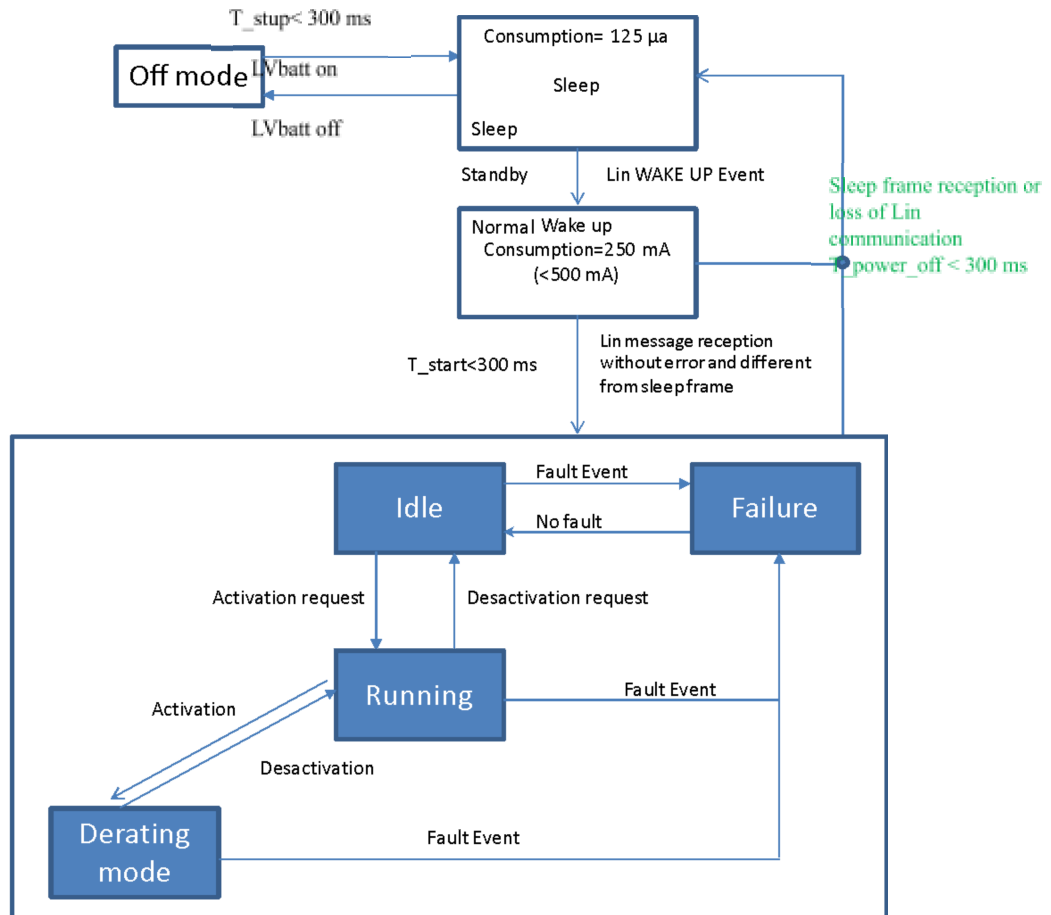


SYSTEM STATES

1.1. Overall Description



1.2. States and Transitions

1.2.1. States and Transitions

1.2.1.1. *Off Mode*

The product is not powered on LV. The LIN communication network is deactivated (no frames). The product is switch off. The product doesn't do any think in this phase.

1.2.1.2. *Sleep Mode*

The product is powered on LV. The LIN communication network is deactivated (no frames). The initialization phase of the micro controller is done. In this mode the product is able to make their internal diagnostic and detect any activity on LIN network.

1.2.1.3. *Idle Mode*

The product is supplied by LV and LIN communication is activated (by frames) and configured. The product is ready to start when he receive the request. The product is able to do internal diagnostic in this phase.

1.2.1.4. *Running Mode*

The product is supplied by LV and HV battery. The Lin communication is also activated. In this phase the product receive the request to activate the compressor and manage the motor to achieve the speed target. The product is able to do internal diagnostic in this phase.

1.2.1.5. *Failure mode*

The product is supplied by 12 V, the Lin communication is activated (activated use frame). The product has logged and internal or external fault. The speed is decreased from a threshold speed to 0 rpm and the fault type will be identified on the Lin network.

In this mode the product should be able to make their internal diagnostic.

