GIGAVAC Contactors J1939 Protocol

Documentation Revision: 8

See the last page of this document for the relevant change history. Note that each change results in a new firmware version.

This documentation is applicable for the following products:

- GXCAN15
- GXCAN16
- MXCAN15
- MXCAN16

It is assumed that the reader is familiar with the J1939 protocol and hardware requirements of the Controller Area Network Bus (CAN-BUS). For more information, please consult the SAE documents and CAN-BUS specification details.

GIGAVAC J1939 products have 4 types of messages: Command, Setting, Request, and Report. Command is a message sent to the contactor for controlling its operations. Setting is used to change the operational characteristics of the contactor. Request is used to read back data or settings from the contactor. Report messages provide relevant data and operational feedback from the contactor. All configuration settings are stored in non-volatile memory.

The default baud rate is **250 kbits/s**. The baud rate can be changed with the Setting message of "Delays, Report-Repetition & Baud Rates" PDU format 178_{10}. The changed baud rate will take effect immediately and can be can be read-back from "Request Contactor Parameters" message PDU format 234_{10}.

At first power-up, the unit joins the CAN bus and will attempt to claim a default address of **0xC8**. If no other device is using the same address, it will keep it as the operational address. If another device has the same address with higher name, this unit will win the address. If another device has the same address with a lower name, this unit will lose the default address of 0xC8 and change to **0xFE**. After losing the address, it will not transmit or receive messages until someone changes its address to ensure it is not overlapping the address of any other device on the CAN BUS.

Proper Configuration before Deployment:

For best results, the contactor should be configured before it is connected to the CAN BUS. At a minimum, the following should be configured:

- J1939 address: The address must be unique on the network. The address can be changed while connected to the CAN-BUS, but it is much easier to program the address in advance.
- Trip points: There are three over-current trip points which can be programmed. If only one trip point is needed, set the first trip point to the desired level and all remaining unused trip points should be set to the highest level, which is the maximum rated

current of the unit. This level will vary depending on which part number is being used. Please consult the spec sheet for details.

- Low-voltage protection shutoff: To avoid nuisance tripping, this setting must be at a level that is reasonably below the power supply voltage of the contactor. Setting this value to zero will disable low-voltage shutoff protection.
- BUS BAR over-voltage protection: To avoid nuisance tripping, this setting must be higher than the anticipated bus-bar voltage at the main contacts. Setting this value to 60V will disable BUS BAR over-voltage protection.

Caution:

- Power supply to the contactor must not exceed coil voltage limit when energize the coil. When idle (coil off) the voltage between pin 2 and pin 7 is limited to 32V max. If supply voltage is over limit, it could cause permanent damage to the internal control circuit.
- The contactor terminals (A1 & A2) voltage sensing is 58V max for MXCAN series, and 850V max for GXCAN series. Do not exceed this limit.
- The contactor terminals (A1 & A2) operating voltage is 48V max for MXCAN and 800V max for GXCAN. Do not operate the contactors over this limit.
- Setting the over-current trip point to zero amps will result in the contactor tripping immediately as soon as the contactor is commanded closed even no current detected. Make sure to set this value to something greater than zero before operating the contactor.
- To avoid nuisance tripping, set trip-delay timers to allow the condition to mature, set current-trip and voltage-shutoff to practical value.
- Be sure to have a unique J1939 name and address on the CAN BUS to prevent conflicts.
- Note that BUS BAR voltage sensing is referenced to pin 2 which is the same ground as the control circuit.

Command Messages

Control Contactor Message:

This message contains the following controls:

Contactor on/off (A): This command will open or close the contactor. 'C' (0x43) will close and 'O' (0x4F) will open. In case of over-current trip, bus-bar over voltage protection, or power supply under voltage shutoff, use this signal to send an Open command after all of the causes of opening have been cleared in order for the contact to be able to close again.

One time report (B): If data report-repetition rate is zero, setting this value to 'R' (0x52) will force the contactor to send out a single report message. If the repetition rate is nonzero, this command will have no effect.

Power-up Contactor State (C): The contactor can be configured to power up in the open, or closed state depending on this value. Set this value to 'C' (0x43) for Close, or to 'O' (0x4F) for Open. This setting will be saved to the EEPROM and will be effective after the next power cycle.

