The HULK next generation

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Port pin usage

Port 0

P0.00 - TX2 – Debug and diagnostics
P0.01 - RX2 – Debug and diagnostics
P0.02 - I2C SCL for 24LC512 EEPROM
P0.03 - I2C SDA for 24LC512 EEPROM
P0.04 - DB4 LCD Display.
P0.05 - DB5 LCD Display.
P0.06 - DB6 LCD Display.
P0.07 - DB7 LCD Display.

P0.08 - Serial TX1 - ISP and Lawicel CAN232..
P0.09 - Serial RX1 - ISP and Lawicel CAN232..
P0.10 - RS LCD Display.
P0.11 -
P0.12 - R/W for LCD Display.
P0.13 - E for LCD Display.
P0.14 - Enable ISP. / Button – State 0.
P0.15 - Electrical water heater core temperature sensor. Smarttemp sensor.

P0.16 - Over temp sensor.
P0.17 – Furnace Temperature. Smarttemp sensor.
P0.18 - Button - Display page forward.
P0.19 - Button - Up.
P0.20 - Button - Down.
P0.21 - Button - Button - Enter.
P0.22 - Button - Force transport motors on.
P0.23 - Reserved for CAN LPC 212x.

P0.24 - Reserved for CAN LPC 212x.
P0.25 - AOUT - Sound - CANRX0 on LPC 212x.
P0.26 - - CAN TX0 on LPC 212x.
P0.27 - ANALOG INPUT - Stove Fire Detector.
P0.28 - ANALOG INPUT - POT (Fire detect level).
P0.29 -
P0.30 –
P0.31 – Reserved.

Port 1

p1.16 - LED 16 - Transport Motor A relay.
p1.17 - LED 17 - Transport Motor B relay.
p1.18 - LED 18 - Fan relay.
p1.19 - LED 19 - Heater element relay.
p1.20 - LED 20 -
p1.21 - LED 21 - Alarm.
p1.22 - LED 22 - Electric water heater element A
p1.23 - LED 23 - Electric water heater element B

p1.24 – Reserved for JTAG i/f
p1.25 – Reserved for JTAG i/f
p1.26 - Reserved for JTAG i/f
p1.27 - Reserved for JTAG i/f
p1.28 - Reserved for JTAG i/f
p1.29 - Reserved for JTAG i/f
p1.30 - Reserved for JTAG i/f
p1.32 - Reserved for JTAG i/f

VSCP Registers

Reg 0 (0x00) – Zone.

The zone for the Hulk Module.

Reg 1 (0x01) – States 0.

bit 0 - Furnace transport Motor A.

bit 1 - Furnace transport Motor B.

bit 2 - Furnace fan.

bit 3 - Furnace heat Element.

bit 4 -

bit 5 -

bit 6 -

bit 7 – Furnace Enabled.

Register 2 (0z02) – States 1.

bit 0 - Water heater element A state

bit 1 - Water heater element B state

bit 2 -

bit 3 -

bit 4 -

bit 5 - Alarm.

bit 6 - Alarm enabled.

bit 7 – Water heater enabled.

Register 3 (0x03) – Fire Detector MSB.

Register 4 (0x04) – Fire Detector LSB.

This is the A/D value from the fire detector. 0-1023.

Register 5 (0x05) – Temp Furnace MSB. **Future functionality**

Register 6 (0x06) – Temp Furnace LSB.

This is the temperature in the furnace in degrees Celsius.

Register 7 (0x07) – Temp furnace outgoing water.

Temperature on outgoing water from furnace. This is the temperature the burner is working against. 0-255 degrees Celsius.

Register 8 (0x08) – Temp furnace incoming water (return).

Temperature on return water to heater. 0-255 degrees Celsius.

Register 9 (0x09) – Temp Transport B.

This temperature is used to prevent backfire. 0-255 degrees Celsius.

Register 10 (0x0A) – Alarm point for temp Transport B.

If the temperature on the transport A mechanism goes over this value an alarm is generated and the system is stooped. 0-255 degrees Celsius.

Register 11 (0x0B) – Preset furnace water temperature.

This is the temperature the furnace should try to get the outgoing water temperature to reach. 0-255 degrees Celsius.

Register 12 (0x0C) – Preset electrical water heater temperature.

This is the temperature the temperature the electrical water heater should try to get the electrical heater core water temperature to reach. 0-255 degrees Celsius.

Register 13 (0x0D) – Current electrical water heater temperature.

This is the current temperature for the core water temperature of the electrical heater. 0-255 degrees Celsius.

Register 14 (0x0E) – Temp Smoke gases MSB. Future functionality

Register 15 (0x0F) – Temp Smoke gases LSB.

