

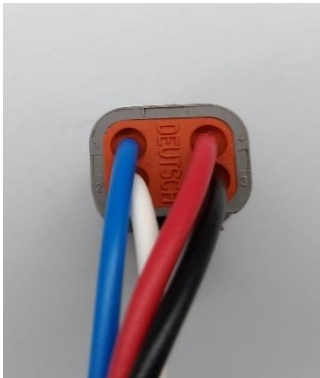
# PowerKey 1000 J1939 user manual



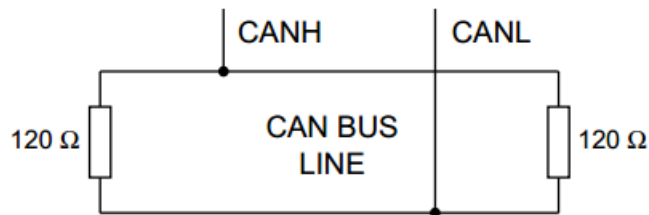
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## 1. How to connect the wires:



PIN	COLOUR	FUNCTION
1	Blue	CAN L
2	White	CAN H
3	Black	Negative battery
4	Red	Vbatt. (12-24V)



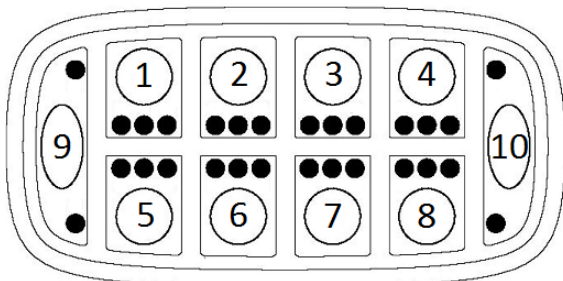
Each end of the CAN bus is terminated with 120Ω resistors in compliance with the standard to minimize signal reflections on the bus. You may need to place a 120Ω resistor between CAN-L and CAN-H.



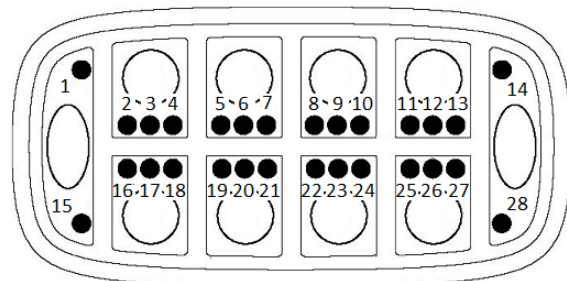
Warning: to avoid breakage do not tighten the backshell nuts with a torque exceeding 0.8 Nm!

## 2. Reference

Key:



LED:



### 3. Message header description

The 29-bit CAN identifier used in J1939 is structured in the following way.

Priority	Reserved	Data Page	PDU Format	PDU Specific	Source Address
3 bits	1 bit	1 bit	8 bits	8 bits	8 bits

The proprietary format used by PK keypads is defined as follows:

Priority = 6.

Reserved = 0.

Data page = 0.

PDU Format = EFh (the message is addressable).

PDU Specific = Destination Address.

Parameter Group Number (PGN) = 61184 (EF00h).

An example of CAN identifier of messages sent to the keypad is 18EF2100h where:

21h is the destination address (keypad)

00h is the source address.

An example of CAN identifier of messages sent by the keypad is 18EFF21h where:

FFh refers to broadcast messages (no specific destination address)

21h is the source address (keypad).

### 4. General Data Format

The proprietary protocol has defined a general format for the data fields in the PGN 61184. The format consists of:

1 header field (2 bytes)

1 command byte

5 bytes (the remaining field) are defined specifically for each command.

The data length is 8 bytes, unused bits and bytes are set to all 1's (0xFF).

