

# My Project

1.0

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# Chapter 1

## Data Structure Index

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## Chapter 2

# File Index

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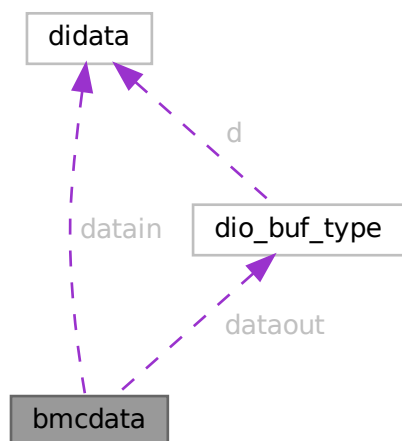


## Chapter 3

# Data Structure Documentation

### 3.1 bmcddata Struct Reference

Collaboration diagram for bmcddata:



#### Data Fields

- double [pv\\_voltage](#)
- double [cc\\_voltage](#)
- double [input\\_voltage](#)
- double [b1\\_voltage](#)
- double [b2\\_voltage](#)
- double [system\\_voltage](#)
- double [logic\\_voltage](#)
- double [pv\\_current](#)
- double [cc\\_current](#)

- double [battery\\_current](#)
- struct [didata](#) datain
- union [dio\\_buf\\_type](#) dataout
- int32\_t [adc\\_sample](#) [32]
- int32\_t [dac\\_sample](#) [32]
- int32\_t [utc](#)

### 3.1.1 Detailed Description

Definition at line [50](#) of file [daq.h](#).

### 3.1.2 Field Documentation

#### 3.1.2.1 [adc\\_sample](#)

```
int32_t adc_sample[32]
```

Definition at line [55](#) of file [daq.h](#).

#### 3.1.2.2 [b1\\_voltage](#)

```
double b1_voltage
```

Definition at line [51](#) of file [daq.h](#).

#### 3.1.2.3 [b2\\_voltage](#)

```
double b2_voltage
```

Definition at line [51](#) of file [daq.h](#).

#### 3.1.2.4 [battery\\_current](#)

```
double battery_current
```

Definition at line [52](#) of file [daq.h](#).

#### 3.1.2.5 [cc\\_current](#)

```
double cc_current
```

Definition at line [52](#) of file [daq.h](#).

#### 3.1.2.6 cc\_voltage

```
double cc_voltage
```

Definition at line 51 of file [daq.h](#).

#### 3.1.2.7 dac\_sample

```
int32_t dac_sample[32]
```

Definition at line 56 of file [daq.h](#).

#### 3.1.2.8 datain

```
struct didata datain
```

Definition at line 53 of file [daq.h](#).

#### 3.1.2.9 dataout

```
union dio_buf_type dataout
```

Definition at line 54 of file [daq.h](#).

#### 3.1.2.10 input\_voltage

```
double input_voltage
```

Definition at line 51 of file [daq.h](#).

#### 3.1.2.11 logic\_voltage

```
double logic_voltage
```

Definition at line 51 of file [daq.h](#).

#### 3.1.2.12 pv\_current

```
double pv_current
```

Definition at line 52 of file [daq.h](#).

#### 3.1.2.13 pv\_voltage

```
double pv_voltage
```

Definition at line 51 of file [daq.h](#).

#### 3.1.2.14 system\_voltage

```
double system_voltage
```

Definition at line 51 of file [daq.h](#).

#### 3.1.2.15 utc

```
int32_t utc
```

Definition at line 57 of file [daq.h](#).

The documentation for this struct was generated from the following file:

- [daq.h](#)

## 3.2 didata Struct Reference

### Data Fields

- uint32\_t [D0](#): 1
- uint32\_t [D1](#): 1
- uint32\_t [D2](#): 1
- uint32\_t [D3](#): 1
- uint32\_t [D4](#): 1
- uint32\_t [D5](#): 1
- uint32\_t [D6](#): 1
- uint32\_t [D7](#): 1

### 3.2.1 Detailed Description

Definition at line 34 of file [daq.h](#).

### 3.2.2 Field Documentation

#### 3.2.2.1 D0

```
uint32_t D0
```

Definition at line 35 of file [daq.h](#).

#### 3.2.2.2 D1

```
uint32_t D1
```

Definition at line 36 of file [daq.h](#).

### 3.2.2.3 D2

`uint32_t D2`

Definition at line 37 of file [daq.h](#).

### 3.2.2.4 D3

`uint32_t D3`

Definition at line 38 of file [daq.h](#).

### 3.2.2.5 D4

`uint32_t D4`

Definition at line 39 of file [daq.h](#).

### 3.2.2.6 D5

`uint32_t D5`

Definition at line 40 of file [daq.h](#).

### 3.2.2.7 D6

`uint32_t D6`

Definition at line 41 of file [daq.h](#).

### 3.2.2.8 D7

`uint32_t D7`

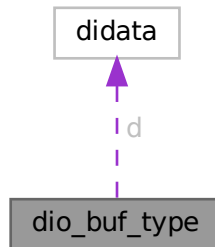
Definition at line 42 of file [daq.h](#).

The documentation for this struct was generated from the following file:

- [daq.h](#)

### 3.3 dio\_buf\_type Union Reference

Collaboration diagram for dio\_buf\_type:



#### Data Fields

- uint32\_t [dio\\_buf](#)
- struct [didata](#) [d](#)

#### 3.3.1 Detailed Description

Definition at line 45 of file [daq.h](#).

#### 3.3.2 Field Documentation

##### 3.3.2.1 d

```
struct didata d
```

Definition at line 47 of file [daq.h](#).

##### 3.3.2.2 dio\_buf

```
uint32_t dio_buf
```

Definition at line 46 of file [daq.h](#).

The documentation for this union was generated from the following file:

- [daq.h](#)



## 3.4 energy\_type Struct Reference

### Data Fields

- volatile bool [once\\_gti](#)
- volatile bool [once\\_ac](#)
- volatile bool [iammeter](#)
- volatile bool [fm80](#)
- volatile bool [dumpload](#)
- volatile bool [homeassistant](#)
- volatile bool [once\\_gti\\_zero](#)
- volatile bool [comedi](#)
- volatile double [gti\\_low\\_adj](#)
- volatile double [ac\\_low\\_adj](#)
- volatile double [dl\\_excess\\_adj](#)
- volatile bool [ac\\_sw\\_on](#)
- volatile bool [gti\\_sw\\_on](#)
- volatile bool [ac\\_sw\\_status](#)
- volatile bool [gti\\_sw\\_status](#)
- volatile bool [solar\\_shutdown](#)
- volatile bool [solar\\_mode](#)
- volatile bool [startup](#)
- volatile bool [ac\\_mismatch](#)
- volatile bool [dc\\_mismatch](#)
- volatile bool [mode\\_mismatch](#)
- volatile bool [dl\\_excess](#)
- volatile uint32\_t [speed\\_go](#)
- volatile uint32\_t [im\\_delay](#)
- volatile uint32\_t [im\\_display](#)
- volatile uint32\_t [gti\\_delay](#)
- volatile uint32\_t [sequence](#)
- volatile uint32\_t [mqtt\\_count](#)
- volatile int32\_t [rc](#)
- volatile int32\_t [sane](#)
- volatile uint32\_t [thirty\\_sec\\_clock](#)
- volatile uint32\_t [log\\_spam](#)
- volatile uint32\_t [log\\_time\\_reset](#)
- pthread\_mutex\_t [ha\\_lock](#)
- volatile int16\_t [di\\_16b](#)
- volatile int16\_t [do\\_16b](#)
- double [adc](#) [16]
- double [dac](#) [16]
- MQTTClient [client\\_p](#)
- MQTTClient [client\\_sd](#)
- MQTTClient [client\\_ha](#)

### 3.4.1 Detailed Description

Definition at line 88 of file [bmc.h](#).

### 3.4.2 Field Documentation

#### 3.4.2.1 `ac_low_adj`

```
volatile double ac_low_adj
```

Definition at line 90 of file [bmc.h](#).

#### 3.4.2.2 `ac_mismatch`

```
volatile bool ac_mismatch
```

Definition at line 91 of file [bmc.h](#).

#### 3.4.2.3 `ac_sw_on`

```
volatile bool ac_sw_on
```

Definition at line 91 of file [bmc.h](#).

#### 3.4.2.4 `ac_sw_status`

```
volatile bool ac_sw_status
```

Definition at line 91 of file [bmc.h](#).

#### 3.4.2.5 `adc`

```
double adc[16]
```

Definition at line 97 of file [bmc.h](#).

#### 3.4.2.6 `client_ha`

```
MQTTClient client_ha
```

Definition at line 98 of file [bmc.h](#).

#### 3.4.2.7 `client_p`

```
MQTTClient client_p
```

Definition at line 98 of file [bmc.h](#).

#### 3.4.2.8 client\_sd

```
MQTTClient client_sd
```

Definition at line 98 of file [bmc.h](#).

#### 3.4.2.9 comedi

```
volatile bool comedi
```

Definition at line 89 of file [bmc.h](#).

#### 3.4.2.10 dac

```
double dac[16]
```

Definition at line 97 of file [bmc.h](#).

#### 3.4.2.11 dc\_mismatch

```
volatile bool dc_mismatch
```

Definition at line 91 of file [bmc.h](#).

