Mini PowerBox CAN

Standard HP Dual

Six fully protected Outputs controlled through CAN bus.

Dual version is two cores in same enclosure and so, have twelve outputs

Electrics:

	Standard version	HighPower	Dual
Supply voltage:	6V to 16V	8V to 16V	6V to 16V
Supply current /(sleep):	25mA (5mA)	25mA (5mA)	50mA (2mA+analog sensors)
Total output currents:			
- Continuous:	30A	150A	TBD
- Short time:	50A	300A	TBD
Current for each output:			
- Continuous:	10A	40A (80A on output 2&5)	2x75A + 4x25A + 6x15A
- Short time	15A	60A (120A on output 2&5)	4x30A
Short circuit protection (typ.):	yes (75A)	135A (300A on output 2&5)	240A – 80A
Thermal protection:	yes	yes	yes
Overload protection:	yes	yes	yes
Under/over voltage protection:	yes	yes	yes
Output current resolution:	0,1A	1A	1A/bit - 0,2A/bit - 0,1A/bit

Mechanics:

	Standard version	HighPower version	Dual
Size:	48x46x30mm	70x100x25 mm	74x56x34
Enclosure:	PA	PA and Aluminium	PA & Aluminium
Mating connector:	MOLEX MX120G (36792-1201), Term: 36799-0001 (16-18AWG) 36799-0002 (22-20AWG)	free ends wires 22AWG Input: M6 brass stud Output: M5 brass stud	AMP 4-1437290-0 Term: 3-1447221-4 (20AWG) 3-1447221-3 (18-16AWG)
Protection:	IP67 (molded)	IP67 (filled with resin)	IP67
Operating temp.:	-20 to 85ºC	-20 to 85ºC	-20 to 85ºC
Weight:	45g	180g	160g
UL94:	V-2	V-2	V-2

Functionalities

CAN:	2.0A and 2.0B
Termination	Open
CAN baudrate:	User settable (1M, 500k, 250k, 125k)
IDs:	IDs user settable. (**!!! Extended IDs are used for laptop protocol. Take care in this case.**)
Messages Rate:	Individually and user settable
PWM:	Each output can be drive as PWM (max 400Hz). Period is same for all outputs. Output 1 and 6 are specifics for inductive load and are clamped at 24V (for standard version).

Each output can be controlled trough CAN bus with one message only. This message contains one byte to enable or disable each output. Also, same message have one byte for each output setting the PWM from 0 to 100 for drive the corresponding output.

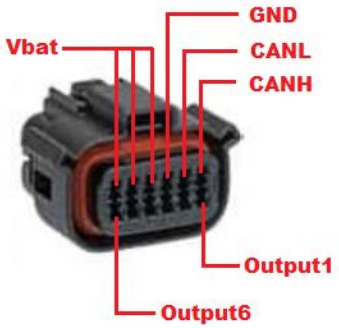
With a specific software tool, some protections values can be set for each output:
- Overload threshold
- Protection sensibility
- Min voltage
- Max voltage
- Auto rearm
- “Always ON” (output is On from the init of the device until any fault is detected. Can't be switched Off through CAN)
- default PWM value in case of CAN failure or output set as “always ON”.

A PWM period can be set for whole outputs.
In case of inductive load, output 1 and output 6 must be preferably used on standard model (small one).

Feedback is controlled by the processor to inform of any open load or high side failure.
NEW: Sleep mode capabilities on user selected CAN message. Wake up on any CAN activity.

PinOut:

Standard version



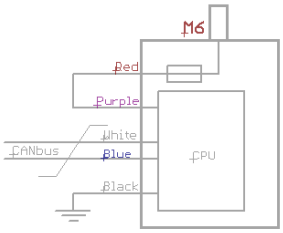
1	CANH
2	CANL
3	GND
4,5,6	VBAT
7..12	Output 1 to 6

High power version

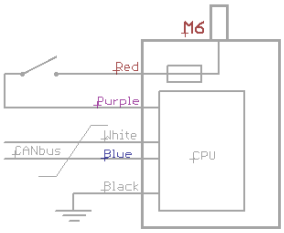
Red:	Power supply out (fused)
Purple:	Power supply in
Black:	Ground
White:	CAN high
Blue:	CAN low

