads without a column are available upon request. Corresponding negative control gel without nucleotide modification: Cat. No. E 010.*
Columns:	0.6 ml € 311.- (A 235 - 06) | 2.5 ml € 938.- (A 235 - 25) | 6 ml € 1,890.- (A 235 - 60)

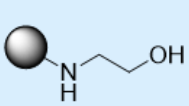
A 183 	**2'- O- (6- Aminohexylcarbamoyl)- cyclic diadenosine monophosphate, immobilized on agarose (2'-AHC-c-diAMP-Agarose)** The second messenger c-diAMP (Cat. No. C 088) immobilized on agarose by an aminohexylcarbamoyl spacer attached to position 2' of the ligand. The gel can be used for affinity chromatography of various c-diAMP-responsive proteins and is also available without column as free beads. Detailed technical information available. Reference: Bai et al., *J. Bacteriol.*, **196**, 614 - 623 (2014). *Normally all affinity gels are supplied in pre-packed columns. The free beads without a column are available upon request. Corresponding negative control gel without nucleotide modification: Cat. No. E 010.*		
Columns:	0.6 ml € 311.- (A 183 - 06)	2.5 ml € 938.- (A 183 - 25)	6 ml € 1,890.- (A 183 - 60)

A 153 	**2'- O- (6- Aminohexylcarbamoyl)- cyclic diguanosine monophosphate, immobilized on agarose (2'-AHC-c-diGMP-Agarose)** The bacterial second messenger c-diGMP (Cat. No. C 057) immobilized on agarose by an aminohexylcarbamoyl spacer attached to position 2' of the ligand. The gel can be used for affinity chromatography of various c-diGMP-responsive proteins. Detailed technical information available. Reference: Düvel et al., *J. Microbiol. Methods*, **88**, 229 - 236 (2012). *Normally all affinity gels are supplied in pre-packed columns. The free beads without a column are available upon request. Corresponding negative control gel without nucleotide modification: Cat. No. E 010.*		
Columns	0.6 ml € 311.- (A 153 - 06)	2.5 ml € 938.- (A 153 - 25)	6 ml € 1,890.- (A 153 - 60)

C 166 	**Cyclic (adenosine monophosphate- 8- (2- aminoethylthio)guanosine monophosphate), immobilized on agarose gel (c-(Ap-8-AET-Gp)-Agarose)** The bacterial second messenger c-(ApGp) (*aka* cGAMP or c[G(3',5')pA(3',5')p], Cat. No. C 117) immobilized on agarose by an aminoethylthio spacer attached to position 8 of the guanine nucleobase of the ligand. The gel may be useful for affinity chromatography of c-(ApGp)-responsive proteins. Free c-(Ap-8-AET-Gp) is offered as well (Cat. No. C 149). Detailed technical information available. *Normally all affinity gels are supplied in pre-packed columns. The free beads without a column are available upon request. Corresponding negative control gel without nucleotide modification: Cat. No. E 010.*		
Columns:	0.6 ml € 311.- (C 166 - 06)	2.5 ml € 971.- (C 166 - 25)	6 ml € 1,890.- (C 166 - 60)

C 184 	**Cyclic (8- (2- aminoethylthio)guanosine- (2' → 5')- monophosphate- adenosine- (3' → 5')- monophosphate), immobilized on agarose gel (c[8-AET-G(2',5')pA(3',5')p]-Agarose)** The metazoan cyclic dinucleotide second messenger c[G(2',5')pA(3',5')p] (aka 2'3'-cGAMP or cGAMP(2',5'), Cat. No. C 161) immobilized on agarose by an aminoethylthio spacer attached to position 8 of the guanine nucleobase of the ligand. The gel may be useful for affinity chromatography of c[G(2',5')pA(3',5')p]-responsive proteins. Free c[8-AET-G(2',5')pA(3',5')p] is offered as well (Cat. No. C 175). Detailed technical information available. *Normally all affinity gels are supplied in pre-packed columns. The free beads without a column are available upon request. Corresponding negative control gel without nucleotide modification: Cat. No. E 010.*		
Columns:	0.6 ml € 300.- (C 184 - 06)	2.5 ml € 971.- (C 184 - 25)	6 ml € 1,890.- (C 184 - 60)