#### 3.4.2.12 di\_16b

```
volatile int16_t di_16b
```

Definition at line 96 of file [bmc.h](#).

#### 3.4.2.13 dl\_excess

```
volatile bool dl_excess
```

Definition at line 91 of file [bmc.h](#).

#### 3.4.2.14 dl\_excess\_adj

```
volatile double dl_excess_adj
```

Definition at line 90 of file [bmc.h](#).

#### 3.4.2.15 do\_16b

```
volatile int16_t do_16b
```

Definition at line 96 of file [bmc.h](#).

#### 3.4.2.16 **dumpload**

```
volatile bool dumpload
```

Definition at line 89 of file [bmc.h](#).

#### 3.4.2.17 **fm80**

```
volatile bool fm80
```

Definition at line 89 of file [bmc.h](#).

#### 3.4.2.18 **gti\_delay**

```
volatile uint32_t gti_delay
```

Definition at line 92 of file [bmc.h](#).

#### 3.4.2.19 **gti\_low\_adj**

```
volatile double gti_low_adj
```

Definition at line 90 of file [bmc.h](#).

#### 3.4.2.20 **gti\_sw\_on**

```
volatile bool gti_sw_on
```

Definition at line 91 of file [bmc.h](#).

#### 3.4.2.21 **gti\_sw\_status**

```
volatile bool gti_sw_status
```

Definition at line 91 of file [bmc.h](#).

#### 3.4.2.22 **ha\_lock**

```
pthread_mutex_t ha_lock
```

Definition at line 95 of file [bmc.h](#).

#### 3.4.2.23 **homeassistant**

```
volatile bool homeassistant
```

Definition at line 89 of file [bmc.h](#).

#### 3.4.2.24 iammeter

```
volatile bool iammeter
```

Definition at line 89 of file [bmc.h](#).

#### 3.4.2.25 im\_delay

```
volatile uint32_t im_delay
```

Definition at line 92 of file [bmc.h](#).

#### 3.4.2.26 im\_display

```
volatile uint32_t im_display
```

Definition at line 92 of file [bmc.h](#).

#### 3.4.2.27 log\_spam

```
volatile uint32_t log_spam
```

Definition at line 94 of file [bmc.h](#).

#### 3.4.2.28 log\_time\_reset

```
volatile uint32_t log_time_reset
```

Definition at line 94 of file [bmc.h](#).

#### 3.4.2.29 mode\_mismatch

```
volatile bool mode_mismatch
```

Definition at line 91 of file [bmc.h](#).

#### 3.4.2.30 mqtt\_count

```
volatile uint32_t mqtt_count
```

Definition at line 92 of file [bmc.h](#).

#### 3.4.2.31 once\_ac

```
volatile bool once_ac
```

Definition at line 89 of file [bmc.h](#).

**3.4.2.32 once\_gti**

```
volatile bool once_gti
```

Definition at line 89 of file [bmc.h](#).

**3.4.2.33 once\_gti\_zero**

```
volatile bool once_gti_zero
```

Definition at line 89 of file [bmc.h](#).

**3.4.2.34 rc**

```
volatile int32_t rc
```

Definition at line 93 of file [bmc.h](#).

**3.4.2.35 sane**

```
volatile int32_t sane
```

Definition at line 93 of file [bmc.h](#).

**3.4.2.36 sequence**

```
volatile uint32_t sequence
```

Definition at line 92 of file [bmc.h](#).

**3.4.2.37 solar\_mode**

```
volatile bool solar_mode
```

Definition at line 91 of file [bmc.h](#).

**3.4.2.38 solar\_shutdown**

```
volatile bool solar_shutdown
```

Definition at line 91 of file [bmc.h](#).

**3.4.2.39 speed\_go**

```
volatile uint32_t speed_go
```

Definition at line 92 of file [bmc.h](#).

#### 3.4.2.40 startup

```
volatile bool startup
```

Definition at line 91 of file [bmc.h](#).

#### 3.4.2.41 thirty\_sec\_clock

```
volatile uint32_t thirty_sec_clock
```

Definition at line 94 of file [bmc.h](#).

The documentation for this struct was generated from the following file:

- [bmc.h](#)

## 3.5 ha\_flag\_type Struct Reference

### Data Fields

- volatile MQTTClient\_deliveryToken [deliveredtoken](#)
- volatile MQTTClient\_deliveryToken [receivedtoken](#)
- volatile bool [runner](#)
- volatile bool [rec\\_ok](#)
- int32\_t [ha\\_id](#)
- volatile int32\_t [var\\_update](#)
- volatile int32\_t [energy\\_mode](#)

### 3.5.1 Detailed Description

Definition at line 30 of file [mqtt\\_rec.h](#).

### 3.5.2 Field Documentation

#### 3.5.2.1 deliveredtoken

```
volatile MQTTClient_deliveryToken deliveredtoken
```

Definition at line 31 of file [mqtt\\_rec.h](#).

#### 3.5.2.2 energy\_mode

```
volatile int32_t energy_mode
```

Definition at line 34 of file [mqtt\\_rec.h](#).

### 3.5.2.3 ha\_id

```
int32_t ha_id
```

Definition at line 33 of file [mqtt\\_rec.h](#).

### 3.5.2.4 rec\_ok

```
volatile bool rec_ok
```

Definition at line 32 of file [mqtt\\_rec.h](#).

### 3.5.2.5 receivedtoken

```
volatile MQTTClient_deliveryToken receivedtoken
```

Definition at line 31 of file [mqtt\\_rec.h](#).

### 3.5.2.6 runner

```
volatile bool runner
```

Definition at line 32 of file [mqtt\\_rec.h](#).

### 3.5.2.7 var\_update

```
volatile int32_t var_update
```

Definition at line 34 of file [mqtt\\_rec.h](#).

The documentation for this struct was generated from the following file:

- [mqtt\\_rec.h](#)



## Chapter 4

# File Documentation

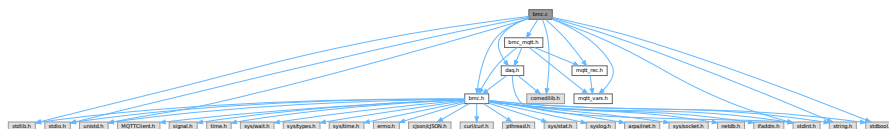
### 4.1 .dep.inc

```
00001 # This code depends on make tool being used
00002 DEFFILES=$(wildcard $(addsuffix .d, ${OBJECTFILES} ${TESTOBJECTFILES}))
00003 ifneq (${DEFFILES},)
00004 include ${DEFFILES}
00005 endif
```

### 4.2 bmc.c File Reference

```
#include <stdlib.h>
#include <stdio.h>
#include <unistd.h>
#include <stdint.h>
#include <string.h>
#include <stdbool.h>
#include <comedilib.h>
#include "daq.h"
#include "bmc.h"
#include "mqtt_rec.h"
#include "mqtt_vars.h"
#include "bmc_mqtt.h"
```

Include dependency graph for bmc.c:



### Functions

- void [led\\_lightshow](#) (int speed)
- int [main](#) (int argc, char \*argv[])

## Variables

- volatile struct [bmcddata](#) [bmc](#)
- struct [energy\\_type](#) [E](#)
- const char \* [board\\_name](#) = "NO\_BOARD"
- const char \* [driver\\_name](#) = "NO\_DRIVER"
- FILE \* [fout](#)
- uint8\_t [sine\\_wave](#) [256]

## 4.2.1 Detailed Description

Demo code for driver testing, a simple console display of data inputs and voltage

This file may be freely modified, distributed, and combined with other software, as long as proper attribution is given in the source code.

Definition in file [bmc.c](#).

## 4.2.2 Function Documentation

### 4.2.2.1 [led\\_lightshow\(\)](#)

```
void led_lightshow (  
    int speed)
```

Definition at line [96](#) of file [bmc.c](#).

### 4.2.2.2 [main\(\)](#)

```
int main (  
    int argc,  
    char * argv[])
```

Definition at line [130](#) of file [bmc.c](#).

## 4.2.3 Variable Documentation

### 4.2.3.1 [bmc](#)

```
volatile struct bmcddata bmc
```

Definition at line [22](#) of file [bmc.c](#).

### 4.2.3.2 [board\\_name](#)

```
const char* board\_name = "NO_BOARD"
```

Definition at line [55](#) of file [bmc.c](#).

#### 4.2.3.3 driver\_name

```
const char * driver_name = "NO_DRIVER"
```

Definition at line 55 of file [bmc.c](#).

#### 4.2.3.4 E

```
struct energy_type E
```

**Initial value:**

```
= {  
    .once_gti = true,  
    .once_ac = true,  
    .once_gti_zero = true,  
    .iammeter = false,  
    .fm80 = false,  
    .dumpload = false,  
    .homeassistant = false,  
    .ac_low_adj = 0.0f,  
    .gti_low_adj = 0.0f,  
    .ac_sw_on = true,  
    .gti_sw_on = true,  
    .im_delay = 0,  
    .gti_delay = 0,  
    .im_display = 0,  
    .rc = 0,  
    .speed_go = 0,  
    .ac_sw_status = false,  
    .gti_sw_status = false,  
    .solar_mode = false,  
    .solar_shutdown = false,  
    .startup = true,  
    .ac_mismatch = false,  
    .dc_mismatch = false,  
    .mode_mismatch = false,  
    .dl_excess = false,  
    .dl_excess_adj = 0.0f,  
}
```

Definition at line 24 of file [bmc.c](#).