Byte 0	04h
Byte 1	1Bh
Byte 2	Command
Byte 3-7	Data required for each specific command

## 5. Default settings

Setting	Default status or level	How to change
CAN bus Baud Rate	250 kbit/s	<a href="#">Command 6Fh</a>
Source Address	21h	<a href="#">Command 70h</a>
Keypad identifier	21h	<a href="#">Command 70h</a>
Destination Address	FFh	<a href="#">Command 6Eh</a>
Heartbeat	Disabled	<a href="#">Command 75h</a>
Periodic key-state message transmission	Disabled	<a href="#">Command 71h</a>
Key-state message period	100ms	<a href="#">Command 77h</a>
Event state transmission	Enabled	<a href="#">Command 72h</a>
Address claim at boot	Disabled	<a href="#">Command 74h</a>
Default LED indicators brightness level	3Fh	<a href="#">Command 7Ch</a>
Default backlight brightness level	OFF	<a href="#">Command 7Bh</a>
Startup LED show	Complete LED Sequence	<a href="#">Command 34h</a>
Default backlight color	Amber	<a href="#">Command 7Dh</a>
LED acknowledgement	Disabled	<a href="#">Command 73h</a>

## 6. Key Contact state (01h)

This message is sent by the keypad to indicate the state of the contacts. The default destination address is set to FFh: broadcast message. See chapter 2 for Key number reference.

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	01h	Key Contact state
Byte 3	XXh	XX: Key Number
Byte 4	YYh	Contact State 00: Switch OFF (Key released) 01: Switch ON (Key pressed)
Byte 5	ZZh	Keypad Identifier (default 21h)
Byte 6,7	FFh	Not used

Examples:

Direction	Identifier	Format	Message	Data
From Keypad	18EFFF21h	Ext	04 1B 01 01 01 21 FF FF	Key 1 ON
From Keypad	18EFFF21h	Ext	04 1B 01 01 00 21 FF FF	Key 1 OFF
From Keypad	18EFFF21h	Ext	04 1B 01 02 00 21 FF FF	Key 2 OFF
From Keypad	18EFFF21h	Ext	04 1B 01 03 01 21 FF FF	Key 3 ON
From Keypad	18EFFF21h	Ext	04 1B 01 05 01 21 FF FF	Key 5 ON
From Keypad	18EFFF21h	Ext	04 1B 01 05 00 21 FF FF	Key 5 OFF
From Keypad	18EFFF21h	Ext	04 1B 01 0A 01 21 FF FF	Key 10 ON
From Keypad	18EFFF21h	Ext	04 1B 01 0A 00 21 FF FF	Key 10 OFF

If the Event state transmission is enabled, the Key Contact state message is sent when a key is switched.

If the periodic key-state transmission is enabled (see [Command 71h](#) for further details), at each given time interval a Key Contact state message is transmitted for each button of the keypad.

## 7. LED command (01h)

This message is sent to the keypad to set the state of the LED indicators. See chapter 2 for Key and LED number reference.

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	01h	LED command
Byte 3	XXh	XX: PK1000 LED number
Byte 4	YYh	LED Color 00: off 01: red 02: green
Byte 5	ZZh	LED State 00: off 01: on 02: blink 03: alternate blink
Byte 6	WWh	LED Secondary Color (only for alt blink) 00: off 01: red 02: green
Byte 7	FFh	Not used

Examples:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 01 01 01 01 00 FF	LED 1 red
To Keypad	18EF2100h	Ext	04 1B 01 01 00 00 00 FF	LED 1 off
To Keypad	18EF2100h	Ext	04 1B 01 0F 02 02 00 FF	LED 15 green blinks
To Keypad	18EF2100h	Ext	04 1B 01 10 01 02 00 FF	LED 16 red blinks
To Keypad	18EF2100h	Ext	04 1B 01 0A 01 03 02 FF	LED 10 blinks red and green in alternate mode

## 8. Set LED indicators brightness level (02h)

This message sets the value of the LED indicators brightness level. The value can be set from 0 to 3Fh (min-100%) of the LED dimming range.

NOTE: this setting has temporary effect and at the startup comes back to the default value. If the default value is desired to change, please refer to the [Command 7Ch](#).

