**Description**
- Régulateur pour tout type de poste de froid (Chambres froides, meubles et vitrines positives ou négatives, bacs surgelés...)
- Gestion de postes de froid standards, avec détendeur électrique ou vanne d'expansion électronique
- Grâce à son interface RS-485, l'appareil se connecte en réseau
- 4 sondes de température, 2 entrées digitales, 4 relais de sortie et 1 sortie analogique. Entrées/Sorties libres de configuratiion

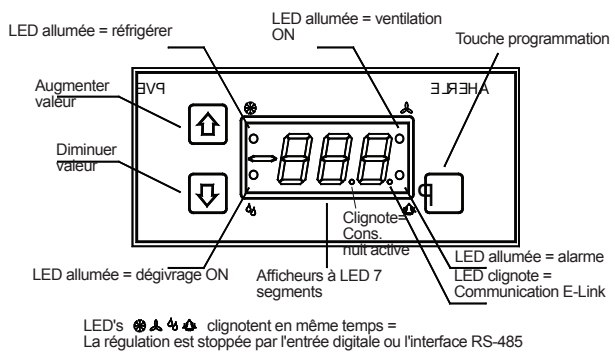
Caractéristiques principales
- Régulation température, gestion du dégivrage, du ventilateur, etc...
- Un appareil peut contrôler le dégivrage de 3 évaporateurs
- Régulation auto-adaptative du détendeur électrique
- Optimisation de la pression de condensation lorsque l'EVP travaille avec le système de gestion de centrales frigorifiques VPR-5140
- Dégivrage intelligent et auto-adaptatif, nécessitant 2 sondes de T°c
- Le lancement du dégivrage se fait automatiquement ou manuellement
- Possibilité de fin de dégivrage en MLI, pilotée par la sonde d'évaporateur
- Reconnaissance automatique du degré de givre de l'évaporateur
- Fonctionnement de sécours en cas de coupure de sonde ou de non-reconnaissance du besoin de dégivrage. Reset automatique si défaut.
- Utilisation de la chaleur latente (inertie thermique)

**ELREHA**
ELEKTRONISCHE REGELUNGEN GMBH

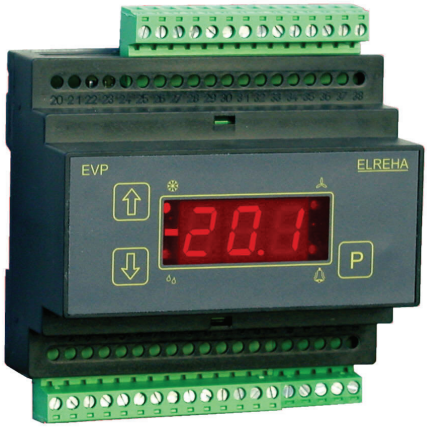
Notice technique **5311092-00/24F**
**Régulateur de poste de froid** Version logiciel **1.58**

**Types: EVP 3150-1**
**EVP 3150-2**

## Eléments d'utilisation




Les 3 touches situées sur la face avant de l'appareil permettent de programmer entièrement le régulateur. Les 4 LED rouge indiquent l'état de fonctionnement actuel.




## Programmation

Tous les paramètres de l'**EVP** sont rangés dans des listes.
En fonctionnement normal ou si aucune touche n'est appuyée durant 3 minutes, l'**EVP** indique les informations suivantes :

1ère priorité : Défauts actuels (clignotement)
2ème priorité : Fonctionnement actuel (ex : Off)
3ème priorité : Affichage de base programmé

### Choisir un paramètre et modifier sa valeur

| Touche | Action |
|---|---|
| **P** (> 2 sec.) | Le nom de la liste s'affiche |
| ⇧ ⇩ | Choisir la liste où se trouve le paramètre |
| **P** | Entrer dans la liste |
| ⇧ ⇩ | Choisir le paramètre |
| **P** | Entrer dans le paramètre. |
| ⇧ ⇩ | Régler la valeur du paramètre à l'aide des flèches. En appuyant longtemps, les valeurs défilent rapidement |
| **P** | Confirmer la nouvelle valeur |
| **P** (> 2 sec.) | Le nom de la liste s'affiche |

### Verrouillage des paramètres

Hormis les consignes de température, les paramètres sont verrouillés et il est nécessaire d'introduire un code pour pouvoir les modifier. Lorsque vous voulez modifier un paramètre, vous appuyez sur la touche "P" : l'afficheur indique C00 et vous devez entrer le code de déverrouillage :

Le régulateur attend le code de déverrouillage

Ce code est toujours la valeur 88. Il faut régler cette valeur à l'aide des touches flèches puis confirmer en appuyant sur "P".

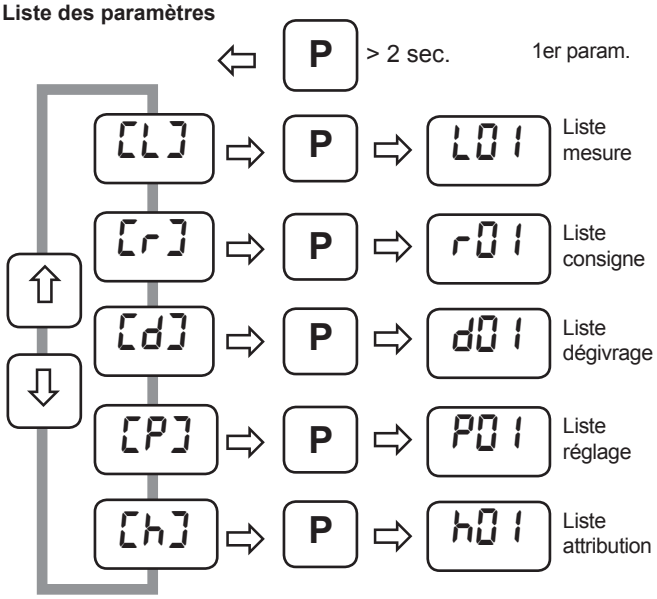
Si aucune touche n'est appuyée durant plus de 3 minutes, l'appareil se verrouille de nouveau.

### Dégivrage manuel

Mettre en route le dégivrage manuel :
- Choisir "**d50**" (Liste dégivrage)
- Régler sur "**on**" puis confirmer.

Arrêter le dégivrage: manuel
- Choisir "**d50**" (Liste dégivrage),
- Régler sur "**oFF**" puis confirmer.

## Liste des paramètres




Attention
**En cas de changement d'anciens modèles, bien faire attention aux modifications de câblage !**

DANGER
**S.V.P Lire les consignes de sécurité !**

Notice
**Il s'agit d'un résumé de la notice technique. La version complète est disponible sur le site www.elreha.de ou sur notre CD d'informations.**

## Données techniques

Alimentation EVP 3150-x ..... 230V, 50-60Hz, max. 9VA
EVP 23150-x ..... 115V, 60 Hz, max. 9VA
max. 240VA
T°C de fonctionnement ..... 0...+50°C
Humidité fonctionnement ..... 85% r.F., non condensée
Entrées analogiques..... 4x sondes de température
TF 201 (PTC) ou TF 501 (PT 1000)
1x capteur de pression 0-10V DC, Ri=69 kOhm
Plages de température..... ± 100°C maximum

Attention — En pratique, la plage de température est déterminée par le type de sonde utilisé. (la plage de température diffère entre une sonde Pt1000 et une sonde PTC)

**Pour des températures plus basses, utiliser des sondes différentes !**
Précision ..... ±0.5K
Entrées digitales ..... 2*230V , max 3 mA
Relais de sortie ..... 3x inverseurs, libre de tt pot. , 8A cos phi = 1 / 250V
Relais statique..... 1x Solid-State-Relay (SSR), max. 1A / 250VAC
ou 230V DC / 500mA

Attention — Un circuit de protection est nécessaire si le relais statique (SSR) pilote des charges inductives

Alimentation capteur..... 22V DC ±10%, 40 mA max.
Sortie analogique..... 0...10V ou 4...20mA configurable
Plage d'affichage / réglage..... voir liste paramètres
Interface ..... RS 485
Sauvegarde des données ..... illimitée
Horloge temps réel ..... Commutation été / hiver, 10 jours de réserve de marche en cas de coupure d'alimentation
Boîtier..... PVC avec touche folio pour montage sur rail DIN
Bornier 2.5mm²

## Accessoires

- Sonde de température TF 501, quantité selon application
- Capteur de pression avec signal 0-10V
- Système de gestion via WEB "**UNIServer**"

## EG-Konformitätserklärung - *EG-Conformity* CE

Für das beschriebene Erzeugnis wird hiermit bestätigt, daß bei bestimmungsgemäßem Gebrauch die Anforderungen eingehalten werden, die in der Richtlinie des Rates zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten über die elektromagnetische Verträglichkeit (2004/108/EG) und der Niederspannungsrichtlinie (2006/95/EG) festgelegt sind. Diese Erklärung gilt für alle Exemplare, auf die sich die vorliegende Bedienungsanleitung (die selbst Bestandteil dieser Erklärung ist) bezieht. Zur Beurteilung des Erzeugnisses hinsichtlich elektromagnetischer Verträglichkeit und der Niederspannungsrichtlinie wurden jeweils die aktuellen Ausgaben der betreffenden Grund- und Fachgrundnormen herangezogen.

*For all described products there is a declaration of conformity which describes that, when operated in accordance with the technical manual, the criteria have been met that are outlined in the guidelines of the council for alignment of statutory orders of the member states on EMC-Directive (2004/108/EC) and the Low Voltage Directive (LVD 2006/95/EC). This declarations are valid for those products covered by the technical manual which itself is part of the declaration. To meet the requirements, the currently valid versions of the relevant standards have been used.*

**EN 61010 Sicherheitsbestimmungen für elektrische Mess-, Steuer-, Regel- und Laborgeräte**
**EN 61326 Elektrische Betriebsmittel für Leittechnik und Laboreinsatz EMV Anforderungen**

Diese Erklärung wird verantwortlich vom Hersteller/Importeur abgegeben durch:
*This statement is made from the manufacturer / importer by:*

**ELREHA Elektronische Regelungen GmbH** (www.elreha.de)
**D-68766 Hockenheim**
**Werner Roemer, *Technical Director***

**Hockenheim**.....**12.11.2008**.....

Nota — L'utilisateur doit toujours être en possession de cette notice. En cas de dommage dû à l'inobservation de la présente notice, la garantie est nulle.

Cette notice contient des consignes de sécurité supplémentaires lors de la description du produit !

Danger — Si vous constatez une quelconque anomalie, l'appareil ne doit pas être mis sous tension ! Risque d'électrocution ! Le fonctionnement n'est plus sûre si :
- l'appareil est détérioré extérieurement,
- l'appareil ne fonctionne plus,
- l'appareil était stocké un long moment dans de mauvaises conditions,
- l'appareil est très sale ou humide
- l'appareil a été endommagé durant le transport.

- **L'installation et la mise en route de l'appareil doivent s'effectuer par ou en présence d'un spécialiste.**
- **Vérifier lors du montage que l'appareil est bien hors tension ! Risque d'électrocution !**
- **Ne jamais utiliser l'appareil dans son boîtier de protection ! Risque d'électrocution !**
- **La borne de terre disponible sur l'appareil doit être reliée à la terre ! Risque d'électrocution !** Si la terre n'est pas correctement branchée, le filtrage interne ne fonctionne pas et peut entraîner des variations sur l'afficheur.
- L'appareil convient uniquement aux applications indiquées à la page 1 de cette notice...
- Respecter les consignes générales de sécurité du pays où l'appareil est installé.

CAUTION
- Vérifier les conditions de fonctionnement de l''appareil :
  - Tension d'alimentation
  - Ambiance (Température et humidité)
  - Puissance maximale des relais par rapport aux appareils commandés (ex : moteur, chauffage). Possibilité de panne ou endommagement si les intensités ne sont pas respectées.
- Les câbles de sonde doivent être blindés et séparés des câbles de puissance. Le blindage doit être relié d'un côté à la terre, au plus près du régulateur, afin d'éviter les problèmes d'induction !
- La section des câbles d'extension de sonde doivent être d'au moins 0,5 mm². Des câbles trop fins peuvent entraîner des défauts d'affichage.
- Eviter de placer le régulateur à proximité de contacteurs de forte puissance.
- Respecter les consignes électriques générales d'installation préconisées.
- Attention, les sondes de température type TF sont étanches mais pas sous pression : pour cela, il est préférable d'utiliser un doigt de gant.