#### 4.2.3.5 fout

```
FILE* fout
```

Definition at line 57 of file [bmc.c](#).

#### 4.2.3.6 sine\_wave

```
uint8_t sine_wave[256]
```

Definition at line 61 of file [bmc.c](#).

## 4.3 bmc.c

[Go to the documentation of this file.](#)

```

00001
00008
00009 #include <stdlib.h>
00010 #include <stdio.h> /* for printf() */
00011 #include <unistd.h>
00012 #include <stdint.h>
00013 #include <string.h>
00014 #include <stdbool.h>
00015 #include <comedilib.h>
00016 #include "daq.h"
00017 #include "bmc.h"
00018 #include "mgtt_rec.h"
00019 #include "mgtt_vars.h"
00020 #include "bmc_mgtt.h"
00021
00022 volatile struct bmcddata bmc; /* DIO buffer */
00023
00024 struct energy_type E = {
00025     .once_gti = true,
00026     .once_ac = true,
00027     .once_gti_zero = true,
00028     .iammeter = false,
00029     .fm80 = false,
00030     .dumpload = false,
00031     .homeassistant = false,
00032     .ac_low_adj = 0.0f,
00033     .gti_low_adj = 0.0f,
00034     .ac_sw_on = true,
00035     .gti_sw_on = true,
00036     .im_delay = 0,
00037     .gti_delay = 0,
00038     .im_display = 0,
00039     .rc = 0,
00040     .speed_go = 0,
00041     .ac_sw_status = false,
00042     .gti_sw_status = false,
00043     .solar_mode = false,
00044     .solar_shutdown = false,
00045     .startup = true,
00046     .ac_mismatch = false,
00047     .dc_mismatch = false,
00048     .mode_mismatch = false,
00049     .dl_excess = false,
00050     .dl_excess_adj = 0.0f,
00051 };
00052
00053
00054 // Comedi I/O device type
00055 const char *board_name = "NO_BOARD", *driver_name = "NO_DRIVER";
00056
00057 FILE* fout; // logging stream
00058
00059 /* ripped from http://aquaticus.info/pwm-sine-wave */
00060
00061 uint8_t sine_wave[256] = {
00062     0x80, 0x83, 0x86, 0x89, 0x8C, 0x90, 0x93, 0x96,
00063     0x99, 0x9C, 0x9F, 0xA2, 0xA5, 0xA8, 0xAB, 0xAE,
00064     0xB1, 0xB3, 0xB6, 0xB9, 0xBC, 0xBF, 0xC1, 0xC4,
00065     0xC7, 0xC9, 0xCC, 0xCE, 0xD1, 0xD3, 0xD5, 0xD8,
00066     0xDA, 0xDC, 0xDE, 0xE0, 0xE2, 0xE4, 0xE6, 0xE8,
00067     0xEA, 0xEB, 0xED, 0xEF, 0xF0, 0xF1, 0xF3, 0xF4,
00068     0xF5, 0xF6, 0xF8, 0xF9, 0xFA, 0xFA, 0xFB, 0xFC,
00069     0xFD, 0xFD, 0xFE, 0xFE, 0xFE, 0xFF, 0xFF, 0xFF,
00070     0xFF, 0xFF, 0xFF, 0xFF, 0xFE, 0xFE, 0xFE, 0xFD,
00071     0xFD, 0xFC, 0xFB, 0xFA, 0xFA, 0xF9, 0xF8, 0xF6,
00072     0xF5, 0xF4, 0xF3, 0xF1, 0xF0, 0xEF, 0xED, 0xEB,
00073     0xEA, 0xE8, 0xE6, 0xE4, 0xE2, 0xE0, 0xDE, 0xDC,
00074     0xDA, 0xD8, 0xD5, 0xD3, 0xD1, 0xCE, 0xCC, 0xC9,
00075     0xC7, 0xC4, 0xC1, 0xBF, 0xBC, 0xB9, 0xB6, 0xB3,
00076     0xB1, 0xAE, 0xAB, 0xA8, 0xA5, 0xA2, 0x9F, 0x9C,
00077     0x99, 0x96, 0x93, 0x90, 0x8C, 0x89, 0x86, 0x83,
00078     0x80, 0x7D, 0x7A, 0x77, 0x74, 0x70, 0x6D, 0x6A,
00079     0x67, 0x64, 0x61, 0x5E, 0x5B, 0x58, 0x55, 0x52,
00080     0x4F, 0x4D, 0x4A, 0x47, 0x44, 0x41, 0x3F, 0x3C,
00081     0x39, 0x37, 0x34, 0x32, 0x2F, 0x2D, 0x2B, 0x28,
00082     0x26, 0x24, 0x22, 0x20, 0x1E, 0x1C, 0x1A, 0x18,
00083     0x16, 0x15, 0x13, 0x11, 0x10, 0x0F, 0x0D, 0x0C,
00084     0x0B, 0x0A, 0x08, 0x07, 0x06, 0x06, 0x05, 0x04,
00085     0x03, 0x03, 0x02, 0x02, 0x02, 0x01, 0x01, 0x01,
00086     0x01, 0x01, 0x01, 0x01, 0x02, 0x02, 0x02, 0x03,
00087     0x03, 0x04, 0x05, 0x06, 0x06, 0x07, 0x08, 0x0A,
00088     0x0B, 0x0C, 0x0D, 0x0F, 0x10, 0x11, 0x13, 0x15,

```

```

00089     0x16, 0x18, 0x1A, 0x1C, 0x1E, 0x20, 0x22, 0x24,
00090     0x26, 0x28, 0x2B, 0x2D, 0x2F, 0x32, 0x34, 0x37,
00091     0x39, 0x3C, 0x3F, 0x41, 0x44, 0x47, 0x4A, 0x4D,
00092     0x4F, 0x52, 0x55, 0x58, 0x5B, 0x5E, 0x61, 0x64,
00093     0x67, 0x6A, 0x6D, 0x70, 0x74, 0x77, 0x7A, 0x7D
00094 };
00095
00096 void led_lightshow(int speed)
00097 {
00098     static int j = 0;
00099     static uint8_t cylon = 0xff;
00100     static int alive_led = 0;
00101     static bool LED_UP = true;
00102
00103     if (j++ >= speed) { // delay a bit ok
00104         if (0) { // screen status feedback
00105             bmc.dataout.dio_buf = ~cylon; // roll leds cylon style
00106         } else {
00107             bmc.dataout.dio_buf = cylon; // roll leds cylon style (inverted)
00108         }
00109
00110         if (LED_UP && (alive_led != 0)) {
00111             alive_led = alive_led * 2;
00112             cylon = cylon << 1;
00113         } else {
00114             if (alive_led != 0) alive_led = alive_led / 2;
00115             cylon = cylon >> 1;
00116         }
00117         if (alive_led < 2) {
00118             alive_led = 2;
00119             LED_UP = true;
00120         } else {
00121             if (alive_led > 128) {
00122                 alive_led = 128;
00123                 LED_UP = false;
00124             }
00125         }
00126         j = 0;
00127     }
00128 }
00129
00130 int main(int argc, char *argv[])
00131 {
00132     int do_ao_only = false;
00133     uint8_t i = 0, j = 75;
00134
00135     /*
00136      * start the MQTT processing
00137      */
00138     bmc_mqtt_init();
00139
00140     if (do_ao_only) {
00141         if (init_dac(0.0, 25.0, false) < 0) {
00142             fprintf(fout, "Missing Analog AO subdevice\n");
00143             return -1;
00144         }
00145
00146         while (true) {
00147             set_dac_raw(0, sine_wave[255 - i++] << 4);
00148             set_dac_raw(1, sine_wave[255 - j++] << 4);
00149         }
00150     } else {
00151
00152         if (init_daq(0.0, 25.0, false) < 0) {
00153             fprintf(fout, "Missing Analog subdevice(s)\n");
00154             return -1;
00155         }
00156         if (init_dio() < 0) {
00157             fprintf(fout, "Missing Digital subdevice(s)\n");
00158             return -1;
00159         }
00160
00161         E.dac[0] = 2.50f;
00162         E.dac[1] = 3.33f;
00163
00164         E.do_16b = 0x01;
00165         E.di_16b = 0x10;
00166
00167         fflush(fout);
00168         while (true) {
00169             usleep(MAIN_DELAY); // sample rate ~1 msec
00170             get_data_sample();
00171             if (!bmc.datain.D0) {
00172                 led_lightshow(10);
00173             }
00174         }
00175     }

```

```

00176         if (ha_flag_vars_ss.runner) { // 30 second timer or trigger from mqtt
00177             comedi_push_mqtt(); // send json formatted data to the mqtt server
00178             ha_flag_vars_ss.runner = false;
00179         }
00180     }
00181 }
00182 }
00183 return 0;
00184 }
00185 }
00186

