



Optimum Vitamin Nutrition

The full potential of vitamin nutrition



There is no life without vitamins!

The name “Vitamin” or “Vitamine” is derived from the Latin word “vita” meaning “life” combined with the chemical term “amine”. Unfortunately, the discoverer of vitamins and creator of the term, Polish American Biochemist Casimir Funk, hypothesized all vitamins were amines. He was incorrect, however, they are Vital for Life.

What is OVN®?

The Optimum Vitamin Nutrition (OVN®) program provides the confidence that pets receive the full value of vitamin fortification from a safe and reliable source. The program is based on the knowledge that:

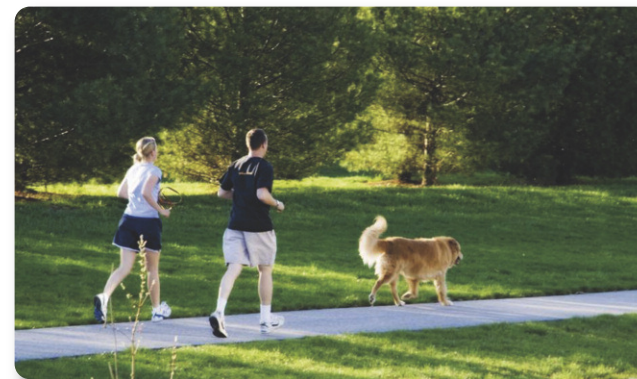
- Vitamins are involved in most metabolic functions, so an improper inclusion in pet food can result in compromised health.
- The OVN® supplementation guidelines help pet nutrition product formulators keep current with advancements in vitamin nutrition.
- The OVN® program only uses vitamins from the leading manufacturer, DSM Nutritional Products, the provider of the highest quality and the most technologically advanced vitamin forms that are in compliance with key global regulations and provide full traceability for maximum safety.
- The OVN® program only uses vitamin premixes from the experts, DSM Nutritional Products. The science behind premix manufacturing plays an important role in ensuring proper nutrient levels in pet food.
- Difficult-to-read and overcrowded pet food labels make it difficult to understand if the pet will receive the optimum level of vitamins. The OVN® logo is the assurance – they will.

Vitamins are as essential for companion animals as they are for humans. Traditionally, the animal feed industry set vitamin fortification levels for complete feeds at a minimum amount required to prevent overt clinical deficiency.

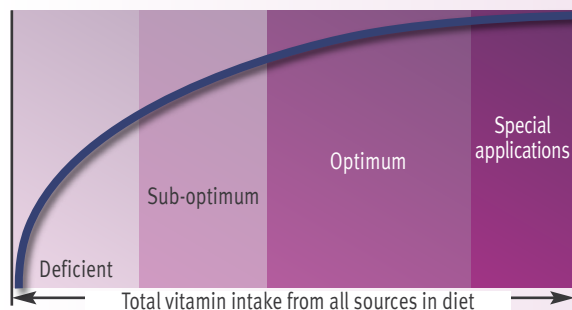
Moving into the 21st century, while industry begins to consider vitamin requirements in the wider context of optimum levels, the trend remains to only follow evidence based upon limited studies of low complexity. Such an approach generally negates experience

or intelligent interpretation or extrapolation of aspects of physiological processes associated with diseases and comparative nutrition as the evidence based approach tends to only consider “hard” end points of trials.

In the context of determining Optimum Vitamin Nutrition for companion animals there should be perhaps a more subtle set of considerations as to what constitutes a positive response to vitamin supplementation. OVN® is a move to maintaining overall animal well-being rather than preventing a clear cut deficiency, which includes functional improvements, like coat condition, outward signs of cognitive function, antioxidant status or stamina during exercise. This is an important point to recognize in the development of quality pet food.



OVN® supplementation levels



- exceed levels needed to prevent clinical deficiency signs
- compensate for various factors influencing an animal's requirements
- ensure fortification not limiting the animal's natural defense against disease

Keeping an eye on science

It is difficult for pet nutritional product formulators in commercial business to keep up with the growing body of scientific evidence supporting advancements in companion animals nutrition. This field has experienced not only rapid development in clinical nutrition research, considering the most recent thrust in the area of nutrigenomics, but also an increase in information being generated by an expanding number of companion animal research centers across the globe. Since DSM Nutritional Products remains a leading manufacturer of vitamins and vitamin pre-mixes, and continues to invest in the pet food industry, the OVN® program provides vitamin supplementation guidelines taking into consideration results from ongoing research in all areas of vitamin nutrition.