Nota — **Nettoyage**
La façade peut être nettoyée à l'aide d'un chiffon humide ou d'une lingette de nettoyage. Ne pas utiliser de produits agressifs, risque de détérioration !

## Mesures, Affichage des états

Toutes les informations de fonctionnement actuel sont visualisables dans la liste mesure (L).

Statuts de l'appareil
Si les 4 LED situées sur la face avant de l'appareil clignotent en même temps et l'appareil affiche "oFF", les fonctions "entrée digitale" et "interface" sont désactivées.

Affichage des températures
"**L01**" à " **L04**" (Liste mesure) indiquent les températures actuelles des sondes 1 à 4 sur une plage de -100...+100°C. "**L05**" affiche la température à atteindre par le capteur de pression, "**L07**" affiche la "température virtuelle".
Les paramètres "**P31**" à "**P34**" et "**P36**" (Liste réglage) permettent d'effectuer une correction de mesure.

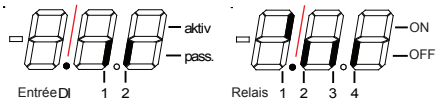
Affichage de l'état du détendeur électrique
Indique le degré d'ouverture du détendeur électrique de 0 à 100% et l'état du détendeur

- cUt = Modification du comportement dans l'évaporateur dûe à un état de fonctionnement inhabituel (cutoff)
- Pdo = Aspiration du fluide frigorigène dans l'évaporateur (relais de réfrigération activé pendant 30 sec.)

Consignes
La consigne actuelle de fonctionnement est indiquée par le clignotement de la LED à gauche de la décimale.

Informations sur les temps
Les temps et retards de fonctionnement sont indiqués dans la liste mesure.

Affichage des entrées
Etat des entrées digitales Etat des relais




Sortie analogique : Paramètre **L50**, valeur en %

**Sondes de température**
Le régulateur accepte les sondes suivantes :
- **TF 201**, sonde PTC délivrant 2000 Ohm à 25°C
- **TF 501**, sonde PT 1000 délivrant 1000 Ohm à 0°C
- Sonde spécifique **So1** (-40...+25°C)
- Sonde spécifique **So2** (-50...+50°C)

Le type de sonde se configure en '**P35**' (liste réglage)

**Notice** **Lorsque vous régulez l'installation avec un détendeur électrique, il faut obligatoirement utiliser les sondes TF 501 (PT 1000).**

## Fonction "Afficheur de base

Lorsque l'appareil est sous tension, l'afficheur indique "l'affichage de base" (si aucun défaut n'apparait).
Vous pouvez choisir un autre paramètre à afficher en général :

Changer l'afficheur de base

- Choisir le paramètre à afficher en permanence
- Appuyer simultanément sur les touches "⇧" et "⇩ " pendant un petit instant. L'afficheur indique "888" puis le paramètre que vous avez sélectionné est validé comme affichage de base

## Annonce de défauts

Lorsqu'un défaut apparaît, l'appareil affiche automatiquement le paramètre **P43** et indique un code. L'appareil enregistre les **15** derniers défauts de l'installation, avec la date et l'heure. Ceux-ci peuvent être consultés via l'interface réseau.

---- ..... Aucun défaut
SEL ..... Défaut d'attribution, fonction attribuée trop de fois
tHi ..... Sur- température (sonde d'alarme)
tLo ..... Sous-température (sonde d'alarme)
tXb ..... Sonde de température n° X coupée
tXc ..... Sonde de température n° X en court-circuit
dbt ..... Nombre maxi de dégivrages dépassés en temps atteint. Défaut des résistances.
rrt ..... Durée maxi de marche réfrigération dépassée. Défaut annoncé à l'heure programmée en **P42** (Liste réglage)
rdo ..... Durée maxi porte ouverte dépassée. Défaut annoncé à l'heure programmée en **P42** (Liste réglages)
dor ..... Porte X ouverte
oPc ..... L'entrée optocoupleur X annonce un défaut
cHA ..... La chaîne de sécurité est ou était ouverte
hrd ..... Défaut de l'électronique

En cas de coupure ou court-circuit de sonde, une temporisation de 5 secondes s'écoule avant l'annonce du défaut.

## Concept de configuration

Pour répondre à toutes les applications, l'EVP est "**libre de configuration",** c'est à dire que toutes les entrées / sorties (4 sondes, 4 relais, 2 entrées de commande, 1 sortie analogique) se configurent selon l'installation à réguler. Les fonctions proposées se trouvent dans la liste attribution.

**Sondes**
Chaque sonde peut prendre une des fonctions proposées. (Fonction (a) de la sonde X, Fonction (b) de la sonde X, Fonction (c) de la sonde X, X = sonde #). *ex* :
1. Une sonde travaille comme sonde de régulation et comme sonde d'alarme de T°c en même temps.
2. Une sonde travaille comme sonde dégivrage et sonde de régulation, pour réguler une vitrine au soufflage.

**Sonde virtuelle**
Jusqu'à 4 sondes peuvent être combinées pour réaliser une "sonde virtuelle" avec réglage de l'influence de chaque sonde.

**Entrées opto-coupleurs (digitales)**
Chaque entrée de commande peut assurer l'une des fonctions proposées.

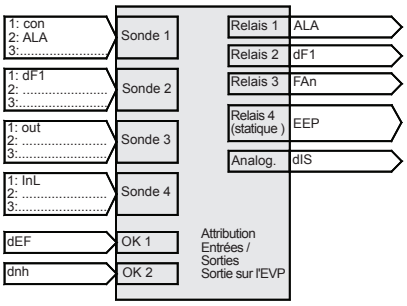
**Relais de sortie**
Chaque relais de sortie peut prendre l'une des fonctions de commande proposées et deux relais peuvent avoir la même fonction.

**Notice** **Le relais 4 est un relais statique et il ne supporte pas autant d'intensité que les relais 1 à 3.**
**Cette sortie permet de gérer les détendeurs électriques ou vannes d'expansion électronique mais peut aussi être configuré pour d'autres fonctions tant que l'intensité maximale n'est pas dépassée.**

**Paramètre**
Selon les attributions des entrées / sorties, les paramètres inutiles sont cachés automatiquement.

**Attribution**
Les fonctions des entrées / sorties se programment dans la "liste attribution". L'attribution se fait soit sur l'appareil soit par PC

**Exemple de configuration avec gestion du détendeur électrique**




**Configurer les entrées / sorties**

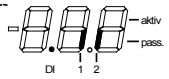
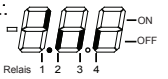
Pour l'exemple, l'installation comporte un évaporateur et un détendeur électrique

| Action | Touche | Affichage | Remarque |
|---|---|---|---|
| Choisir le menu liste | "P" | (A) | Maintenir plus de 2 secondes |
| Choisir la Liste attribution | "⇧⇩" | (h) | |
| Entrer dans la liste | "P" | h01 | h01 est le 1er paramètre dans la liste et il indique la fonction du relais 1 |
| Fonction du relais 1 affichée | "P" | tous | |
| Donner une nouvelle fonction | "P" | C00 | Seulement si aucune touche n'est appuyée durant 3 minutes |
| Entrer le code d'accès | "⇧" | C88 | |
| Confirmer | "P" | tous | |
| Choisir la fonction | "⇧⇩" | ALA | ALA = relais d'alarme |
| Confirmer | "P" | h01 | Le numéro du paramètre apparaît |
| Choisir une autre entrée/sortie | "⇩" | h02 | Fonction du relais 2 |
| Fonction du relais 2 affichée | "P" | tous | |
| Donner une nouvelle fonction | "P" | tous | |
| Choisir la fonction | "⇧⇩" | dF1 | dF 1= dégivrage 1 (Evaporateur 1) |
| Confirmer | "P" | h02 | Le numéro du paramètre apparaît |

**Répéter l'opération pour toutes les autres entrées / sorties.**

## Liste des paramètres

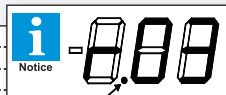
### Liste mesure [L]

| Param. | Aff | Description | Plage | Valeur d'usine |
|---|---|---|---|---|
| L01 jusqu'à L04 | X | Température sonde 1 (Correction possible +/- 10K) | ± 100°C | --- |
| L04 | X | Température sonde 4 | ± 100°C | --- |
| L05 | X | Affichage équivalence en T°c mesure pression | ± 100°C | --- |
| L07 | X | Valeur sonde virtuelle, calculée selon l'influence de chaque sonde | ± 100°C | --- |
| L09 | X | Valeur de surchauffe réelle | ± 100°C | --- |
| L21 | X | Durée de marche réfrigération / jour | 24.0 h:(10min) max. | 00:00 |
| L22 | X | Durée porte ouverte / jour | 24.0 h:(10min) max. | 00:00 |
| L31 | X | Durée restante porte ouverte avant alarme | 240 minutes max. | |
| L32 | X | Durée restante avant alarme de température | 120 minutes max. | |
| L33 | X | Durée restante avant fin dégivrage par temps | minutes | |
| L34 | X | Durée restante d'égouttement | minutes | |
| L35 | X | Durée restante avant marche ventilation | minutes | |
| L36 | X | Durée restante anti-court cycle | minutes | |
| L41 | X | Electrovanne | 0, 1, oFF | |
| L42 | X | Etat du détendeur électrique, degré actuel d'ouverture en % de la plage programmée | cUt = cutoff<br>Pdo = pumpdown | |
| L43 | X | Etat du fonctionnement jour / nuit | on, oFF | |
| L44 | X | Etat de fonctionnement du régulateur | on, oFF | |
| L50 | X | Valeur actuelle de la sortie analogique en X% de la plage programmée | 0-100% | |
| L60 | X | Etat des entrées opto-coupleurs (digitales) OK1 (DI1) et OK2 (DI2) |  | |
| L61 | X | Etat des relais de sortie 1-4 |  | |
| | | - Les paramètres comportant une croix dans la colonne "Aff" ne sont pas modifiables | | |

### Liste consigne [r]

| Param. | Aff. | Description | Plage | Valeur d'usine |
|---|---|---|---|---|
| r01 | | Jeu de consignes | 1, 2 | 1 |
| r02 | X | Consigne de jour | -100/+100°C | -20°C |
| r03 | X | Consigne de nuit | -100/+100°C | -20°C |
| r04 | X | Consigne de jour jeu 2 | -100/+100°C | -20°C |
| r05 | X | Consigne de nuit jeu 2 | -100/+100°C | -20°C |
| r10 | | Hystérésis | 0,1...20K | 2 K |
| r22 | | Retard de marche ventilation | 0...30 (min.) | 5 min. |
| r23 | | Temps de marche supplémentaire ventilation | 0...30 (min.) | 0 min. |
| r31 | | Durée maxi marche réfrigération (dizaines de minutes) | oFF, 00.0...23.5 | oFF |
| r32 | | Durée maxi porte ouverte (dizaines de minutes) | oFF, 00.0...23.5 | oFF |
| r33 | | Anti-court cycle compresseur | 0...30 min. | 0 min. |
| r34 | | Retard de marche réfrigération après coupure d'alim. | 0...30 min. | 0 min. |
| r41 | X | Ecart haut d'alarme température (écart à la consigne) | 0...100K | 7 K |
| r42 | X | Ecart haut d'alarme température jeu 2 (écart à la consigne jeu 2) | 0...100K | 7 K |
| r43 | X | Alarme basse température (valeur absolue)<br>**!! La fonction ne peut pas être arrêtée.** | -100/+100°C | - 50°C |
| r44 | X | Alarme basse température jeu 2 (valeur absolue) | -100/+100°C | - 50°C |
| r45 | | Retard d'alarme | 0...120 min. | 45 min. |
| r46 | | Retard d'alarme chaîne de sécurité | 0...60 sec. | 60 sec. |
| r51 | | Bande proportionnelle sortie PID | 0.1...30.0 | 4.0 |
| r52 | | Temps intégral sortie PID | oFF, 1...600 sec. | 10 sec. |
| r53 | | Temps dérivé sortie PID | oFF, 1...10 sec. | oFF |
| r54 | | Filtre passe-bas sortie PID | oFF, 0.1...10.0 sec. | oFF |
| r56 | | Temps mort sortie analogique PID | 0...240 sec. | 0 sec. |
| r57 | | Variation sortie analogique PID durant temps mort | 1...100% | 100% |
| r58 | | Période relais Froid/Chaud | 1...240 sec. | 1 sec. |
| r59 | | Cycle relais Froid/Chaud | 1...240 sec. | 240 sec. |
| r61 | | Retard opto-coupleur (digitales) | 0 à 120 min. | 5 min. |
| r62 | | Retard opto-coupleur porte (digitales) | 1 à 240 min. | 5 min. |
| r63 | | Valeur analogique commandée par optocoupleur : tension / intensité | 0.0...100.0 %, | 0% |

Notice



S'allume lorsque le paramètre interrogé correspond à la consigne actuelle.