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Note: If you need to change one parameter, use meaningful value for the parameter you want to change, and use a meaningless value for all others. For example: Contactor on/off can be set to 'O' (0x4F), but all others can be FF.

Control Contactor Message:

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
not used, don't care			C	B	A	ID bytes	
			'C' / 'O'	'R'	'C' / 'O'	'G'	'V'

Send J1939 control message: **[**priority: 6**]**, **[**PDU format: 181_{10}**]**, **[**destination: this unit's address**]**, **[**source address: user unit's address**]**. 5 bytes data length, see above definitions.

Example: send a command to only turn on the contactor byte1 & byte0 = "GV", byte2 = 'C', byte3 = 0 and byte4 = 0.

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Setting Messages:

Trip Points and Low Voltage Shutoff Message:

There are 3 Trip Points available for over current condition protection. If the current going through the contactor is greater than any of these settings in either direction, the contactor will trip. Trip Point 1 should be set to lowest value and Trip Point 3 should be set to the highest value.

The default values for each trip points are:

- Trip Point 1 = 200 Amps (170 counts)
- Trip Point 2 = 600 Amps (512 counts)
- Trip Point 3 = 600 Amps (512 counts)

Note: If you are using a contactor that is rated for 350 Amps maximum continuous current, it is preferred if you change the maximum trip point value from 600 Amps to 350 Amps to provide better protection for the contactor.

Low Voltage Shutoff is when the power supply voltage to the contactor drops to less than or equal to the low voltage setting. When this happens, the contactor will automatically open the main contacts. If the automatic Low Voltage Shutoff feature is not needed, simply set these values to zero.

The default value for the low-voltage shutoff is:

- 23 Volts for the 24 Volt coil product (675 counts)
- 11 Volts for the 22 Volt coil product (323 counts)

If contactor is opened automatically by either the over-current trip function or the under-voltage trip function, it must be commanded to open before it can be closed again. This is necessary to reset the protection conditions. For firmware version 6 and greater:

- Trip Points greater than 512 counts will be ignored
- Low Voltage Shutoff settings greater than 940 counts (32V) will be ignored

Trip Point and Low Voltage Shutoff Message:

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
unused	Shared	LV-Off	Trip 3	Trip 2	Trip 1	ID bytes	
free byte	4x2 bits	8+2 bits	8+2 bits	8+2 bits	8+2 bits	'G'	'V'

Byte 6 share-bits:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
2 bits MSB: LV-Off		2 bits MSB: Trip-3		2 bits MSB: Trip-2		2 bits MSB: Trip-1	

Trip Point calculation: The Trip Point setting equation is: counts-per-Amp = 512 counts/600.
Trip Point example: To set a Trip Point for 200A: (512/600) * 200 = 170 counts.

Low Volts Shutoff calculation: Shutoff counts = shutoff voltage * (4.02/28.02) * (1024/5)
Low Voltage Shutoff example: To set shutoff voltage for 18.6V:
18.6 * (4.02/28.02) * (1024/5) = 546 counts.

Trip Points and Low Voltage Shutoff J1939 message: **[**priority: 6**]**, **[**PDU format: 180_{10}**]**, **[**destination: this unit's address**]**, **[**source address: user unit's address**]**. 8 bytes data length, see above definitions.

Note: This unit's default address is 0xC8. If you change the address, you need to use the new address that you had changed. You can get this unit's name & address by sending a "request for address claimed" message. In case you forget what address you changed to the unit, just use address 0xFF. Using 0xFF the global address will cause all devices on the BUS to respond.

J1939 message example for Trip Points and Low Voltage Shutoff: User's address is 125_{10} and this unit's address is 200_{10}, using a 600A contactor, Set Trip Point 1 to 120A, Trip Point 2 to 350A, Trip Point 3 to 450A, and set the Low Voltage Shutoff to 20.5V. See command and data below:
The CAN extended address becomes J1939 PGN:

Byte 3	Byte 2	Byte 1	Byte0
Priority & data page	PDU format	Destination	User-source address
0x18	180_{10}	200_{10}	125_{10}

CAN data byte is the same as J1939 data:
The 6th byte shares the two most significant bits of each data.
Trip Point 1 = 120A (0x66 counts),
Trip Point 2 = 350A (0x12A counts), and
Trip Point 3 = 450A (0x180 counts).
Low Voltage Shutoff = 20.5V (0x25A counts).
Shared byte = 0x94.