```

## 4.4 bmc.h

```

00001 /*
00002  * File:    bmc.h
00003  * Author:  root
00004  *
00005  * Created on September 21, 2012, 12:54 PM
00006  */
00007
00008 #ifndef BMC_H
00009 #define BMC_H
00010
00011 #ifdef __cplusplus
00012 extern "C" {
00013 #endif
00014
00015 #include <stdlib.h>
00016 #include <stdio.h> /* for printf() */
00017 #include <unistd.h>
00018 #include <stdint.h>
00019 #include <string.h>
00020 #include <stdbool.h>
00021 #include <signal.h>
00022 #include <time.h>
00023 #include <sys/wait.h>
00024 #include <sys/types.h>
00025 #include <sys/time.h>
00026 #include <errno.h>
00027 #include <cjson/cJSON.h>
00028 #include <curl/curl.h>
00029 #include <pthread.h>
00030 #include <sys/stat.h>
00031 #include <syslog.h>
00032 #include <arpa/inet.h>
00033 #include <sys/socket.h>
00034 #include <netdb.h>
00035 #include <ifaddrs.h>
00036 #include "MQTTClient.h"
00037
00038 #define LOG_VERSION      "V0.02"
00039 #define MQTT_VERSION     "V3.11"
00040 #define TNAME            "maint9"
00041 #define LADDRESS         "tcp://127.0.0.1:1883"
00042 #ifdef __amd64
00043 #define ADDRESS          "tcp://10.1.1.172:1883"
00044 #else
00045 #define ADDRESS          "tcp://10.1.1.172:1883"
00046 #endif
00047 #define CLIENTID1        "Energy_Mqtt_BMC1"
00048 #define CLIENTID2        "Energy_Mqtt_BMC2"
00049 #define CLIENTID3        "Energy_Mqtt_BMC3"
00050 #define TOPIC_P           "comedi/bmc/data/bmc"
00051 #define TOPIC_SPAM        "comedi/bmc/data/spam"
00052 #define TOPIC_PACA        "home-assistant/comedi/bmc"
00053 #define TOPIC_PACB        "mateq84/data/#"
00054 #define TOPIC_AI          "comedi/bmc/data/ai"
00055 #define TOPIC_AO          "comedi/bmc/data/ao"
00056 #define TOPIC_DI          "comedi/bmc/data/di"
00057 #define TOPIC_DO          "comedi/bmc/data/do"
00058 #define QOS               1
00059
00060 #define TOPIC_SS          "mateq84/data/solar" // receive data testing
00061
00062 #define TIMEOUT           10000L
00063 #define SPACING_USEC      500 * 1000
00064 #define USEC_SEC          1000000L
00065
00066 #define CMD_SEC           30
00067 #define TIME_SYNC_SEC     30
00068
00069 #define SBUF_SIZ          16 // short buffer string size

```

```

00070 #define RBUF_SIZ      82
00071 #define SYSLOG_SIZ     512
00072
00073 #define LOG_TO_FILE      "/var/log/bmc/bmc_comedi.log"
00074 #define LOG_TO_FILE_ALT  "/tmp/bmc_comedi.log"
00075
00076 #define MQTT_RECONN      3
00077 #define KAI              60
00078
00079 /*
00080  * system testing defines
00081  * all should be undefined for normal operation
00082  */
00083 #define DAC_TESTING
00084
00085 extern FILE* fout; // logging stream
00086 extern struct energy_type E;
00087
00088 struct energy_type {
00089     volatile bool once_gti, once_ac, iammeter, fm80, dumpload, homeassistant,
once_gti_zero, comedi;
00090     volatile double gti_low_adj, ac_low_adj, dl_excess_adj;
00091     volatile bool ac_sw_on, gti_sw_on, ac_sw_status, gti_sw_status, solar_shutdown,
solar_mode, startup, ac_mismatch, dc_mismatch, mode_mismatch, dl_excess;
00092     volatile uint32_t speed_go, im_delay, im_display, gti_delay, sequence, mqtt_count;
00093     volatile int32_t rc, sane;
00094     volatile uint32_t thirty_sec_clock, log_spam, log_time_reset;
00095     pthread_mutex_t ha_lock;
00096     volatile int16_t di_16b, do_16b;
00097     double adc[16], dac[16];
00098     MQTTClient client_p, client_sd, client_ha;
00099 };
00100
00101 void led_lightshow(int);
00102
00103 #ifdef __cplusplus
00104 }
00105 #endif
00106
00107 #endif /* BMC_H */
00108

```

## 4.5 bmc\_mqtt.c File Reference

```
#include "bmc_mqtt.h"
```

Include dependency graph for bmc\_mqtt.c:



## Functions

- void [showIP](#) (void)
- void [skeleton\\_daemon](#) (void)
- char \* [log\\_time](#) (bool log)
- void [timer\\_callback](#) (int32\_t signum)
- void [connlost](#) (void \*context, char \*cause)
- void [delivered](#) (void \*context, MQTTClient\_deliveryToken dt)
- void [bmc\\_mqtt\\_init](#) (void)
- int32\_t [msgarrvd](#) (void \*context, char \*topicName, int topicLen, MQTTClient\_message \*message)
- void [mqtt\\_bmc\\_data](#) (MQTTClient client\_p, const char \*topic\_p)
- void [comedi\\_push\\_mqtt](#) (void)

## Variables

- struct itimerval [new\\_timer](#)
- struct itimerval [old\\_timer](#)
- time\_t [rawtime](#)
- MQTTClient\_connectOptions [conn\\_opts\\_p](#) = MQTTClient\_connectOptions\_initializer
- MQTTClient\_connectOptions [conn\\_opts\\_sd](#) = MQTTClient\_connectOptions\_initializer
- MQTTClient\_connectOptions [conn\\_opts\\_ha](#) = MQTTClient\_connectOptions\_initializer
- MQTTClient\_message [pubmsg](#) = MQTTClient\_message\_initializer
- MQTTClient\_deliveryToken [token](#)
- char [hname](#) [256]
- char \* [hname\\_ptr](#) = hname
- size\_t [hname\\_len](#) = 12
- struct [ha\\_flag\\_type](#) [ha\\_flag\\_vars\\_ss](#)

### 4.5.1 Detailed Description

show all assigned networking addresses and types on the current machine

Definition in file [bmc\\_mqtt.c](#).

### 4.5.2 Function Documentation

#### 4.5.2.1 [bmc\\_mqtt\\_init\(\)](#)

```
void bmc_mqtt_init (
    void )
```

Definition at line [216](#) of file [bmc\\_mqtt.c](#).

#### 4.5.2.2 [comedi\\_push\\_mqtt\(\)](#)

```
void comedi_push_mqtt (
    void )
```

Definition at line [429](#) of file [bmc\\_mqtt.c](#).

#### 4.5.2.3 [connlost\(\)](#)

```
void connlost (
    void * context,
    char * cause)
```

trouble in River-city

Definition at line [164](#) of file [bmc\\_mqtt.c](#).



#### 4.5.2.4 delivered()

```
void delivered (
    void * context,
    MQTTClient_deliveryToken dt)
```

Definition at line 202 of file [bmc\\_mqtt.c](#).

#### 4.5.2.5 log\_time()

```
char * log_time (
    bool log)
```

Definition at line 128 of file [bmc\\_mqtt.c](#).

#### 4.5.2.6 mqtt\_bmc\_data()

```
void mqtt_bmc_data (
    MQTTClient client_p,
    const char * topic_p)
```

Definition at line 354 of file [bmc\\_mqtt.c](#).

#### 4.5.2.7 msgarrvd()

```
int32_t msgarrvd (
    void * context,
    char * topicName,
    int topicLen,
    MQTTClient_message * message)
```

Definition at line 277 of file [bmc\\_mqtt.c](#).

#### 4.5.2.8 showIP()

```
void showIP (
    void )
```

Definition at line 35 of file [bmc\\_mqtt.c](#).

#### 4.5.2.9 skeleton\_daemon()

```
void skeleton_daemon (
    void )
```

Definition at line 69 of file [bmc\\_mqtt.c](#).

#### 4.5.2.10 timer\_callback()

```
void timer_callback (
    int32_t signum)
```

Definition at line 152 of file [bmc\\_mqtt.c](#).

### 4.5.3 Variable Documentation

#### 4.5.3.1 conn\_opts\_ha

```
MQTTClient_connectOptions conn_opts_ha = MQTTClient_connectOptions_initializer
```

Definition at line 16 of file [bmc\\_mqtt.c](#).

#### 4.5.3.2 conn\_opts\_p

```
MQTTClient_connectOptions conn_opts_p = MQTTClient_connectOptions_initializer
```

Definition at line 14 of file [bmc\\_mqtt.c](#).

#### 4.5.3.3 conn\_opts\_sd

```
MQTTClient_connectOptions conn_opts_sd = MQTTClient_connectOptions_initializer
```

Definition at line 15 of file [bmc\\_mqtt.c](#).

#### 4.5.3.4 ha\_flag\_vars\_ss

```
struct ha_flag_type ha_flag_vars_ss
```

##### Initial value:

```
= {
    .runner = false,
    .receivedtoken = false,
    .deliveredtoken = false,
    .rec_ok = false,
    .ha_id = COMEDI_ID,
    .var_update = 0,
}
```

Definition at line 22 of file [bmc\\_mqtt.c](#).