Control for Affinity Chromatography Gels

E 010 	**Ethanolamine; immobilized on agarose gel (EtOH-NH-Agarose)** Agarose gel without nucleotide ligands as negative control in affinity chromatography experiments. This agarose matrix is identical to the material used for the synthesis of the affinity gels listed above. The reactive groups on the bead surface normally used to immobilize the functionalized nucleotide, have been deactivated with ethanolamine. References: Antl et al., *Blood*, **109**, 552 - 559 (2007); Hammerschmidt et al., *PLoS One* **7**(7): e39848 (2012).		
Columns:	0.6 ml € 82.- (E 010 - 06)	2.5 ml € 255.- (E 010 - 25)	6 ml € 513.- (E 010 - 60)

Inquire	**Custom Syntheses and Bulk Supply** BIOLOG offers custom syntheses for cyclic dinucleotides and corresponding affinity gels not listed in this catalogue. Our website (www.biolog.de) offers an updated list of products. Please inquire concerning prices and delivery schedules. If you need one of our products or a different structure in bulk, please request a corresponding offer.

Alphabetical listing of products and abbreviations

We appreciate your interest in our product line. Please take a moment to review the following notes:

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- **Shipping** of your order will be prepared as soon as possible. Unless otherwise instructed, items requiring refrigeration may not be shipped on Thursday or Friday to avoid weekend storage under unsuitable conditions.

- **Prices** are shown in Euro and do not include taxes or foreign duties (if applicable). We reserve the right to change prices without prior written notice, however, products will not be shipped at an increased price without authorization from the customer.

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- **Invoices** are payable net 30 days by bank transfer; no deductions accepted. European customers are urged to use the SEPA payment system. Corresponding bank details (BIC and IBAN) are shown on all our paper work. Prepayment may apply at our sole discretion.

- **Bulk:** Many of our products can be supplied in larger sizes. Favourable quotations for bulk quantities or discounts on purchase of multiple vials are available upon request.

- **Discounts** can be granted for amounts exceeding catalogue sizes, and for customers identified as permanent buyers. Standing orders with favourable conditions are possible upon request.

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- **Feed-back** on performance of our products is very much appreciated, be it positive or negative. It encourages us, helps us to improve, and leads to better and more qualified service for our customers. Also, we would like to hear about your new papers with our products, in order to have the citation included in the corresponding technical information.

- **Custom syntheses** of many structures not listed in this catalogue are offered. Please contact us with your research needs, and be sure to specify purity, salt form and amounts necessary.

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- **Safety:** All products in this catalogue are sold for research purposes only and are **not** intended for human, drug, food additive, clinical, or household use. Only qualified professionals and trained laboratory staff familiar with their potential hazards and trained in good laboratory practices should handle them. Some of the products could be toxic or hazardous compounds. When available, information pertaining to the potential hazards is provided. However, the absence of a warning must **not** be interpreted as an indicator of safety. Material Safety Data Sheets (MSDS) are available upon request.

Terms and Conditions of Sale and Synthesis

Last updated: May 20, 2017

I. Conclusion of Contract

1. The following conditions apply and become an integral part of all purchase or other orders for synthesis of products confirmed by us, Biolog Life Science Institute, and apply to all our quotations. They are deemed accepted and acknowledged by our clients in placing an order with us or in taking possession of the delivery. Divergent conditions of our clients whose application is not explicitly confirmed in writing by us are not binding even if there was no expressed contradiction.
2. All our quotations are subject to change. The conclusion of the contract can be regarded final only after the client has received our order confirmation. Oral agreements, amendments or additions to the contract are binding only if confirmed by us in writing.
3. We retain ownership, copyright and inventor's rights in all quotations, cost estimates, compound lists, structures and other documents. Quotations and connected documentation must not be disclosed to third parties unless our prior authorization has been obtained.
4. The client accepts that personal data are recorded by us within the scope of the provisions of the BDSG (German Federal Data Protection Law).