The product should go on modes:

- Power off mode when request is received on Lin network (if Lin network is available)
- Idle mode if the logged defect disappears
- Off mode if network isn't available

1.2.1.6. *Power off mode description*

The product is power on LV network. The product receives the request to switch off. So the transceiver is deactivated. The contain is stored on EEPROM. In this mode the product doesn't do anything. The product could go on mode off only when LV is switch off.

1.2.1.7. *Derating mode*

The product is powered by LV network and HV network and he is in idle mode–running. The product switch in derating mode when:

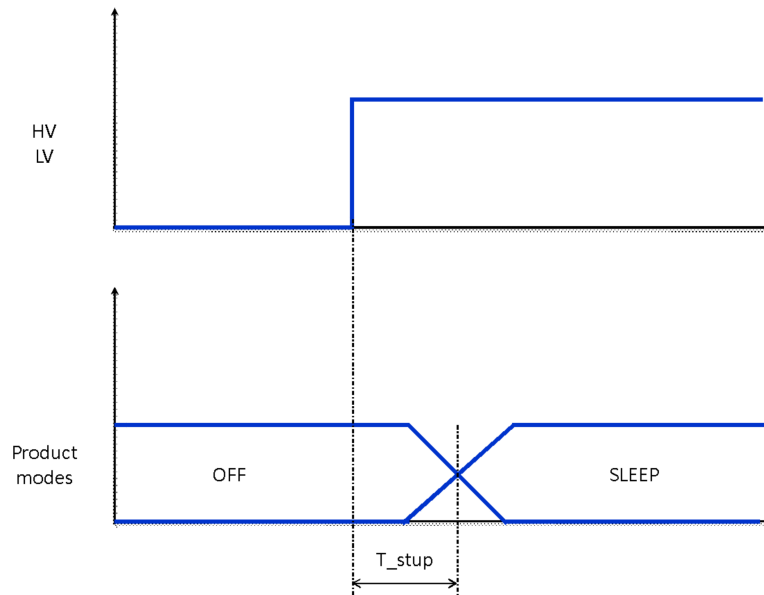
- High voltage decrease under a threshold voltage which allow the product to operate at nominal
- Over load if the load achieve the limitation of the product
- Temperature if the temperature of product achieve high level than threshold value

1.3. Transitions

The aim of this section is to specify and clarify the transition

1.3.1. Switch on description

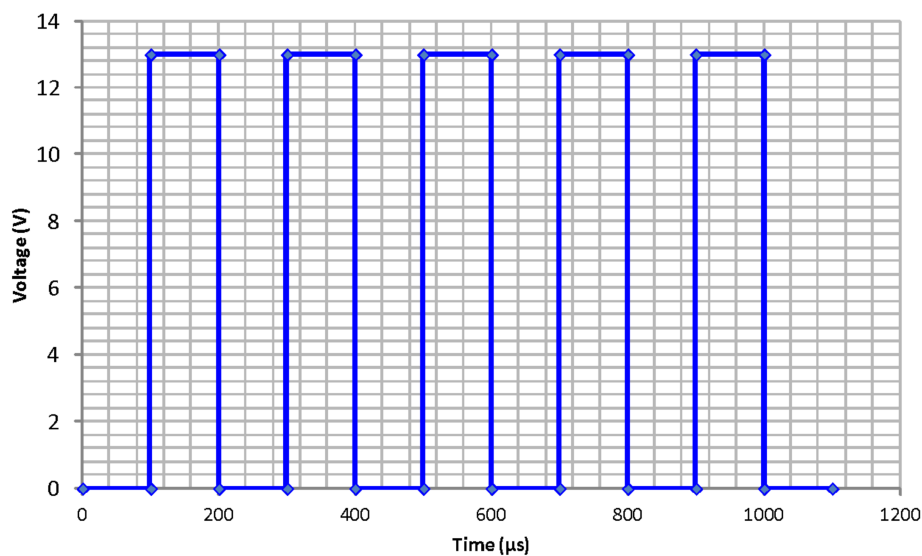
The product starts up from product power on as follow. After sleep mode the product stays in this mode until he receive first Lin frame. On product power on (12 V power supply on) the product go in sleep mode after $T_{\text{stup_on}}$ time.



The wake up duration should not exceed $t_{\text{stup}} = 300$ ms. Time t_{stup} is measured between rising edge on LV network input and the end of the initialization of the microcontroller.

