

INSTALLATION INSTRUCTION

350DNG40-24-8

4 kW Liquid Cooled DC-DC Down Converter



DC INPUT:	240 – 450 VDC
DC OUTPUT:	20 – 30 VDC / 50 – 143 A; 4 kW (set to 28 VDC by default)
CAN BUS:	For details regarding CAN communication please refer to COMMUNICATION MANUAL (doc. no. BCA.20039)



IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS – This installation contains important instructions for our model 350DNG40-24-8 that should be followed during the maintenance of the unit.

These component level DC-DC converters are intended exclusively for installation within other equipment by an industrial assembly operation or by professional installers. Component DC-DC converters are to be installed in end-use equipment according to the requirements of the safety standard used for that equipment.

DISCLAIMER

It is the customer's responsibility to check the suitability and qualify the product in their application, if any queries please contact Bel (at tech.support@psbel.com or website www.belfuse.com) to ensure product remains within specification at all time.

Supplier shall in no way be liable for use or installation of the product outside of the parameters of the specification.

INSTALLATION

For details, please see 350DNG40-24-8 product datasheet (BCD.20258) and mechanical drawing (350DNG40-24-8.FD).

FUSING

The DC-DC converter is not internally fused on the HV side, therefore, external fuse is mandatory to use in final application (25 A external fuse is recommended).

CAUTION / ATTENTION



CAUTION – To reduce the risk of electric shock, connect only to properly grounded outlets.

ATTENTION – Brancher l'appareil uniquement sur des prises correctement mises à la terre afin de prévenir tout risque d'électrocution.

CAUTION – Do not use this product if there is any damage to the unit.

ATTENTION – Ne pas utiliser le produit si celui-ci est endommagé.

CAUTION – Risk of electric shock. Do not remove the top cover or attempt to open the enclosure.

No user serviceable parts are inside. Please refer servicing to qualified service personnel.

ATTENTION – Risque d'électrocution. Ne pas retirer le couvercle ni tenter d'ouvrir le boîtier. Cet appareil ne contient aucun composant susceptible d'être réparé par l'utilisateur. Pour toute réparation, s'adresser à des spécialistes qualifiés.

CAUTION – Do not remove the top cover or attempt to open the enclosure as you will void the warranty.

ATTENTION – Ne pas retirer le couvercle supérieur ni tenter d'ouvrir le boîtier au risque d'annuler la garantie.



CAUTION – Hot Surfaces: The surface of our DC-DC converter can achieve high temperatures ($T > +70^{\circ}\text{C}$).

The end customer must install the DC-DC converter in such a way that a safe operation is guaranteed.

ATTENTION – Surfaces chaudes : La surface de notre convertisseur DC-DC embarqué peut atteindre des températures très élevées ($T > +70^{\circ}\text{C}$). Le client final doit installer le convertisseur DC-DC embarqué de sorte à garantir un fonctionnement en toute sécurité.



CAUTION – High voltage: Turn off the DC-DC converter before disconnecting any terminal. Discharge the power terminals or wait for 5 minutes before servicing. Do not turn on the DC-DC converter when any terminal is not connected.

ATTENTION – Haute tension; éteindre le convertisseur DC-DC avant de déconnecter toute borne. Décharger les bornes d'alimentation ou patienter 5 minutes avant toute réparation. Ne pas mettre le convertisseur DC-DC en marche lorsqu'aucune borne n'est connectée.



CAUTION – READ THIS CAREFULLY BEFORE INSTALLATION! Before operating, read this document thoroughly and keep it for future reference. Not respecting these instructions may reduce the performance and safety of the converter and could cause danger for people.

ATTENTION – À LIRE ATTENTIVEMENT AVANT TOUTE INSTALLATION! Avant toute utilisation, lire ce document attentivement et le conserver à des fins de consultation ultérieure. Le non-respect de ces instructions peut altérer les performances et la sécurité des dispositifs et impliquer des dangers pour les personnes et l'appareil.

WARNING / AVERTISSEMENT

WARNING – Do not operate the DC-DC converter without proper cooling. Do not add cold coolant when the unit is hot as there is a risk of potential cracks in the chassis. Coolant needs to be added prior to any operation of unit.

AVERTISSEMENT – Ne pas utiliser le convertisseur DC-DC sans un refroidissement adapté. Ne pas ajouter de liquide de refroidissement froid lorsque l'appareil est chaud, au risque de causer des fissures sur le châssis. Ajouter le liquide de refroidissement avant toute mise en fonctionnement de l'appareil.

WARNING – External pre-charging circuit is required as part of battery management system.

AVERTISSEMENT – Un circuit de pré-charge externe est nécessaire à titre de composant du système de gestion de la batterie.

WARNING – Mounting holes are designed to support the DC-DC converter only and cannot be used to support other assemblies.

AVERTISSEMENT – Les trous de montage sont destinés à supporter le convertisseur DC-DC uniquement et ne doivent pas être utilisés pour supporter d'autres assemblages.

DISABLING HVIL - CAUTIONS / WARNINGS

Disabling or bypassing the High Voltage Interlock Loop (HVIL) circuit of this unit, can present significant risks. The HVIL circuit is a critical safety feature designed to prevent exposure to high-voltage components and ensure safe operation. La désactivation ou le contournement du circuit HVIL (High Voltage Interlock Loop) de cette unité peut présenter des risques importants. Le circuit HVIL est un dispositif de sécurité essentiel conçu pour empêcher l'exposition aux composants à haute tension et assurer un fonctionnement sûr.