Most advanced vitamin forms

It is vital to be able to impart to the pet owner the element of confidence in that the vitamins in their pet's food, treat, or dietary supplement of any kind are beneficial, safe, stable and the highest quality possible. In the highly competitive and dynamic global pet food market manufacturers of pet nutritional products struggle with the rising cost of high quality protein sources and speciality ingredients; materials necessary for a brand to stay relevant. The temptation is therefore to reduce cost wherever possible. This often results

in the procurement of the least expensive micro-nutrients, because they are often perceived as commodity ingredients, without realizing quality is being compromised. Today, pet owners' awareness related specifically to vitamin quality is high due to a greater exchange of information across social media. Consumers are therefore willing to pay a premium for high quality pet nutritional



products and demand that they are formulated with optimum levels of high quality vitamins. This is, of course, an appropriate demand since providing optimum nutritional intake for all companion animals is equally important as it is for humans.

The past century has witnessed remarkable discoveries that have advanced our understanding of vitamins and their vital role in health and wellness. DSM Nutritional Products, the global leader in vitamins, is proud to have been part of this vitamin journey and is committed to making further scientific advances for generations to

come including production of the highest quality and the most technologically advanced vitamin forms worldwide.

Vitamin premix, it's not just a blend

Vitamins come in many chemical and physical forms resulting in particles ranging in size, density, shape, and electrostatic charge. Formu-

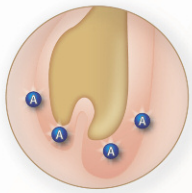
lating a premix requires knowledge of the application relative to manufacturing and product type. Factors used for formulating a vitamin premix include vitamin form selection and balancing nutrient potency using the appropriate carriers. The experts at DSM Nutritional Products understand how to formulate and manufacture premixes to achieve the highest quality outcome.



Did you know:

Sub-optimal or unsafe levels of vitamins can occur for many practical reasons:

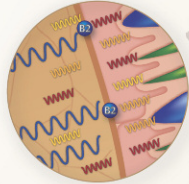
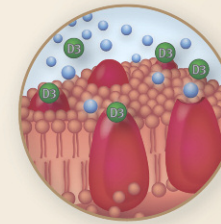
1. Most pet foods and treats are manufactured using some of the harshest processes known in the food industry.
2. A vitamin's activity can be greatly reduced when exposed to heat, light, oxygen, high and low pH conditions, and/or exposure to other reactive substances while less expensive, basic vitamin forms may be over formulated in a product in anticipation of these losses leading to nutrient imbalances.
3. As dogs and cats age their bodies are less able to absorb certain vitamins at the same rate and often their total daily food intake goes down; Vitamin forms play a role by influencing bioavailability of the nutrient.
4. How a pet shop owner or consumer stores the pet food (e.g. storage of the food in a hot store room, the quality of the food packaging) will impact what vitamin activity the animal receives. Proper distribution of the vitamins throughout the food product during manufacturing relies heavily on high quality and technologically advanced vitamin forms which deliver the right potency for proper weight and optimum particle characteristics for best homogeneity and flow.



Vitamin A
For vision, reproduction, growth, teeth, nails, hair, bone, and glands, cellular differentiation, and morphogenesis.

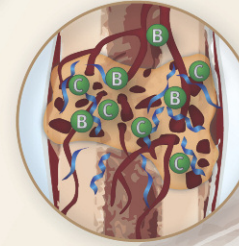


Vitamin D
Regulates calcium and phosphorus metabolism supporting bones and teeth. Supports biological processes including immune and cognitive function.

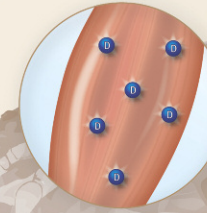


Vitamin B₂
Central to energy metabolism, plays a role in antioxidant capacity of the body, and helps maintain healthy skin and eyes.