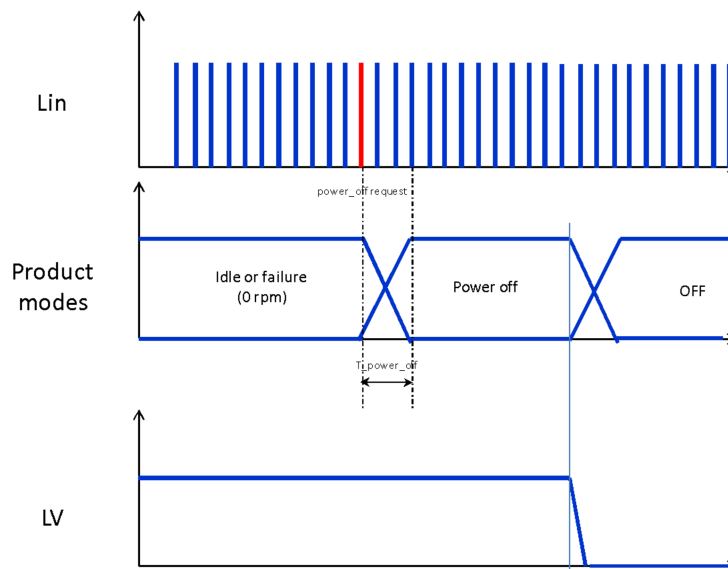
In sleep mode the product shall be able to detect an activity on the Lin and activate the transceiver Lin.

The inverter should be compliant with 120000 start-up sequences according to the figure below



1.3.2. Switch off description

The product shut- down is managed as follow:



Compressor consumption (LV) is stopped in less than 100ms after EL_CMD_ACTIVATION_CPR_ELEC value switches to « Compressor OFF ».

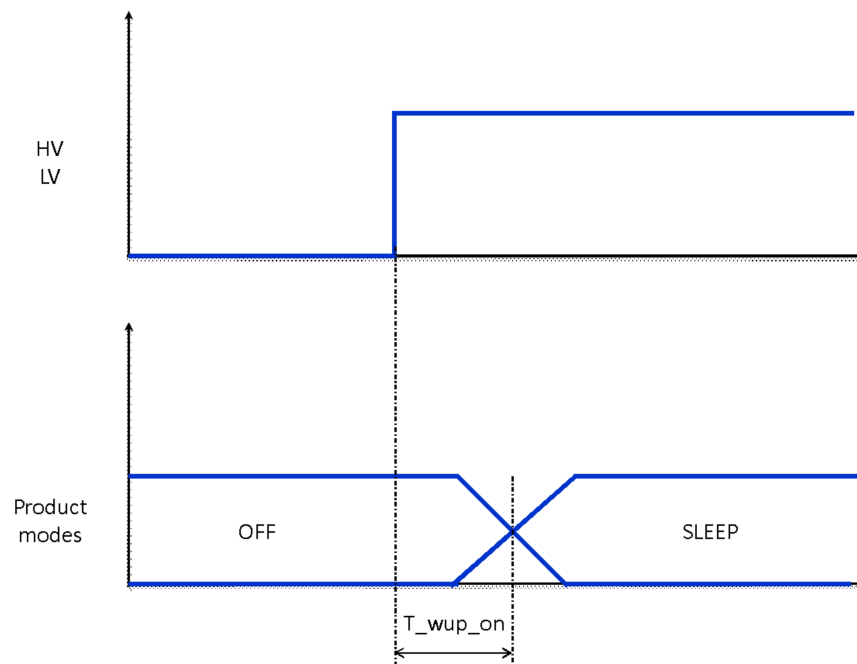
The product shall record the parameters and diagnosis used for maintenance and expertise into

Permanent memory during the shutdown sequence:

- All default status mentioned in LIN frame requirement
- Temperature level of the compressor

1.3.3. Sleep to idle transition description

The wakeup should be as follow:



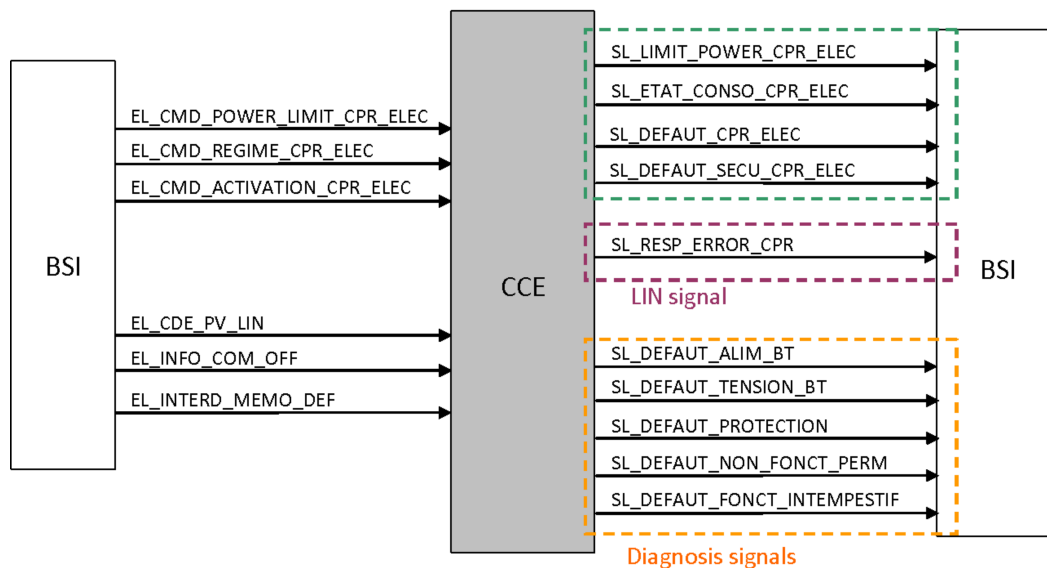
The transition «LIN network wake up event of the TS Network Life Phase corresponds to the detection of a network activity. The time should be equal to 300 ms

When the component is powered but not ordered, the variation of its current consumption on +LIN supply is lower than 5%.

2. PRESENTATION OF THE SYSTEM

2.1. Communication Protocols

The compressor is a slave ECU of the LIN 2.1 Network. according ISO 11898-2-2003.
The diagram of frame communication is show below:



The Lin frame communication will be described below:

- This part describes all of functional frames produced by the ECU (inverter of compressor).

Mnémonique de la trame / Frame mnemonic	Ident.	Long. / Lgth	Lmin	Type READ	Mode
ETAT CPR	0x12	6		Lecture	Inconditionnel

ETAT CPR	
Octet	Mnémonique de regroupement / mnemonic group
1 à 2	données compresseur élec.
2 à 4	défaut
5	response error
5 à 6	données compresseur élec.

données compresseur élec.			
Bit	Signal	Description	Codage / Coding
			Valeurs spécifiques et par défaut / Specific and default values

1.0 à 2.0	I_CONSO_CPR_ELEC	Consommation compresseur <i>Compressor consumption</i>	UNM-9 Resolution : 0.1 Offset : 0 A Min : 0 A Max : 50 A Invalide : 0x1FF Unite : A	PROD_INIT : 0x1FF
2.1	LIMIT_POWER_CPR_ELEC	Puissance maximum atteinte <i>Maximum power reached</i>	0 = Limite non atteinte 1 = Limite atteinte <i>0 = limit not reached 1 = limit reached</i>	PROD_INIT : 0
2.2	DEFAULT_CPR_ELEC	Défaut compresseur non sécuritaire <i>Compressor non safety default</i>	0 = pas de défaut 1 = défaut <i>0 = no default 1 = default</i>	PROD_INIT : 0
2.3	DEFAULT_SECU_CPR_ELEC	Défaut compresseur sécuritaire <i>Compressor safety default</i>	0 = pas de défaut 1 = défaut <i>0 = no default 1 = default</i>	PROD_INIT : 0

défaut				
Bit	Signal	Description	Codage / Coding	Valeurs spécifiques et par défaut / Specific and default values
2.4 à 2.7	DEFAULT ALIM_BT	Défaut alimentation BT <i>power low voltage default</i>	0b0000 = Diagnostic non encore réalisé 0b0001 = Pas de défaut 0b0010 = Invalide 0b0011 = Invalide 0b0100 = Invalide 0b0101 = Invalide 0b0110 = Invalide 0b0111 = Invalide 0b1000 = Absence de signal 0b1001 = Cohérence 0b1010 = CC+ (Court Circuit au +Bat) 0b1011 = CCM (Court circuit à la masse) 0b1100 = CO (Circuit Ouvert) 0b1101 = Butée basse 0b1110 = Butée haute 0b1111 = Défaut non caractérisé 0b0000 = <i>Diagnostics not carried out</i> 0b0001 = <i>No fault</i>	PROD_INIT : 0b0