By disabling, incorrect setting or bypassing the HVIL circuit, you acknowledge and accept the following risks: En désactivant, en réglant mal ou en contournant le circuit HVIL, vous reconnaissez et acceptez les risques suivants:

- CAUTION – Electrical Shock Hazard: Deactivating the HVIL circuit can expose individuals to high-voltage components, increasing the risk of electrical shock or injury.
- ATTENTION – Risque de choc électrique: La désactivation du circuit HVIL peut exposer les individus à des composants à haute tension, augmentant le risque de choc électrique ou de blessure.
- CAUTION – Equipment Damage: Disabling the HVIL circuit may lead to improper operation or damage to the electrical system, potentially resulting in costly repairs or replacement.
- ATTENTION – Dommages matériels: La désactivation du circuit HVIL peut entraîner un mauvais fonctionnement ou endommager le système électrique, pouvant entraîner des réparations ou un remplacement coûteux.
- CAUTION – Safety Violations: Tampering with safety features may violate regulatory standards or manufacturer guidelines, which can have legal implications and affect warranty coverage.
- ATTENTION – Violations de sécurité: La modification des dispositifs de sécurité peut enfreindre les normes réglementaires ou les directives du fabricant, ce qui peut avoir des implications juridiques et affecter la couverture de garantie.
- CAUTION – Operational Risks: Without the HVIL circuit, the system may operate in an unsafe manner, leading to potential failure or hazardous conditions.
- ATTENTION – Risques opérationnels: Sans le circuit HVIL, le système peut fonctionner de manière dangereuse, pouvant entraîner une défaillance ou des conditions dangereuses.
- CAUTION – Liability: The responsibility for any damages, injuries, or legal consequences resulting from the disabling of the HVIL circuit rests solely with the individual or entity performing the modification.
- ATTENTION – Responsabilité: La responsabilité des dommages, blessures ou conséquences juridiques résultant de la désactivation du circuit HVIL incombe uniquement à la personne ou à l'entité qui effectue la modification.

By proceeding with disabling the HVIL circuit, you explicitly agree to assume all risks associated. En procédant à la désactivation du circuit HVIL, vous acceptez explicitement d'assumer tous les risques associés.

ENVIRONMENTAL CONDITIONS

- TRANSPORTATION & STORAGE:** Ambient Temperature Range: -40°C to +95°C
Relative Humidity Range: 5% to 95% at 25°C, non-condensing
Altitude: -300 m to 12,200 m above sea level
- OPERATION:** Ambient and Coolant Temperature Range: -40°C to +65°C (up to +85°C with power derating)
Relative Humidity Range: 10% to 90% at 25°C, non-condensing
For cooling see details below
IP 67 * watertight when all mating connectors are installed.
Altitude: -150 m to 4,000 m above sea level

SERVICING

There are no user-serviceable parts in DC-DC converter. In case of failure, the DC-DC converter must be returned to a Bel Fuse Authorized Service Centre for repair, with a Bel Fuse pre-assigned RMA number. For unit replacement, refer servicing to the vehicle manufacturer.

LIMITED WARRANTY

Bel Fuse warrants each DC-DC converter of its manufacture for a period of two years from the date of original shipment. This warranty applies to defects in materials and workmanship that results in non-performance to our published specifications. Bel Fuse takes no liability for any consequential damages of any kind through the misuse of our products by any user. No other obligations are expressed or implied.

NUCLEAR AND MEDICAL APPLICATIONS

Products are not designed for, intended for use in, or authorized for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems without the express written consent of the respective divisional president.

TECHNICAL REVISIONS

The appearance of product, including safety agency certifications pictured on labels, may change depending on the date manufactured. Specifications are subject to change without notice.

EARTH CONNECTION

Wire of protective earth PE screwed to grounding stud (located on the chassis) needs to be 10 mm². Cable lug suitable for M6 needs to be used.

RECOMMENDED FUSE PROTECTION

An external fuse shall be used to protect against catastrophic failures.

DC input shall be protected by fuse which shall be a safety approved component. If a single fuse is being used, it shall be placed in the positive input line.

Fuse rating per unit:

- HV DC Input: external HV fuse recommended - Bel EV fuse PN: 0AKLx9250-xx, fast characteristic
- LV DC Signals (+VBAT): external fuse recommended automotive 1 ADC, 32 V rating, fast characteristic

Units operating in parallel or series configuration shall be protected with individual fuse on HVDC input, which remains connected in parallel. For signal protection, one common fuse can be used.

RECOMMENDED WIRING

- HV DC Input: recommended wire MFG: HUBER AND SUHNER, MPN: 12582674 RADOX AUTOL 155S/REMS
- LV DC OUTPUT: recommended wire – minimum cross section 50 mm² per unit.