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	02h	Set LED indicators brightness level
Byte 3	XXh	XX: Dim Value (default 3Fh) From 00h (min) to 3Fh (100%)
Byte 4,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 02 20 FF FF FF FF	Brightness level set to 50%

## 9. Set backlight level (03h)

This message sets the value of the backlight brightness. The value can be set from 0 to 3Fh (0-100%) of the brightness range.

NOTE: this setting has temporary effect and at the startup comes back to the default value. If the default value is desired to change, please refer to the [Command 7Bh](#).

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	03h	Set backlight level
Byte 3	XXh	XX: Value (default 00h) From 00h (0%) to 3Fh (100%)
Byte 4,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 03 10 FF FF FF FF	Backlight level set to 25%

## 10. Set startup keys message(28h)

This command enables the transmission during power up of the state of the keys.

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	28h	Set startup keys message
Byte 3	XXh	XX: 00h Disabled (default) 01h Enabled
Byte 4,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 28 01 FF FF FF FF	Startup keys message enabled

## 11. Get software revision (2Ah)

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	2Ah	Get software revision
Byte 3,7	FFh	Not used

### Answer:

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	2Ah	Get software revision
Byte 3,6	XXh XXh XXh XXh	SW revision ASCII
Byte 7	00h	Not used

### Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 2A FF FF FF FF	Get software revision
From Keypad	18EFFF21h	Ext	04 1B 2A 56 32 2E 30 00	V2.0

## 12. Set startup LED show (34h)

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	34h	Set startup LED show
Byte 3	XXh	XX: 00h OFF 01h Complete LED show (default) 02h Fast flash
Byte 4,7	FFh	Not used

### Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 34 00 FF FF FF FF	Set startup LED show OFF

## 13. Set Destination Address (6Eh)

This message is used to set the addressee node of the Key Contact state transmitted by the keypad. The default destination address is FFh (broadcast).

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	6Eh	Set Destination Address
Byte 3	XXh	XX: CAN Destination Address From 00h to FFh FEh: reserved
Byte 4,7	FFh	Not used

### Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 6E 00 FF FF FF FF	CAN destination address set to 00h



## 14. Baud rate setting (6Fh)

This message is used to change the baud rate of the CAN bus. Connecting only one keypad to the bus when changing the baud rate is recommended. If an invalid value is chosen, then no change is done to the stored value.

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	6Fh	Baud rate setting
Byte 3	02h	500kbit/s
	03h	250kbit/s
Byte 4,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 6F 02 FF FF FF FF	Baud rate set to 500kbit/s

## 15. Set Source Address (70h)

This message is used to change the keypad CAN Source Address and/or the Keypad Identifier. Either or both the Source Address or Keypad Identifier may be changed independently. Connecting only one keypad to the bus when changing the keypad address is recommended. If an invalid value is chosen, then no change is done to the stored value.

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	70h	Set Source Address
Byte 3	XXh	XX: CAN Source Address From 01h to FDh FEh: reserved FFh: no change
Byte 4	YYh	YY: Keypad Identifier From 00h to FDh FEh: reserved FFh: no change
Byte 5,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 70 05 21 FF FF FF	Source address set to 05h; keypad identifier set to 21h.

## 16. Periodic key-state transmission (71h)

This message enables or disables the periodic transmission of the Key state.

When enabled, one contact state message is periodically sent for each button of the keypad. The period is set to 100ms as default value but can be changed by command 77h.

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	71h	Periodic key-state transmission
Byte 3	XXh	XX: 00h Disabled (default) 01h Enabled
Byte 4,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 71 01 FF FF FF FF	Periodic key-state transmission enabled

## 17. Event state transmission (72h)

This message enables or disables event-driven key state transmissions. When this feature is enabled, the keypad transmits the state of a contact at the time that the contact changes state (pressed or released).

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	72h	Event state transmission
Byte 3	XXh	XX: 00h Disabled 01h Enabled (default)
Byte 4,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 72 00 FF FF FF FF	Event state transmission disabled

## 18. LED Acknowledgment (73h)

This message enables or disables the transmission of the LED Acknowledgement message. When this feature is enabled the keypad transmits an acknowledgement message each time a LED Command is received.