			<i>0b0010 = Invalid</i> <i>0b0011 = Invalid</i> <i>0b0100 = Invalid</i> <i>0b0101 = Invalid</i> <i>0b0110 = Invalid</i> <i>0b0111 = Invalid</i> <i>0b1000 = Lack of signal</i> <i>0b1001 = Consistency</i> <i>0b1010 = CC+ (Short Circuit at +Bat)</i> <i>0b1011 = CCM (Short circuit to the ground)</i> <i>0b1100 = CO (Open Circuit)</i> <i>0b1101 = Lower stop</i> <i>0b1110 = Upper stop</i> <i>0b1111 = Fault not characterized</i>	
3.0 à 3.3	DEFAULT_TENSION_BT	Défaut sous-tension ou sur-tension BT <i>undervoltage or overvoltage LV fault</i>	0b0000 = Diagnostic non encore réalisé 0b0001 = Pas de défaut 0b0010 = Invalide 0b0011 = Invalide 0b0100 = Invalide 0b0101 = Invalide 0b0110 = Invalide 0b0111 = Invalide 0b1000 = Absence de signal 0b1001 = Cohérence 0b1010 = CC+ (Court Circuit au +Bat) 0b1011 = CCM (Court circuit à la masse) 0b1100 = CO (Circuit Ouvert) 0b1101 = Butée basse 0b1110 = Butée haute 0b1111 = Défaut non caractérisé <i>0b0000 = Diagnostics not carried out</i> <i>0b0001 = No fault</i> <i>0b0010 = Invalid</i> <i>0b0011 = Invalid</i> <i>0b0100 = Invalid</i> <i>0b0101 = Invalid</i>	PROD_INIT : 0b0

			<i>0b0110 = Invalid</i> <i>0b0111 = Invalid</i> <i>0b1000 = Lack of signal</i> <i>0b1001 = Consistency</i> <i>0b1010 = CC+ (Short Circuit at +Bat)</i> <i>0b1011 = CCM (Short circuit to the ground)</i> <i>0b1100 = CO (Open Circuit)</i> <i>0b1101 = Lower stop</i> <i>0b1110 = Upper stop</i> <i>0b1111 = Fault not characterized</i>	
3.4 à 3.7	DEFAULT_PROTECTION	Défaut mise en protection (T°, courant, surcharge, couple bloqué) <i>protection fault</i>	0b0000 = Diagnostic non encore réalisé 0b0001 = Pas de défaut 0b0010 = Invalide 0b0011 = Invalide 0b0100 = Invalide 0b0101 = Invalide 0b0110 = Invalide 0b0111 = Invalide 0b1000 = Absence de signal 0b1001 = Cohérence 0b1010 = CC+ (Court Circuit au +Bat) 0b1011 = CCM (Court circuit à la masse) 0b1100 = CO (Circuit Ouvert) 0b1101 = Butée basse 0b1110 = Butée haute 0b1111 = Défaut non caractérisé <i>0b0000 = Diagnostics not carried out</i> <i>0b0001 = No fault</i> <i>0b0010 = Invalid</i> <i>0b0011 = Invalid</i> <i>0b0100 = Invalid</i> <i>0b0101 = Invalid</i> <i>0b0110 = Invalid</i> <i>0b0111 = Invalid</i> <i>0b1000 = Lack of signal</i>	PROD_INIT : 0b0