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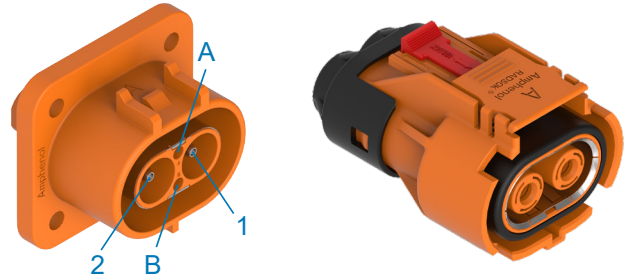
CONNECTORS MPN AND PINOUTS DESCRIPTION

HV DC INPUT CONNECTOR

PSU side: MFG: AMPHENOL; PN: ELR2A02
 Mating connector: MFG: AMPHENOL; PN: ELP2A02
 Use copper conductors only with an insulation rating of 120°C, 4 mm²
 Follow connector MFG instructions for correct connector assembly.

Note: HVIL pins shall be shorted on mating part.

PIN	FUNCTION
1	HV DC positive
2	HV DC negative
A	HVIL
B	HVIL



LV DC OUTPUT CONNECTOR

PSU side: MFG: Amphenol; PN: SLPIRBBPSB1
 SLPIRBBPSR1
 Mating connector: MFG: Amphenol; PN: SLPIPB50BSB1
 SLPIPB50BSR1
 Use copper conductors only with an insulation rating of 120°C, 50 mm²
 Follow connector MFG instructions for correct connector assembly.

CONNECTOR	FUNCTION
RED	LV DC positive
BLACK	LV DC negative

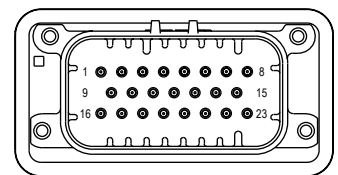


SIGNAL CONNECTOR

PSU side: MFG: TE Connectivity; PN: 1-776087-5
 Mating connector: MFG: TE Connectivity; PN: 770680-5
 Pin: MFG: TE Connectivity; PN: 770520-1
 Max. 2 Amps per pin (wire AWG 20)
 It is recommended to use shielded connecting cables.



PIN	NAME	FUNCTION
1	ADDR_0	Address bit 0 input Open = add 0 x 01 to base address +VBAT = add 0 x 02 to base address GND = add 0 x 03 to base address
2	WAKE_UP	KL15 wake-up input, parallel with pin 17
3	CAN_L	CAN Bus L, parallel with pin 18
4	CAN_H	CAN Bus H, parallel with pin 19
5	GND	KL31, auxiliary supply ground
6	+VBAT	KL30 +12/24V for auxiliary supply
7	HVIL_IN	HVIL loop input
8	HVIL_OUT	HVIL loop output
9	ADDR_1	Address bit 1 input Open = add 0 x 00 to base address +VBAT = add 0 x 03 to base address GND = add 0 x 06 to base address
10	GPI	General purpose analog input
11	CAN_BAUD_IN	CAN baud rate select input Open = 500 kbps +VBAT = 250 kbps GND = user specific (EEPROM)
12	GND	KL31, auxiliary supply ground
13	+VBAT	KL30 +12/24V for auxiliary supply
14	SENSE+	Sense wire – positive polarity
15	SENSE+	Sense wire – positive polarity
16	GP_OUT	General purpose output
17	WAKE_UP	KL15 wake-up input, parallel with pin 2
18	CAN_L	CAN Bus L, parallel with pin 3
19	CAN_H	CAN Bus H, parallel with pin 4
20	GND	KL31, auxiliary supply ground
21	+VBAT	KL30 +12/24 V for auxiliary supply
22	SENSE -	Sense wire – negative polarity
23	SENSE -	Sense wire – negative polarity



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CONTROL SIGNALS

GENERAL CONTROL SIGNAL REQUIREMENTS

These are Control signals which are directly connected from the vehicle system to the DC-DC converter. Although these signals are input to the DC-DC converter, the control signals are capable of being shared with other system components.

WAKE_UP

Input signal with impedance >5 kOhm.

PARAMETER	MIN	TYP	MAX	UNIT
VWAKE_UP input voltage	9	14.4 / 28	32	V
RDS(ON) On state resistance	5			kOhm
IWAKE_UP Nominal input current			3	mA

VBAT

Input signal, energy taken from 12 V or 24 V battery.

PARAMETER	MIN	TYP	MAX	UNIT
VVBAT Input voltage	9	14.4 / 28	32	V
RDS(ON) On state resistance	100			Ohm
IBAT Nominal output current			100	mA

CAN_BAUD_IN

Communication speed is selectable by pin on Signal connector.

- Pin – floating – 500 kbit/s
- Pin – connected to VBAT – 250 kbit/s
- Pin – connected to RTN – optional CAN speed (default 125kbit/s). Changeable by CAN command to 1Mbit/s.

HVIL_IN

The HV connector is assembled with HVIL interlock loop to detect if connectors are properly inserted. HVIL loop is supplied from HVIL_IN pin. Values of HVIL_IN, HVIL_OUT voltage and HVIL current are sensed by communication microprocessor and shall be reported on CAN bus.

HVIL bypass connection is assembled inside HV input connector - mating part.

HVIL LOOP is not designed to withstand LOAD DUMP test according ISO16750. In case of supplying from V_BAT external clamping device shall be used with clamp point below 40 VDC.

PARAMETER @ 25°C	MIN	TYP	MAX	UNIT
VHVIL Absolut maximum rating	-0.2		32	V
VHVIL High level	7.5		32	V
VHVIL Low level	0		5.5	V
IHVIL Input OK current	10		100	mA
IHVIL Measurement range	0		150	mA
IHVIL Maximum continuous current	0		300	mA
RHVIL Series resistance (Shunt + Fuse) @ 100 mA	1.15		2	Ohm
Fuse type: automotive 1 ADC / 32 V rating, fast characteristic				

ADR0 and ADR1

Inputs to set CAN addresses. Not connected pin is pulled internally to 0.5 * VAUX. Address inputs are sampled only after start-up.