Smoke gas temperature can be used for air mix (primary/secondary). This value should be written from an external sensor through the decision matrix.

Register 16 (0x10) – CO measurement MSB. Future functionality

Register 17 (0x11) – CO measurement LSB.

This is the A/D value form a CO measurement sensor.

Register 18 (0x12) – Electrical Heater Control.

Bit 0 – Enable element 1

Bit 1 – Enable element 2

Bit 2 –

Bit 3 -

Bit 4 –

Bit 5 -

Bit 6 -

Bit 7 -

Register 19 (0x13) – Time before element 2 is activated. MSB.

Register 20 (0x14) – Time before element 2 is activated. LSB.

Element 2 will be activated this amount of seconds after element 1 has been activated. 0 is off.

Register 21 (0x15) – Minutes to run fan after target temperature reached.

The fan will continue to run for this time to burn out fuel in the burning chamber after the preset temperature has been reached.

Register 22 (0x16) – Seconds to run transport motor B before rest.

The transport Motor B will continue to run for this time to empty the transport mechanism on fuel after the preset temperature has been reached and the fan has turned off.

.**Register 23 (0x17) – Seconds to run motor A + B to fill fuel.**

The transport Motor A + B will run for this time to fill fuel in the burning chamber during startup.

Register 24 (0x18) – Furnace restart attempts.
Max number of retries that should be done to fire up the furnace. 0 is no retries. Alarm if unable to fire up the furnace.

Register 25 (0x19) – Temperature hysteresis electrical water heater.

The temperature in the electrical heater has to go down with this amount for the heater to be turned on again.

Register 26 (0x1A) – Temperature hysteresis furnace.

The temperature in the furnace has to go down with this amount for the heater to be turned on again.

Register 27 (0x1B) – Fire Detector hysteresis MSB.

Register 28 (0x1C) – Fire Detector hysteresis LSB.

The fire detector has to be this amount below the preset value to detect **no fire**.

Register 29 (0x1D) – Temp electrical water heater outgoing water.

Temperature on outgoing water from water heater. 0-255 degrees Celsius.

Register 30 (0x1E) – Furnace start timeout

This is the time in minutes a furnace fire attempt should be carried out before a retry should be performed.

31(0x1F) reserved

Register 32(0x20) – 39(0x27) Dallas 1-Wire ID Temp sensor furnace outgoing water.

Register 40(0x28) – 47(0x2F) Dallas 1-Wire ID Temp sensor furnace incoming water.

Register 48(0x30) – 55(0x37) Dallas 1-Wire ID Temp sensor transport B.

Register 56(0x38) – 63(0x3F) Dallas 1-Wire ID Temp sensor hot water.

Register 64(0x40) – 72(0x47) Reserved

States

There are two state machines for the HULK II. One for the furnace control and one for the electrical heater.

Furnace States

FURNACE_STATE_FAILURE

This is the failure state. Can't go to any other state then **FURNACE_STATE_ON** form here. Temperatures are monitored in the state.

- Fan OFF
- Heater Element OFF
- Transport Motor A OFF
- Transport Motor B OFF
- Alarm ON

FURNACE_STATE_OFF

This is the inactive state. Can't go to any other state then **FURNACE_STATE_ON** form here. This state can only be reached manually and be left manually. Manual control included VSCP register writes.

- Fan OFF
- Heater Element OFF
- Transport Motor A OFF
- Transport Motor B OFF

FURNACE_STATE_PREREST

This is the pre rest rest state. Can just go to FURNACE_**STATE**_REST from here. The Transport mechanism B will be on for a while to empty it on fuel to prevent backfire.

- Fan OFF
- Heater Element OFF
- Transport Motor A OFF
- Transport Motor B ON

FURNACE_STATE_REST

This is the rest state. Wait until the furnace temperature goes below the setpoint the start up the machine again.

- Fan OFF
- Heater Element OFF
- Transport Motor A OFF
- Transport Motor B OFF

FURNACE_STATE_PRESTART

The furnace should be started in this state. This means that fuel should be transported to the burning chamber. The fan and the heat element is turned on. The state is active for a user selectable time and then left but can also be left by detected events.

- Fan ON
- Heat element ON
- Transport motor A ON.
- Transport motor B ON.
- GOTO **FURNACE_STATE_PREWAIT** if temp>=preset temperature.
- GOTO **FURNACE_STATE_ACTIVE** if fire detected.
- Always GOTO **FURNACE_STATE_START**

FURNACE_STATE_START

The pre-start sequence has been performed and we wait for the fire-detector to go active.