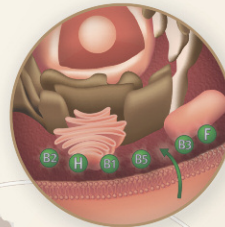
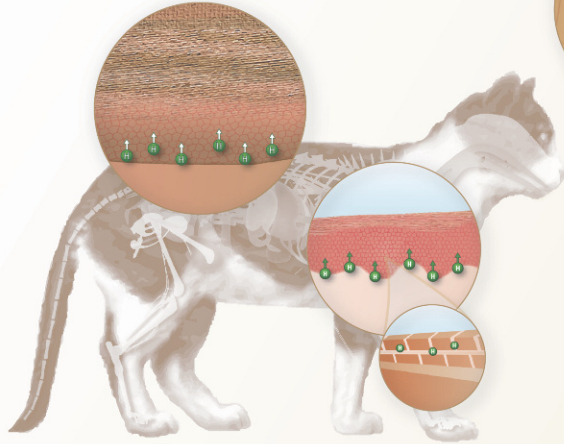
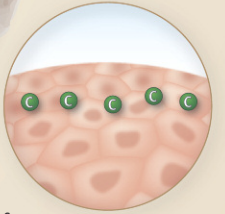
Pantothenic Acid (Vitamin B₅)
Involved in energy metabolism and glucose production. Needed for the synthesis of fatty acids, steroids, and hemoglobin.



Niacin (Vitamin B₃)
Required for energy and protein metabolism and fat synthesis. Essential for DNA repair, transcription, and replication.



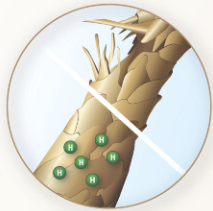
Vitamin C
A water soluble antioxidant that aids in the production of collagen, providing support to muscles, vascular tissues, bones, and cartilage.



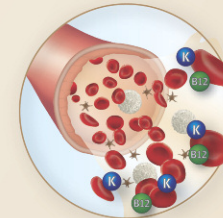
Folic Acid
Important in mitochondrial protein synthesis, blood health, and the metabolism of amino acids and nucleotides.

Vitamin K
Essential for healthy blood clotting and a critical factor in bone formation and metabolism.

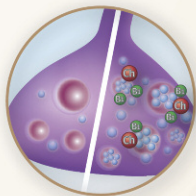
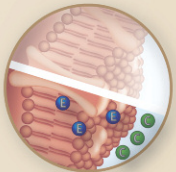
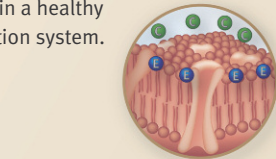
Vitamin E
Antioxidant that protects cells from damaging free radicals resulting in improved immune function, prolong life of red blood cells, and maintain a healthy circulation system.



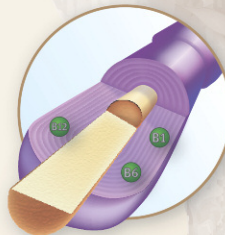
Biotin (H)
Needed in glucose and fatty acid synthesis, amino acid metabolism, and energy metabolism. Important for healthy skin and hair coat quality.



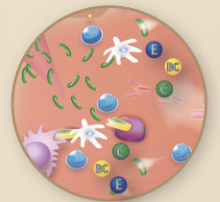
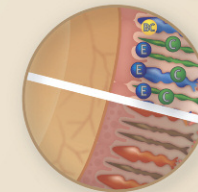
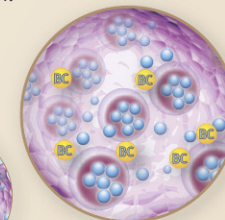
Vitamin B₁₂
Necessary for DNA formation and red blood cell production. Helps maintain the nervous system, essential for healthy mental function, and critical for heart health.



Vitamin B₁
Facilitates the metabolism of carbohydrates, lipids, and amino acids. Supports healthy neurological function.



Vitamin B₆
Significant role in physiological processes in the body, such as glucose production, red blood cell function, nervous system function, immune response, lipid metabolism, hormone modulation, gene expression, etc.



Choline (Ch)
Is critical in lipid metabolism and healthy liver function. Involved in the synthesis of methionine, creatine, carnitine, and the neurotransmitter acetylcholine.