PARAMETER @ 25°C	MIN	TYP	MAX	UNIT
VADR_ABS Absolut maximum rating	-0.2		32	V
VADR_HI High level	3		32	V
VADR_LOW Low level	0	0	0.2	V
VADR_NC Not connected level	0.6	floating	1.8	V
IADR_IN Input current @ 14.4 V	0		2	mA

The default CAN base address is 0xB0 and can be changed over CAN command.

Unit can calculate its address claim offset by reading the Address inputs. See table below:

		ADR1 PIN VALUE		
		Floating	High	Low
ADR0 PIN VALUE	Floating	0x01	0x04	0x07
	High	0x02	0x05	0x08
	Low	0x03	0x06	0x09

The Base Address is a configurable parameter with a default value of 0xB0. Base address is also a global address, which can be used to command all units of this type (for example when more than one unit is connected in parallel).



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CAN_H, CAN_L

External communication interface. Detailed description is at BCA.20039.

GPI, GPO

General purpose pin input/output pins

Definitions TBD.

REMOTE SENSE

The signals SENSE + and SENSE- are capable to compensate cable drop for specific load.

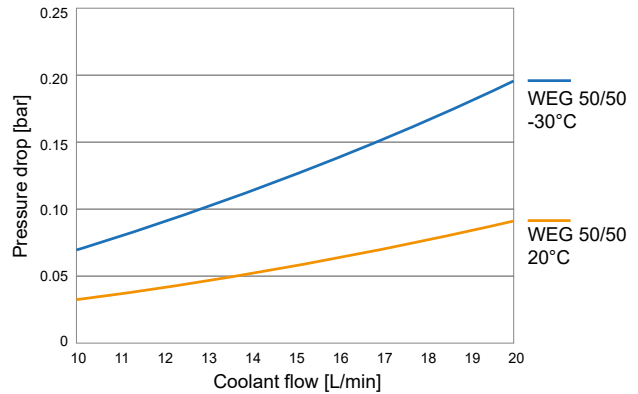
Minimum capability for voltage drop compensation shall be 0.5V for all models.

In the event of loss of remote sense, output will revert to internal sense. Output voltage will stay in range $\pm 5\%$ of V_{out} nominal.

LIQUID COOLANT REQUIREMENTS

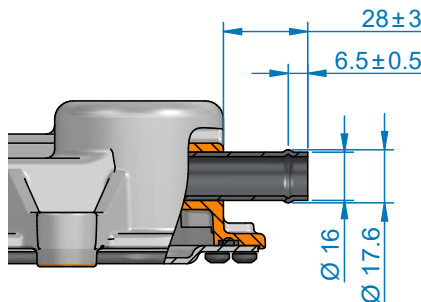
The DC-DC converter must be liquid cooled.

Inlet Coolant Temperature Range: (up to +85°C with reduced output power)	-40°C to +65°C
Operational Ambient Air Temperature: (up to +85°C with reduced output power)	-40°C to +65°C
Coolant Medium/Mixture:	50/50 Ethylene Glycol/Water
Min. Coolant Flow:	2.64 GPM (10 LPM)
Max. Coolant Flow:	5.28 GPM (20 LPM)
Max. Pressure Drop:	based on graph
Max. Coolant Pressure:	29 psi ~ 2 bar
Vacuum Level:	-29 psi ~ -2 bar