II. Prices and Payment

1. Prices shown on the web and in the printed catalogue are in Euro. For price information and our acceptance of other currencies such as US Dollar, please inquire.
2. Prices shall be understood without value added tax. Shipping costs are extra charged (approx. Euro 30.00 within Germany; approx. Euro 40.00 - 100.00 within Europe, and for the rest of the world according to destination). Please note, that some products, e.g. all triphosphates, require courier transport with blue or dry ice in order to maintain their original high quality and purity. This will lead to extra costs, please inquire for details. Airmail postal service may be available for some destinations without any additional costs.
3. We are entitled to charge our clients additionally to the contract price all increases in expenses accrued in connection with the supply or service provided such increases become effective after conclusion of the contract. This right is independent from the cause of increase as there are legal regulations or other regulations or factual reasons. Expenses which we debit to our clients are especially export and import charges as custom duties, price-adjustment levies and taxes, storage charges, insurance premiums and similar costs which are out of the scope of our direct influence.
4. Along with the products ordered you will receive our invoice which is due net 30 days. Payment becomes overdue on the 31st day after invoice date. Invoices should be paid by bank transfer free of expenses for us. Bank details are given on the invoice.
5. Without prejudice to any more extensive rights we are entitled in case of default of payment to demand interest on arrears of 8 % above the current discount rate published by the Deutsche Bundesbank.
6. A set-off or other retention of payment in view of counter claims of the client is admissible only if the counter-claims have been acknowledged by us or the claims have been finally determined by court order.
7. We are entitled to demand, in our choice, the provision of security through letter of credit or other securities such as prepayment. Should the client not comply with this demand within ten days, we have the rights, after expiry of an additional term of 5 days to repudiate the contract.

III. Terms of Delivery

1. We are not obliged to comply with the agreed delivery term until the client has fulfilled his contractual obligations or duties imposed on him in particular the stipulated financial commitments. The term of delivery shall be complied with if the products to be delivered have left our premises or readiness for despatch has been announced.
2. The term of delivery shall be adequately extended if the completion or delivery of the products is delayed by strikes, lockouts or other obstacles beyond our control (force majeure). We shall notify the client about such circumstances without undue delay.
3. Delivery of products which are not produced by us is subject to obtaining punctual and complete supply ourselves.
4. Goods may not be returned to us except with our prior permission. Goods can only be accepted for return if they are unopened and in good condition. Transport costs for returned goods are for the purchaser's account. Any returned items may be subject to a processing fee.

IV. Transition of Risk

1. We despatch products on account and risk of our clients. The risk shall pass to the client, even with freight prepaid shipments, at the time the products are handed over to the carrier or with commencement of transit by ourselves or by acceptance by the persons instructed by the client. We undertake to assign existing rights and remedies against the carrier on first simple demand and unconditional payment of the contract price by the client.
2. By unconditional acceptance of the products by the carrier or by the person instructed by the client all subsequent claims regarding the external condition (packing, leakage etc.) are precluded.
3. Even if the delivered products show considerable faults, they have to be accepted by the client, however, without prejudice for subsequent guaranty claims concerning the product. The client must, however, examine the delivery in every respect for any lack of conformity with the contract and shall give notice of any lack of conformity with the contract or will be excluded with all subsequent claims.
4. In the event the client defaults in the acceptance of the products or providing security, we are entitled, without prejudice to our rights for repudiation of the contract, to demand a lump sum indemnity of 5 % of the total delivery value. We as well as the client are not precluded from claiming and proving a higher or lower damage.

V. Retention of Title

1. We retain the right of property in the products delivered until all our present or accessory claims against the client, irrespective of their cause, are settled. In acceptance of drafts or of bills of exchange or in assuming the liability under a bill of exchange by acceptance or issue of a bill of exchange the title in the products does not pass to the client before the draft or bill of exchange has been finally honoured and it has been ascertained that no claims can be lodged against us based upon the documentary credits. Inserting claims in a current account as well as acknowledgment of a balance does not affect the retention of title.
2. The client is authorized to use the products supplied for research purposes only if not otherwise confirmed in writing. He is also entitled to mix or synthesize with the products at his own risk. The title in our products is extended to new products synthesized by our client. In case our title in the products is extinguished by combination, mixture up or incorporation of other products the client herewith transfers title in the new synthesized products to us which is held as security for all claims as per para. 1 above. The products we obtained title in are stored free of charge by the client without giving any cause of action against us in view of the mixing up, the synthesis or the storage of the products.
3. In any case, the client agrees that any and all intellectual property or other rights, know-how, and methods relating to the synthesis or purchase contract remain our sole property.