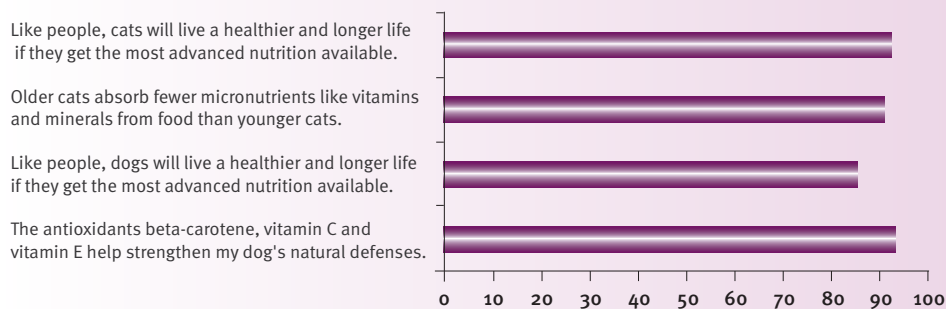
B-Carotene
A powerful antioxidant and immune modulator. Also a pro-vitamin A in dogs and stimulates both cellular and humoral immune responses.

OVN[®] a symbol of quality

Vitamins are long-established nutritional ingredients that are recognized for their health benefits with a world-wide awareness exceeding any other nutrient. A sampling from a 2015 U.S. pet consumer study highlights how pet parents see the impact of vitamins on the health of their pets. The OVN[®] logo on a pet food package communicates that the product is formulated to fully leverage this potential for the pet's benefit. Ultimately, OVN[®] contributes to happiness and long-lasting interaction between pets and their owner.



Percent of pet owners that agreed with the statement



SOURCE: DSM 2015 U.S. Pet Consumer Study by MetrixLab

Optimum Vitamin Nutrition (OVN[®]) for Dogs and Cats

Establishing precise Optimum Vitamin Nutrition for dogs and cats is very challenging. Many factors affect OVN[®] for dogs and cats. These factors include, but are not limited to, animal species, life stages, life styles, individual variation, the forms and bioavailability of the vitamin, nutrient interactions in food and the body, environment conditions, and the end points used to establish OVN[®].

Vitamin A

Vitamin A is important for vision, reproduction, growth, cellular differentiation, and morphogenesis. It is needed for the growth and maintenance of teeth, nails, hair, bones, and glands. For example, improved skin and hair coat quality in adult dogs was associated with a premium dry dog food containing 22972 IU vitamin A/kg diet.¹

Vitamin D

Vitamin D regulates calcium and phosphorus metabolism. It supports strong bones and teeth. The metabolite of Vitamin D also affects many biological functions of the body such as skin health and regulation of cell differentiation. Most immune cells have vitamin D receptors and their immune function is enhanced by vitamin D.²

Vitamin E

Vitamin E is a major lipid soluble antioxidant in cell membranes, plasma, and tissues. It protects cells from damaging free radicals generated during normal energy metabolism, stressful conditions, and pathological situations, such as inflammation. It helps to improve immune function, prolong the life of red blood cells, and maintain a healthy circulatory system. It has been found that diets containing 552 IU vitamin E/kg diet significantly improved immune function in both young and old cats.³ In another study, dietary vitamin E concentration at 598 IU/kg and 540 IU/kg significantly reduced serum alkenal concentration, a product of oxidative damage, in dogs and cats, respectively.⁴

Vitamin K

Vitamin K is essential for healthy blood clotting and is

a critical factor in bone formation and metabolism in dogs and cats.

Vitamin B₁ (Thiamin)

Vitamin B₁ facilitates the metabolism of carbohydrates, lipids and amino acids. It supports healthy neurological functions and the maintenance of peripheral nerve tissues.

Vitamin B₂ (Riboflavin)

Vitamin B₂ is central to energy metabolism and is involved in both one-electron and two-electron transferring. It also plays a key role in antioxidant capacity of the body through participating in the glutathione redox cycle. Riboflavin helps maintain healthy skin and eyes.

Vitamin B₆ (Pyridoxine)

Vitamin B₆ plays a significant role in a broad range of physiological processes in the body, such as glucose

production, red blood cell function, nervous system function, immune response, lipid metabolism, hormone modulation and gene expression.

Niacin (Vitamin B₃)

Niacin is required for energy metabolism, fat synthesis, and protein metabolism. It is also essential for DNA repair, transcription, and replication.