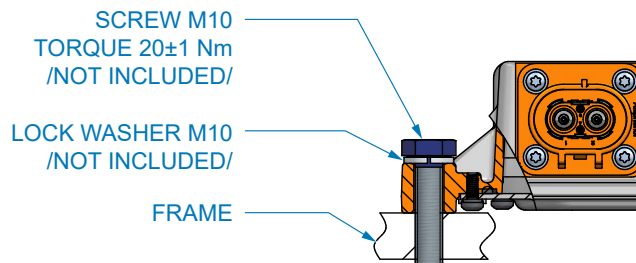


COOLING FITTING CONNECTION

Cooling pipe in chassis (2x) : SAE J1231 TYPE 2

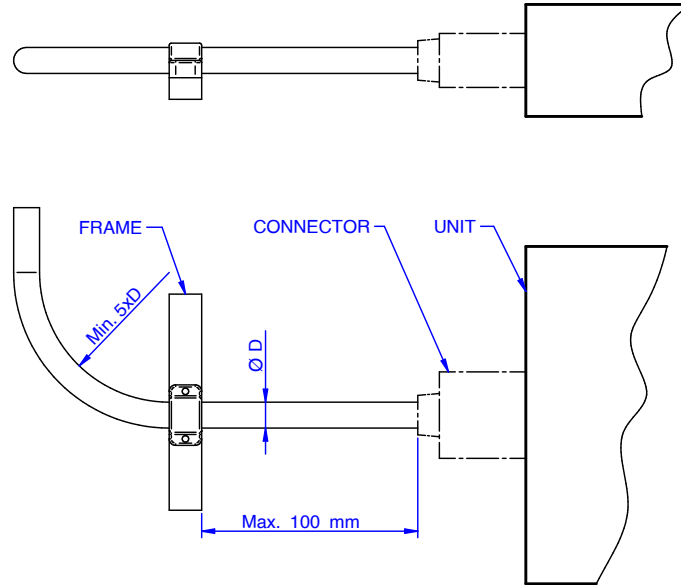


MOUNTING RECOMMENDATION



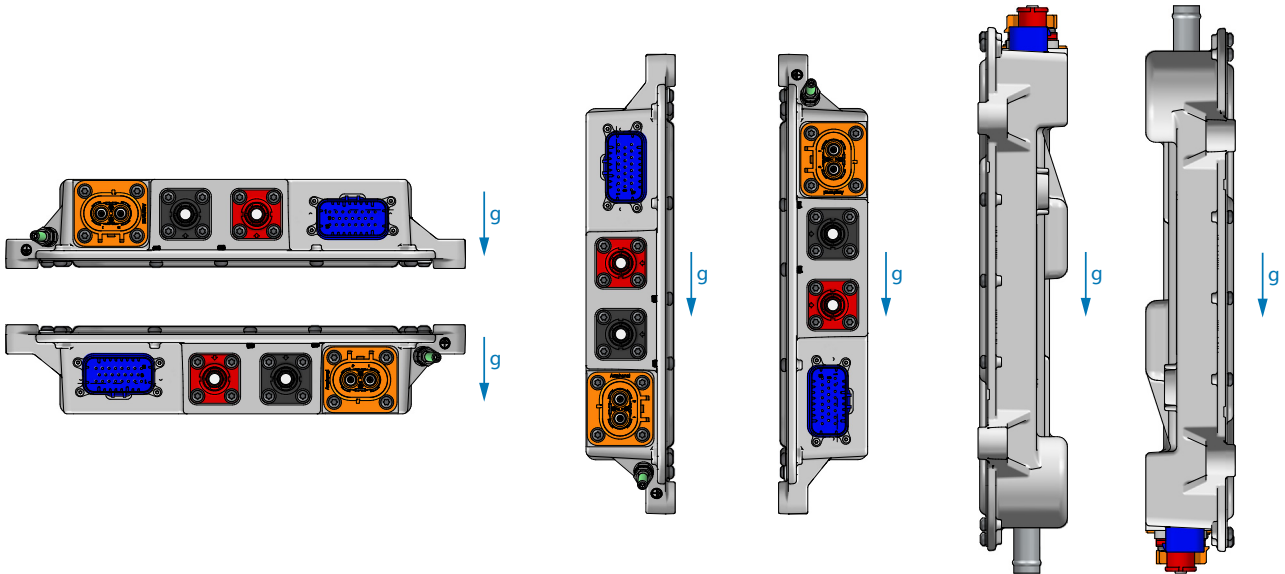
CABLE (WIRE HARNESS) FIXING

- The bending radius of cable or wire harness should be more than five times the diameter of the cable or wire harness.
- Fix the cable at a distance of max. 100 mm from the connector.

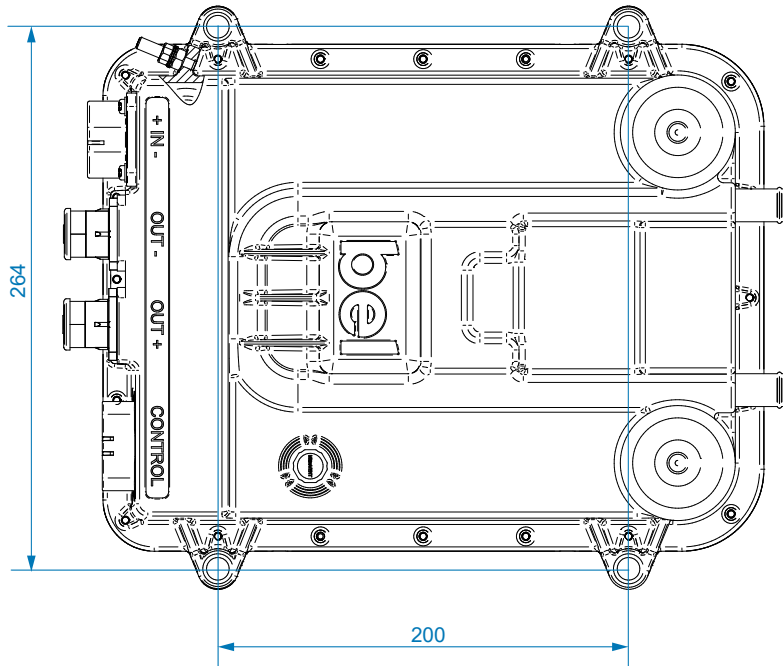


MOUNTING POSITIONS / ORIENTATION IN FINAL APPLICATION

DC-DC converter can be mouted in any position, see examples below.