- GOTO **FURNACE_STATE_PREWAIT** if temp>=preset temperature.
- GOTO **FURNACE_STATE_ACTIVE** if fire detected.
- GOTO **FURNACE_STATE_PRESTART** if time out and retry-flag is active.
- GOTO **FURNACE_STATE_ALARM** if max tries has been performed.

FURNACE_STATE_PREWAIT

This state is active when the preset temperature has been reached. Its purpose is to empty the transport mechanisms close to the burner on fuel to prevent backfire and then burn out the fuel in the burn chamber.

- Heat element OFF.
- Motor A OFF.
- Fan ON.
- Run motor B for five seconds. Then turn off.

FURNACE_STATE_WAIT

This is the rest state. The preset temperature has been reached. The fuel in the burn chamber has been burned out. The only thing we need to check is for alarm conditions and/or temperature going below preset temperature – hysteresis.

- Fan off.
- Heat element off.
- Motor A off.
- Motor B off.
- GOTO **FURNACE_STATE_OFF** if requested to go off.
- GOTO **FURNACE_STATE_START** if temp below preset temp – hysteresis.

FURNACE_STATE_ACTIVE

In this state the material in the burning chamber is burning, the fan is on and both Transport Motor A and transport Motor B is running to continuously fill the burning chamber with fuel.

- Fan ON.
- Heat element ON.
- Transport motor B ON.
- Transport motor A ON.
- GOTO **FURNACE_STATE_PREWAIT** if preset temp has been reached.
- GOTO **FURNACE_STATE_LIGHTS_OUT** if fire detector does not detect fire.

FURNACE_STATE_LIGHTS_OUT

This state is reached when the fire detector does not detect fire in a situation where fire should be expected. This state is here to be able to determine major faults.

- Fan ON.
- Heat element ON.
- Transport motor B OFF.
- Transport motor A OFF.
- GOTO **FURNACE_STATE_START**

Water heater States

HEATER_STATE_OFF

This state can only be reached and left manually.

- Element A off.
- Element B off

HEATER_STATE_REST

This state is reached when the system is started or the preset water temperature has been reached.

- Element A off.
- Element B off
- If temp is less then preset temp hysteresis goto **HEATER_STATE_ON_LEVEL1**

HEATER_STATE_ON_LEVEL1

This state is active when the temperature is below the set point and element A has been on less then the time set to activate element B

- Element A on.
- Element B off
- If temp is higher then preset temp goto **HEATER_STATE_REST**

HEATER_STATE_ON_LEVEL2

This state is active when the temperature is below the set point and element A has been on more then the time set to activate element B

- Element A on.
- Element B on
- If temp is higher then preset temp goto **HEATER_STATE_REST**

Display States

DISPLAY_STATE_STARTUP

This is a state that is shown for one second during startup.

DISPLAY

```
The HULK II
Version 0.0.1
```

BUTTONS

prev – no function.

next – no function.

forward – no function.

enter – no function.

DISPLAY_STATE_HULK

This state shows HULK states

DISPLAY

```
HULK: state
Temp: xxxC AHFAB
```

where **state** is

“OFF”

“PRESTART”

“START”

“PREWAIT”

“WAIT”

“ACTIVE”

“LIGHTS OUT”

xxx Furnace outgoing water temperatures.

A is set if alarm is enabled.

H Heater is on.

F Fan is on.

A Transport motor A on.

B Transport motor B on.

BUTTONS

up – Select among temperatures.

down – Select among temperatures.

forward – next menu.

enter – no function.

DISPLAY_STATE_HEATER

This state shows water heater states

DISPLAY

```
Heater: state
Temp: xxxC
```

where **state** is

“OFF”

“Element A”

“Element A + B”

xxx warm water temperature.

BUTTONS

up – no function.

down – no function.

forward – next menu.

enter – no function.

DISPLAY_STATE_STATUS1

This state shows furnace out/in water temperatures.

DISPLAY

```
Out: xxxC
In: yyyC
```

BUTTONS

up – no function.

down – no function.

forward – next menu.

enter – no function.

DISPLAY_STATE_STATUS2

This state shows warm water temperature and .

DISPLAY

```
Warm: xxxC
Core: yyyC
```

BUTTONS

up – no function.

down – no function.

forward – next menu.

enter – no function.

DISPLAY_STATE_CONFIGURE

This state shows warm water temperature and .

DISPLAY

```
Configure
```

BUTTONS

up – no function.

down – no function.

forward – next menu.

enter – Enter configure mode.

DISPLAY_STATE_ALARM

This state shows that the system is in alarm state. The alarm state is also rested by pressing the “forward” key. The only way to reach this state is for an alarm to become active.