Pantothenic Acid (Vitamin B₅)

Pantothenic acid is a part of Coenzyme A that is involved in energy metabolism and glucose production. It is needed for the synthesis of fatty acids, steroids, and hemoglobin in dogs and cats.

Vitamin B₁₂ (Cobalamin)

Vitamin B₁₂ is necessary for DNA formation and red blood cell production. It helps maintain the nervous system and is essential for healthy mental function. Vitamin B₁₂, along with vitamin B₆ and folic acid, is critical for heart health.

Folic Acid (Vitamin B₉)

Folic acid is an important player in mitochondrial protein synthesis, blood health, and the metabolism of amino acids and nucleotides. It serves as donors and acceptors of one-carbon units.

Biotin (Vitamin H)

Biotin is needed in glucose synthesis, amino acid metabolism, energy metabolism, and fatty acid synthesis. It is important for healthy skin and hair coat quality. For example, dietary biotin concentration at 10 mg/4000 kcal ME was associated with improved skin and hair quality in dogs.⁵

Vitamin C

Vitamin C aids in the production of collagen, which provides support to muscles, vascular tissues, bones, and cartilage. It is an important water soluble antioxidant. Vitamin C can be synthesized in dogs and cats. However, a number of studies have demonstrated health benefits of vitamin C supplementation in dog and cat foods. For example, Stay-C[®] 50, a special form of vitamin C, improved canine and feline periodontal health.⁶ Together with β-carotene and vitamin E supplementation, dietary vitamin C at 70 ppm decreased oxidative stress in healthy adult dogs.⁷

Choline

Choline is critical in lipid metabolism and for healthy liver function. It provides active methyl groups for methylation reactions in the body, including synthesis of methionine – an essential

amino acid, creatine – a muscle power enhancer, carnitin – a healthy body weight facilitator, and acetylcholin – a neuro-transmitter used throughout the nervous system.

β-Carotene



β-Carotene is a powerful antioxidant and immune modulator. It is also a pro-vitamin A in dogs. β-Carotene stimulates both cellular and humoral immune responses. For example, β-carotene supplementation increased plasma antibody concentration and enhanced the delayed-type hypersensitivity response in both dogs and cats.⁸

References

1. Davenport, GM and Reinhart GA. In: Recent Advances in Canine and Feline Nutrition, p. 3-21, 2000.
2. Maggini S, et al. British Journal of Nutrition. 98, Suppl. 1, S29-S35, 2007.
3. Hayek, MG, et al. In: Recent Advances in Canine and Feline βββ Nutrition, p. 555-603, 2000.
4. Jewell, DE, et al. Veterinary Therapeutics, 1:264-272, 2000.
5. Patent: US6177107 B1
6. Patent: EP1633201 B1 and Reports No. 2000007, No. 2000006, and P06532
7. Jewell, DE, et al. Veterinary Therapeutics, 1:264-272, 2000.
8. Chew, BP and Park, JS. Journal of Nutrition, 134:257S-261S, 2004.

Optimum Vitamin Nutrition

DSM vitamin supplement guidelines for dogs and cats*

Vitamins	Unit/kg		
Vitamin A ¹	I.U.	7100-23000	9000-25000
Vitamin D ₃	I.U.	640-1100	750-1300
Vitamin E ²	I.U.	50-500	51-550
Vitamin K ³	mg	1.7-2	1-2
Vitamin B ₁	mg	3-8	7-10
Vitamin B ₂	mg	7-60	5-27
Vitamin B ₆	mg	2-60	4-14
Vitamin B ₁₂ ⁴	mg	0.04-0.1	0.03-0.1
Niacin	mg	19-170	60-170
D-Pantothenic acid	mg	17-150	8-60
Folic acid	mg	0.3-2	1-2
Biotin ⁵	mg	0.3-10	0.1-0.8
Vitamin C ⁶	mg	100-200	100-200
Choline	mg	2100-3000	3200-3300
β-Carotene ⁷	mg	30-150	30-50

* Expressed as unit/kg food with energy density of 4000 kcal/kg on dry matter basis. The dietary vitamin concentration should be corrected for energy density if the food energy density is greater than 4000 kcal/kg. The vitamin amounts stated are those which should be provided to the animal in the feed at the point of consumption. Additional vitamins should be added to the product to account for processing and shelf life storage losses to achieve the targeted consumption amounts of vitamins. These losses can be variable. Please ask your local DSM representative for typical vitamin process and storage loss information.