			<p> <i>0b1001 = Consistency</i> <i>0b1010 = CC+ (Short Circuit at +Bat)</i> <i>0b1011 = CCM (Short circuit to the ground)</i> <i>0b1100 = CO (Open Circuit)</i> <i>0b1101 = Lower stop</i> <i>0b1110 = Upper stop</i> <i>0b1111 = Fault not characterized</i> </p>	
4.0 à 4.3	DEFAULT_NON_FONCT_PERM	<p> Défaut interne entraînant un non fonctionnement permanent <i>internal fault induce permanent no working</i> </p>	<p> <i>0b0000 = Diagnostic non encore réalisé</i> <i>0b0001 = Pas de défaut</i> <i>0b0010 = Invalide</i> <i>0b0011 = Invalide</i> <i>0b0100 = Invalide</i> <i>0b0101 = Invalide</i> <i>0b0110 = Invalide</i> <i>0b0111 = Invalide</i> <i>0b1000 = Absence de signal</i> <i>0b1001 = Cohérence</i> <i>0b1010 = CC+ (Court Circuit au +Bat)</i> <i>0b1011 = CCM (Court circuit à la masse)</i> <i>0b1100 = CO (Circuit Ouvert)</i> <i>0b1101 = Butée basse</i> <i>0b1110 = Butée haute</i> <i>0b1111 = Défaut non caractérisé</i> <i>0b0000 = Diagnostics not carried out</i> <i>0b0001 = No fault</i> <i>0b0010 = Invalid</i> <i>0b0011 = Invalid</i> <i>0b0100 = Invalid</i> <i>0b0101 = Invalid</i> <i>0b0110 = Invalid</i> <i>0b0111 = Invalid</i> <i>0b1000 = Lack of signal</i> <i>0b1001 = Consistency</i> </p>	<p>PROD_INIT : 0b0</p>

			<i>0b1010 = CC+ (Short Circuit at +Bat) 0b1011 = CCM (Short circuit to the ground) 0b1100 = CO (Open Circuit) 0b1101 = Lower stop 0b1110 = Upper stop 0b1111 = Fault not characterized</i>	
4.4 à 4.7	DEFAULT_FONCT_INTEMPESTIF	Défaut interne entraînant un fonctionnement intempestif internal fault induce untimely working	0b0000 = Diagnostic non encore réalisé 0b0001 = Pas de défaut 0b0010 = Invalide 0b0011 = Invalide 0b0100 = Invalide 0b0101 = Invalide 0b0110 = Invalide 0b0111 = Invalide 0b1000 = Absence de signal 0b1001 = Cohérence 0b1010 = CC+ (Court Circuit au +Bat) 0b1011 = CCM (Court circuit à la masse) 0b1100 = CO (Circuit Ouvert) 0b1101 = Butée basse 0b1110 = Butée haute 0b1111 = Défaut non caractérisé <i>0b0000 = Diagnostics not carried out 0b0001 = No fault 0b0010 = Invalid 0b0011 = Invalid 0b0100 = Invalid 0b0101 = Invalid 0b0110 = Invalid 0b0111 = Invalid 0b1000 = Lack of signal 0b1001 = Consistency 0b1010 = CC+ (Short Circuit at +Bat)</i>	PROD_INIT : 0b0

			<i>0b1011 = CCM (Short circuit to the ground) 0b1100 = CO (Open Circuit) 0b1101 = Lower stop 0b1110 = Upper stop 0b1111 = Fault not characterized</i>	
--	--	--	--	--

response error				
Bit	Signal	Description	Codage / Coding	Valeurs spécifiques et par défaut / Specific and default values
5.0	RESP_ERROR_CPR	Esclave contient une erreur dans le champ response <i>Slave node contains an error in the frame response</i> Esclave contient une erreur dans le champ response <i>Slave node contains an error in the frame response</i>	0 = aucune erreur détectée 1 = erreur détectée <i>0 = no detected error 1 = detected error</i>	PROD_INIT : 0

données compresseur élec.				
Bit	Signal	Description	Codage / Coding	Valeurs spécifiques et par défaut / Specific and default values
5.1 à 5.7	TENSION_LV_CPR_ELEC	Mesure tension BT compresseur <i>Compressor power High voltage</i>	UNM-7 Resolution : 5 Offset : 0 V Min : 0 V Max : 630 V Invalide : 0xFF Unite : V	PROD_INIT : 0xFF
6.0 à 6.7	ETAT_REGIME_CPR_ELEC	Lecture vitesse régime compresseur <i>Compressor speed state</i>	UNM-8 Resolution : 50 Offset : 0 tr/min Min : 0 tr/min Max : 12700 tr/min Invalide : 0xFF Unite : tr/min	PROD_INIT : 0x00

Consumed frames:

Mnémonique de la trame / frame mnemonic	Ident.	Long. / Lgth	Lmin	Type WRITE	Mode
CDE CPR CTP	0x11	4		Ecriture	Inconditionnel
CDE RESEAU LIN 3	0x3B	8		Ecriture	Inconditionnel