### Liste dégivrage [d]

| Param. | Aff | Description | Plage | Valeur d'usine |
|---|---|---|---|---|
| d01 | | Ventilateur en marche au dégivrage | on, oFF | oFF |
| d02 | | Mode de lancement du dégivrage | Etn = externe,<br>Int = externe + interne<br>RdR = adaptif | Int |
| d03 | | Ventilation avant dégivrage (pour dég. adaptatif) | 0...15 minutes | 3 minutes |
| d04 | X | Durée avant prochain dégivrage (pour dég. adaptatif) | 168.0 h/min. | 00.0 |
| d05 | | Temps maxi. avant dégivrage (dizaines de minutes) | 02.0...168.0 h/min. | 24.0 h |
| d11 | | Horaire dégivrage 1 (dizaines de minutes) | 00.0 - 23.5, oFF | 05.0 |
| d12 | | Horaire dégivrage 2 (dizaines de minutes) | 00.0 - 23.5, oFF | oFF |
| d13 | | Horaire dégivrage 3 (dizaines de minutes) | 00.0 - 23.5, oFF | oFF |
| d14 | | Horaire dégivrage 4 (dizaines de minutes) | 00.0 - 23.5, oFF | oFF |
| d15 | | Horaire dégivrage 5 (dizaines de minutes) | 00.0 - 23.5, oFF | oFF |
| d16 | | Horaire dégivrage 6 (dizaines de minutes) | 00.0 - 23.5, oFF | oFF |
| d31 | | Température de fin de dégivrage | 0.0°C...100°C | 14.0°C |
| d32 | | Temps maxi dégivrage | 0...240 minutes | 45 min. |
| d33 | | Supplément retard d'alarme au dégivrage | 0...60 minutes | 30 min. |
| d34 | | Seuil d'impulsion dégivrage | -5,0...+100°C | 100°C |
| d35 | | Temps d'égouttement | 0...30 minutes | 0 min. |
| d36 | X | Durée du dernier dégivrage | minutes | |
| d37 | | Nombre maxi de dégivrage dépassé en temps | oFF, 1-15 | oFF |
| d38 | X | Pause avant lancement dégivrage (pour dég. adaptatif) | 0...15 minutes | 0 min |
| d50 | | Lancement de dégivrage manuel | on, oFF | |

## Liste réglage [P]

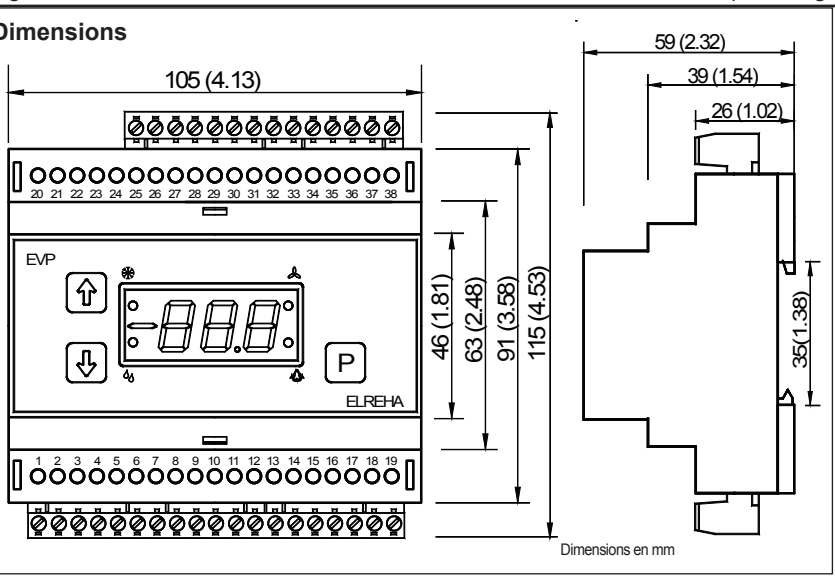
| Param. | Aff | Description | Plage | Valeur d'usine |
|---|---|---|---|---|
| P01 | | Attribution centrale (0 = aucune) | 0, 1, 2, 3 | 1 |
| P02 | | Mode de fonctionnement ventilateur | Int = Intervalle, PEr = Permanent<br>Rdd = mode spécial pour poste positif<br>+ utilisation de la chaleur latente | Int |
| P03 | | Mode froid (Vérifier le sens de commutation du relais) | nor = normal, in = inversé | nor |
| P04 | | Marche de sécurité en % de commande du froid | 0...100% | 50% |
| P11 | | Période cadre chauffant | 10...60 minutes.....1 | 15 min. |
| P12 | | Rapport cyclique cadre chauffant en marche de jour | 0...100% | 100% |
| P13 | | Rapport cyclique cadre chauffant en marche de nuit | 0...100% | 100% |
| P14 | X | Largeur d'impulsion actuelle pour le cadre chauffant | (information transmise par le VPR) | |
| P21 | | Début consigne de nuit (dizaines de minutes) | 00.0...23.5, oFF | oFF |
| P22 | | Fin consigne de nuit (dizaines de minutes) | 00.0...23.5, oFF | oFF |
| P31 | | Correction de mesure sonde 1 | +/-10.0, ajustable | 0.0 |
| P32 | | Correction de mesure sonde 2 | +/-10.0, ajustable | 0.0 |
| P33 | | Correction de mesure sonde 3 | +/-10.0, ajustable | 0.0 |
| P34 | | Correction de mesure sonde 4 | +/-10.0, ajustable | 0.0 |
| P35 | | Type de sonde (utiliser PT 1000 si commande dét. élect.) | 201 = TF201 501 = TF501 (Pt1000) | 501 |
| P36 | | Correction équiv. temp. du capteur de pression | +/-10.0, ajustable | 0.0 K |
| P41 | | Alarme basse température | on, oFF | on |
| P42 | | Heure annonce défaut (Heure) | 0...23h, oFF | 6h |
| P43 | X | Défaut actuel | | |
| P51 | | Sortie analogique à 0V / 4mA si sonde de régul. = | -/+ 100°C | -100°C |
| P52 | | Sortie analogique à 10V / 20mA si sonde de régul. = | -/+ 100°C | +100°C |
| P53 | | Seuil bas capteur de pression | -1,0...+90,0 bar | -1,0 bar |
| P54 | | Seuil haut capteur de pression | -1,0...+90,0 bar | +9,0 bar |
| P55 | | Type de fluide frigorigène<br>0= non utilisé, gestion détendeur seulement par 2 sondes de température. | 1= NH3, 2= R134a, 3= R22, 4= R23,<br>5= R404a, 6= R507, 7= R404a, 8= R402b,<br>9= R407C (pt. de bulle), 10= R407C (pt. rosée)<br>11 = R123, 12 = R290, 13 = CO2, 14 = R502,<br>15=R 723, 16= R410A, 17= R407F (pt rosée) | 0<br><br><br><br>(15+16 seulement vers. logiciel 1.41) |
| P56 | | Tension pour seuil bas capteur de pression<br>Tension en dessous de cette limite = message d'erreur | 0,0...10,0 V | 0 V |
| P57 | | Tension pour seuil haut capteur de pression<br>Tension au dessus de cette limite = message d'erreur | 0,0...10,0 V | 10,0 V |
| P60 | | Surchauffe (Superheat) | 0,0...50,0 K | 8,0 K |
| P61 | | MOP (Limitation de la température d'évaporation)<br>(dépend de l'installation frigorifique) | -100,0...+100,0°C | +100,0°C |
| P62 | | Bande proportionnelle régulation détente élect. | 0,1...20,0 K | 8,0 K |
| P63 | | Temps intégral régulation détente élect. | 1...999 sec. | 240 sec |
| P65 | | Surchauffe maximale | 2,0...20,0K | 8,0K |
| P66 | | Limitation signal d'ouverture détente élect. | 0...100% | 100% |
| P67 | | Variation détente élect. durant temps mort | 1...100% | 100% |
| P68 | | Temps mort détente élect. | 0...240 sec. | 0 |
| P79 | X | Numéro de version du programme | | |
| P81 | | Changement d'heure été / hiver | oFF, on = UE depuis 1996 | on |
| P82, P83 | | Année, Mois | | |
| P84, P85 | | Jour, Heure | | |
| P86, P87 | | Minute, Seconde | | |
| P90 | | Adresse appareil | 0 - 78 | 78 |
| P91 | | Vitesse de transmission des données (Bauds) | Aut(o), 12(00)...576(00) | Aut(o) |

## Liste attribution [h]

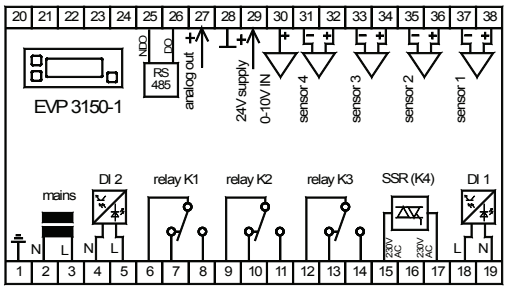
| Param. | Aff. | Description | Plage | Valeur d'usine |
|---|---|---|---|---|
| h01 | | Fonction du relais 1 (libre de tout potentiel) | ---, on= Permanent, rEF= Réfrigération, dF1= Dég. 1... dF3= Dég. 3 ..<br>FAn = Ventilateur, ALA = Alarme, FrA = Cadre chauffant, roL = Rideau,<br>Lit = Lumière, hEA = Chauffage, EEP = détendeur élec. Un1 = le relais déclenche si "Régulateur Off". En marche normale, il est enclenché. | rEF |
| h02 | | Fonction du relais 2 (libre de tout potentiel) | idem | dF1 |
| h03 | | Fonction du relais 3 (libre de tout potentiel) | idem. | FAn |
| h04 | | Fonction du relais 4 **(relais statique)** | idem. | EEP |
| h11 | | Fonction sonde 1a | --- = déconnectée, con = régulation froid, dF1 = fin de dégivrage 1,<br>dF2 = fin de dégivrage 2, dF3 = fin de dégivrage 3,<br>ALA = alarme de température, dis = affichage,<br>inL = entrée évaporateur, out = sortie évaporateur | con |
| h12 | | Fonction sonde 1b | idem. | ALA |
| h13 | | Fonction sonde 1c | idem. | --- |
| h17 | | Sonde 1, influence sonde virtuelle | 0...100% | 0% |
| h21 | | Fonction sonde 2a | idem. | dF1 |
| h22 | | Fonction sonde 2b | idem | --- |
| h23 | | Fonction sonde 2c | idem. | --- |
| h27 | | Sonde 2, influence sonde virtuelle | 0...100% | 0% |
| h31 | | Fonction sonde 3a | idem. | inL |
| h32 | | Fonction sonde 3b | idem. | --- |
| h33 | | Fonction sonde 3c | idem. | --- |
| h37 | | Sonde 3, influence sonde virtuelle | 0...100% | 0% |
| h41 | | Fonction sonde 4a | idem. | out |
| h42 | | Fonction sonde 4b | idem. | --- |
| h43 | | Fonction sonde 4c | idem. | --- |
| h47 | | Sonde 4, influence sonde virtuelle | 0...100% | 0% |
| h71 | | Fonction (a) sonde virtuelle | idem (comme température réelle) | |
| h72 | | Fonction (b) sonde virtuelle | idem | |
| h73 | | Fonction (c) sonde virtuelle | idem | |
| h51 | | Sortie analogique délivrant | 0 10 = Tension 0-10V, 420 = Intensité 4-20mA | 0 10 |
| h52 | | Sortie analogique utilisée comme | 0 = 0% (0V ou 4 mA), 100 = 100% (10V ou 20 mA)<br>dis = copie de mesure, P= Régulation PID-T1,<br>Pr= Régul. PID-T1 inverseur, EEP= Vanne d'expension électronique | 0 |
| h61 | | Fonction de l'entrée opto-coupleur 1 (digitale) | ---= déconnectée, dEF= dégivrage externe,<br>dnL=Marche de nuit passif, dnH= marche de nuit actif<br>oFL= Régul. Off (quand 0V), oFH= Régul. Off (quand 230V)<br>cHA= Chaîne de sécurité, SEt= Jeu de consigne, dor= Contact porte,<br>ALA= Entrée d'alarme, AnA= Blocage valeur sortie analogique,<br>rLL= Blocage froid actif, rLH= blocage froid passif<br>rFL= Autorisation froid actif, rFH= Autorisation froid passif | --- |
| h62 | | Fonction de l'entrée opto-coupleur 2 (digitale) | idem. | --- |