INPUT:	stud M6
OUTPUTS:	stud M5

Wiring: as standard use



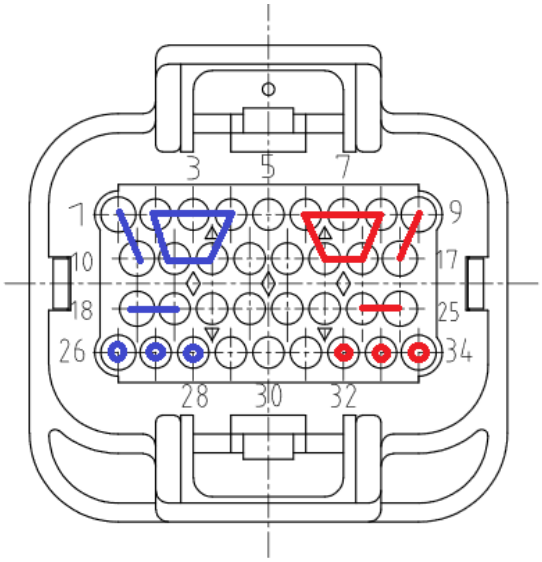
as main relay



Dual version

Side	Function	Pin
Right (“R”)	Output 1	2,3,4,11,12
	Output 2	1,10
	Output 3	18,19
	Output 4	26
	Output 5	27
	Output 6	28
	Ain 1	20
	Ain 2	21
LEFT (“L”)	Output 1	6,7,8,15,16
	Output 2	9,17
	Output 3	24,25
	Output 4	34
	Output 5	33
	Output 6	32
	Ain 1	22
	Ain 2	23
Common	CANH	13
	CANL	14
	Vref (5V 50mA)	31
	AGND	29
	12V fused	5
	GND	30

Rear connector view



12V fused can be used for power the device independently without supply power output. This is useful for setup the device in situ. Another use is power the CPU by another device and drive autopower on/off

Add switch between GND output and car GND make the device as main relay.

CAN Protocol

Received message (for activate/deactivate output):

N.º byte	Byte0 (b0..b5)	Byte1 (b0..b5)	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Function	Output reset	Digital Enable	PWM output1	PWM output2	PWM output3	PWM output4	PWM output5	PWM output6

Digital Enable: each first bit switch ON/OFF the corresponding output. This mode override the PWM so, if set to 1, the corresponding output PWM will be same as 100%.

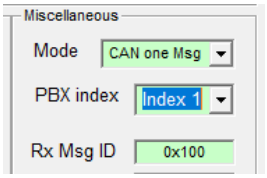
PWM: each output can be drive by individual PWM from 0% (OFF) to 100% (fully ON). The frequency is settable and same for all outputs (from 4Hz to 400Hz). Use PWM with inductive load can damage the device. PWM must be use only for resistive load, leds,…

Case of "CAN one Msg" or "Stand Alone" mode

In this mode the CAN message sent by a master device can manage up to eight power box.

N.º byte	Byte0 (b0..b5)	Byte1 (b0..b5)	Byte2 (b0..b5)	Byte3 (b0..b5)	Byte4 (b0..b5)	Byte5 (b0..b5)	Byte6 (b0..b5)	Byte7 (b0..b5)
Function	PBX1 outputs	PBX2 outputs	PBX3 outputs	PBX4 outputs	PBX5 outputs	PBX6 outputs	PBX7 outputs	PBX8 outputs

Each Power box must have a setup with a different index.
If same index is put on several powerbox, all corresponding outputs will be drive together.



This message can also be use in Stand alone mode (from 3.02 firmware version)

Transmitted messages:

First message: Consumptions

N.º byte	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Function	Current on Output 1	Current on Output 2	Current on Output 3	Current on Output 4	Current on Output 5	Current on Output 6	Total consumption (MSB)	Total consumption (LSB)
Standard	0,1A/bit	0,1A/bit	0,1A/bit	0,1A/bit	0,1A/bit	0,1A/bit	0,1A/bit	
HP	1A/bit	1A/bit	1A/bit	1A/bit	1A/bit	1A/bit	1A/bit	
Dual	1A/bit	0,2A/bit	0,2A/bit	0,1A/bit	0,1A/bit	0,1A/bit	0,1A/bit	

Output Open Load state: If Output is ON and no current detected or feedback voltage not match, load is defined as unconnected
Output protection state: 1=protection ON, output is disable. 0=standard mode

Second message: Output State

N.º byte	Byte0 (b0..5)	Byte1 (b0..5)	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Function	Output1 State	Output2 State	Output3 State	Output4 State	Output5 State	Output6 State	Vbat (0,1V/b)	CPU temp (ºC)