Control frame

commande CCE				
Bit	Signal	Description	Codage / Coding	Valeurs spécifiques et par défaut / Specific and default values
1.7	CMD_ACTIV_CPR_ELEC	Activation du compresseur <i>Compressor activation</i>	0 = pas de pilotage 1 = pilotage <i>0 = no control 1 = control</i>	CONS_INIT : 0 TT_MODE_DEG_CONS : 0
2.0 à 2.7	CMD_PWR_LIM_CPR_ELE C	Puissance maximum compressor <i>Compressor maximum power</i>	UNM-8 Resolution : 40 Offset : 0 W Min : 0 W Max : 10160 W Invalide : 0xFF Unite : W	CONS_INIT : 0x0 TT_MODE_DEG_CONS : 0xFF
3.0 à 3.7	CMD_REGIME_CPR_ELEC	Commande régime compresseur <i>Compressor speed command</i>	UNM-8 Resolution : 50 Offset : 0 tr/min Min : 0 tr/min Max : 12700 tr/min Invalide : 0xFF Unite : tr/min	CONS_INIT : 0x0 TT_MODE_DEG_CONS : 0xFF

Ident.	Long. / Lgth	Lmin	Type	Mode	Prod/Cons
0x3B	8		Ecriture WRITE	Inconditionnel	Consommée / Consumed

CDE RESEAU LIN 3	
Octet	Mnémonique de regroupement / mnemonic group
1	Commandes phases de vie
2	Etat du réseau
3 à 8	NON CONSOMME / NOT CONSUMED

Commandes phases de vie				
Bit	Signal	Description	Codage / Coding	Valeurs spécifiques et par défaut / Specific and default values
1.0 à 1.7	CDE_PV_LIN	Commande réseau LIN <i>LIN network command</i>	0x00 = Préparation à la mise en veille 0x01 = Autorisation du réveil 0xAUTRES = Réservés 0xFF = Invalide <i>0x00 = Preparing for shift to standby 0x01 = Waking authorized 0xAUTRES = Reserved 0xFF = Invalid</i>	CONS_INIT : 0x01 TT_MODE_DEG_CONS : 0x00

Etat du réseau				
Bit	Signal	Description	Codage / Coding	Valeurs spécifiques et par défaut / Specific and default values
2.0	INFO_COM_OFF	Information sur l'état du COM OFF <i>Information of COM OFF state</i>	0 = Pas activé 1 = Activé <i>0 = Not activated 1 = activated</i>	CONS_INIT : 0 TT_MODE_DEG_CONS : 0
2.1 à 2.7	<i>NON CONSOMME / NOT CONSUMED</i>			

<i>NON CONSOMME / NOT CONSUMED</i>				
Bit	Signal	Description	Codage / Coding	Valeurs spécifiques et par défaut / Specific and default values
3.0 à 8.7	<i>NON CONSOMME / NOT CONSUMED</i>			