DISPLAY

```
ALARM
type of alarm
```

BUTTONS

up – no function.

down – no function.

forward – next menu.

enter – no function.

Configuration states

Configuration states allow certain configurations to be changes viewed.

CONFIG_STATE_PRESET_HEATER_TEMP

This state allows changes of the water heater preset temperature.

DISPLAY

```
Warmwater
setpoint xxxC
```

BUTTONS

up – temp + 1.

down – temp - 1.

forward – next menu.

enter – Save.

CONFIG_STATE_PRESET_FURNACE_TEMP

This state allows changes of the furnace preset temperature.

DISPLAY

```
Warmwater
setpoint xxxC
```

BUTTONS

up – temp + 1.

down – temp - 1.

forward – next menu.

enter – Save.

CONFIG_STATE_FUEL_TRANSPORT_START_TIME

This is the time the fuel transport A+B should run when the furnace should be started to fill fuel in the burning chamber. 0-256 seconds

DISPLAY

```
Fuel tr. end
time xxx seconds
```

BUTTONS

up – time + 1.

down – time - 1.

forward – next menu.

enter – Save.

CONFIG_STATE_FUEL_TRANSPORT_END_TIME

This is the time the fuel transport B should run after the furnace preset temperature has been reached to empty the transport mechanism of fuel. 0-256 seconds

DISPLAY

```
Fuel tr. startup
time xxx seconds
```

BUTTONS

up – time + 1.

down – time - 1.

forward – next menu.

enter – Save.

CONFIG_STATE_FAN_END_TIME

This is the time the fan should be on after the preset furnace temp has been reached to burn out fuel in the burning chamber.
0-256 minutes

DISPLAY

```
Fan end time
xxx minutes
```

BUTTONS

up – time + 1.

down – time - 1.

forward – next menu.

enter – Save.

CONFIG_STATE_RESTART_TIMEOUT

This is the restart timeout before a new attempt is made to fire the furnace. 0-256 minutes

DISPLAY

```
Restart time
xxx minutes
```

BUTTONS

up – time + 1.

down – time - 1.

forward – next menu.

enter – Save.

CONFIG_STATE_RESTART_ATTEMPTS

This is the number of attempts that should be done to fire ip the furnace before giving up. Zero is means give up on first try. 0-256 attempts.

DISPLAY

```
Restart attempts

xxx
```

BUTTONS

up – cnt + 1.

down – cnt - 1.

forward – next menu.

enter – Save.

CONFIG_STATE_FURNACE_ENABLE

Enable/disable furnace control logic. If disabled the furnace can only be controlled through the VSCP interface.

DISPLAY

```
Furnace
enabled/disabled
```

BUTTONS

up – switch states

down – switch states

forward – next menu.

enter – Save.

CONFIG_STATE_HEATER_ENABLE

Enable/disable water heater control logic. If disabled the furnace can only be controlled through the VSCP interface.

DISPLAY

```
Water heater
enabled/disabled
```

BUTTONS

up – switch states

down – switch states

forward – next menu.

enter – Save.

CONFIG_STATE_ALARM_ENABLE

Enable/disable alarm control logic. If disabled the alarm can only be controlled through the VSCP interface. The alarm must be reactivated after an alarm condition.

DISPLAY

```
Alarm
enabled/disabled
```

BUTTONS

up – switch states

down – switch states

forward – next menu.

enter – Save.

CONFIG_STATE_LEAVE

Leave the configuration menu system.

DISPLAY

```
Enter to return
to main menu.
```

BUTTONS

up – no functionality.

down – no functionality.

forward – first configuration menu.

enter – first entry in main menu..

Events

Temperature furnace water out

Send event every minute.

CLASS.MEASUREMENT TYPE=6, Temperature

Format: Integer Format (one byte).

Data coding: 0x60 Index = 0

Temperature furnace water return

Send event every minute.

CLASS.MEASUREMENT TYPE=6, Temperature

Format: Integer Format (one byte).

Data coding: 0x61 Index = 1

Temperature transport B

Send event every minute.

CLASS.MEASUREMENT TYPE=6, Temperature

Format: Integer Format (one byte).

Data coding: 0x60 Index = 2

Temperature Water Heater Core

Send event every minute.

CLASS.MEASUREMENT TYPE=6, Temperature

Format: Integer Format (one byte).

Data coding: 0x60 Index = 3

Temperature Hot Water

Send event every minute.

CLASS.MEASUREMENT TYPE=6, Temperature

Format: Integer Format (one byte).

Data coding: 0x60 Index = 4

Fire Detector

Send event every minute.