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
Unused	Shared	LV-Off	Trip 3	Trip 2	Trip 1	ID bytes	
don't care	0x94	0x5A	0x80	0x2A	0x66	'G'	'V'

Delays, Report Repetition, and Baud Rate Message:

A delay timer can be used to allow an over current or low voltage shutoff condition to mature before the contactor opens. There are 3 trip points delays and 1 low voltage shutoff delay. In practice, it's generally better to have longer delays for lower over-current conditions, and shorter delays for higher over-current conditions. Therefore, set Delay 1 to longest value, and Delay 3 to the shortest value.

The Report Repetition rate is the interval of time between each report messages sent by the contactor. The default rate is **800ms**, and it is changeable in 100ms increments.

The CAN baud rate can only be changed to 250 or 500. All other values will be ignored. Note: Changing the baud rate will take effect immediately. The ability to modify the baud rate is

available in firmware version 3 or later. In firmware version 6C or later, delays and report rate will not be changed if 255 (0xFF) is entered.

Delays, Report Repetition and Baud Rate Message:

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
CAN Baud	Report Repetition	LV Delay	Delay 3	Delay 2	Delay 1	ID bytes	
8 bits	8-bits	8-bits	8-bits	8-bits	8-bits	'G'	'V'

The Trip Delay range is from 0 to 255 (each count = 1 second of delay)
Report repetition rate ranges from 0 to 255, each count is = 100ms.
The value to change the baud rate must be 25 or 50 to represent 250 kbits/s or 500 kbits/s.

Delays, Report Repetition, and Baud Rate J1939 Message: **[**priority: 6**]**, **[**PDU format: 178_{10}**]**, **[**destination: this unit's address**]**, **[**source address: user unit's address**]**. 8 bytes data length, see above definitions.

Bus-Bar Over-Voltage Protection Message:

Note: This feature is available in firmware version 5 and later.

There are 2 bus-bar terminals labeled A1 and A2. If the voltage at either of these terminals exceeds the setting value, the contactor will open. If the contact is already open, over-voltage will not cause any action. The sensing inputs at terminals A1 and A2 are limited to 60V max, therefore, a setting of greater than 1023 counts will not be registered.

Bus Bar Over-Voltage Protection Message:

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
unused	unused	unused	unused	OVP-H	OVP-L	ID bytes	
don't care	don't care	don't care	don't care	H-2-bits	L-8-bits	'G'	'V'

The OVP-H has 2bits, bit 1 and bit 0 will become bit 9 and bit 8 of the protection value. The combination of OVP-H (2 bits) and OVP-L (8 bits) will become a 10 bit integer value to compare with the bus bar voltage.

Bus bar over-voltage protection calculation:

For MXCAN max:
Protection counts = protection voltage * (2.74/32.74) * (1024/5)
Example:
To set a protection of 40V on the bus-bar to open the contactor
40 * (2.74/32.74) * (1024/5) = 685 counts.

For GXCAN max:
Protection counts = protection voltage * (2.74/32.74) * (1024/5)
Example:

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To set a protection of 600V on the bus-bar to open the contactor
40 * (2.74/32.74) * (1024/5) = 685 counts.

Bus Bar Over-Voltage Protection J1939 Message: [priority: 6], [PDU format: 183_{10}], [destination: this unit's address], [source address: user unit's address]. 4 bytes data length, see above definitions.

Change Name Message:

The lower 4 bytes [3:0] of this device is defined by the manufacture and cannot be changed. The upper 4 bytes [7:4] can be changed by users using the following J1939 data format:

Byte 7			Byte 6	
Bit 8 (should be 0)	Bite 6, 5, 4	Bit 3, 2, 1, 0	Bit 7, 6, 5, 4, 3, 2, 1	Bit 0
Arbitrary Address Cap.	IND Group	VE-Sys Instance	Vehicle System	Don't care

Byte 5	Byte 4	
Functions	Bits 7, 6, 5, 4, 3	Bits 2, 1, 0
	ECU Instance	Function Instance

Bytes [3:0] cannot be changed, use "GVAC" for identification.