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	73h	LED Acknowledgment
Byte 3	XXh	XX: 00h Disabled (default) 01h Enabled
Byte 4,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 73 01 FF FF FF FF	Enable LED acknowledgment
To Keypad	18EF2100h	Ext	04 1B 01 01 01 03 02 FF	LED Command
From Keypad	18EFFF21h	Ext	00 03 01 01 02 FF FF FF	LED Ack message

**LED Acknowledgement message:**

Byte 0	00h	
Byte 1	XXh	XX: LED state
Byte 2	YYh	YY: LED indicator number
Byte 3	PPh	PP: Primary color
Byte 4	ZZh	ZZ: Secondary color
Byte 5,7	FFh	Not used

## 19. Address Claim at boot (74h)

This message enables or disables the address claim procedure.

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	74h	Address claim at boot
Byte 3	XXh	XX: 00h Disabled (default) 01h Enabled
Byte 4,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 74 01 FF FF FF FF	Address claim enabled

### Address claiming procedure:

Under normal operation, the keypad application sends an Address Claim parameter group at start up and waits up to 250 ms for the other devices connected to the same network to send a message containing the device's address and name. The keypad checks every response and compares the names to see who has the highest priority. If a device is already using the address and has a higher priority, then a new address is selected, and the process starts over. If the keypad has a higher priority than the device in use then it waits for other systems to reply, while the responding device will have to change its address and send an address claim itself. If no message is received after the time (250ms) is up, then the device has claimed the address.

### Address claim parameter group:

Priority = 6.

Destination Address should always be the Global Address FFh

Parameter Group Number (PGN) = 60928(EE00h).

Data Length = 8

Data = NAME field

Example:

Direction	Identifier	Format	Message	Data
From Keypad	18EEFF21h	Ext	3F 42 6F 1A 00 82 3C C0	

## 20. Heartbeat (75h)

This message enables or disables the transmission of Heartbeat message. This message is designed to indicate to other devices on the bus that this unit continues to function.

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	75h	Heartbeat
Byte 3	XXh	XX: 00h Disabled (default) 01h Enabled
Byte 4	YYh	YY: Period in milliseconds ÷ 10 From 05h (50ms) to FEh (2.54 sec)
Byte 5,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 75 01 32 FF FF FF	Set heartbeat enabled with 500ms period.

**Heartbeat generated message:**

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	F9h	Heartbeat message
Byte 3	XXh	XX: Message counter, incremented each message sent
Byte 4	K8 K7 K6 K5 K4 K3 K2 K1	Button state indicators Each bit represents a button state 0: OFF 1: ON
Byte 5	00 00 00 00 00 00 K10 K9	
Byte 6,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
From Keypad	18EFFF21h	Ext	04 1B F9 03 02 00 FF FF	Heartbeat message with button 2 pressed

## 21. Key-state message period (77h)

This message sets the period time for the PERIODIC KEY-STATE TRANSMISSION (71h).

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	77h	Key-state message period
Byte 3	XXh	XX: Period in milliseconds ÷ 10 From 05h (50ms) to FEh (2.54 sec)
Byte 4,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 77 0A FF FF FF FF	Period set to 100ms

## 22. Start Demo mode(7Ah)

This message enables the Demo mode function. Demo mode is a special feature that consists in different LED states for each button pressing. Refer to the appendix “Demo mode instructions” to try these special features. Disconnect and reconnect the keypad after the enable message to enter this mode. To exit the Demo mode, send the Disable Demo mode command or another command message.

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	7Ah	Start Demo mode
Byte 3	XXh	XX: 00h Disabled (Default) 01h Enabled
Byte 4,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 7A 01 FF FF FF FF	Demo mode enabled

## 23. Default backlight brightness level (7Bh)

This message sets the value of the backlight at keypad power up. The value can be set from 0 to 3Fh from 0 to 100% of the brightness range.