MOUNTING HOLE POSITIONS



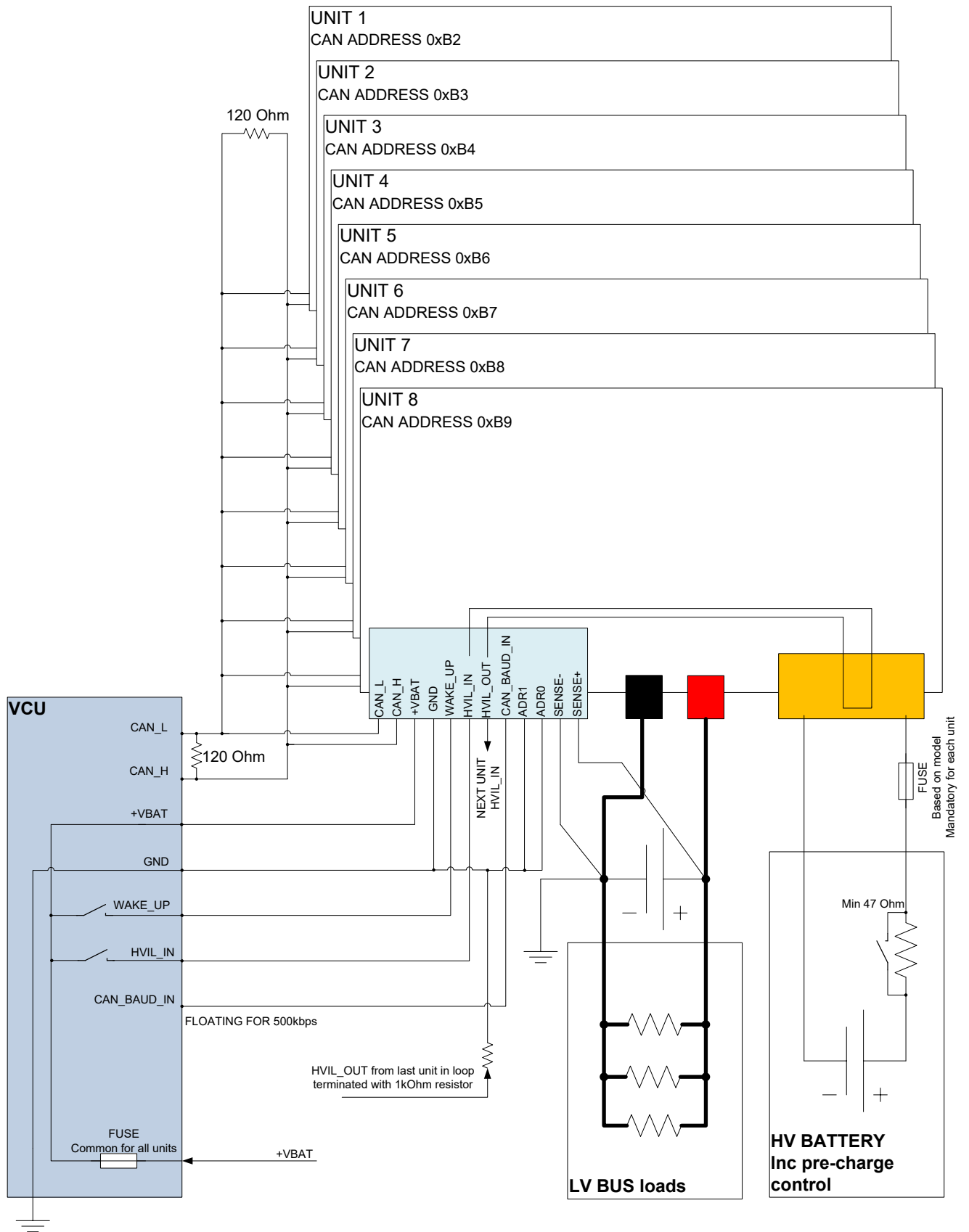
PARALLEL / SERIES OPERATION

Up to eight DC-DC converters can be connected in parallel (see Parallel operation wiring diagram, page 7).
 Two sets of up to four parallelly connected DC-DC converters can be connected in series (see Operation in series wiring diagram, page 9).
 Total output power - 90% of nominal output power per unit connected in parallel configuration.
 Current sharing between the converters working in parallel is based on voltage drop – passive sharing.
 Accuracy of current sharing shall be within the following limits:

TOTAL OUTPUT CURRENT	OUTPUT CURRENT ACCURACY PER UNIT	NOTE
20 – 90%	±10% of nominal out current	
0 – 20%	±20% of nominal out current	Common point for sense wire is required for all units in parallel

For parallel operation, the control signals in signal connector can be used twice for interconnecting the units (see Signal connector wiring diagram in parallel operation, page 8).
 For single unit operation, only one control signal can be used for standard operation.