CLASS.MEASUREMENT TYPE=50, Relative Level

Format: Integer Format (two byte).

Data coding: 0x60 Index = 0

Over Temperature

On/off

CLASS.INFORMATION TYPE=3/4, ON/OFF

Zone=Configurated

SubZone=0

Transport motor A

On/off.

CLASS.INFORMATION TYPE=3/4, ON/OFF

Zone=Configurated

SubZone=1

Transport motor B

On/off.

CLASS.INFORMATION TYPE=3/4, ON/OFF

Zone=Configurated

SubZone=2

Fan

On/off.

CLASS.INFORMATION TYPE=3/4, ON/OFF

Zone=Configurated

SubZone=3

Heater

On/off.

CLASS.INFORMATION TYPE=3/4, ON/OFF

Zone=Configurated

SubZone=4

Electrical Water heater element A

On/off.

CLASS.INFORMATION TYPE=3/4, ON/OFF

Zone=Configurated

SubZone=5

Electrical Water heater element B

On/off.

CLASS.INFORMATION TYPE=3/4, ON/OFF

Zone=Configurated

SubZone=6

Alarm

CLASS.ALARM TYPE=2, Alarm occurred.

Zone=Configurated

SubZone=7

Furnace

On/off.

CLASS.INFORMATION TYPE=3/4, ON/OFF

Zone=Configurated

SubZone=8

Water Heater

On/off.

CLASS.INFORMATION TYPE=3/4, ON/OFF

Zone=Configurated

SubZone=9

Control

The following events can be sent to the module to control certain functionality.

Alarm on/off

Send

CLASS.CONTROL TYPE=5/6, TurnOn/TurnOff

Zone=Configurated

SubZone=7

Furnace on/off

Send

CLASS.CONTROL TYPE=5/6, TurnOn/TurnOff

Zone=Configurated

SubZone=8

Water heater on/off

Send

CLASS.CONTROL TYPE=5/6, TurnOn/TurnOff

Zone=Configurated

SubZone=9

Connections

Main connector

Pos	*Pin*	*Colour*	*Description*
1	P0.15	White/Blue	Smarttemp – Water heater core
2	P0.16	Blue/White	Over temperature sensor
3	P1.27	Brown/Black	Fire Sensor
4	---	---	---
5	P1.23		Heat Element B
6	P1.22		Heat Element A
7	P1.19		Furnace Heater
8	P1.18		Furnace Fan
9	P1.17		Transport Motor B
10	P1.16		Transport Motor A
11	P1.21		Alarm +
12	P0.17		1-Wire

Furnace Connector

Pin	*Colour*	*Description*
1	Black	Transport motor A.
2	Brown	Transport Motor B.
3	Red	Furnace Fan.
4	Orange	Furnace Heater.
5	Yellow	Over temp Sensor.
6	Green	Fire Detector.
7	Blue	GND.
8	Purple	Temperature Transport B.
9	--	
10	--	
11	--	
12	--	
13	--	

Pin	*Colour*	*Description*
14	--	
15	--	
16	--	
17	--	
18	--	
19	--	
20	Grey	+5V DC
21	--	
22	White	+3.3V DC
23		
24		
25		

LCD Pinout

Pin	*Cable Colour*	*Description*
1	--	GND
2	--	+5V
3	--	
4	Black/Blue	RS, **P0.10**
5	Blue/Black	R/W, **P0.12**
6	Grey/Black	E, **P0.13**
7	NC	
8	NC	
9	NC	
10	NC	
11	White/Orange	DB4, **P0.04**
12	Red/Black	DB5, **P0.05**
13	Black/Green	DB6, **P0.06**
14	Green/Black	DB7, **P0.07**
15	--	
16	--	

Cables

Port	*Cable color*	*Description*
P0.11	Orange/white	Status LED.
P0.14	Black/Red	State 0 – Internal.
P0.15	White/Blue	Smart temp Sensor, Heater Core temperature.
P0.16	Blue/White	Over temp Sensor.
P0.20	Black/Brown	Button Down.
P0.21	Orange/Blue	Button Enter.
P0.22	Black/Yellow	Button Force Transport ON.
P0.18	White/Black	Button Forward.
P0.19	Black/White	Button Up.
P1.27	Brown/Black	Fire Sensor.
P1.23	Blue/White	Element B – Main Connector 5.
P1.22	White/Blue	Element A – Main Connector 6.
P1.19	Green/Black	Furnace Heater – Main Connector 7.
P1.18	Black/Green	Furnace Fan – Main Connector 8.
P1.17	Black/Blue	Transport Motor B – Main Connector 9.
P1.16	Blue/Black	Transport Motor A – Main Connector 10.