Byte 3	Byte 2	Byte 1	Byte0
Identification Bytes			
'G'	'V'	'A'	'C'

Change Name J1939 Message: [priority: 6], [PDU format: 177_{10}], [destination: this unit's address], [source address: user unit's address]. 8 bytes data length, see above definitions.

Change Address Message:

These contactors are not capable of arbitrary address changes, but the address can be changed with this command message. This message uses more than 8 bytes of data. Therefore, it must use Multi-Packet Broadcast Message format. This message requires the use of the contactor device name. Send a "request for address claimed" message to retrieve this unit device name.

8 Bytes data 1: Broadcast Announce Message (BAM) indicates 9 bytes and 2 packages.

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
0	0xFE	0xD8	0xFF	2	0	9	32_{10}

Send J1939 change address message 1: [priority: 7], [PDU format: 236_{10}], [destination: 255_{10}], [source address: user unit's address]. 8 bytes data length, see above definitions.

8 Bytes data 2: CA Name of this unit (7 bytes) and package number 1.

Byte 7 to byte 1	Byte 0

Use byte 6 to byte 0 from the name of this unit. Name[6-0]	1

Send J1939 change address message 2: **[**priority: 7**]**, **[**PDU format: 235_{10}**]**, **[**destination: 255_{10}**]**, **[**source address: user unit's address**]**. 8 bytes data length, see above definitions.

8 Bytes data 3: Unused bytes are filled with 0xFF, new address, 1 byte name [7], package number 2.

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
0xFF	0xFF	0xFF	0xFF	0xFF	New Address (0-253)	Name[7]	2

Send J1939 change address message 3: **[**priority: 7**]**, **[**PDU format: 235_{10}**]**, **[**destination: 255_{10}**]**, **[**source address: user unit's address**]**. Data 8 bytes see above definitions.

Change Report Message PS (PGN):

The report message is broadcast on a regular basis on the J1939 network using a fixed PDU format (PF) value (255_{10}) and default PDU specific (PS) value (255_{10}). The user can change the PDU from 0 to 255 by this command.

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
don't care		PF	New PS	Identification Bytes			
0xFF	0xFF	0xFF (fixed)	range (0-255)	'G'	'V'	'A'	'C'

Send J1939 change report PGN message: **[**priority: 6**]**, **[**PDU format: 179_{10}**]**, **[**destination: this unit's address**]**, **[**source address: user unit's address**]**. 8 bytes data length, see above definitions.

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Request Messages:

Request for Address Claimed Message:

When this message is received by the contactor, it will report back its J1939 address and its name. If you don't know the units address, use the 0xFF global address. Note: using the global address will cause all devices on the network to respond.

Request for Address Claimed Message:

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
not used, don't care					0x00	0xEE	0x00

Request for Address Claimed J1939 message: **[**priority: 6**]**, **[**PDU format: 234_{10}**]**, **[**destination: this unit's address**]**, **[**source address: user unit's address**]**. 3 bytes data length, see above definitions.

Return if address is successfully claimed: It will returns this units address embedded in the CAN extended ID and the 8 bytes of data containing the name of this unit.
Return if address cannot be claimed: It will return the NULL address (254) in the CAN extended ID bytes and the 8 bytes data with the name of this unit.

Return Address Data Message:

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
Name[7]	Name[6]	Name[5]	Name[4]	Name[3]	Name[2]	Name[1]	Name[0]

- The 21 bits of the lower bytes contain the serial number of the unit.

Return J1939 address claimed message: **[**priority: 6**]**, **[**PDU format: 238_{10}**]**, **[**destination: 255**]**, **[**source address: return-ADDR (claimed address or 0x254)**]**. 8 bytes data length, see above definitions.

Request Contactor Parameters Message:

Sending this message result in the contactor reporting back the settings and configuration. The return data includes: trip points, low voltage shutoff, delay timers, repetition rate, baud rate, power-up contactor state, bus bar over-voltage setting, and a 24 bit contactor ON/OFF cycle log (3 bytes: byte 2 to byte 0).