PARALLEL OPERATION WIRING DIAGRAM



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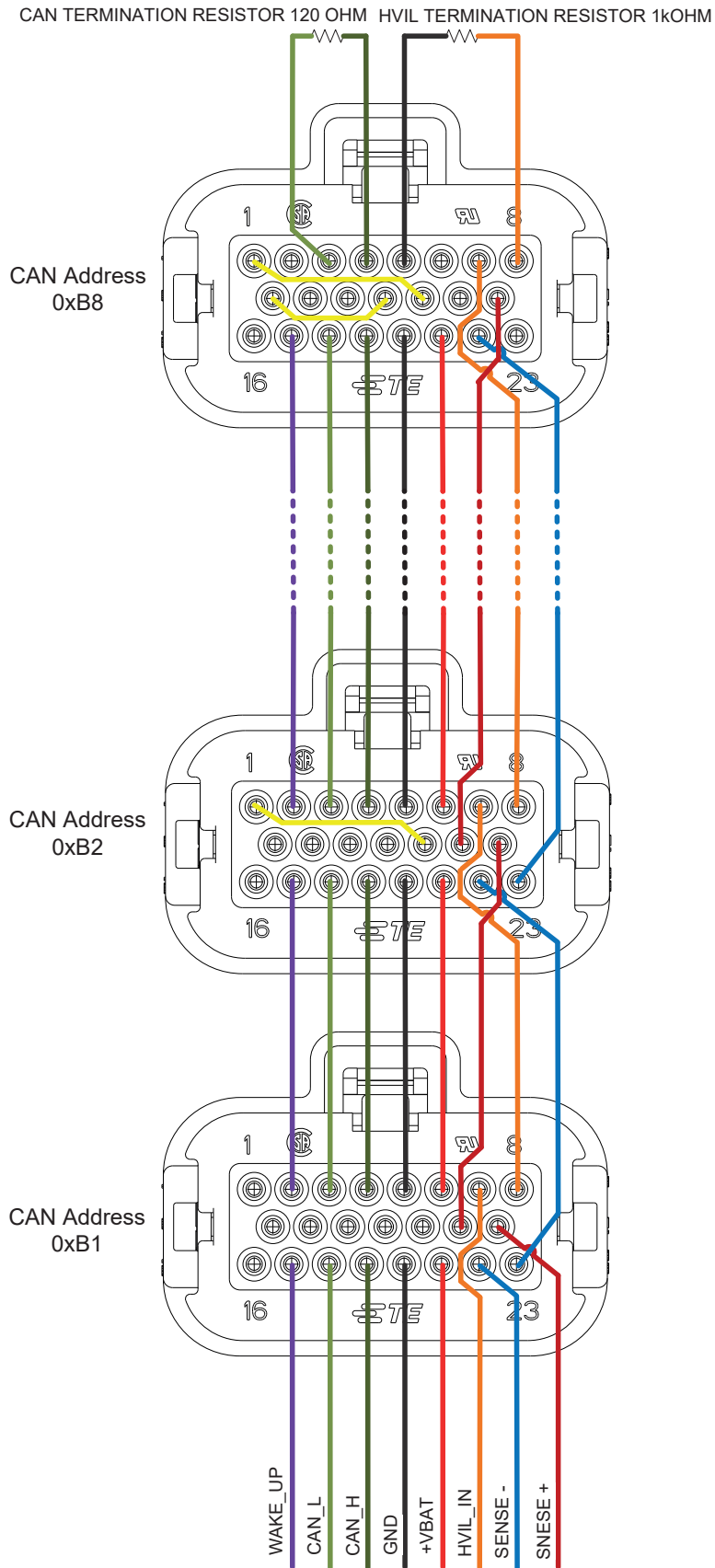
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SIGNAL CONNECTOR WIRING DIAGRAM IN PARALLEL OPERATION



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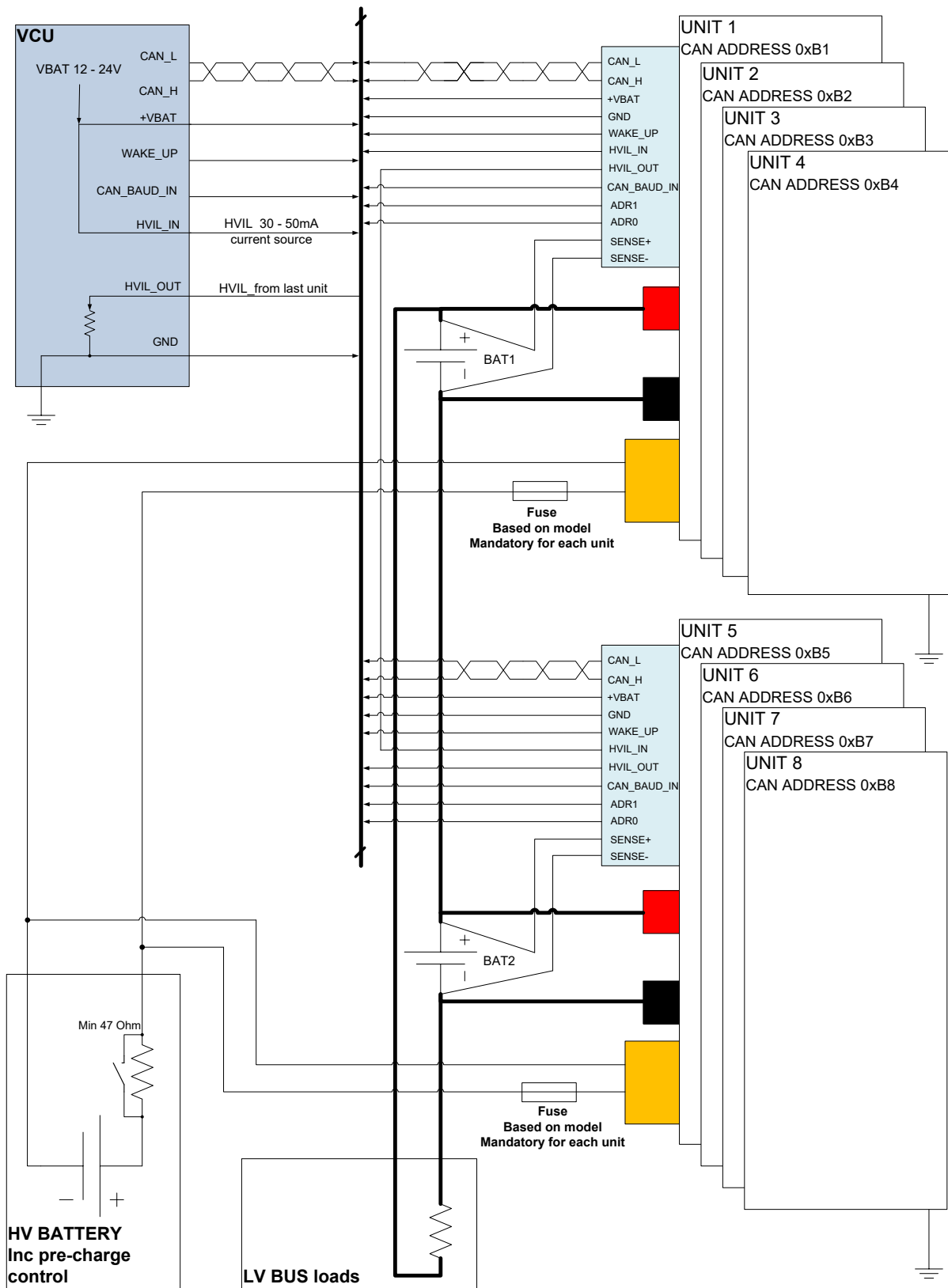
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OPERATION IN SERIES WIRING DIAGRAM