Notice: Les paramètres comportant une croix dans la colonne "Aff" ne sont pas modifiables

## Dimensions



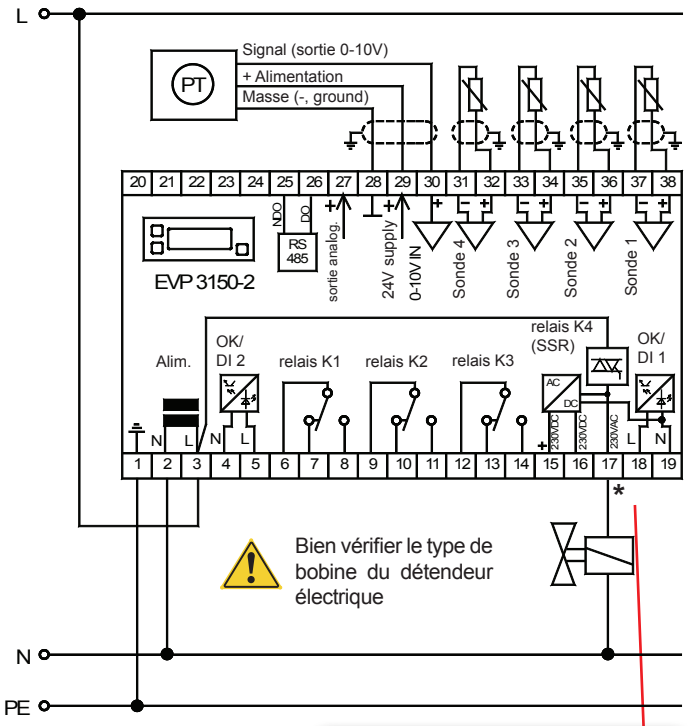

## Connexions EVP 3150-1




Notice

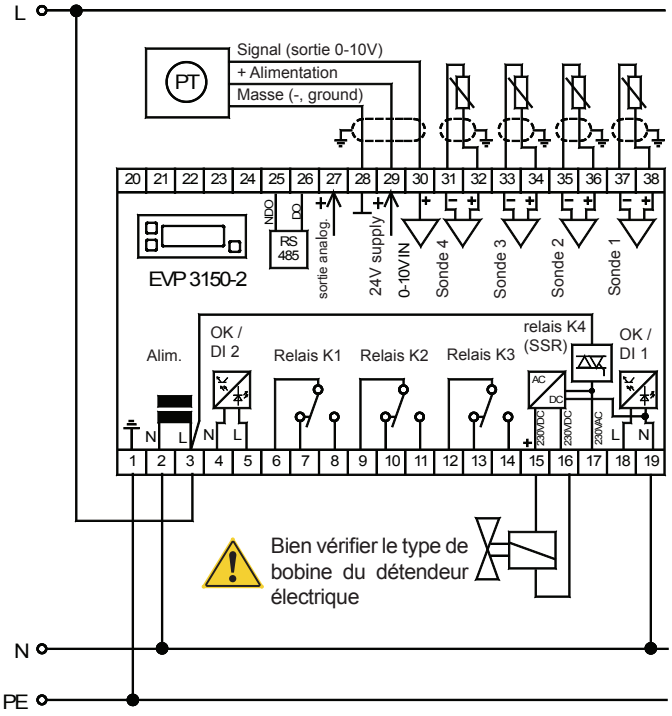
Ancien produit, production arrêtée.

## Connexions EVP 3150-2




Bien vérifier le type de bobine du détendeur électrique

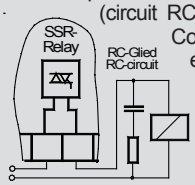
Connexions détendeur avec bobine en 230V AC




Bien vérifier le type de bobine du détendeur électrique

Connexions détendeur avec bobine en 230V DC

* Les charges inductives (par exemple : un relais) doivent être équipées d'un circuit de protection en parallèle adapté (circuit RC – Résistance / Condensateur par exemple) afin de protéger le relais statique et éviter toute mise en marche incontrôlée. La protection doit être adaptée à la charge inductive.



## 'Physical' and 'virtual' sensors

1. Chaque sonde peut avoir jusqu'à 3 fonctions en même temps. (voir liste attribution), any sensor is able to do the same job.
Up to 4 control sensors can be assigned the same time. If *one of them* gets warmer than setpoint + hysteresis, then cooling starts.

2. It is possible to create a 'virtual' sensor to realize different kinds of averaging, e.g. multiple sensors in a huge room or averaging of inlet and outlet sensor in a chest freezer. The 'virtual' sensor resp. value (**L07**) follows from the selectable emphasis of the sensors which must have an effect on the result (**h17, h27, h37, h47**, Assignment Page). The functions assigned to this 'sensors' (**h71, h72, h73**, Assignment Page) are the same as the functions for the 'physical' sensors.
*Example*: If the 'physical' sensor 1 got the function "**con**" (control sensor) and also the 'virtual' sensor, then the warmer one initiates refrigeration.

- Selection of a "virtual sensor":
  - Assignment of a function by **h71-h73**
- Selection of a 'physical' sensor which must have an effect on the result :
  - Activating of the sensor by assigning a function (e.g. display only sensor)
- Set emphasis for the selected sensor (**h17, h27, h37, h47**).

The sum of all emphasis values must be 100%. *Example*:
If sensor 1 and sensor 2 must have an effect on the result and you set "**h17**" to "30%" and "**h27**" to "60%", then you get the error message "**SEL**" (assignment error).

Further causes for the error message "**SEL**
- The sum of all emphasis parameters is 100%, but no virtual sensor function is selected
- All 4 emphasis values are set to '0' and a 'virtual' sensor function is assigned
- A physical sensor is switched off, but an emphasis value > 0 is selected.

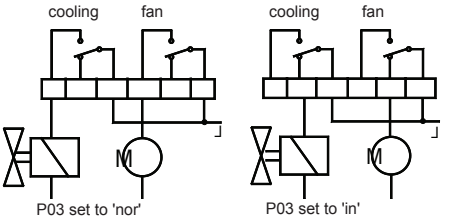
Example 1, Chest Freezer:
For the detection of the actual value, inlet and outlet sensor must be used. Sensor 1 is mounted at the suction side (inlet) and must have an 60% influence on the result. Sensor 2 is mounted at the outlet and must have an 40% influence.
- set "**h17**" to "60"
- set "**h27**" to "40"
- set "**h71**" to "con" (control sensor)

Example 2, huge room, standard application
Sensors 1-3 must measure the rooms temperature, an arithmetic average must be calculated, sensor 4 is the defrost limitation sensor in the evaporator.
- set "**h17**", "**h27**" to "33" and "**h37**" to "34"
- set "**h71**" to "con" (control sensor)
- set "**h41**" to "df1"

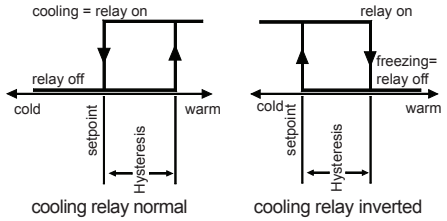
**Special Function**
If an emphasis parameter value is set to 100% (others to 0), up to 6 functions can be assigned to the corresponding physical sensor. This may be of interest for applications where more than 3 sensor functions are used.

## Cooling

**Cooling control by Solenoid Valve / Compressor**
Cooling is controlled by switching the output relay contacts ON an OFF.
For freezing applications, the N/C contact can be used (inverted mode) to secure permanent cooling in case of a controller defect, adjustable by "**P03**" (Mode Page).




The point of cut-off is always the valid setpoint. If the temperature at the control sensor exceeds setpoint + hysteresis ("**r10**", Setpoint Page), the control relay will switch on. "**P03**" also affects to the switching characteristic of the fan relay.




Do not use 'inverted', if compressors are controlled directly. Risk of compressor damage by continuous running!

The control relay can be locked via data interface.

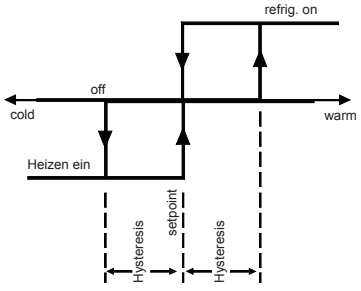
Low temperature Limitation
Can be used e.g. for refrigerated shelfs with roller blinds to limit the temperature at the air outlet during night operation. When the temperature at the alarm sensor decreases the limit set by "**r43**" (resp. "**r44**", Setpoint Page) cooling will switch off.
This value is the threshold for the low temperature alarm at the same time.

**The low temperature limitation cannot be switched off.**

## Heating function

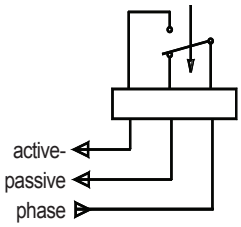
One relay is able to work as a heat relay. Then the control setpoint is the cut-off of heating and cooling at the same time. Cut-in will be:

- for cooling: setpoint + hysteresis (r10)
- for heating: setpoint - hysteresis (r10).




## Temperature Alarm

If a relay gets the function "ALA", a temperature alarm will be forwarded by the 'Quiescent current' principle. After power-up of the controller, the alarm relay will be energized after ~4 sec. In case of a failure the relay will be de-energized after a delay timer (**r45**", Setpoint Page) has been run down. LED "Alarm" shows the alarm state. If temperature comes back to the normal range, the relay will be energized again. "**L32**" shows the remaining time up to an alarm.




Overtemperature Alarm
It is possible to select max. 4 (5 with the 'virtual') alarm sensors (e.g. 4x "**ALA**"). If the temperature at one of the alarm sensors exceeds the control setpoint + the "**r41**" (resp. "**r42**", Setpoint Page) setting, an alarm will be initiated after the delay time "**r45**".

Low temperature Alarm
If the temperature at any alarm sensor gets lower than the "**r43**" (resp. "**r44**, Setpoint Page) setting, an alarm will come on with the delay explained above. This setting is an absolute value and does not refer to the control setpoint. At the same time, this setting works as threshold for the "low temperature limitation" function.
Low temperature alarm can be disabled by "**P41**" (Mode Page).

Supplementary alarm delay during defrost
After a defrost cycle the temperature may take longer to stabilize and the normal alarm delay turns out to be too short. For this reason the value of parameter „**d33**" (defrost page) will be added on to the normal alarm delay after defrosting.

## Runtime Monitoring

The controller monitors the total running hours of the cooling output over 3 days. A 'day' is defined as the period within "**P42**" and 1 minute before the same point in time next day.
*Example*:
"**P42**" set to 11:00 am =
Monitoring time range is from 11:00 o'clock day 1up to 10:59 o'clock day 2.
The overall runtime of the cooling relay over a day will be added and stored ("**L21**", Actual Values Page). If this runtime exceeds the value set by "**r31**" three days in a sequence, this will cause an alarm at the hour programmed by "**P42**" (Mode Page). The alarm relay will be de-activated and the alarm LED switches on.

**This alarm will be cancelled automatically 1 hour later.**

## Operation with a single compressor

If a single compressor is controlled by a refrigeration relay, it is suggestive to have an idle time to prevent the machine from damages caused by short cycle operation. The compressor can restart only after the timer "**r33**" (Setpoint Page) has been run down. The remaining time up a restart can be read at "**L36**" (Actual Values Page).