After the Request Contactor Parameters Message is received, it will send back the report using multi-packet broadcast message transport protocol.

Request Contactor Parameters Message:

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
not used, don't care					0x00	0xEA	0x00

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Request Contactor Parameters J1939 Message: [priority: 6], [PDU format: 234_{10}], [destination: this unit's address], [source address: user unit's address]. 3 bytes data length.

Request Contactor Parameters return: The first 8 bytes contain the J1939 PGN. The second 8 bytes signal the multi-packet number 1. The third 8 bytes contain packet number 2, and the forth 8 bytes are the final 8 bytes which contain package number 3.

Return first 8 bytes: Broadcast Announce Message (BAM) shows 3 packages, 17 bytes, byte4 is reserved value (0xFF) and PGN 65240 (0x00FED8).

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
0x00	0xFE	0xD8	0xFF	3	0	17_{10}	32_{10}

Return J1939 first message: [priority: 7], [PDU format: 236_{10}], [destination: user's ADDR], [source address: user unit's address]. 8 bytes data length, see above definitions.

Return second 8 bytes: Contactor on/off cycle-log byte0, contactor power-up default, shared bits, shutoff volts, trip-points and package number 1 indicator.

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
Cycle	C_PW-St	Shared	LV-Off	Trip 3	Trip 2	Trip 1	Package#
Byte 0	C/O	4x2 bits	8+2 bits	8+2 bits	8+2 bits	8+2 bits	1

Definition of byte-5 second package:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
2 bits MSB: LV-Off		2 bits MSB: Trip-3		2 bits MSB: Trip-2		2 bits MSB: Trip-1	

Return J1939 second message: [priority: 7], [PDU format: 235_{10}], [destination: user's ADDR], [source address: user unit's address]. 8 bytes data length, see above definitions.

Return Third 8 bytes: Contactor ON/OFF cycle-logs bytes 2 & 1, repetition-rate, delays and package number 2 indicator.

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
Cycle	Cycle	RP-rate	LV-Delay	Delay 3	Delay 2	Delay 1	Package#
Byte 2	Byte 1	8 bits	8 bits	8-bits	8-bits	8-bits	2

Return J1939 third message: [priority: 7], [PDU format: 235_{10}], [destination: user's ADDR], [source address: user unit's address]. 8 bytes data length, see above definitions.

Return Forth 8 bytes: The unused bytes contain 0xFF, CAN Baud Rate and package number 3 indicator. This is also a final byte of the package. 25=250 kbits/s, 50=500 kbits/s

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
unused	unused	Unused	unused	OVP-H	OVP-L	CAN-Baud	Package#
0xFF	0xFF	0xFF	0xFF	H-2-bits	L-8-bits	25_{10} or 50_{10}	3

Return J1939 forth & final message: [priority: 7], [PDU format: 235_{10}], [destination: user's ADDR], [source address: user unit's address]. 8 bytes data length, 1 byte used, see above definitions.

Contactor-cycle-log max value is 0x7FFFFF. It is unlikely the max value will reach during lifetime of the contactor. However, if the contactor reaches max value, it will wrap around to 0 and start counting up again.

Request Firmware Version, Report PS & A1-A2 Voltage Message:

Sending this request will return the unit's firmware version, the PS (PGN) of the report message, and the non-isolated contact-voltage-sensing at the bus-bar terminals labeled A1 and A2. If this unit has no contact-voltage sensing option, the A1 and A2 values will be irrelevant.

Request firmware, PS (PGN), A1, A2 Volts Message:

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
not used, don't care					0x00	0xFE	0xDA

Request Firmware RP Rate A1, A2 Volts J1939 Message: **[**priority: 6**]**, **[**PDU format: 234_{10}**]**, **[**destination: this unit's address**]**, **[**source address: user unit's address**]**. 3 bytes data length, see above definitions.

Return of request firmware PS (PGN) & A1 A2: 8 bytes data combination of firmware version, report PS (PGN) and A1 A2.