Output state:

bit 7: Strategy state (used in standalone mode)
bit 6: Always ON
bit 5: Internal Mosfet fault detected
bit 4: Vbat protection tripped
bit 3: Overload protection tripped
bit 2: Open load (note that output is ON and measurement current is 0, this flag is set)
bit 1: Output is ON (also if PWM apply is >0)
bit 0: Digital output feedback read (is set if voltage feedback is not 0 when output is OFF)

Third message: I2t

N.º byte	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Function	I2t output 1	I2t output 2	I2t output 3	I2t output 4	I2t output 5	I2t output 6	Not used	Note used

I2t is the over current integration value. Range is from 0 to 255. Threshold value depend of the setting (1 to 8). In auto rearm, output switch again when I2t reach 0.

I2t value corresponding to each threshold:

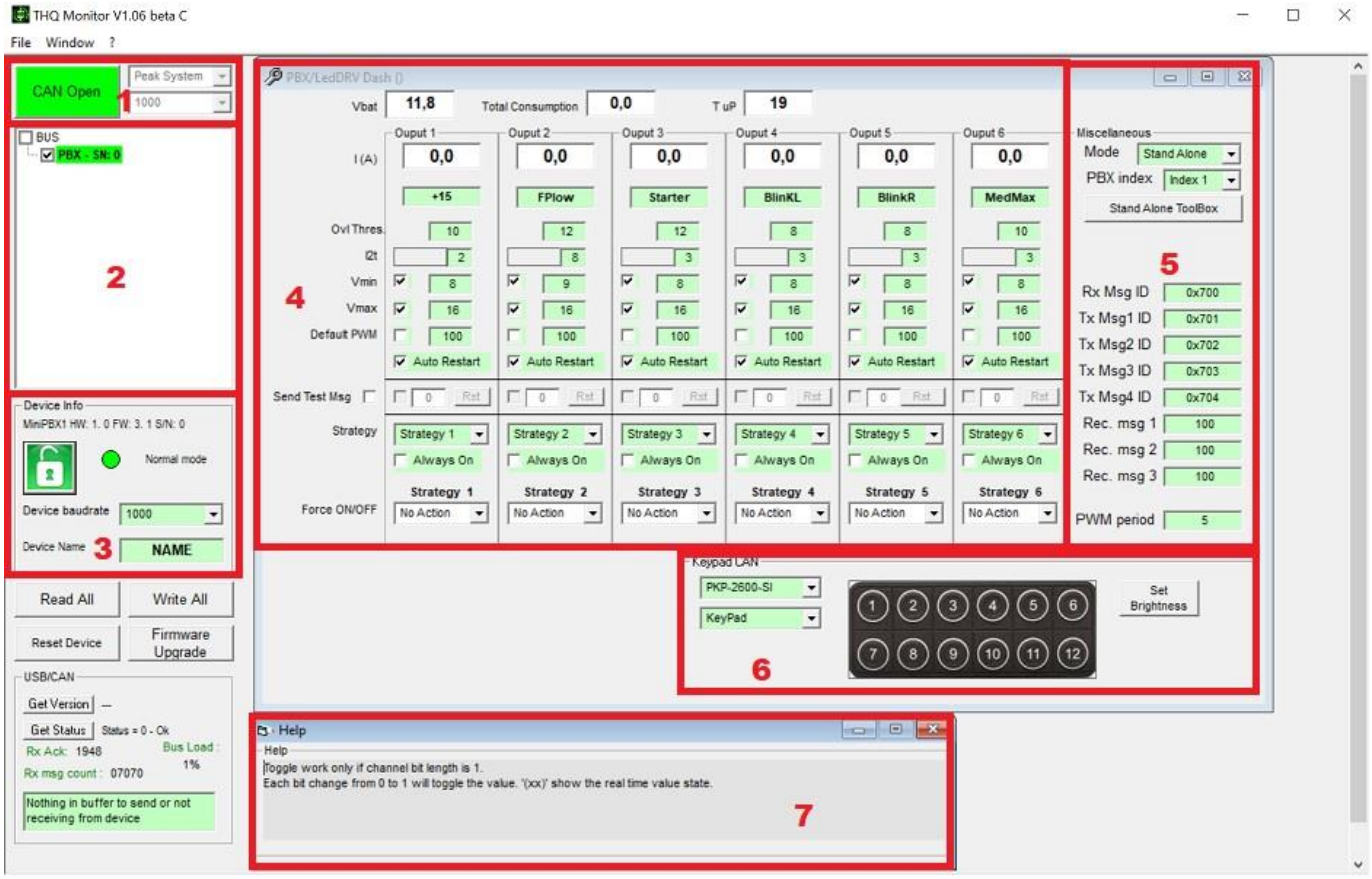
I2t Threshold	1	2	3	4	5	6	7	8
I2t value (rounded)	4	15	35	62	97	140	191	250