## **Second setpoint** (night operation)

A second setpoint can be defined by "**r03**" (Setpoint Page). This can be used for night operation or other energy savings. Switching between these setpoints can be made by internal clock or by digital input. The current used setpoint is marked by a lighted decimal point in the parameter display. On the 'Actual Values Page', parameter "**L43**" shows the current state.

Internal switching
The parameters „**P21**“ and „**P22**“ determine the 2nd setpoint period. If the internal timer is not used, set both times to "**oFF**".

External switching
The digital inputs can be configured for external switching, selectable as "**dnL**" (active low) or "**dnh**" (active high). After the input has been activated, the 2nd setpoint is active all time and the internal timer is disabled. If you want to use external switching only, please set „**P21**“ and „**P22**“ to "**oFF**".

## Second Set of Setpoints

The controller offers two complete setpoint sets including day/night setpoints and alarm limits.
Example Application: By an external switch it is possible to change a cold room from refrigeration to freezing for temporary storage of other products, without changing any parameters at the controller. Even here the currently used setpoint is marked by a lighted decimal point in the parameter display.

Toggling between the setpoint layers

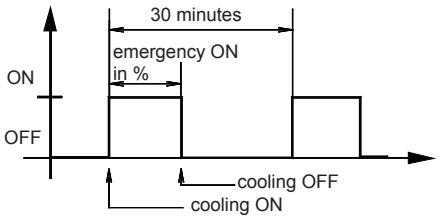
1. internal: by parameter „**r01**“ (Setpoint Page)
2. external: assign function „**SEt**“ to a digital input. If connected to mains phase, the 2nd layer is in use.

## Light Control

One of the relays is able to control room lightings (function "**Llt**"). In this case, the relay switches together with the night settings.
While 'day'-operation the light relay keeps energized.

## Emergency Operation

If all control sensors fail, the unit turns to an emergency mode automatically. The cooling relay cycles with a %-part (**P04**, Mode Page) of the 30 minutes period.




## **Digital Inputs** (Optocoupler Inputs)

### Switching OFF the controller unit

Sometimes it is necessary to switch off cold storages completely including the controller.
If the controller works in a network, the bus-master so detects a malfunction and generates an alarm. To prevent this, the unit must be switched OFF via digital input.

Controller OFF
If a digital input is assigned to the functions "**oFL**" or "**oFH**" and is activated by the matching signal, then all control functions will be disabled. All alarm functions are locked and the display shows "**oFF**".

### Safety Chain Monitoring

When using the controller for single compressor applications, one of the digital inputs can be used to monitor the safety chain ("**chA**").
Normally the digital input is connected to phase via this chain of contacts. If the chain opens, cooling and fan will switch off, a running defrost cycle will be terminated and a new defrost cycle is impossible. Parameter "**r46**" defines the response time on the missing signal voltage.

### Door Contact Input

If a digital input with the function "**dor**" is connected to phase, the evap fan stops immediately. The control range of the EEx-Valve will be changed automatically, to avoid a further evaporation. If the door is open **> 3 minutes**, cooling will be stopped. All other functions continue working.
If the door is open **> 5 minutes**, the unit generates the error message "**rdo**". After the timer "**r62**" (Setpoint Page) has been run down, cooling restarts and an alarm message will be forwarded.

**Exception:**
**If no alarm sensor is assigned or if the temperature is above the alarm limit, cooling continues without interruption. The cooling keeps switched ON and the fan starts again, so the door opening is ignored.**

Door open monitoring
Every time a door is opened, the controller adds the time to the total opening time of the present day "**L22**" (Actual Values Page). If the total opening time exceeds the value set by "**r32**" (Setpoint Page), an alarm will be generated.
The alarm message will be forwarded at the point in time determined by "**P42**" (Mode Page) and will be cancelled automatically 1 hour later. "**L31**" shows the remaining time up to the alarm message.

### External Alarm

The digital inputs are able to process external alarm messages. For this, the function "**ALA**" must be assigned (Assignment Page).
While normal operation, the input is connected to mains phase. When the voltage drops down, a delay time starts ("**r61**", Setpoint Page). After this timer has been run down, an alarm will be forwarded.

## Real Time Clock

The built-in real time clock has a buffer for max. 10 days without mains voltage. Date and time can be set by "**P82**"..."**P87**" (Mode Page).
An automatic summer / winter switch ("**P81**", Mode Page) considers the current EU-rules from 1996 (EU 96), but can also be switched off.

## Temperature control with Electronic Expansion Valves

The EVP 3150-2 is able to control one (1) cold storage with an evaporator equipped with an Electronic Expansion Valve (EExV).
***In such applications, the EExV takes over the jobs of the former solenoid valve and the compulsive thermal expansion valve.***

### Expansion Valves

The EVP is able to drive **pulse-width modulated, cycling expansion valves** and **valves with thermal drive**.
AC or DC type valves can be used, they are supplied by mains voltage via SSR-relay with 2 outputs.
Missmatches valve/nozzle and evaporator will be compensated in a wide range. Because the valves need no high pressure difference to open, it's possible to work with low condensation pressures, as long as the configuration allows that.
From this it follows a higher COP-value for the compressor and so an option for energy saving. The energy saving depends on outdoor temperature (if the condenser is located on the roof) and is higher in winter than in summer.
By the optimal filling of the evaporator and the more equable icing an additional energy saving of 2 - 5% is possible.

### Measuring Methods

The EVP is able to work with 2 measuring methods:
1. Pressure Transmitter and Temperature Sensor at the evaporator outlet, this is equivalent to the arrangement of a thermal expansion valve.
2. 2 Temperature Sensors at the inlet and the outlet of the evaporator.

The unit always controls the 'virtual' aperture size of the valve to reach an optimal filling and so the optimal efficiency ratio of the evaporator. Period time and pulse-width of the PWM-control are defined by the control algorithm (autoadaptive), disturbances like suction pressure fluctuations and flashgas will be filtered out.

1. Pressure / Temperature method

To capture the superheat, a pressure transmitter with 2-10V output signal and a TF 501 temperature sensor at the evaporators outlet is used. The arrangement of this parts is equivalent to the components of a thermal expansion valve.

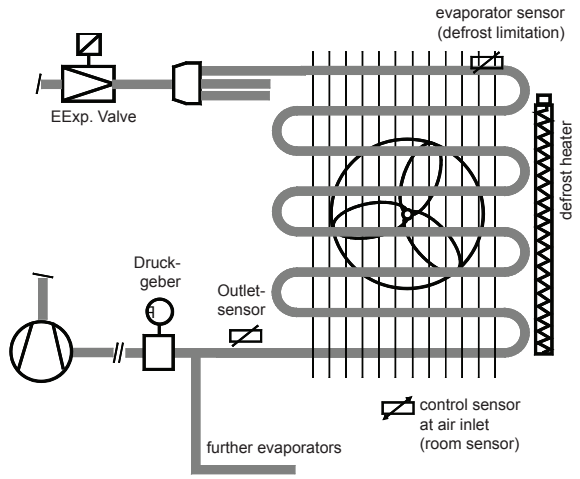
**This method is strongly recommended for single machines or plants with just a few evaporators. The compressor can be controlled by an external suction pressure switch or the cooling relay of the EVP. By this, special operating modes and an automatic "pumpdown" function are possible.**

Variable Overheat Control
If you get a difference by the settings of **P60** (Superheat, minimum value) und **P65** (Superheat, maximum value), then the superheat will be shifted by the control algorithm within the ON-point (setpoint+hysteresis **r10**) and the OFF-point (setpoint). If the function is disabled, the superheat value is determined by **P60** only.

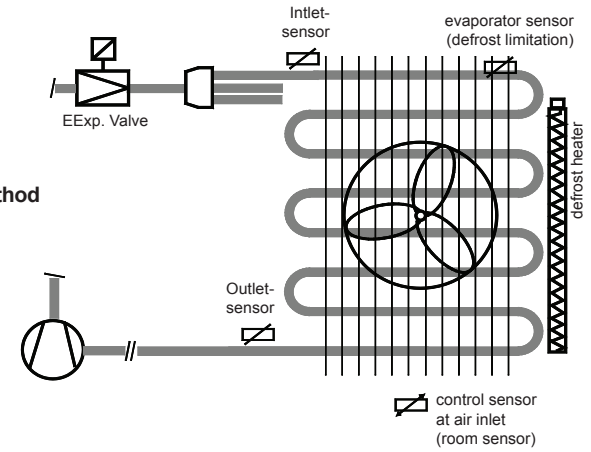
Function is disabled:
**P65** (Superheat, maximum value) exceeds **P60**.
Function enabled:
**P65** is below or equal to **P60**.

**Sensor Positions**

**Pressure Transmitter/ Temperatur Sensor method**




**2 Temperature Sensors method**




Parameterization

The following recommendations refer to the pressure transmitter "DG 0/10 HUB".

**L05** .....Display of the temperature which is calculated from pressure value and refrigerant
**P55** .....Method is active as soon as the used refrigerant is selected.
**P53** .....Lower limit of transmitter (-1.0, relative pressure)
**P54** .....Upper limit of transmitter (+9.0, relative pressure)
**P56** .....Lower voltage limit of the pressure transmitter input. (2V. Below this 2V, an error message is generated).
**P57** .....Upper voltage limit of the pressure transmitter input (10V).
**P60** .....Superheat setpoint, minimum value (depends on evaporator)
**P61** .....MOP-setpoint (Maximum Opening Pressure, i.e. limitation of the evaporation temperature at the outlet. Depends on compressor resp. plant).
**P65** .....Superheat setpoint, maximum value
The settings of **P60/P61** depend on the used compressor and the used evaporator.

**P62** .....P-Part of the Expansion Valve Control
**P63** .....I-Part of the Expansion Valve Control
The factory settings of P62/P63 are almost ideal for all kind of cold storages, changes must be made with care.
After this basic settings, all other relevant parameters must be set.

2. Temperature sensor method

To capture the superheat, 2 temperature sensors (TF 501) are used, one at the inlet and one at the outlet of the evaporator. For this method, no pressure information is necessary.

Parameterization

**P55** .....Must be set to 0, i.e. no refrigerant selected. Inlet- and outlet sensor must be assigned. No further parameterizing necessary, except standard settings.

### Limitation of the EEx-Valve Signal

With this function (**P66**) the maximum opening of oversized expansion valves can be limited. It affects on all possible expansion valve output signals:
- Analogue output assigned to an EEx-Valve
- Expansion valve relay

### Actuating Variable Delay for EEx-Valves

**P67** (setep size) and **P68** (output delay) affect as actuating variable delay for the Electronic Expansion Valve, both for the analogue output as well as the relay output. The OFF-value (0%) will be initiated immediately with:
- Controller OFF
- Defrost initiation

### Information

Parameter "**L42**" (Actual Values Page) shows the state of the EEx-valve permanently.

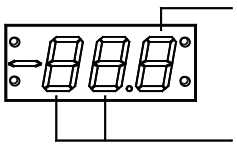
## Defrost

The EVP allows several, different defrost methods. Up to 3 defrost relays can be assigned. This relay output(s) then control an electric heater or fan which defrost the evaporator(s).
Each evaporator with electric heater is monitored by a defrost termination sensor.
According to the application, the fan can stop or run during the defrost cycle.

- **d02**" (Defrost Page) fixes the defrost initiation mode.
  - "**Etn**" : Defrost is initiated by a digital input
  - "**Int** : Defrost can be initiated by digital input or the internal time-switch.
  - "**AdA**": Defrost is controlled by the intelligent (adaptive) defrost algorithm

Electric defrost heaters are always switched by the N/O contact of the defrost relay. "**L33**" shows the remaining time up to the end of the defrost cycle.

Defrost release by internal timer
With parameters "**d11**"..."**d16**" (Defrost Page) you set six (6) possible defrost release times. This points-in-time can be set in 10 minute steps only, that means a defrost time like 6:55 is impossible. Times on the display:



**3rd position =** Minutes x 10, that means no single minutes will be displayed

**1st/ 2nd position =** hours

The precondition for the start of a defrost cycle is that at least one of the defrost termination sensors detects a temperature below limitation temperature. If parameter **d02**" is set to "**Etn**" (external only), a defrost cycle cannot be initiated by the timer.