#### 4.5.3.5 hname

```
char hname[256]
```

Definition at line 19 of file [bmc\\_mqtt.c](#).

#### 4.5.3.6 hname\_len

```
size_t hname_len = 12
```

Definition at line 20 of file [bmc\\_mqtt.c](#).

#### 4.5.3.7 hname\_ptr

```
char * hname_ptr = hname
```

Definition at line 19 of file [bmc\\_mqtt.c](#).

#### 4.5.3.8 new\_timer

```
struct itimerval new_timer
```

##### Initial value:

```
= {  
    .it_value.tv_sec = CMD_SEC,  
    .it_value.tv_usec = 0,  
    .it_interval.tv_sec = CMD_SEC,  
    .it_interval.tv_usec = 0,  
}
```

Definition at line 6 of file [bmc\\_mqtt.c](#).

#### 4.5.3.9 old\_timer

```
struct itimerval old_timer
```

Definition at line 12 of file [bmc\\_mqtt.c](#).

#### 4.5.3.10 pubmsg

```
MQTTClient_message pubmsg = MQTTClient_message_initializer
```

Definition at line 17 of file [bmc\\_mqtt.c](#).

#### 4.5.3.11 rawtime

```
time_t rawtime
```

Definition at line 13 of file [bmc\\_mqtt.c](#).

#### 4.5.3.12 token

```
MQTTClient_deliveryToken token
```

Definition at line 18 of file [bmc\\_mqtt.c](#).

## 4.6 bmc\_mqtt.c

[Go to the documentation of this file.](#)

```

00001 #include "bmc_mqtt.h"
00002
00003 static const char *const FW_Date = __DATE__;
00004 static const char *const FW_Time = __TIME__;
00005
00006 struct itimerval new_timer = {
00007     .it_value.tv_sec = CMD_SEC,
00008     .it_value.tv_usec = 0,
00009     .it_interval.tv_sec = CMD_SEC,
00010     .it_interval.tv_usec = 0,
00011 };
00012 struct itimerval old_timer;
00013 time_t rawtime;
00014 MQTTClient_connectOptions conn_opts_p = MQTTClient_connectOptions_initializer,
00015     conn_opts_sd = MQTTClient_connectOptions_initializer,
00016     conn_opts_ha = MQTTClient_connectOptions_initializer;
00017 MQTTClient_message pubmsg = MQTTClient_message_initializer;
00018 MQTTClient_deliveryToken token;
00019 char hname[256], *hname_ptr = hname;
00020 size_t hname_len = 12;
00021
00022 struct ha_flag_type ha_flag_vars_ss = {
00023     .runner = false,
00024     .receivedtoken = false,
00025     .deliveredtoken = false,
00026     .rec_ok = false,
00027     .ha_id = COMEDI_ID,
00028     .var_update = 0,
00029 };
00030
00035 void showIP(void)
00036 {
00037     struct ifaddrs *ifaddr, *ifa;
00038     int s;
00039     char host[NI_MAXHOST];
00040
00041     if (getifaddrs(&ifaddr) == -1) {
00042         perror("getifaddrs");
00043         exit(EXIT_FAILURE);
00044     }
00045
00046     for (ifa = ifaddr; ifa != NULL; ifa = ifa->ifa_next) {
00047         if (ifa->ifa_addr == NULL)
00048             continue;
00049
00050         s = getnameinfo(ifa->ifa_addr, sizeof(struct sockaddr_in), host, NI_MAXHOST, NULL, 0,
00051             NI_NUMERICHOST);
00052
00053         if (ifa->ifa_addr->sa_family == AF_INET) {
00054             if (s != 0) {
00055                 exit(EXIT_FAILURE);
00056             }
00057             printf("\tInterface : <%s>\n", ifa->ifa_name);
00058             printf("\tAddress : <%s>\n", host);
00059         }
00060     }
00061     freeifaddrs(ifaddr);
00062 }
00063
00064 /*
00065  * setup ha_energy program to run as a background daemon
00066  * disconnect and exit foreground startup process
00067  */
00068 void skeleton_daemon(void)
00069 {
00070     pid_t pid;
00071
00072     /* Fork off the parent process */
00073     pid = fork();
00074
00075     /* An error occurred */
00076     if (pid < 0) {
00077         printf("\r\n%s DAEMON failure LOG Version %s : MQTT Version %s\r\n", log_time(false),
00078             LOG_VERSION, MQTT_VERSION);
00079         exit(EXIT_FAILURE);
00080     }
00081
00082     /* Success: Let the parent terminate */
00083     if (pid > 0) {
00084         exit(EXIT_SUCCESS);

```

```

00085     }
00086
00087     /* On success: The child process becomes session leader */
00088     if (setsid() < 0) {
00089         exit(EXIT_FAILURE);
00090     }
00091
00092     /* Catch, ignore and handle signals */
00093     /*TODO: Implement a working signal handler */
00094     //     signal(SIGCHLD, SIG_IGN);
00095     //     signal(SIGHUP, SIG_IGN);
00096
00097     /* Fork off for the second time*/
00098     pid = fork();
00099
00100     /* An error occurred */
00101     if (pid < 0) {
00102         exit(EXIT_FAILURE);
00103     }
00104
00105     /* Success: Let the parent terminate */
00106     if (pid > 0) {
00107         exit(EXIT_SUCCESS);
00108     }
00109
00110     /* Set new file permissions */
00111     umask(0);
00112
00113     /* Change the working directory to the root directory */
00114     /* or another appropriated directory */
00115     chdir("/");
00116
00117     /* Close all open file descriptors */
00118     int x;
00119     for (x = sysconf(_SC_OPEN_MAX); x >= 0; x--) {
00120         close(x);
00121     }
00122 }
00123 }
00124
00125 /*
00126  * sent the current UTC to the Dump Load controller
00127  */
00128 char * log_time(bool log)
00129 {
00130     static char time_log[RBUF_SIZ] = {0};
00131     time_t rawtime_log;
00132     int32_t len = 0;
00133
00134     tzset();
00135     timezone = 0;
00136     daylight = 0;
00137     time(&rawtime_log);
00138     sprintf(time_log, "%s", ctime(&rawtime_log));
00139     len = strlen(time_log);
00140     time_log[len - 1] = 0; // munge out the return character
00141     if (log) {
00142         fprintf(fout, "%s ", time_log);
00143         fflush(fout);
00144     }
00145     return time_log;
00146 }
00147
00148 /*
00149  * data update timer flag
00150  * and CMD_SEC seconds software time clock
00151  */
00152 void timer_callback(int32_t signum)
00153 {
00154     signal(signum, timer_callback);
00155     ha_flag_vars_ss.runner = true;
00156     E.thirty_sec_clock++;
00157     E.log_time_reset++;
00158 }
00159 }
00160
00161 /*
00162  * MQTT Broker connection errors can be fatal
00163  */
00164 void connlost(void *context, char *cause)
00165 {
00166     struct ha_flag_type *ha_flag = context;
00167     int32_t id_num = ha_flag->ha_id;
00168     static uint32_t times = 0;
00169     char * where = "Missing Topic";
00170     char * what = "Reconnection Error";
00171

```

```

00172 // bug-out if no context variables passed to callback
00173 if (context == NULL) {
00174     id_num = -1;
00175     goto bugout;
00176 }
00177
00178 if (times++ > MQTT_RECONN) {
00179     goto bugout;
00180 } else {
00181     if (times > 1) {
00182         fprintf(fout, "%s Connection lost, retrying %d \n", log_time(false), times);
00183         fprintf(fout, "%s cause: %s, h_id %d, c_id %d, %s \n", log_time(false), cause, id_num,
0, what);
00184         fprintf(fout, "%s MQTT DAEMON reconnect failure, LOG Version %s : MQTT Version %s\n",
log_time(false), LOG_VERSION, MQTT_VERSION);
00185     }
00186     fflush(fout);
00187     times = 0;
00188     return;
00189 }
00190
00191 bugout:
00192 fprintf(fout, "%s Connection lost, exit ha_energy program\n", log_time(false));
00193 fprintf(fout, "%s cause: %s, h_id %d, c_id %d, %s \n", log_time(false), cause, id_num, 0,
where);
00194 fprintf(fout, "%s MQTT DAEMON context is NULL failure, LOG Version %s : MQTT Version %s\n",
log_time(false), LOG_VERSION, MQTT_VERSION);
00195 fflush(fout);
00196 exit(EXIT_FAILURE);
00197 }
00198
00199 /*
00200  * set the broker has message token
00201  */
00202 void delivered(void *context, MQTTClient_deliveryToken dt)
00203 {
00204     struct ha_flag_type *ha_flag = context;
00205
00206     // bug-out if no context variables passed to callback
00207     if (context == NULL) {
00208         return;
00209     }
00210     ha_flag->deliveredtoken = dt;
00211 }
00212
00216 void bmc_mqtt_init(void)
00217 {
00218     E.mqtt_count = 0;
00219     gethostname(hname, hname_len);
00220     hname[12] = 0;
00221     printf("\r\n LOG Version %s : MQTT Version %s : Host Name %s\r\n", LOG_VERSION, MQTT_VERSION,
hname);
00222     showIP();
00223     skeleton_daemon();
00224 #ifdef LOG_TO_FILE
00225     fout = fopen(LOG_TO_FILE, "a");
00226     if (fout == NULL) {
00227         fout = fopen(LOG_TO_FILE_ALT, "a");
00228         if (fout == NULL) {
00229             fout = stdout;
00230             printf("\r\n%s Unable to open LOG file %s \r\n", log_time(false), LOG_TO_FILE_ALT);
00231         }
00232     }
00233 #else
00234     fout = stdout;
00235 #endif
00236
00237 /*
00238  * set the timer for MQTT publishing sample speed
00239  * CMD_SEC sets the time in seconds
00240  */
00241     setitimer(ITIMER_REAL, &new_timer, &old_timer);
00242     signal(SIGALRM, timer_callback);
00243
00244     if (strncmp(hname, TNAME, 6) == 0) {
00245         MQTTClient_create(&E.client_p, LADDRESS, CLIENTID1,
MQTTCLIENT_PERSISTENCE_NONE, NULL);
00246         conn_opts_p.keepAliveInterval = KAI;
00247         conn_opts_p.cleansession = 1;
00248         hname_ptr = LADDRESS;
00249     } else {
00250         MQTTClient_create(&E.client_p, ADDRESS, CLIENTID1,
MQTTCLIENT_PERSISTENCE_NONE, NULL);
00251         conn_opts_p.keepAliveInterval = KAI;
00252         conn_opts_p.cleansession = 1;
00253         hname_ptr = ADDRESS;
00254     }
00255 }