Fourth message (only for Dual version): Analogue inputs

N.º byte	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Function	Ain1 raw MSB (mV)	Ain1 raw LSB (mV)	Ain1 Lin MSB	Ain1 Lin LSB	Ain2 raw MSB (mV)	Ain2 raw LSB (mV)	Ain2 Lin MSB	Ain2 Lin LSB

Configuration tool:

A configuration tool through USBCAN Lawicel, PEAK system or InnoMaker MS124 interface allow to set the device.



Zone 1: Select interface used, CAN baud rate and then, open the CAN port.

Zone 2: On the tree view window the devices present on the bus must be showed. Click on the node that you want to work. All device parameters will read.

Zone 3: Device info must be show here with several info as firmware version, hardware version and serial number. In this zone, you can also lock the memory write for avoid any memory over writing.

Zone 4: Ouputs dashboard show the different parameters to set and also current for each output.

General protection philosophy:

The overload protection is done integrating the current value who exceed the user defined threshold (I2t). The sensibility can be set from 1 to 8. When the I2t reach the sensibility threshold, the output is switched off. Then the I2t is decreasing until 0. When I2t return to 0, if “autorestart” is set, the output try to work again.
This method make that the output don’t go in protection immediately when the current value exceed the threshold. The delay for start protection is depending of the overshooting situation. As strong is it, as fast is switched off.

Default PWM: This value is applied (if checked) in case of CAN timeout (1s).

Always On : If checked, the output is permanently On (if no protection active). Default PWM is apply in this case.
“Always On” is not available in Stand Alone mode due to conflict with strategies.
In this case one strategy must be set where result is always output “ON”

Inhib time (not on picture): Inhib time is output protection in case of inductive load and avoid too fast commutation which can destroy the output. This time is 10ms resolution. The output can’t become “On” after switch “off” situation + the delay. It also make not usable the PWM.

Current back ground color change depending of output state:

Grey: Device Time out
White : output Off
Green: output On
Cyan: output Open load with output On
Blue: output Open load with output Off
Red: output Overload

Yellow: Internal Mosfet protection (Temperature or short circuit)

Send Test Msg : If checked, a message with the “RX Msg ID” ID is sent for drive the outputs through CAN.

Force ON/OFF: Allow to drive manually each output. A device reset clear this effect.

Zone 5: General configuration for the device.

Mode: Three modes avalables.

Standard mode:
Ouputs are set On/Off using a CAN message. Each output can be set On using the corresponding bit or setting the PWM byte. This message ID is the “RX Msg ID”

CAN one Message:
Each byte of the message drive one power box with the corresponding index 1 to 8. This allow to drive each 8 devices with only one CAN message. This message ID is the “RX Msg ID”

Stand Alone:
In this mode, each output can be set On or Off through user strategy. If this mode is selected, the Stand Alone tool box become available for set parameters.

PBX Index:
Set the index of each power box if used in “CAN one message” mode. If two power box have the same Index, outputs will be drive at the same time on both (not tested).

Sleep MSG:
Select the CAN message (from the ID message list). If the selected messge is not received during one second, the device enters in sleep mode process. The sleep process is: switch off all output, wait for around one second, enter in sleep mode.
Wake up is done by power cycle or any CAN activity. Wake up by CAN will rest all the device.
Sleep Mode is disable if THQmonitor is connected to the device.
NOTE: External 5V is actually not disable and external 5V consumption must be add to 2mA internal consumption. Future hardware version will disconnect it for optimise the sleep stand by current.

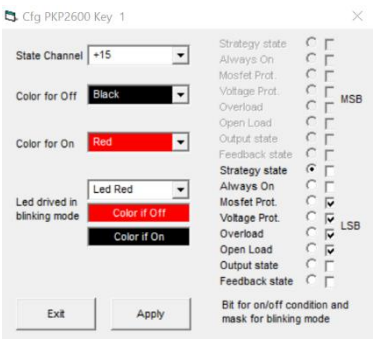
Rx Msg ID:
This is the ID message for drive the output. The device who drive the outputs must send the message on this ID. For standard ID, set 0xNNN. For extended ID set 0xNNNNNNNN. Ex: 0x100 vs 0x00000100

Tx Msg ID/ Rec. Msg:
ID and period for send the 3 CAN messages (see CAN protocol on page 2). As the integral period is 100ms, the Tx Msg3 period must be higher or equal than 100 to make sense.
Msg4 is fixed 10ms recurrence.