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
Shared bits	A2 Volts	A1 Volts	Report PS	FW Minor	FW Major	ID bytes	
See below	8+2 bits	8+2 bits	PGN #	Alphabet	Numeric	'G'	'V'

Byte 7 shared bits:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Not used				2bits MSB: A2_V		2bits MSB: A1_V	

Return J1939 Firmware, RP rate, A1-A2 Volts message: **[**priority: 6**]**, **[**PDU format: 254_{10}**]**, **[**destination: 218_{10}**]**, **[**source address: this unit's address**]**. 7 bytes data length, see above definitions.

Byte 5 & 6 (A1 & A2) Volts: A1 & A2 voltages are a 10 bit unsigned integer.
A1 or A2 Voltage = (5/1024) * Reading ADC counts * (32.74/2.74).
A1 & A2 Volts example:
Reading ADC value of 0x1EA = (5/1024) * 0x1EA * (32.74/2.74) = 28.59V.

Request Product Model Bar Code Data Message:

Sending this request to the unit will return the product model and date code, a total of 64 bytes. This type of data is mainly for factory record keeping and provides tractability information.

Request Product Model & Date-code J1939 Message:

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
not used, don't care					0x00	0xFE	0xEB

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Bar Code Request J1939 Message: [priority: 6], [PDU format: 234_{10}], [destination: this unit's address], [source address: user unit's address]. 3 bytes data length, see above definitions.

Request Product Model & Date-code return: Using Multi-Packet Broadcast message transport protocol.

Return first 8 bytes: Broadcast announce message (BAM) shows 10 packages, 64 bytes, byte4 is reserved value (0xFF) and PGN 65240 (0x00FED8).

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
0x00	0xFE	0xD8	0xFF	0x0A	0	64_{10}	32_{10}

Return J1939 first message: [priority: 7], [PDU format: 236_{10}], [destination: user's ADDR], [source address: user unit's address]. 8 bytes data length, see above definitions.

Return second 8 bytes: 7 bytes bar-code data from array index 0 to index 6 and package number 1.

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
D6	D5	D4	D3	D2	D1	D0	1

Return J1939 second message: [priority: 7], [PDU format: 235_{10}], [destination: user's ADDR], [source address: user unit's address]. 8 bytes data length, see above definitions.

Return third 8 bytes: 7 bytes bar-code data from array index 7 to index 13 and package number 2.

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
D13	D12	D11	D10	D9	D7	D7	2

Return J1939 third message: [priority: 7], [PDU format: 235_{10}], [destination: user's ADDR], [source address: user unit's address]. 8 bytes data length, see above definitions.

Continue to package number 3 …to the end of package 10.

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Report Messages:

Contactor Data Report Message:

The unit sends out reports regularly on the J1939 bus every **800ms** (default). The repetition rate can be changed with the Delays, Report Repetition and Baud Rate Message. The report message can be disabled by setting the repetition rate to zero. Temperature is a signed integer, all other data is unsigned.

The Data Report Message, contains the following:

- Current: The total current going through the contactor
- Temperature: The temperature inside the contactor in degree C.
- Power Supply Voltage: The voltage of the external power supply.
- Status: Bus bar over-voltage protection will set the OVP bit. Power supply under-voltage protection will set UVP bit. Over-current protection will set the TRIP bit. Contactor ON will set the STATE bit.
- Countdown (time to trip): This is the time in seconds before the contactor will open.

Note: there are 3 trip point delays and 1 under-volt delay, for a total of 4 different delay-timers. In case there are multiple countdown timer happening simultaneously, the timer which is the shortest will be reported.

Contactor Data Report Message for firmware older than rev 6C:

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte0
Trip time 10 bits		Status	Shared bits	PS-V	Temperature		Current
countdown (sec)		OV/UV/Trip/St	Below	8+2 bits	Signed 16 bits		8+2 bits

Byte 4 definition: 2 bits MSB of Power supply & current data.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
not used, don't care				2 bits MSB: PS-V		2 bits MSB: Current	

Byte 5 status definition: OVP is the bus bar over-voltage protection. For firmware version 5 and later, it will open the contactor and set bit7 if the bus bar voltage is higher than the protection setting. If the power supply is <= the low voltage shutoff setting, the under-voltage-protection (UVP) will open the contactor and set bit 5. The TRIP-state is the over-current protection trip (set bit 3). The contact-STATE is the status of the contactor: either open or closed. (bit0).