項目	タイマ	検出基準	検出時間	検出期間	確認時間	応答	解除方法	解除制限時間
低圧電圧	下限	U_LV < MCDOLVD_U_LV_UnderVoiIC(7.53V)	100 ms	初期化後	300 ms	Failure mode	Vadc < MCDOLVD_U_LV_UnderVoiIC	300 ms
低圧電圧	上限	U_LV > MCDOLVD_U_LV_OverVoiIC(16.25V)	100 ms	初期化後	300 ms	Failure mode	Vadc < MCDOLVD_U_LV_OverVoiIC	300 ms
高圧電圧	上限	UHV > MCDHVD_UHVMaxVoiTHC(32A)	50ms	初期化後	150 ms	Failure mode	Next Power Cycle	Next Power Cycle
高圧電圧	上限	UHV > MCDHVD_UHVMaxVoiTHC(510V)	50ms	初期化後	150 ms	Failure mode	UHV < MCDHVD_UHVOverVoiIC	150 ms
高圧電圧	下限	UHV < MCDHVD_UHVMinVoiTHC(151V)	50ms	初期化後	150 ms	Failure mode	UHV > MCDHVD_UHVUnderVoiIC	150 ms
高圧電圧	下限	UHV < MCDHVD_UHVUnderVoiIC(171V)	50ms	初期化後	150 ms	Failure mode	UHV > MCDHVD_UHVVeryLowVoiTHC	150 ms
高圧電圧	上限	UHV > MCDHVD_UHVOverVoiIC(481V)	50ms	初期化後	150 ms	Failure mode	UHV < MCDHVD_UHVHighVoiTHC	150 ms
高圧電圧	下限	UHV < MCDHVD_UHVLowVoiTHC(277V)	50ms	初期化後	150 ms	Alert Network	UHV > MCDHVD_UHVLowVoiTHC	150 ms
スライジング素子温度	上限	CmbdBT > MCDDTFD_CmbdBOVerTempHtHC(120°C)	100ms	初期化後	300ms	Failure mode	CmbdBT < MCDDTFD_CmbdBOVerTempLowC	300ms
スライジング素子温度	下限	CmbdBT < MCDDTFD_CmbdBUnderTempLowC(27°C)	100ms	初期化後	300ms	Failure mode	CmbdBT > MCDDTFD_CmbdBUnderTempHtHC	300ms
スライジング素子温度	上限	PwMkdtTemp > MCDDTFD_PwMkdtOverTempHtHC(140°C)	100ms	初期化後	300ms	Failure mode	PwMkdtTemp < MCDDTFD_PwMkdtOverTempLowC	300ms
スライジング素子温度	下限	PwMkdtTemp < MCDDTFD_PwMkdtUnderTempLowC(27°C)	100ms	初期化後	300ms	Failure mode	PwMkdtTemp > MCDDTFD_PwMkdtUnderTempHtHC	300ms
CPU温度	上限	MicroTemp > MCDDTFD_MicroPOVerTempHtHC(120°C)	100ms	初期化後	300ms	Failure mode	MicroTemp < MCDDTFD_MicroPOVerTempLowC	300ms
CPU温度	下限	MicroTemp < MCDDTFD_MicroPUnderTempLowC(30°C)	100ms	起動時	300ms	Failure mode	MicroTemp > MCDDTFD_MicroPUnderTempHtHC	300ms
Inverter 内部温度		Internal Temperature < 25	100ms	起動時	100ms	Failure mode	Internal Temp > 25	100ms
Inverter 内部温度		Cmbd Board Power Mdl. Micro Temperature	100ms	起動時	100ms	Alert Network	Internal Temp < 100°C	100ms
Inverter 内部温度		80°C Internal Temperature < 100°C	100ms	起動時	100ms	Failure mode	Internal Temp < 100°C	100ms
Inverter 内部温度		Cmbd Board Power Mdl. Micro Temperature	100ms	起動時	100ms	Failure mode	Internal Temp < 100°C	100ms
Inverter 内部温度		100°C Internal Temperature < 120°C / 140 °C	100ms	起動時	100ms	Failure mode	Internal Temp < 100°C	100ms
Inverter 内部温度		Cmbd Board Power Mdl. Micro Temperature	100ms	起動時	100ms	Alert Network	Internal Temp < 100°C	100ms
Inverter 内部温度		Motor turning	100ms	起動時	100ms	Alert Network	Internal Temp < 100°C	100ms
モーター相1実行電流	上限	Iphase a rms > MCDOPCD_RmsOverCurrentHtHC	100ms	同期運転時	100ms	Failure mode	MCDOPCD_OC_RehabRequest = 1	200ms
モーター相2実行電流	上限	Iphase b rms > MCDOPCD_RmsOverCurrentHtHC	100ms	同期運転時	100ms	Failure mode	MCDOPCD_OC_RehabRequest = 1	200ms
モーター相3実行電流	上限	Iphase c rms > MCDOPCD_RmsOverCurrentHtHC	100ms	同期運転時	100ms	Failure mode	MCDOPCD_OC_RehabRequest = 1	200ms
回路電流	上限	abs(Iphase a) OR abs(Iphase b) OR abs(Iphase c) >= 45Apeak	On event	初期化後	Immediate	Failure mode	Next Power Cycle	Next Power Cycle
LIN通信		LIN 通信異常	Event based	初期化後	1 time fault confirmed	Alert Network		Event based
相電流一貫性	上限	If (abs(Iphase a - Iphase b) OR abs(Iphase b - Iphase c) OR abs(Iphase c - Iphase a)) > 4A	150ms	同期運転	300ms	Failure mode	Next Power Cycle	Next Power Cycle
上限トルク	上限	MCTTOC_TorqueHt = 6.25	1ms	セツナリス運転時		Alert Network	Torque load < 6.25 Nm	Next Power Cycle
起動異常3回検出	上限	MCTIMCS_SwitchFaultCounter >= 3		初期化後		Failure mode	CMD_ACTIV_CPR_ELEC = 0	Instantaneous

[illegible]