PWM period:
PWM period in ms (not good precision of timing due to software loop management). The period is applied for all the outputs. Take care that long period will apply a delay to update the outputs state.

Zone 6: CAN Keypad (only for GrayHill device and PKP2600-SI from Blink Marine)

Grayhill:
If a keypad is selected, the wake-up message is periodically sent. Also, user can set which central led can be managed as toggle when the corresponding switch is pushed. Check box are for raw, column.



Blink Marine (PKP2600-SI):
Click on each button on the picture for button LEDs setup.
Color for Off, On or failure (blinking) can be set.

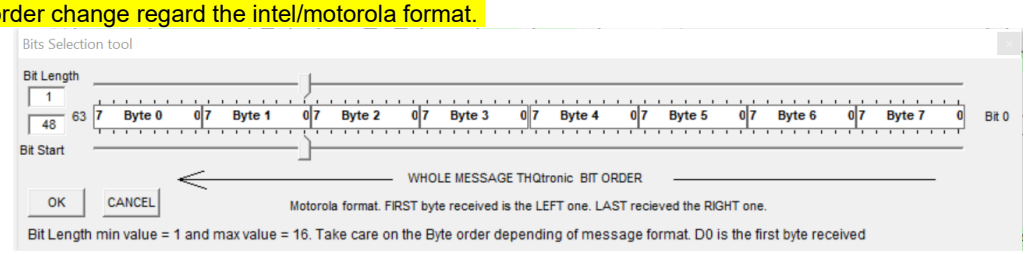
See annexe for PKP2600-SI CAN message sent for button state.

Zone 7: When the mouse click or move over an object, a small help appear on this tool box.

STAND ALONE TOOLBOX:

First Step: -Set all ID message need to be received.
-Each message can have a name (8 car). Ex: “ECU1”.
Two special channels are reserved: “IGN” used for user strategies as ignition flag. “KILL” is used on user strategies for switch off outputs as “Main OFF”

Second step: -Set CAN channels.
-Set name (7 car) of each channel.
-Select the CAN message where the channel come from.
-Check if intel format (LSB/MSB instead MSB/LSB).
-Select Start bit and bit length. A tool box help to define where is the bit package in the message. Take care that Byte order change regard the intel/motorola format.



Important: Motorola format manage bytes order from left to right (byte0 at the left, byte7 at the right)
Intel format will manage bytes from right to left (byte0 at the right and byte7 at the left). This allow consecutive bits number in each case.

-If one bit length only, the channel can be toggled. The final value show in his case is State (Mom) ex: “On (Off)”.

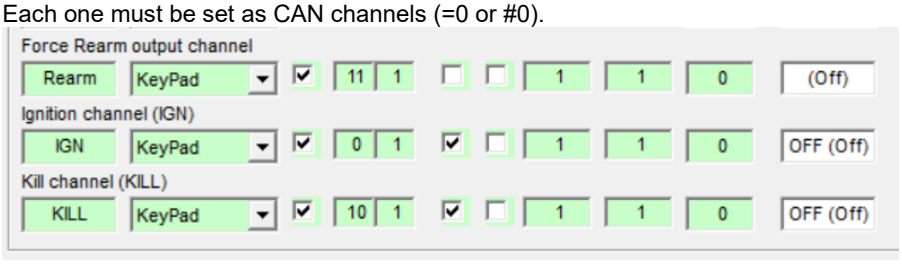
-Select if input value is signed (-32768 to 32767). Else, the input value will be considered as unsigned (0 to 65536).
Note that after apply conversion factors, the result always will be as integer (-32768 to 32767). So, a value >32767 must be reduced for don’t give negative values.

Three special channels are used as “IGN” and “KILL”. You can define each one from CAN. Then you can use them as another conditions for define strategies.
If “IGN” checkbox is selected, the ON condition will be true only if IGN channel is true.

For KILL, if “KILL” checkbox is selected and KILL channel is true, the strategy is forced to OFF.

Force Rearm (from version 3.1 only) function reset the tripped output from a CAN value.

Each one must be set as CAN channels (=0 or #0).