```

```

00257
00258     fprintf(fout, "\r\n%s Connect MQTT server %s, %s\n", log_time(false), hname_ptr, CLIENTID1);
00259     fflush(fout);
00260     MQTTClient_setCallbacks(E.client_p, &ha_flag_vars_ss, connlost, msgarrvd, delivered);
00261     if ((E.rc = MQTTClient_connect(E.client_p, &conn_opts_p)) != MQTTCLIENT_SUCCESS) {
00262         fprintf(fout, "%s Failed to connect MQTT server, return code %d %s, %s\n", log_time(false),
E.rc, hname_ptr, CLIENTID1);
00263         fflush(fout);
00264         pthread_mutex_destroy(&E.ha_lock);
00265         exit(EXIT_FAILURE);
00266     }
00267
00268     MQTTClient_subscribe(E.client_p, TOPIC_P, QOS); // sub for testing data from the HA_Energy system
00269
00270     pubmsg.payload = "online";
00271     pubmsg.payloadlen = strlen("online");
00272     pubmsg.qos = QOS;
00273     pubmsg.retained = 0;
00274     ha_flag_vars_ss.deliveredtoken = 0;
00275 }
00276
00277 int32_t msgarrvd(void *context, char *topicName, int topicLen, MQTTClient_message *message)
00278 {
00279     int32_t i, ret = 1;
00280     const char* payloadptr;
00281     char buffer[MBMQTT];
00282     struct ha_flag_type *ha_flag = context;
00283
00284     E.mqtt_count++;
00285     // bug-out if no context variables passed to callback
00286     if (context == NULL) {
00287         ret = -1;
00288         goto null_exit;
00289     }
00290
00291 #ifdef DEBUG_REC
00292     fprintf(fout, "Message arrived\n");
00293 #endif
00294     /*
00295      * move the received message into a processing holding buffer
00296      */
00297     payloadptr = message->payload;
00298     for (i = 0; i < message->payloadlen; i++) {
00299         buffer[i] = *payloadptr++;
00300     }
00301     buffer[i] = 0; // make a null terminated C string
00302
00303     // parse the JSON data in the holding buffer
00304     cJSON *json = cJSON_ParseWithLength(buffer, message->payloadlen);
00305     if (json == NULL) {
00306         const char *error_ptr = cJSON_GetErrorPtr();
00307         if (error_ptr != NULL) {
00308             fprintf(fout, "%s Error: %s NULL cJSON pointer\n", log_time(false), error_ptr);
00309         }
00310         ret = -1;
00311         ha_flag->rec_ok = false;
00312         E.comedi = false;
00313         goto error_exit;
00314     }
00315
00316     /*
00317      * MQTT messages for COMEDI
00318      */
00319 #ifdef DEBUG_REC
00320     fprintf(fout, "COMEDI MQTT data\r\n");
00321 #endif
00322     cJSON *data_result = json;
00323
00324     data_result = cJSON_GetObjectItemCaseSensitive(json, "Comedi_Request");
00325
00326     if (cJSON_IsString(data_result) && (data_result->valuestring != NULL)) {
00327         fprintf(fout, "%s Comedi Trigger from MQTT server, Topic %s %s\n", log_time(false), topicName,
data_result->valuestring);
00328         fflush(fout);
00329         ret = true;
00330     }
00331     E.comedi = true;
00332
00333     // done with processing MQTT async message, set state flags
00334     ha_flag->receivedtoken = true;
00335     ha_flag->rec_ok = true;
00336     ha_flag_vars_ss.runner = true; // send data in response to received message of any type
00337     /*
00338      * exit and delete/free resources. In steps depending of possible error conditions
00339      */
00340 error_exit:
00341     // delete the JSON object

```

```

00342     cJSON_Delete(json);
00343     null_exit:
00344         // free the MQTT objects
00345         MQTTClient_freeMessage(&message);
00346         MQTTClient_free(topicName);
00347         fflush(fout);
00348         return ret;
00349     }
00350
00351     /*
00352     * send Comedi variables MQTT host
00353     */
00354     void mqtt_bmc_data(MQTTClient client_p, const char * topic_p)
00355     {
00356         cJSON *json;
00357         time_t rawtime;
00358         static uint32_t spam = 0;
00359
00360         MQTTClient_message pubmsg = MQTTClient_message_initializer;
00361         MQTTClient_deliveryToken token;
00362         ha_flag_vars_ss.deliveredtoken = 0;
00363
00364         fprintf(fout, "%s Sending Comedi data to MQTT server, Topic %s\n", log_time(false), topic_p);
00365         fflush(fout);
00366
00367         E.adc[0] = get_adc_volts(0);
00368         E.adc[1] = get_adc_volts(1);
00369
00370         #ifdef DAC_TESTING
00371             E.dac[0] = E.adc[0];
00372             E.dac[1] = E.adc[1];
00373         #endif
00374
00375         set_dac_volts(0, E.dac[0]);
00376         set_dac_volts(1, E.dac[1]);
00377         E.do_16b = bmc.dataout.dio_buf;
00378         E.di_16b = get_dio_bit(0) + (get_dio_bit(1) << 1) + (get_dio_bit(2) << 2) + (get_dio_bit(3) << 3) +
00379             (get_dio_bit(4) << 4);
00380
00381         E.mqtt_count++;
00382         E.sequence++;
00383         json = cJSON_CreateObject();
00384         cJSON_AddStringToObject(json, "name", CLIENTID1);
00385         cJSON_AddNumberToObject(json, "sequence", E.sequence);
00386         cJSON_AddNumberToObject(json, "mqtt_do_16b", (double) E.do_16b);
00387         cJSON_AddNumberToObject(json, "http_di_16b", (double) E.di_16b);
00388         cJSON_AddNumberToObject(json, "bmc_adc0", E.adc[0]);
00389         cJSON_AddNumberToObject(json, "bmc_adc1", E.adc[1]);
00390         cJSON_AddNumberToObject(json, "bmc_dac0", E.dac[0]);
00391         cJSON_AddNumberToObject(json, "bmc_dac1", E.dac[1]);
00392         cJSON_AddStringToObject(json, "build_date", FW_Date);
00393         cJSON_AddStringToObject(json, "build_time", FW_Time);
00394         time(&rawtime);
00395         cJSON_AddNumberToObject(json, "sequence_time", (double) rawtime);
00396         // convert the cJSON object to a JSON string
00397         char *json_str = cJSON_Print(json);
00398
00399         pubmsg.payload = json_str;
00400         pubmsg.payloadlen = strlen(json_str);
00401         pubmsg.qos = QOS;
00402         pubmsg.retained = 0;
00403
00404         MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token);
00405         // a busy, wait loop for the async delivery thread to complete
00406         {
00407             uint32_t waiting = 0;
00408             while (ha_flag_vars_ss.deliveredtoken != token) {
00409                 usleep(TOKEN_DELAY);
00410                 if (waiting++ > MQTT_RETRY) {
00411                     if (spam++ > 1) {
00412                         fprintf(fout, "%s SW mqtt_bmc_data, Still Waiting, timeout\n", log_time(false));
00413                         fflush(fout);
00414                         spam = 0;
00415                     }
00416                     break;
00417                 } else {
00418                     spam = 0;
00419                 }
00420             }
00421         }
00422         cJSON_free(json_str);
00423         cJSON_Delete(json);
00424     }
00425
00426     /*
00427     * main program function to send Comedi data to the MQTT server

```



```

00428  */
00429 void comedi_push_mqtt(void)
00430 {
00431     mqtt_bmc_data(E.client_p, TOPIC_P);
00432 }