VI. Guaranty and Liability

1. We do not assume liability for oral advices of any kind - which are non-binding in any event - to the client. Any advice, oral or written, regarding the area of application of our products does not dispense the client from a self-responsible examination regarding the qualification of the products for the intended purposes or methods as well as of any infringement with issued or pending intellectual property rights belonging to third parties.
2. Our products are for laboratory research use only if not otherwise confirmed in writing. They must not be used with human subjects or for clinical diagnosis or therapeutic use in humans or animals, including, but not limited to, commercial purposes, *in vitro* diagnostic purposes, ex vivo or in vivo therapeutic purposes, investigational use, in foods, drugs, devices or cosmetics of any kind, or for consumption by or use in connection with or administration or application to humans or animals.
3. Our products are not sterile and are not regularly checked for endotoxins. Products carrying a charge are essentially desalted by common standard techniques for nucleotides. Please be aware, that efficacy of all known desalting methods is limited and dependent on properties of the particular product. Final preparations of products may therefore contain a minor residual salt content.
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5. If any research product fails to meet the physical criteria ascribed to it on the catalogue, our web site or by any other analysis or description issued by us in writing, we will, after validating the deficiency, at the option of the client, either replace the deficient product in kind or will issue a Euro credit equivalent to the purchase price of the deficient product.
6. We will not be liable under any legal theory (including but not limited to contract, negligence, strict liability in tort or warranty of any kind) for any indirect, special, incidental, consequential or exemplary damages (including but not limited to lost profits), even if we had notice of the possibility of such damages. We shall not be liable for any loss, damage or penalty as a result of any delay in or failure to deliver or otherwise perform hereunder. In any event the extent of our liability is restricted to the damage to the product itself.
7. If the fault or omission of the ascribed quality is caused by the delivery or performance of a sub-supplier our liability is restricted to an assignment of our rights and remedies we have against the sub-supplier. We undertake to assign these rights and remedies on first simple demand. If the client is not able to recover from the sub-supplier, he is entitled to keep us liable according para. VI. 4. in a subsidiary way.
8. Refund, replacement or any other claims is conditioned on client giving written notice to us within thirty (30) days after arrival of the products at its destination. Failure of client to give said notice within said thirty (30) days shall constitute a waiver by the client of all claims hereunder with respect to said material. Our liability under VI. 9. below remains unaffected.
9. In any event, any claim of the client against us for, but not limited to refund, replacement, remuneration for consequential damages or otherwise is excluded under the statute of limitations after one year after arrival of the products at its destination. Our liability under VI. 9. below remains unaffected.
10. Our liability for intention or gross negligence, for an expressed warranty, for the violation of an obligation which was of absolute material importance for the intended purpose of the contract, under the statute for the liability for defect products, and for personal injury or death remains unaffected. In cases of gross negligence and in cases of our failure to fulfil an obligation which was of absolute material importance for the intended purpose of the contract we are liable only for the immediate and foreseeable damage.
11. As our products are delivered to the clients for research purposes only, the client shall indemnify us, without prejudice to our continuing legal rights and waiving any defence of limitation, without limit against any and all claims of third parties which are brought against us on the grounds of product liability, to the extent the claim is based on circumstances which were caused after risk passed to the client.

VII. Legal Clauses

1. The sole and exclusive place of performance for all contractual or other obligations under the contract as well as the sole and exclusive place of jurisdiction shall be Bremen for both parties.
2. Any dispute between the parties shall be governed by German law.
3. In case one of the above stipulations has been proved invalid the validity of the remaining provisions remain unaffected.

BIOLOG - *LIFE SCIENCE INSTITUTE* -

BIOLOG Life Science Institute
Forschungslabor und Biochemica-Vertrieb GmbH
Flughafendamm 9a
28199 Bremen / Germany

Phone: +49 (0) 421 59 13 55
Fax: +49 (0) 421 597 97 13
E-Mail: service@biolog.de

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