Then you can use them as condition for each strategy

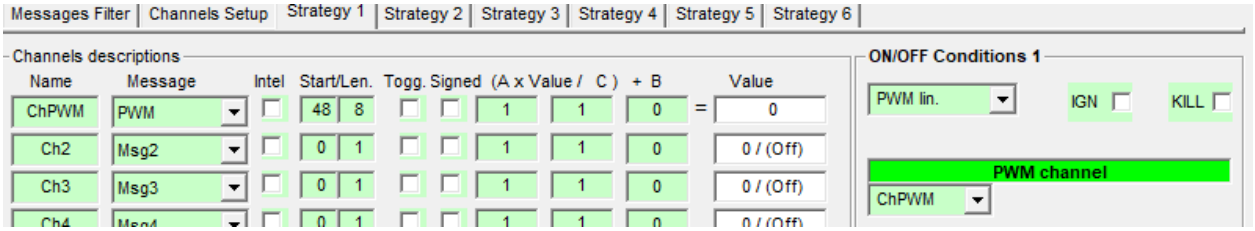
Third step: Define the user strategies (up to six).

-Standard:

Select conditions for ON and conditions for OFF. If both are true, the OFF has most priority.

-PWM Lin:

This mode allows to read a PWM value on the CAN and apply it to the selected outputs.
A channel must be configurated for select the value on the CAN. This value can be customised with coefficients A, B and C. if the final value is too big or negative, it will be truncated for have value between 0 and 100%.
Then, select the channel on the PWM lin setup. “IGN” and “KILL” will force PWM to 0 if conditions don’t match.

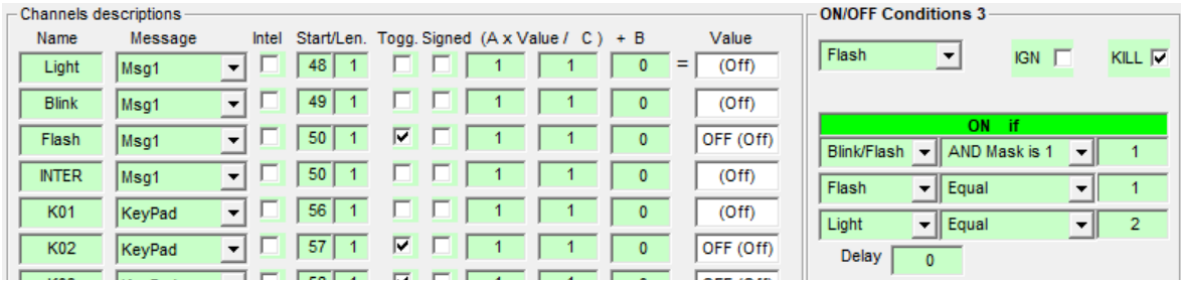


-Fuel Pump:

build-in fuel pump management. First channel selected must be RPM channel. Second one is Fuel drain switch channel. “Delay” (in 0,01s) set the timeout when IGN is ON and RPM=0.

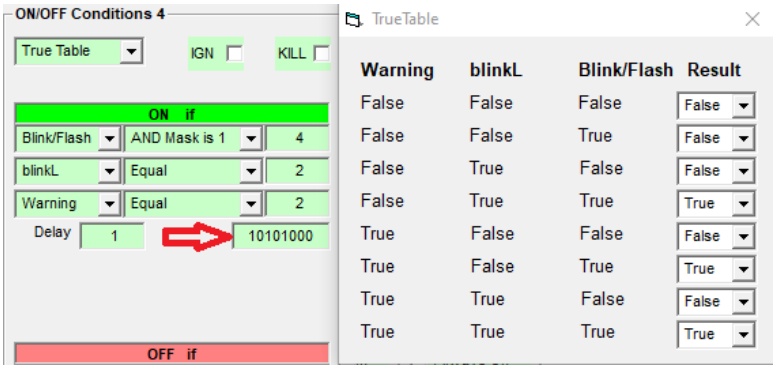
-Flash:

Build-in flash management. First channel is Flash/Blink channel (internal channel). This channel is internal blinking signal. The condition must be “AND Mask is 1” and value the bit mask for select the frequency. Second the Flash switch channel and third Light ON/OFF.