**Please note that this function differs with the 'adaptive' defrost method**

External (Remote) Defrost Initiation
To start de-icing by a digital input, note that mains phase has to be applied for 2 seconds minimum and last not longer than the shortest possible defrost cycle.

Break before defrost
Parameter '**d38**' (defrost page) effects a delayed energizing of the heater at the beginning of the defrost cycle. By this, the rest of the evaporators chillness can be blown to the storage.
The defrost heaters must deliver less energy, because the evaporator is already warmed up.

Defrost termination by temperature
The EVP controller is able to work with up to 3 defrost relays (= evaporators). Defrost is individually teminated for each defrost output by the corresponding defrost (evaporator) sensor. This evaporator sensor must be placed at a position where, by experience, ice remains the longest time. If the temperature rises at that position, the ice in the evaporator is probably melted completely.
A defrost cycle is completed as soon as the defrost sensor has reached the defrost limitation temperature "**d31**" (Defrost Page).
If 2 defrost sensors are assigned, both sensors must achieve the limitation temperature to terminate defrost.

Defrost termination by time
If no defrost sensors are assigned or if they are out of order, the defrost cycle will be terminated after "**d32**" (Defrost Page) has been run down. "**L33**" shows the remaining time up to termination.

Defrost termination time monitoring
The unit captures the number of defrost cyles which are terminated by time (min. 1 defrost term. sensor must be assigned). If the number of defrost cycles terminated by time exceed the number programmed by "**d37**" (Defrost Page) an alarm message will be generated. With this function, massive icing or defective defrost heaters can be recognized timely and reliable.

In case of airflow-defrost without evaporator sensor, this function must be disabled ("**oFF**"), because here every defrost will be terminated by timer and no alarm message is desired.

Cooling Delay (drain time)
After defrost is terminated, the solenoid valve keeps locked for the time set by "**d35**" (Defrost Page). "**L34**" shows the remaining time up to the restart of cooling.

Manual Defrost
A manual defrost initiation is possible at any time.
To start manual defrost:
Select "**d50**" (Defrost Page),
set it to "**on**" and confirm.
Stop manual defrost
Select "**d50**" (Defrost Page),
set it to "**oFF**" and confirm.

**Pulsed Defrost**

To save energy it's possible to work with a pulsed (switched in intervals) defrost function.
If the evaporator temperature is located within "**d34**" (Defrost Page) and the limitation temperature "**d31**" (the value of "**d34**" must be lower than limitation temperature), the controller determines about the optimal heat distribution in the evaporator depending on the gradients of the temperature. The heater will be switched on in controlled periods until the defrost limitation temperature is reached.

The result of this procedure:

- heat energy in the evaporator will be distributed much better
- defrost limitation temperature can be set to a lower value
- less of humidity in the chamber
- save of energy

## Intelligent Defrost (adaptive defrost) for Walk-In Coolers

### Main Characteristics

This defrost control method, developed in co-operation with the '*GÜNTNER*' company, fits especially for **cold stores** and freezers which are closed (like walk-ins).

It is **less efficient** in applications where the limitation sensor is located in the airflow (e.g. open chest freezers).

This technique **reduces significantly the amount of energy** the refrigeration plant needs.
Especially while **difficult situations** (like high air-humidity, in cool-down chambers, while long opening times of the door of the cold storage room, uneven feeding of the cold storage room, etc.) the adaptive method protects the evaporator from glaciation safely.
**Dynamic 'room-feeding' situations engage the controller to adapt itself to the new situation, without expensive adjustment by technical personnel.**

**Specialized sensors or additional probes are not required.**

### Parameterization is very easy:

- set parameter "**d02**" to value "**AdA**" (adaptive)
- set parameter "**d05**" (Defrost Page) to a value which is 2 or 3 times the normal defrost interval.
  Within this period the algorithm decides independly about the point in time to defrost. After the end of this period defrost starts in all cases.
- parameter "**d04**" (Defrost Page) shows the time up to the next defrost.
- parameters "**d34**" and "**d31**" define the range the heater will be pulsed within.

### Process Sequence

1. If [setpoint + hysteresis > 2,5°C] the controller uses the fan to reduce icing.
2. In the time period set by „**d05**" the controller decides itself if and at which moment a defrost cycle is necessary. If icing is detected, the controller prepares defrost and begins either immediately or at the next allowed defrost time.
3. Cooling stops, the fan goes on turning a certain time
4. The fan stops and the defrost heater starts
5. If several evaporators are installed, each one has its own defrost sensor and heater relay, so it is individually heated.
6. After achieving a defined evaporator temperature, the heater will be cut on/ off in calculated periods. The period lenghts depend on evaporator temperature.
7. Defrost heater cut off, limit temp. is reached.
8. Cooling and fan remain still off (drain time).
9. After the end of „**d35**" cooling starts, but the fan remains still off.
10. After end of „**r22**" the fan starts and normal refrigeration goes on.

**Refrigeration**
Even during normal operation the fan stays on after cut-off of cooling to reduce icing.

**Recognition of icing**
The more ice on the fins the more increases the difference of temperature between the roomsensor and evaporator sensor. The controller uses the value of these sensors, their difference, the historic curves of these values as well as curves and duration of the past defrostings to calculate the necessity of defrosting.

**Use of latent energy by airflow**
We recommend to use "**d03**" (defrost forerun, defrost page) to switch on the fan several minutes ahead the defrost cycle, while cooling stops and the heater is not yet on.
Additionally, the fan is switched on automatically at a certain difference between the sensors. By this, the „cooling-energy" is brought out of the evaporator and stored in the chamber. This helps also to reduce the amount of heat energy necessary to defrost.

**Defrost start**
If all six parameters release times are set to Off, the controller decides itself when it starts defrost.

- *Further time influence*
  If you want to prevent that defrost starts at certain day-times use all the defrost release times and set them to points in time where defrost is allowed. If no icing is detected, these times will be ignored.
  On the other hand, once icing detected, the controller will wait for the next defrost release time before starting a defrost cycle.
- *External command*
  Assign one of the digital inputs to "**deF**". By applying voltage to that input it is possible to start defrosting at every moment.

**Defrost heating**
When „**d34**" is achieved, the heater will be cut off. The heat energy of the resistances will dissipate slowly and melt the ice. The length of the cut-off is calculated by the controller and as soon as some criteria are fulfilled, it will switch on the heater again. The heater will be pulsed until the temperature of the evaporator sensor reaches the defrost limitation temperature "**d31**".
This procedure fits in the same way for the case of several evaporators in the chamber.
**By this way defrost period will take longer, but will be more efficient.**

**Special mode for room temperatures > 2,5°C**
Evaporators can be de-iced already at temperatures from 2°C by forced air. When cooling stops, fans are turning on until ice and frost are melted.
Thus humidity stays in the chamber which will improve the quality of certain goods like meat or vegetables.
Additonally to the compulsatory "*fan trailing delay*" (**r23**, fan is forced to continue turning after cooling reached the setpoint and stopped), the fan will turn from a specific temperature [setpoint + hysteresis => +2,5°C] until the evaporator sensor has reached a certain value.

- At room temperatures [setpoint+hysteresis => +2,5°C] notify to set parameter "**d05**" to a higher value, because a defrost start is forced if this time is past.

**Several evaporators in one chamber**
For certain plants it is necessary to use several evaporators in one chamber. The controller is able to control up to 4 evaporators in one chamber. Even in this case one unique room sensor is sufficient. E.g. for a chamber with 3 evaporators you need only 4 sensors:

- one controlsensor
- three defrost sensors (one for each evaporator)

If a defrost cycle is necessary, all evaporators will start defrost at the same time to avoid short circuit of air, when one is heating and the fan of another is turning. The one with the highest rate of icing determines the start of the defrost cycle. The EVP controller units are capable to **determine just this evaporator** and even to adapt it when conditions change.
Thus always the evaporator with the most ice initiates defrost start, nevertheless the quantity of energy which is necessary to defrost will be calculated for each evaporator separately.
To finish defrost cycle all evaporators must have reached the defrost limitation temperature.

**Emergency Operation Mode**
In cases the controller recognizes that it would be incapable or to slow to control the process, or when it gets not enough information, e.g.:

- charge of unusual very humid goods
- freezer door was open a very long time
- the evaporator is sprinkled with water
- sensor broken or shortened
- defrost terminated by the max. defrost time

the emergency operation starts.
To detect malfunction of the defrost control the unit uses the increasing of "**d05**".
If a defrost cycle is terminated by this time, the controller starts several defrost events with the interval corresponding to (¼) one quarter of the time programmed by "**d05**".

**Therefore be careful in choosing the time for this parameter.**

After the end of the disturbance the controller works on normally.

*Example*
Max time to defrost is set to 24 hours. If defrost is not terminated by the evaporator sensor, the controller will start defrost cycle every 24 / 4 = 6 hours until a cycle will be finished by the evaporator sensor and not by timer.
Independent from this procedure, a failure message will be initiated.

**End of defrost**
When the defrost sensor has reached the defrost limitation temperature "**d31**", the heater stops and the controller waits until "**d35**" has expired, to allow the melted water drop to the drainage.
While the following 'drain-on' time ("**r22**", Setpoint Page) cooling starts, but the fan still stay OFF to prevent that the fans blow warm and humid air or water drops into the chamber.

## Analogue Output

The analogue output can be used for regulation purposes or to provide a remote display with an actual value image. The signal is available as a DC-Voltage or a DC-Current-Signal, fixed by "**h51**" (Assignment Page).
Parameter "**L50**" (Actual Values Page) shows the current output signal as a %-part of the selected range, "**h52**" (Assignment Page) determines the behaviour of the output:

*Test functions*

**"h52" = "0"** output signal is 0V resp. 4 mA (fixed)
**"h52" = "100** output signal is 10V resp. 20mA (fixed)

*Transmission of actual values to remote displays or similar*
Copie de la mesure pour affichage déporté :
Cette fonction permet de copier la mesure actuelle de la sonde de régulation par l'entrée digitale (ex: pour un afficheur déporté). En temps normal, la sonde de régulation est utilisée. Si plusieurs sondes sont reliées au régulateur, la sonde indiquant la valeur la plus élevée sera utilisée pour la copie de mesure. Idem si des sondes virtuelles sont paramétrées.

**"h52" = "dIS"** The output provides an image of the value of cooling sensor 1.
U-output: -50°C = 0V, +100°C = 10V
I-output: -50°C = 4mA, +100°C = 20mA

*Control with the analog output signal (PID-control)*

**"h52" = "P"** PID-controller, whose output signal represents an addition of the components P, I, D and T1.
**"h52" = "Pr"** PID-controller like above, but with inverted output (rising temperature = falling signal).

To adapt the controller to the process use the following parameters:

**r51**" = PID proportional band, located symmetrically around setpoint 1
"**r52**" = PID-integral time (I-part)
**r53**″ = PID-derivative time (D-part)
**r54**″ = PID-actuator response time (T1-part)

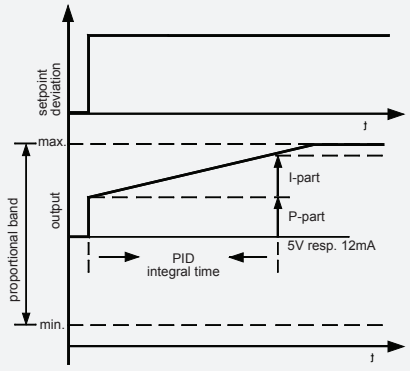
How to influence the analog output manually

For certain applications it may be useful to affect the output signal manually. Any digital input can be assigned to a function "**AnA**". Once activated, the analogue output delivers a predefined voltage- or current signal, e.g. to drive a valve to a specific position.

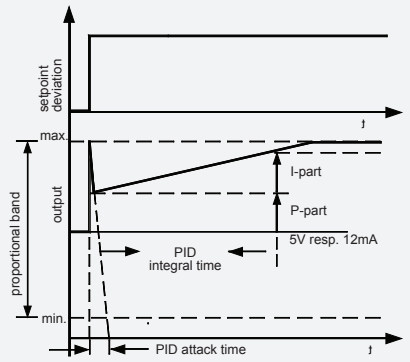
"**h61**" or "**h62**" set to "**AnA**" (Assignment Page)
= configure digital input 1 or 2
**r63**" (Setpoint Page)
= amount of the output in % of the selected range, if the digital input is activated.