1. Vitamin A: preformed vitamin A is vital in diets for cats.
2. Vitamin E: the supplemental level should be at least 10 mg/kg for 1% of PUFAs in the diet. Higher levels are recommended to support the total antioxidant capacity of dogs and cats.
3. Vitamin K as Menadione: supplementation is particularly important in canned cat foods that contain > 25% fish when fed for a long period of time.
4. Vitamin B12: higher levels of supplementation might be needed in vegetarian diets as plants are a poor source of this vitamin.
5. Biotin: higher level is recommended for the improvement of coat and skin condition for cats and dogs.
6. Use ROVIMIX[®] STAY-C[®] (L-Ascorbyl-2-Polyphosphate) for reducing loss during processing and supporting the total antioxidant capacity of dogs and cats.
7. β-Carotene: recommended for supporting the total antioxidant capacity of dogs or cats and as a modulator of immune function.



DSM Nutritional Products

To find out more about our ingredients for pet nutrition, please contact your nearest DSM Nutritional Products office.

Headquarters

DSM Nutritional Products AG
P.O. Box 2676
4002 Basel
Switzerland
Email: petfood.nbd@dsm.com
www.dsmnutritionalproducts.com

Area Europe, Middle East & Africa

DSM Nutritional Products Europe AG
Heanor Gate Industrial Estate
Delves Road, Unit 41
Heanor Derbyshire DE75 7SG
United Kingdom
Phone: + 44 17 7353 6598
Fax: + 44 17 7353 6600
Email: marketing.dnpe@dsm.com

China

DSM (China) Limited
118 Baisha Road
Xinghuo Development Zone
Shanghai 201419
China
Phone: + 86 21 5750 4888
Fax: + 86 21 5750 4567
Email: petfood.nbd@dsm.com

Asia Pacific, Australia

DSM Nutritional Products Asia Pacific Pte. Ltd.
41 Edison Rd
Wagga Wagga, NSW 2650
Australia
Phone: + 61 2 6922 7015
Email: marketing.dnpap@dsm.com

Area Latin America

DSM Nutritional Products Latin America
Av. Eng. Billings, 1729-Predio 31
05321-010 São Paulo – SP
Brasil
Phone: + 55 11 3760 6300
Fax: + 55 11 3760 6492
Email: america-latina.dnp@dsm.com

North America

DSM Nutritional Products, LLC
45 Waterview Boulevard
Parsippany, NJ 07054-1298
United States of America
Phone: + 1 973-257-8504
Fax: + 1 973-257-8653
Email: petfood.nbd@dsm.com

This brochure does not constitute a recommendation or guidance for decisions concerning the purchase, use or application of products and does not relieve the user of the product of the obligation to undertake its own suitability, performance or quality testing. THIS BROCHURE IS PROVIDED ON AN "AS IS" BASIS. ALTHOUGH THE INFORMATION SET FORTH IN THIS BROCHURE IS PRESENTED IN GOOD FAITH AND BELIEVED TO BE CORRECT, DSM NUTRITIONAL PRODUCTS AG AND ITS AFFILIATED COMPANIES (HEREINAFTER "DSM") MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE WITH RESPECT TO INFORMATION OR THE PRODUCTS TO WHICH INFORMATION REFERS. No information set forth in this brochure constitutes a solicitation or offer, or invitation to conclude any legal act of any kind whatsoever.

The content of any purchase contract (i.e. technical data, price and applications of the products of DSM) concerning the purchase of DSM products is constituted only by the purchase agreement as such and integral parts thereof (specifications in this brochure never form part of a contract).

All trademarks, product names, symbols and graphics appearing in this brochure are the property of DSM unless indicated otherwise. All DSM trademarks are either registered trademarks or trademarks of DSM Group of Companies in the Netherlands and/or other countries. No license to or right in any such trademarks, trade names, trade secrets, products or other proprietary rights of DSM is granted or conferred to any party without a written agreement.

© DSM Nutritional Products Ltd 2015

A0123

Designed by: graphic art studio - GAS.Grenzach@t-online.de 03/15