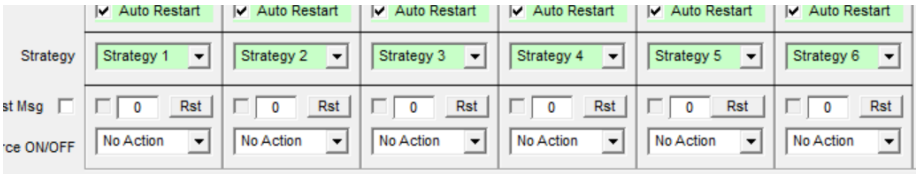


-True Table:

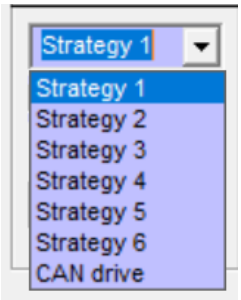
This mode makes easier to define the logical result. Set the three channels condition and then click on the Boolean result textbox for open the true table toolbox. Select the result (true or false) for each possibility. With three conditions, no more of eight combination are possible.



Fourth step: Select which strategy for which output.
When “Stand Alone” mode is selected, this selection is show on zone 4.



Then you must select the strategy which must be used for each output. As the output drive is synchronized, you can use the same strategy for more than one output and connect these same outputs together on the wiring.
From 3.02 firmware version, you can also drive some outputs using the CAN mask as “CAN One Msg”.
From 3.03 firmware version, both mode (standard and stand alone) are merged adding the possibility to select “CAN drive” as strategy. In this case the output is set by the CAN mask but only ON/OFF as “CAN one message” (see CAN protocol section).



Internal channel description:

Ton OUTx : For each output, the “Ton OUT” channel is a timer giving the time that the out is in “ON” state with 0,1s resolution
Toff OUTx : Same as previous but for OFF state
Internal Vbat : internal Vbat measurement in 0,1V
Internal temperature: This is the core processor temperature evaluation.
Blink/Flash : This rolling counter byte is use for manage various blinking frequency. This counter increase of one each 0,1s.

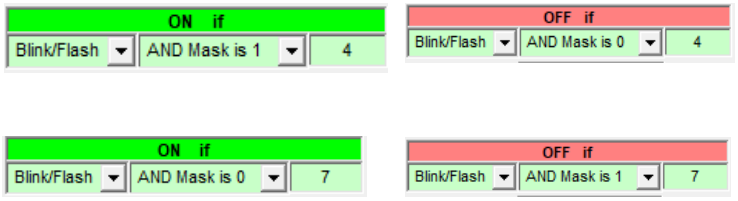
How to use it? Using the AND mask you can select which bit set ON (or OFF) the output and so, manage a large different blink effect.

Example:

Blink/Flash value On		AND mask is 1=1 (0000 0001)	AND Mask is 1=2 (0000 0010)	AND Mask is 1=4 (0000 0100)	AND Mask is 0=7 (0000 0111)
Blink/Flash value Off		AND mask is 0=1	AND Mask is 0=2	AND Mask is 0=4	AND Mask is 1=7
Blink/Flash value		Result			
Dec	Boolean				
0	0000 0000	Off	Off	Off	On
1	0000 0001	On	Off	Off	Off
2	0000 0010	Off	On	Off	Off
3	0000 0011	On	On	Off	Off
4	0000 0100	Off	Off	On	Off
5	0000 0101	On	Off	On	Off
6	0000 0110	Off	On	On	Off
7	0000 0111	On	On	On	Off
8	0000 1000	Off	Off	Off	On
9	0000 1001	On	Off	Off	Off
		Fast blink	half of previous	half of previous	Acyclic blink

Of course, Off condition must be coherent with On condition

Ex:

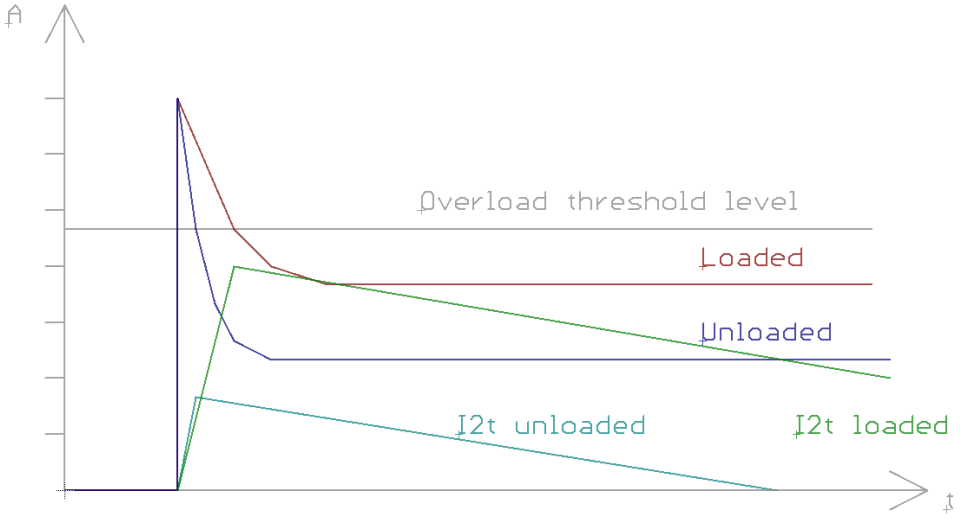


Analogue input (PBX_Dual version only): analogue input after conversion factors.

How to define current protection level?

Resistive load:
It's the easier case. Set the overload threshold level a little bit higher than the maximum condition consumption. Ex, with maximum battery voltage, if the resistive load consumption is 3,8A; set the threshold at 4.5A. The I2t can be quite low value because no inrush current in this case.

Capacitive or motor load:
In both case there is an inrush current higher than the nominal consumption. This inrush current can be different depending of condition use. See the picture below where is show motor inrush with and without load (ex: fuel pressure pump).
In case of common capacitive load, current peak could be high but very short and may not affect the protection circuit.



As show in this picture, the overload threshold must be set between maximum load and inrush current peak to be sure that the protection will be operate in case of locked motor or ever. Else, only short circuit protection will be active.
I2t can be adjust depending of the sensibility requested. An I2t value is internally computed when consumption is higher than overload threshold (I2t = SUM((I - Overload level)^2). When the internal I2t integration reach the I2t value set, the device active the protection mode on the output (switched off). Lower value=higher sensibility, higher value=lower sensibility.

Another way for define trip current threshold is set it depending of wire section use for the output. Max of 10 to 15A/mm2 is a first base for protect the loom.

Important:

Current are filtered for have coherent values in PWM condition and when actuator is pulsed current (as ignition coils). This make protection quite slow and are not adapted for semiconductor device where short circuit protection must be activated in some microseconds.

Use PWM can damage the device if used with inductive load. It is not recommended to drive inductive load in PWM. Only resistive or capacitive load.

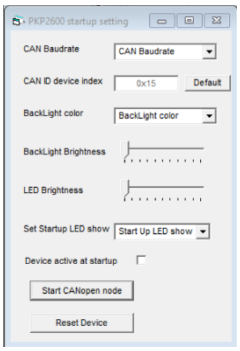
Annexe PKP2600-SI:

PKP2600-SI is a CANopen device with default setting when is new.

Default setting

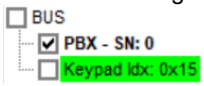
Setting	Default state or level
Baud Rate	125 kbit/s
CANopen Node ID	15h
Device active on startup	Not active
Key Brightness	3Fh (Maximum Brightness)
Backlight Brightness	00h (OFF)
Backlight Color	Amber
Startup LED Light Show	Complete LED Sequence
Periodic State Transmission	Disable
DEMO mode	Disable
Heartbeat Message	Disable
Boot-up service	Active

Using THQmonitor for set the keypad, at the first use, you must start the CAN bus at 125kb.
Then connect and power On the keypad.
Select “Window/PKP2600 setup” on the menu.



Several setting are available as :

- CAN Baudrate
- Backlight color
- Backlight brightness
- LED brightness
- LEDs sequnce at startup
- Device active at startup (important to check it. This allow the keypad to work at init without activation message. Also, this allow to see the keypad on the treeview at startup).



- Start CANopen node (manual keypad activation).

Keypad ID can’t be change yet. Is set at 0x15 by default.

Key State:

Identifier	180 + current CAN ID	Default 195h
Byte 0	Keys from #1 to #8 K8 K7 K6 K5 – K4 K3 K2 K1	Keys: 1=pressed; 0=released
Byte 1	Keys from #9 to #12 0 0 0 0 – K12 K11 K10 K9	Keys: 1=pressed; 0=released
Byte 2,3	00h	Not used
Byte 4	XXh	Tick Timer

Note that the following CAN ID are used for LED management:

- 0x195 Key state (as above)
- 0x215 LED activation
- 0x315 LED blink
- 0x415 LED brightness
- 0x515 Backlight brightness
- 0x615 CANopen settings

Pinout:

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

Connector:

DT04-4P. Mating (loom) DT06-4S

For more info, see Blink Marine web site.