*Example*:
Digital input OK/DI1 is configured at "**h61**" to the value "**AnA**", "**r63**" is set to "50".
If the analogue output works as voltage output, it delivers 5V DC. If it works as current output, it delivers 12 mA.

### Control Characteristic




PI-control, D and T1-parts de-activated




PID-control, T1-part de-activated

**Electronic Expansion Valves with analogue input**

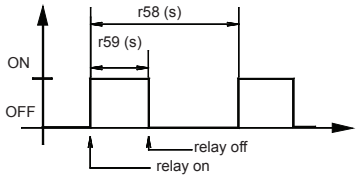
The analogue output is able to control expansion valves with analog input. Therefore, "**h52**" must be set to "**EEP**". Also in this case, "**h51**" serves as a switch for a voltage- or current output.

## Actuating Variable Delay for PID

For using control processes with large reaction times the controller offers an 'Actuating Variable Delay'.

1. Analogue Output
If the controller sends a signal which initiates the analogue output to rise or to fall, then an adjustable delay time (**r56**, Setpoint Page) starts. Within this time period, the output signal is able to alter only by a specific %-part (step size, **r57**).
If "**r57**" is set to "100%" and "**r56**" to "0", then the function is disabled.

2. Relay Output
In applications with motorized actuators, the Actuating Variable Delay takes effect by clocking the cooling resp. heating relays. If the controller sends a signal to initiate a relay permanently ON, an adjustable time period "**r58**" (Setpoint Page, Cooling/Heating Relay Time Period) starts. Within this period, the relay is engaged for the time set by "**r59**" (Setpoint page, Cooling/Heating Relay ON-Time).




If "**r59**" is equal to "**r58**" or exceeds it, then the function is disabled, the relay switch as normal again.

**Reaching the The OFF-value**

The OFF-value (0%) will be initiated immediately with:
- defrost initiation
- solenoid valve lock
- safety chain error
- controller OFF
- cooling OFF with an open door

**Important !!**

**Please note the decreased lifetime of the relay contacts in cycling operation. Please care for a suitable relief.**

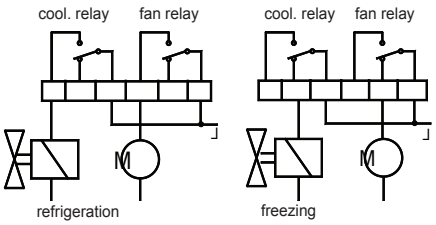
Cycle 40 sec.:
load current 0,8A res. --> 5 years
load current 1,2A res. --> 2,5 year
load current 1,9A res. --> 15 months

(Theoretical values according to the relays data sheet)

## Evaporator Fan Control

Each output relay can be configured for evaporator fan control. The fan control depends on the following parameters:

**P03** ..... (cooling mode, Mode Page)
"**reF**" = refrigeration, fan will be switched by the N/O-contact of the fan relay
"**FrE**" = freezing, fan will be switched by the N/C-contact




**P02** .... (fan operation, Mode Page), defines the characteristic of the fan during the cooling period.
"**Int**" = fan runs together with solenoid valve/compressor
"**PEr**" = fan runs continously while cooling
"**Add**" = Using of latency heat by a special fan control + "Special mode for room temperatures > 2,5°C", as described in chapter "Intelligent Defrost".

**d01** .... (fan during defrost, Defrost Page), defines the fan characteristic during the defrost cycle.
"**on**" = during defrost, fan runs continuously
"**off**" = fan is stopped during defrost.

Fan start-up (freeze-on) delay

The start-up time delay for the fan after defrosting is defined by parameter "**r22**" (Setpoint Page). This avoids that water drops will be blown into the chamber. "**L35**" (Actual Values Page) show the remaining time up to the fan will switch on.

Examples for fan operation modes

1. *fan in permanent mode*
   This mode is mainly used in refrigerated shelfs, refrigerated display counters and chest freezers
   - fan is directly connected to mains voltage, not connected to the controller unit
     *or*
   - a relay is reserved for fan control, "**P02**" is set to "**PEr**", "**d01**" is set to "**on**". Drain-time "**d35**" is set to "0".
2. *fan interval mode, defrost by fan*
   A relay is reserved for fan control, "**P02**" is set to "**Int**", "**d01**" is set to "**on**".
3. *fan interval mode, defrost by electric heater/ hot gaz:*
   A relay is reserved for fan control, "**P02**" is set to "**Int**", "**d01**" is set to "**oFF**". The fan runs while cooling is on, will be disabled during defrost periods and comes on after defrost with a time delay set by parameter "**r22**".
4. *fan in permanent mode and defrost by electric heater*
   A relay is reserved for fan control, "**P02**" is set to "**PEr**", "**d01**" is set to "**oFF**". The fan will run continously and stops during a defrost period only.

### Chances to exploit Latency Heat

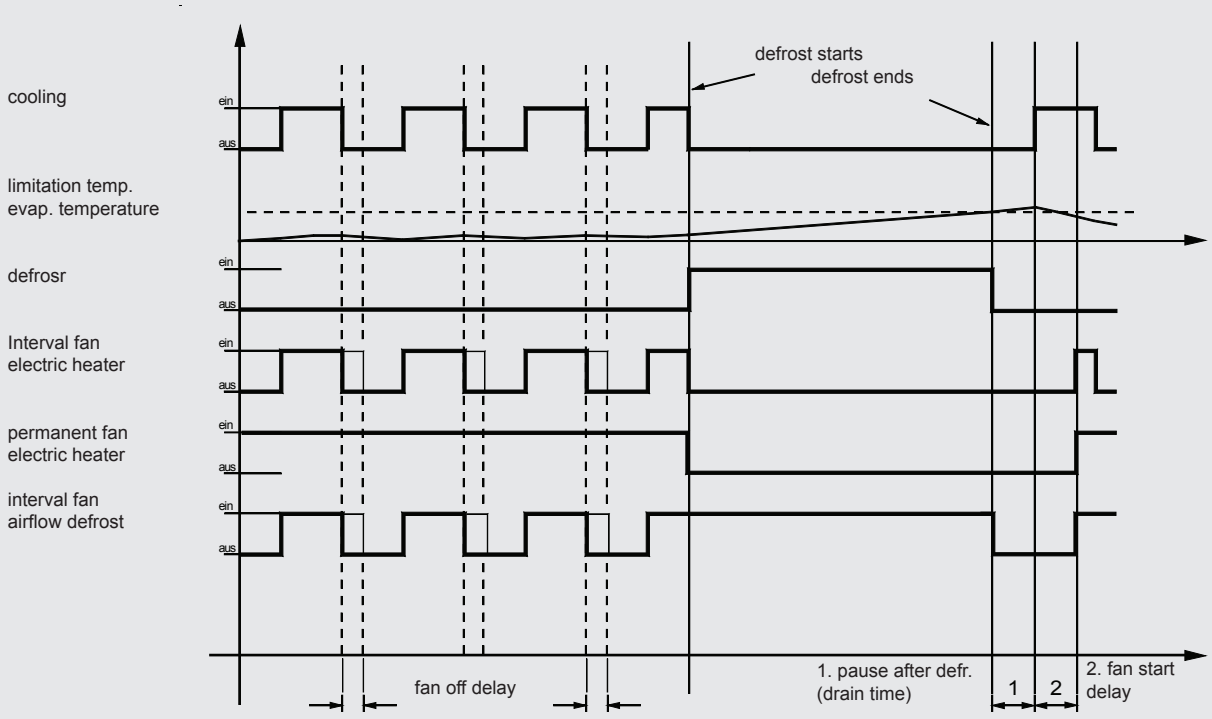
**1. Fan operation mode P02 = "Add"**

If temperature falls, cooling and fan will stop with reaching the control setpoint.
If the room temperature rises to a value equal to *Control Setpoint + 1/2 Hysteresis*, the fans restart under the condition that the temperature of the evaporator (detected with limitation sensor) is lower than *Control Setpoint - 1/2 Hysteresis*. So remaining chillness will be blown into the room which reduces the number of compressor starts.

**2. Fan trailing delay**

To utilize latent energy, the fan is able to run for up to further 30 minutes after the cut-off of valve or compressor ("**r23**", Setpoint Page).

### Fan operation modes, defrost termination using electric heaters



## Roller Blind Control

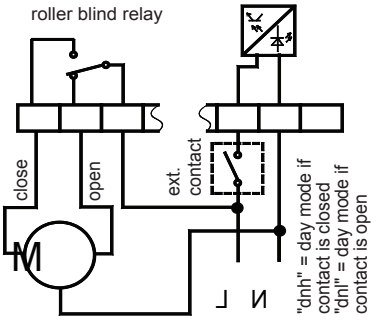
To enable the EVP to control roller blinds automatically, it is necessary to assign the function "**roL**" to a relay output. The roller blind control is coupled to the day/night-mode, so the blind will be closed in night-mode. Defrosting overrides this function and opens the roller blind during a defrost period.

Internal control:

No digital input has got the functions "**dnL**" or "**dnh**", but if yet, the input must be set to day-mode. The switch times "**P21**" (night operat. ON) and "**P22**" (night operat. OFF, Mode Page) must be programmed.
Day-Mode: Roller blind relay is de-activated, so the motor will turn the blind to the 'open'-position via the relay's N/C contact.
Night -Mode: Roller blind relay will be activated to close the blind via the N/O contact of the relay.

External control

A digital input has got the function "**dnL**" or "**dnh**". Switch times "**P21**" and "**P22**" (night operation on/off) must be set to "**oFF**".

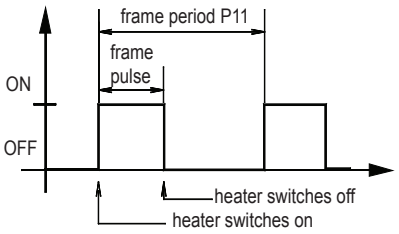



If the digital input is activated, the relay switches on and closes the roller blind. After de-activating the digital input, the relay switches off and opens the roller blind via its N/C-contact.

## Frame Heater control

Frame heaters are used to avoid a door freezing onto the door frame. In addition it prevents condensing water around the door or on top of the frames of open chest freezers.
If one of the relays is assigned to "**FrA**", this will control the frame heater energy with a certain frequency and pulse-width. For day and night operation you can choose different values to save energy. The corresponding parameters on Mode Page are:

- "**P11**" defines the duration of the cycle,
- "**P12**" defines the percentage of heating during day operation within each cycle. 100% = continuous heating, 0% = off
- "**P13**" defines the percentage of heating during night operation within each cycle. 100% = continuous heating, 0% = off
- "**P14**" shows the current active ON-time of the heating, which may varied by a VPR host system.




Power Optimization

To optimize the power requirement of the connected heaters, the controller is able to adapt the pulse ratio (within a specific range) to the current humidity of the ambient air (market temperature). The information about current market temperature and humidity the controller gets from a superior system (VPR 5xxx) to calculate the absolute humidty.

Limit values

- Temperature: 19-24°C
- Air Humidity: 40-70% r.H.