Note: Signals SENSE+ and SENSE- connect to proper battery.



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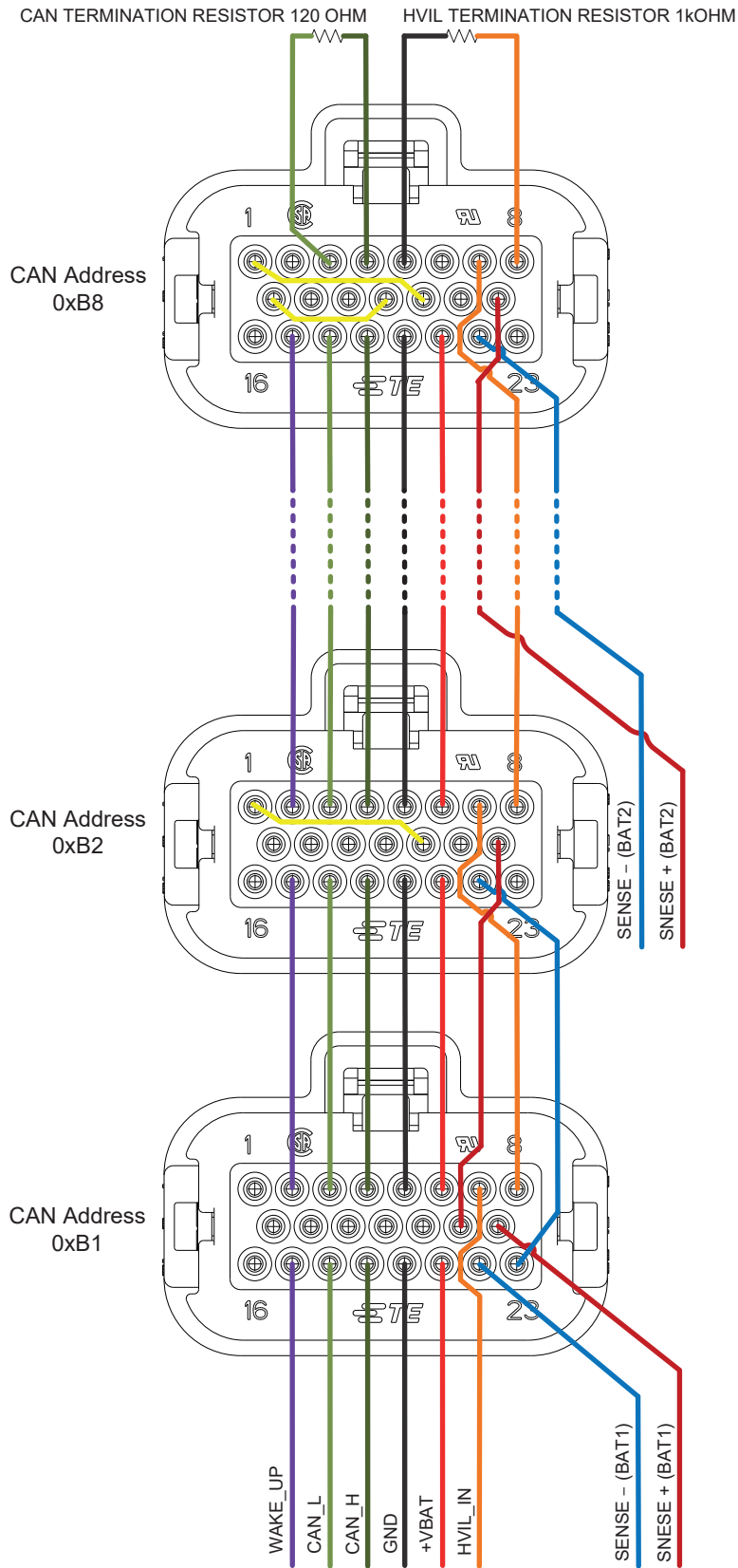
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SIGNAL CONNECTOR WIRING DIAGRAM FOR OPERATION IN SERIES



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