```

## 4.7 bmc\_mqtt.h

```

00001
00002 #ifndef BMC_MQTT_H
00003 #define BMC_MQTT_H
00004
00005 #ifdef __cplusplus
00006 extern "C" {
00007 #endif
00008
00009 #include "bmc.h"
00010 #include "daq.h"
00011 #include "mqtt_rec.h"
00012 #include "mqtt_vars.h"
00013
00014 #define MQTT_RETRY 10
00015
00016     extern struct ha_flag_type ha_flag_vars_ss;
00017
00018     void mqtt_bmc_data(MQTTClient, const char *);
00019     void delivered(void *, MQTTClient_deliveryToken);
00020     int32_t msgarrvd(void *, char *, int, MQTTClient_message *);
00021     void connlost(void *, char *);
00022     void showIP(void);
00023     void skeleton_daemon(void);
00024     void bmc_mqtt_init(void);
00025     char * log_time(bool);
00026
00027     void timer_callback(int32_t);
00028     void comedi_push_mqtt(void);
00029
00030 #ifdef __cplusplus
00031 }
00032 #endif
00033
00034 #endif /* BMC_MQTT_H */
00035

```

## 4.8 bmc.o.d

```

00001 build/Debug/GNU-Linux/bmc.o: bmc.c daq.h bmc.h mqtt_rec.h mqtt_vars.h \
00002     bmc_mqtt.h
00003 daq.h:
00004 bmc.h:
00005 mqtt_rec.h:
00006 mqtt_vars.h:
00007 bmc_mqtt.h:

```

## 4.9 bmc.o.d

```

00001 build/Release/GNU-Linux/bmc.o: bmc.c daq.h bmc.h mqtt_rec.h mqtt_vars.h \
00002     bmc_mqtt.h
00003 daq.h:
00004 bmc.h:
00005 mqtt_rec.h:
00006 mqtt_vars.h:
00007 bmc_mqtt.h:

```

## 4.10 bmc\_mqtt.o.d

```

00001 build/Debug/GNU-Linux/bmc_mqtt.o: bmc_mqtt.c bmc_mqtt.h bmc.h daq.h \
00002     mqtt_rec.h mqtt_vars.h
00003 bmc_mqtt.h:
00004 bmc.h:
00005 daq.h:
00006 mqtt_rec.h:
00007 mqtt_vars.h:

```

## 4.11 bmc\_mqtt.o.d

```
00001 build/Release/GNU-Linux/bmc_mqtt.o: bmc_mqtt.c bmc_mqtt.h bmc.h daq.h \
00002 mqtt_rec.h mqtt_vars.h
00003 bmc_mqtt.h:
00004 bmc.h:
00005 daq.h:
00006 mqtt_rec.h:
00007 mqtt_vars.h:
```

## 4.12 daq.o.d

```
00001 build/Debug/GNU-Linux/daq.o: daq.c daq.h bmc.h
00002 daq.h:
00003 bmc.h:
```

## 4.13 daq.o.d

```
00001 build/Release/GNU-Linux/daq.o: daq.c daq.h bmc.h
00002 daq.h:
00003 bmc.h:
```

## 4.14 daq.c

```
00001 /*
00002  * \file daq.c
00003  */
00004
00005
00006
00007
00008 #include <stdio.h> /* for printf() */
00009 #include <unistd.h>
00010 #include <stdbool.h>
00011 #include <stdint.h>
00012 #include <comedilib.h>
00013 #include "daq.h"
00014
00015 int subdev_ai = 0; /* change this to your input subdevice */
00016 int chan_ai = 0; /* change this to your channel */
00017 int range_ai = 0; /* more on this later */
00018 int aref_ai = AREF_GROUND; /* more on this later */
00019 int maxdata_ai, ranges_ai, channels_ai;
00020
00021 int subdev_ao = 0; /* change this to your input subdevice */
00022 int chan_ao = 0; /* change this to your channel */
00023 int range_ao = 0; /* more on this later */
00024 int aref_ao = AREF_GROUND; /* more on this later */
00025 int maxdata_ao, ranges_ao, channels_ao;
00026
00027 int subdev_di = 0; /* change this to your input subdevice */
00028 int chan_di = 0; /* change this to your channel */
00029 int range_di = 0; /* more on this later */
00030 int maxdata_di, ranges_di, channels_di, datain_di;
00031
00032 int subdev_do = 0; /* change this to your input subdevice */
00033 int chan_do = 0; /* change this to your channel */
00034 int range_do = 0; /* more on this later */
00035 int maxdata_do, ranges_do, channels_do, datain_do;
00036
00037 int subdev_dio; /* change this to your input subdevice */
00038 int aref_dio; /* more on this later */
00039
00040 int subdev_counter; /* change this to your input subdevice */
00041 int chan_counter = 0; /* change this to your channel */
00042 int range_counter = 0; /* more on this later */
00043 int maxdata_counter, ranges_counter, channels_counter, datain_counter;
00044
00045 comedi_t *it;
00046 comedi_range *ad_range, *da_range;
00047 bool ADC_OPEN = false, DIO_OPEN = false, ADC_ERROR = false, DEV_OPEN = false,
00048      DIO_ERROR = false, HAS_AO = false, DAC_ERROR = false, PWM_OPEN = false,
00049      PWM_ERROR = false;
```

```

00050
00051 int init_daq(double min_range, double max_range, int range_update)
00052 {
00053     int i = 0;
00054
00055     if (!DEV_OPEN) {
00056         it = comedi_open("/dev/comedi0");
00057         if (it == NULL) {
00058             comedi_perror("comedi_open");
00059             ADC_OPEN = false;
00060             DEV_OPEN = false;
00061             return -1;
00062         }
00063         DEV_OPEN = true;
00064     }
00065
00066     subdev_ai = comedi_find_subdevice_by_type(it, COMEDI_SUBD_AI, subdev_ai);
00067     if (subdev_ai < 0) {
00068         return -2;
00069         ADC_OPEN = false;
00070     }
00071
00072
00073     subdev_ao = comedi_find_subdevice_by_type(it, COMEDI_SUBD_AO, subdev_ao);
00074     if (subdev_ao < 0) {
00075         HAS_AO = false;
00076     } else {
00077         HAS_AO = true;
00078     }
00079
00080     fprintf(fout, "Comedi DAQ Board Name: %s, Driver: %s\r\n",
comedi_get_board_name(it), comedi_get_driver_name(it));
00081
00082     fprintf(fout, "Subdev AI %i ", subdev_ai);
00083     channels_ai = comedi_get_n_channels(it, subdev_ai);
00084     fprintf(fout, "Analog Channels %i ", channels_ai);
00085     maxdata_ai = comedi_get_maxdata(it, subdev_ai, i);
00086     fprintf(fout, "Maxdata %i ", maxdata_ai);
00087     ranges_ai = comedi_get_n_ranges(it, subdev_ai, i);
00088     fprintf(fout, "Ranges %i ", ranges_ai);
00089     ad_range = comedi_get_range(it, subdev_ai, i, range_ai);
00090     if (range_update) {
00091         ad_range->min = min_range;
00092         ad_range->max = max_range;
00093     }
00094     fprintf(fout, ": ad_range .min = %.3f, max = %.3f\r\n", ad_range->min,
ad_range->max);
00095
00096
00097     if (HAS_AO) {
00098         fprintf(fout, "Subdev AO %i ", subdev_ao);
00099         channels_ao = comedi_get_n_channels(it, subdev_ao);
00100         fprintf(fout, "Analog Channels %i ", channels_ao);
00101         maxdata_ao = comedi_get_maxdata(it, subdev_ao, i);
00102         fprintf(fout, "Maxdata %i ", maxdata_ao);
00103         ranges_ao = comedi_get_n_ranges(it, subdev_ao, i);
00104         fprintf(fout, "Ranges %i ", ranges_ao);
00105         da_range = comedi_get_range(it, subdev_ao, i, range_ao);
00106         fprintf(fout, ": da_range .min = %.3f, max = %.3f\r\n", da_range->min,
da_range->max);
00107     }
00108
00109
00110     ADC_OPEN = true;
00111     comedi_set_global_oor_behavior(COMEDI_OOR_NUMBER);
00112     return 0;
00113 }
00114
00115 int init_dac(double min_range, double max_range, int range_update)
00116 {
00117     int i = 0;
00118
00119     if (!DEV_OPEN) {
00120         it = comedi_open("/dev/comedi0");
00121         if (it == NULL) {
00122             comedi_perror("comedi_open");
00123             ADC_OPEN = false;
00124             DEV_OPEN = false;
00125             return -1;
00126         }
00127         DEV_OPEN = true;
00128     }
00129
00130     subdev_ao = comedi_find_subdevice_by_type(it, COMEDI_SUBD_AO, subdev_ao);
00131     if (subdev_ao < 0) {
00132         HAS_AO = false;
00133     } else {
00134         HAS_AO = true;
00135     }