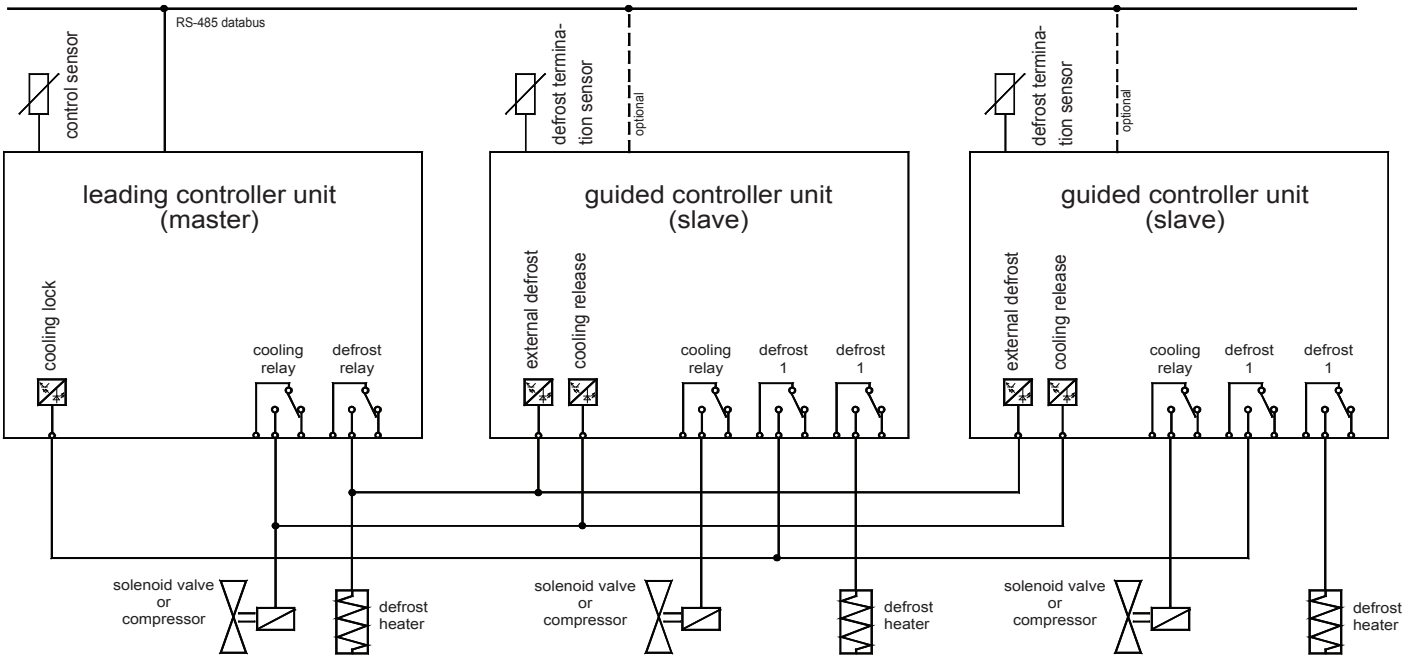
At the upper limit, the pulse ratio is equivalent to the value set by P11...P13. At the lower limit, the ON-time decreases by the half value.

## Cascading controller units to extend cold storages

To control multiple evaporators, any number of EVP-units can be added. The units transmit their information via the cooling/defrost relay(s) and the digital inputs with the functions 'cooling lock' and 'forced cooling'.
Each digital input can be assigned to this functions:

- **rLL** (cooling lock, active low): Cooling function of the unit is disabled if no voltage is present at the digital input
- **rLH** (cooling lock, active high): Cooling function of the unit is disabled if the digital input is connected to mains phase
- **rFL** (cooling release, active low): Cooling function of the unit is released if no voltage is present at the digital input
- **rFH** (cooling release, active high): Cooling function of the unit is released if the digital input is connected to mains phase

Principle of cascading:




The leading EVP-unit releases the cooling function of the 'slaves' via their input "cooling release". The 'slave' units lock the cooling function of the master unit via its input 'cooling lock', as long as a defrost cycle works.

## Networking of controllers via *E-LINK*

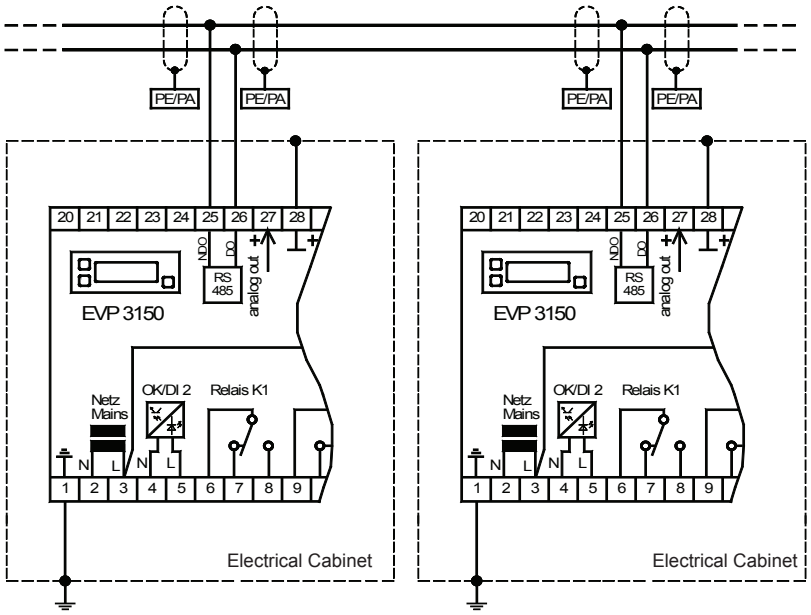
The EVP can be networked together with other ELREHA control devices via an RS-485-2-wire databus, which enables up to 78 controllers to communicate. For communication, the *E-LINK* transmission protocol is used.
Each controller in a network has its individual address ("**P90**", Mode Page). The data transmission rate is factory set to "Aut(o)", this means that it will be identified automatically. If necessary, the rate can also be set manually ("**P91**", Mode Page).
This address is necessary for selecting the right controller when a data package is transmitted on the network bus. If the controller is used outside a network, these parameters are of no importance.

**Remote control at Frontend Systems**
EVP controllers can be operated remotely via interface when they are connected to Frontend Systems such as SMZ or VPR.
In this case, the Frontend System shows the EVP's display contents and the keys of the frontend work as if they where the keys of the EVP.

**Configuration / Service via PC**
The controller can be linked to a PC via its RS-485 interface. By using the PC-software „Coolvision-MES", parameters can be changed, they can be saved to the hard disk (download) and can be send to other controllers (upload).
To do this, the PC must be equipped with an RS-485 interface (internal card or an converter of the SSC-series).

## Wiring of data lines

The scheme beside shows briefly, how dataline wiring of several controllers is made. At each controller, the shield has to be connected to the nearest ground terminal. Also the ground connector of the controller and terminal #28 must be connected to the nearest ground terminal.
This will assure good interference suppression, even for long datalines between the controllers.




## Communication with the VPR Compound Controller System

The EVP-controller can be used as intelligent cold storage controller in co-operation with the compound control system VPR.
In this case, the VPR central processing unit monitors the EVP.

When the EVP's are connected to the compound controller, each one needs an individual address ("**P90**", Mode Page)

For the EVP's there is a possibility of assigning each controller to a certain compound ("**P01**", Mode Page). This enables the VPR to transmit specific information to the cold storage controllers assigned to the compound where a failure occurs. Additionally, the information exchange allows different optmizing methods for suction and condensing control.
More detailed information you will find in the technical manuals of the VPR compound systems.

Behavior in case of a compound failure

If an EVP is assigned to a certain compound and a disturbance occurs, the unit responds as follows:

- The solenoid valves close
- The fan switches off
- A defrost will be terminated. A new defrost period is only possible after the compound problem is solved.
  To see if this function is released, look at "**L41**" (Actual Values Page).
  "**0**" = solenoid valve closed
  "**1**" = solenoid valve open
  "**oFF**" = solenoid valve closed via interface

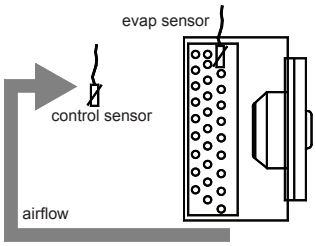
Data transmission disturbances

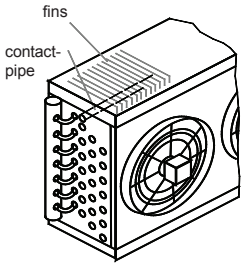
If the controller gets no new information from the VPR, it continues working with the current settings.
If there was an order from the VPR to close the solenoid valves and a technical defect interupts the data transmission for more than 30 minutes, the EVP ignores this order and starts working normally.
When data transmission is restored, the EVP will work again immediately according to the commands of the VPR.

## Sensor Positions

Sensor positions are not critical in standard applications. The **control sensor** or **alarm sensor** has to be fixed behind the evaporator (air-inlet) or at a representative place in the chamber, but not in the air outlet.

The second sensor (**defrost term-ination sensor, evaporator sensor**) should be assembled in the contact pipe or within the fins of the evaporator. A good thermal exchange to the fins is important. It should be placed at the position where the ice remains the longest time while a defrost cycle.




Sensors for intelligent (adaptive) defrost
To detect icing the EVP doesn't need additional sensors. The control sensor and the defrost (evap.) sensor are sufficient. Please note that the emergency defrost mode is not able to prevent ice-clusters or slow glacieration in case of a incorrect sensor position. If ice-clusters appear, the defrost sensor must be placed at this position.

**Notice** **After start-up, Please check the position of the evaporator sensors accurately!!**

## Installation / Start-Up

Upon applying voltage to the controller, after a few seconds the display shows the parameter which is selected as permanent display or an actual error code.

Start-up sequence
- Assign inputs/outputs to functions (see example on page 3)
- Select type of used temperature sensors ("**P35**", Mode Page), use TF 501 types for EEx-valves.
- Correct the displayed temperature values if necessary ("**P31**"-"**P34**", Mode Page).
- Set date and time ("**P81**"-"**P87**", Mode Page)
- Set defrost mode ("**d02**", Defrost Page)
- Set fan mode "**d01**" and "**P02**"
- Set cooling mode "**P03**" (Mode Page)
- See page 9 for parameterization of the pressure transmitter inputs

These are the most important steps for the basic configuration of the controller. Upon that, adapt the other parameters like temperature setpoint, hysteresis, delay times.... Refer to the previous chapters in this manual.

Start-up in a data network
- Set the address of the controller ("**P90**", Mode Page)
- Upload parameters from PC to controller

The EVP offers several status messages, which enables you to check the states of inputs and outputs:

- "**L50**", value of the analogue output
- "**L60**", state of the digital inputs DI1 and DI2
- "**L61**", state of the relays

### Sensor positions for EEx-Valve Control, Pressure Transmitter / Temperature Sensor Method

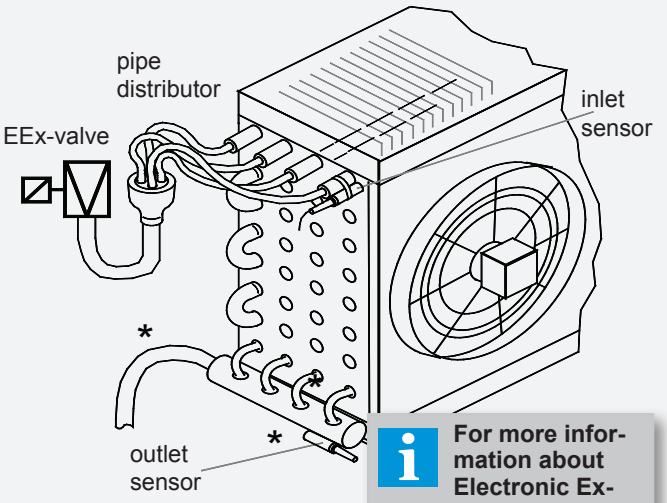
The pressure transmitter must be mounted at the suction pipe, at a position where no pressure decrease can affect the measuring. The best place is close to the evaporator. If there are several evaporators, select a position from where the distance to all evaporators is as short as possible.

Selection of Pressure Transmitter
To detect a pressure transmitter malfunction, the signal voltage input is scalable. So you can use e.g. transmitters with an 2...10V output which makes it easier to recognize a malfunction.

### Number of controllers working with the same pressure transmitter

The input resistance of the pressure transmitter input is 80 kOhm. Several inputs can be connected in parallel, but the resulting resistance must not fall below the minimum specifications of the used pressure transmitter. In practise, up to 10 controllers mostly work trouble-free.

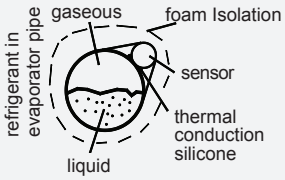
### Sensor positions for EEx-Valve control, Temperature Sensors Method




**For more information about Electronic Expansion Valves see page 9 !**

* = alternative positions for Outlet-Sensor

**Please care for a good isolation by foamed material, so that none of the sensors get contact with the airflow.**




Pipe mounting
Most expedient is it to use **cable fixers**, some thermal conduction silicone cares for a good thermal flow.
Metallic fixers with high mass are not qualified.





| original set up: 29.10.10, tkd/jr | checked: 18.11.10, ek/jk | approved: | translated: 4.1.10, tkd/jr | corr.: 5.11.13, tkd/jr |
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