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	7Bh	Default backlight brightness level
Byte 3	XXh	XX: Value From 00h (0%) to 3Fh (100%)
Byte 4,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 7B 06 FF FF FF FF	Default backlight level set to 10%

## 24. Default LED indicators brightness level (7Ch)

This message sets the default value of the LED indicator brightness level. The value can be set from 0 to 3Fh from a minimum value to 100% of the LED dimming range.

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	7Ch	Default LED indicators brightness level
Byte 3	XXh	XX: Value From 00h (0%) to 3Fh (100%)
Byte 4,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 7C 10 FF FF FF FF	Default LED indicators brightness level set to 25%

## 25. Default backlight color (7Dh)

This message sets the default color of the backlight.

Byte 0	04h	Header bytes
Byte 1	1Bh	
Byte 2	7Dh	Default backlight color
Byte 3	XXh	XX: color 01h: red 02h: green 03h: blue 04h: yellow 05h: cyan 06h: magenta 07h: white/light blue 08h: amber/orange 09h: yellow/green
Byte 4,7	FFh	Not used

Example:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 7D 05 FF FF FF FF	Default backlight color set to cyan

## 26. Set CAN protocol

This set of messages are used to change to the desired CANbus protocol.

- Change from J1939 to CANopen:

Direction	Identifier	Format	Message	Data
To Keypad	18EF2100h	Ext	04 1B 80 00 FF FF FF FF	Change to CANopen

- Change from CANopen to J1939:

Direction	Identifier	Format	Message	Data
To Keypad	615h	Std	2B FF 20 01 01	Change to J1939

## APPENDIX: DEMO Mode instructions

In DEMO Mode you can try the following functions by pressing buttons on the PK1000.  
Entering this mode, you turn on key-LEDs with color red.

For the key 1, each time you press the button you can change the color of key-LEDs with this sequence:

1. Red;
2. Green;
3. OFF.

Holding down the key 2, you can increase LED brightness level.

Holding down the key 3, you can decrease LED brightness level.

If you press the key 4, there are different steps in this sequence:

1. Complete LED show of all colors: at first with red, then green;
2. Backlight active with LED indicators on in sequence (it is possible to change the color of the LED indicators by pressing key 1 and the backlight color by pressing key 5);
3. Alternate blinking of LED indicators number 1-7 and 22-28 with red color; 8-14 and 15-21 with green color;
4. Return to the starting demo mode state.

In the case you press the other keys, there are no events.



## 27.Revision history

Date	Manual Revision	Comment	Related SW version	Related HW version
03/02/2017	1.0	First Release	SW 1.6J	PK1000 HW-V03
14/03/2018	1.1	Second Release <ul style="list-style-type: none"> <li>• replaced 0% with minimum value for LED brightness</li> <li>• replaced the symbol * with ÷ in "heartbeat" and in "periodic key message period" command</li> <li>• replaced the words amber/orange and yellow with color 03 and 04 in "LED COMMAND" explaining how these colors are obtained</li> <li>• Added "SET CANprotocol" command, "BAUD RATE SETTING" command and "DEMO MODE instructions"</li> <li>• Updated to the latest software version the values of allowable addresses range in the command "SET SOURCE/KEYPAD ADDRESS/IDENTIFIER"</li> </ul>	SWx.x	PK1000
21/02/2019	1.2	Third Release <ul style="list-style-type: none"> <li>• Added warning note at page 3</li> </ul>		
07/05/2019	1.3	Fourth Release <ul style="list-style-type: none"> <li>• In compliance with the SAE J1939 standard, in the command {70h} the value FEh has been excluded from the list of the addresses assignable by the user to the keypad</li> </ul>		
22/06/2020	1.4	Fifth release: <ul style="list-style-type: none"> <li>• Removed colours 03 and 04 from the LED command chapter</li> <li>• Reviewed DEMO mode instructions</li> </ul>		
28/09/2020	1.5	Sixth release: <ul style="list-style-type: none"> <li>• Added command 6Eh</li> </ul>		