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
OVP	unused	UVP	unused	TRIP	unused	Unused	STATE

Byte 6 & byte 7:
Countdown to trip: This is the number of seconds that will be counted down when either the over-current or the under-voltage condition is true. The time to trip can be changed with the delay command. When there is no over-current or under-voltage condition, this countdown to trip value is 0xFFFE.

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Contactor Data Report Message for firmware rev 6C and later:

Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
Trip Time	Status	Power supply Volts		Current Magnitude		Temperature	
8bit (sec)	OV/UV/Trip/St	16 bits unsigned		Signed 16 bits		Signed 16 bits	

Report J1939 message: **[**priority: 6**]**, **[**PDU format: 255_{10}**]**, **[**destination: PS**]**, **[**source address: this unit's address**]**. 8 bytes data length, see above definitions.

Note: The PDU format is always 255, and the destination address default is 255. The destination address can be changed by sending "Change Report Message PS (PGN)" command.

How to interpret the report values:

Current: Current is 10 bit unsigned integer combining byte 0 with 2 bits from byte 4.
Current in shown in Amps: ADC counts * (600/512).
Current example: Reading current value of 220 counts = 220 * 1.17 = 258 Amps

Byte 1 and 2 Temperature: Temperature is a 16 bit signed integer.
Temperature value in reported in °C = ((reading data – 3) / 128)
Temperature example 1: reading data 0x3E83 is a temperature of 125°C
Temperature example 2: reading data 0xF383 is a temperature of -25°C

Byte 3 Power Supply Voltage: The power supply voltage is a 10 bit unsigned integer combined with 2 bits from byte 4.
The equation is: Supply Volts = (5/1024) * ADC counts * (28.02 / 4.02).
Supply voltage example:
If read-back ADC counts = 0x198, the supply voltage is:
(5/1024) * 408 * (28.02/4.02) = 13.89V

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Appendix: J1939 format

CAN	29 bit ID						Data
J1939	PDU (Protocol Data Unit)						
	P	**R**	**DP**	**PF**	**PS**	**SA**	Data
Bits	3	1	1	8	8	8	0-64
	24 bit PGN (Parameter Group Number) (1st 6 bits are 0)						

Abr.	**Full Name**	**Description**
PGN	Parameter Group Number	
P	Priority	Priority of command.
R	Reserved	
DP	Data Page	Use 0. 1 reserved for future expansion.
PF	PDU Format	Command
PS	PDU Specific	Address of recipient
SA	Source Address	Address of sender

Document Revision History:

R1: to **R3.**
Prototype.

R4: For firmware version 2 and later.
- First release.
- Data format of firmware version 2 or later.
- Add low voltage shutoff delay and all delays ranges are 8-bits.
- Add firmware version major and minor numbers.

R5:
- No change to the core date format.
- Reorganized command and setting, split into 2 groups.
- There are total of 4 messages types.
- A note for the baud rate info.

R6: For firmware version 3 and later.
- Added changeable baud rate
- Changed CAN BUS baud rate message affects the message of “Request Contactor Parameters” PDU format: 234_{10}. This message will return 1 more value, the CAN-BUS baud rate setting 25 or 50.

R7: For firmware version 5 and later.
- Added A1 and A2 over voltage protection.
- Added BUS BAR over-voltage protection setting message, PDU format 183.
- “Request Contactor Parameters” PDU format: 234_{10}. This message will return 1 more value, the over-voltage value to protect the bus bar in 10 bits integer (OVP).
- Report data will set bit7 if over-voltage protection of the bus bar is activated.

R8: For firmware version 6C and later.
- Added ability to send a command with selective values to change or to keep it as old value when a value is rejected.

- Trip Points will reject input values of greater than 512.
- Trip-delays, Low voltage shutoff delay, and report rate will reject values of 255.
- Low voltage shutoff will reject values greater than 940 (32V).
- Bus bar over-voltage protection will only accept a value of < 1023.
- Report current in both directions.
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