```

```

00136
00137     if (HAS_AO) {
00138         fprintf(fout, "Subdev AO %i ", subdev_ao);
00139         channels_ao = comedi_get_n_channels(it, subdev_ao);
00140         fprintf(fout, "Analog Channels %i ", channels_ao);
00141         maxdata_ao = comedi_get_maxdata(it, subdev_ao, i);
00142         fprintf(fout, "Maxdata %i ", maxdata_ao);
00143         ranges_ao = comedi_get_n_ranges(it, subdev_ao, i);
00144         fprintf(fout, "Ranges %i ", ranges_ao);
00145         da_range = comedi_get_range(it, subdev_ao, i, range_ao);
00146         fprintf(fout, ": da_range .min = %.3f, max = %.3f\r\n", da_range->min,
00147                 da_range->max);
00148     }
00149
00150     comedi_set_global_oor_behavior(COMEDI_OOR_NUMBER);
00151     return 0;
00152 }
00153
00154 int adc_range(double min_range, double max_range)
00155 {
00156     if (ADC_OPEN) {
00157         ad_range->min = min_range;
00158         ad_range->max = max_range;
00159         return 0;
00160     } else {
00161         return -1;
00162     }
00163 }
00164
00165 int dac_range(double min_range, double max_range)
00166 {
00167     if (ADC_OPEN) {
00168         da_range->min = min_range;
00169         da_range->max = max_range;
00170         return 0;
00171     } else {
00172         return -1;
00173     }
00174 }
00175
00176 int set_dac_volts(int chan, double voltage)
00177 {
00178     lsampl_t data;
00179     int retval;
00180
00181     data = comedi_from_phys(voltage, da_range, maxdata_ao);
00182     bmc.dac_sample[chan] = data;
00183     retval = comedi_data_write(it, subdev_ao, chan, range_ao, aref_ao, data);
00184     if (retval < 0) {
00185         comedi_perror("comedi_data_write in set_dac_volts");
00186         DAC_ERROR = true;
00187     }
00188     return retval;
00189 }
00190
00191 int set_dac_raw(int chan, lsampl_t voltage)
00192 {
00193     int retval;
00194
00195     retval = comedi_data_write(it, subdev_ao, chan, range_ao, aref_ao, voltage);
00196     if (retval < 0) {
00197         comedi_perror("comedi_data_write in set_dac_raw");
00198         DAC_ERROR = true;
00199     }
00200     return retval;
00201 }
00202
00203 double get_adc_volts(int chan)
00204 {
00205     lsampl_t data[16];
00206     int retval;
00207
00208     retval = comedi_data_read_n(it, subdev_ai, chan, range_ai, aref_ai, &data[0], 8);
00209     if (retval < 0) {
00210         comedi_perror("comedi_data_read in get_adc_volts");
00211         ADC_ERROR = true;
00212         return 0.0;
00213     }
00214     bmc.adc_sample[chan] = data[0];
00215     return comedi_to_phys(data[0], ad_range, maxdata_ai);
00216 }
00217
00218 int set_dio_output(int chan)
00219 {
00220     return comedi_dio_config(it,
00221                             subdev_dio,
00222                             chan,

```

```

00223         COMEDI_OUTPUT);
00224     }
00225
00226     int set_dio_input(int chan)
00227     {
00228         return comedi_dio_config(it,
00229             subdev_dio,
00230             chan,
00231             COMEDI_INPUT);
00232     }
00233
00234     int get_dio_bit(int chan)
00235     {
00236         lsampl_t data;
00237         int retval;
00238
00239         retval = comedi_data_read(it, subdev_di, chan, range_di, aref_dio, &data);
00240         if (retval < 0) {
00241             comedi_perror("comedi_data_read in get_dio_bits");
00242             DIO_ERROR = true;
00243             return 0;
00244         }
00245         return data;
00246     }
00247
00248     int put_dio_bit(int chan, int bit_data)
00249     {
00250         lsampl_t data = bit_data;
00251         int retval;
00252
00253         retval = comedi_data_write(it, subdev_do, chan, range_do, aref_dio, data);
00254         if (retval < 0) {
00255             comedi_perror("comedi_data_write in put_dio_bits");
00256             DIO_ERROR = true;
00257             return -1;
00258         }
00259         return 0;
00260     }
00261
00262     int init_dio(void)
00263     {
00264         int i = 0;
00265
00266         if (!DEV_OPEN) {
00267             it = comedi_open("/dev/comedi0");
00268             if (it == NULL) {
00269                 comedi_perror("comedi_open");
00270                 DIO_OPEN = false;
00271                 DEV_OPEN = false;
00272                 return -1;
00273             }
00274             DEV_OPEN = true;
00275         }
00276
00277         subdev_di = comedi_find_subdevice_by_type(it, COMEDI_SUBD_DI, subdev_di);
00278         if (subdev_di < 0) {
00279             return -1;
00280             DIO_OPEN = false;
00281         }
00282         subdev_do = comedi_find_subdevice_by_type(it, COMEDI_SUBD_DO, subdev_do);
00283         if (subdev_do < 0) {
00284             return -1;
00285             DIO_OPEN = false;
00286         }
00287
00288         subdev_counter = comedi_find_subdevice_by_type(it, COMEDI_SUBD_COUNTER, subdev_counter);
00289         if (subdev_counter < 0) {
00290             return -1;
00291             PWM_OPEN = false;
00292         }
00293
00294         fprintf(fout, "Subdev DI  %i ", subdev_di);
00295         channels_di = comedi_get_n_channels(it, subdev_di);
00296         fprintf(fout, "Digital Channels %i ", channels_di);
00297         maxdata_di = comedi_get_maxdata(it, subdev_di, i);
00298         fprintf(fout, "Maxdata %i ", maxdata_di);
00299         ranges_di = comedi_get_n_ranges(it, subdev_di, i);
00300         fprintf(fout, "Ranges %i \r\n", ranges_di);
00301
00302         fprintf(fout, "Subdev DO  %i ", subdev_do);
00303         channels_do = comedi_get_n_channels(it, subdev_do);
00304         fprintf(fout, "Digital Channels %i ", channels_do);
00305         maxdata_do = comedi_get_maxdata(it, subdev_do, i);
00306         fprintf(fout, "Maxdata %i ", maxdata_do);
00307         ranges_do = comedi_get_n_ranges(it, subdev_do, i);
00308         fprintf(fout, "Ranges %i \r\n", ranges_do);
00309

```

```

00310     fprintf(fout, "Subdev COU %i ", subdev_counter);
00311     channels_counter = comedi_get_n_channels(it, subdev_counter);
00312     fprintf(fout, "Digital Channels %i ", channels_counter);
00313     maxdata_counter = comedi_get_maxdata(it, subdev_counter, i);
00314     fprintf(fout, "Maxdata %i ", maxdata_counter);
00315     ranges_counter = comedi_get_n_ranges(it, subdev_counter, i);
00316     fprintf(fout, "Ranges %i \r\n", ranges_counter);
00317     DIO_OPEN = true;
00318     return 0;
00319 }
00320
00321 int get_data_sample(void)
00322 {
00323     unsigned int obits;
00324
00325     bmc.datain.D0 = get_dio_bit(0);
00326
00327     if (JUST_BITS) { // send I/O bit by bit
00328         put_dio_bit(0, bmc.dataout.d.D0);
00329         put_dio_bit(1, bmc.dataout.d.D1);
00330         put_dio_bit(2, bmc.dataout.d.D2);
00331         put_dio_bit(3, bmc.dataout.d.D3);
00332         put_dio_bit(4, bmc.dataout.d.D4);
00333         put_dio_bit(5, bmc.dataout.d.D5);
00334         put_dio_bit(6, bmc.dataout.d.D6);
00335         put_dio_bit(7, bmc.dataout.d.D7);
00336     } else { // send I/O as a byte mask
00337         obits = bmc.dataout.dio_buf;
00338         comedi_dio_bitfield2(it, subdev_do, 0xff, &obits, 0);
00339     }
00340
00341     return 0;
00342 }
00343
00344 double lp_filter(double new, int bn, int slow) // low pass filter, slow rate of change for new,
LPCHANC channels, slow/fast select (-1) to zero channel
00345 {
00346     static double smooth[LPCHANC] = {0};
00347     double lp_speed, lp_x;
00348
00349     if ((bn >= LPCHANC) || (bn < 0)) // check for proper array position
00350         return new;
00351     if (slow) {
00352         lp_speed = 0.033;
00353     } else {
00354         lp_speed = 0.125;
00355     }
00356     lp_x = ((smooth[bn]*100.0) + (((new * 100.0)-(smooth[bn]*100.0)) * lp_speed)) / 100.0;
00357     smooth[bn] = lp_x;
00358     if (slow == (-1)) { // reset and return zero
00359         lp_x = 0.0;
00360         smooth[bn] = 0.0;
00361     }
00362     return lp_x;
00363 }

```

## 4.15 daq.h

```

00001 /*
00002  * File:   daq.h
00003  * Author: root
00004  *
00005  * Created on September 21, 2012, 6:49 PM
00006  */
00007
00008 #ifndef DAQ_H
00009 #define DAQ_H
00010
00011 #ifdef __cplusplus
00012 extern "C" {
00013 #endif
00014
00015 #define PVV_C    0
00016 #define CCV_C    1
00017 #define SYV_C    2
00018 #define B1V_C    3
00019 #define B2V_C    4
00020 #define INV_C    5
00021 #define VD5_C    7
00022 #define PVC_C    8
00023 #define CCC_C    9
00024 #define BAC_C    10
00025

```

```

00026 #define LPCHANC          16
00027
00028 #define JUST_BITS false
00029
00030 #include <stdint.h>
00031 #include <comedilib.h>
00032 #include "bmc.h"
00033
00034     struct didata {
00035         uint32_t D0 : 1; //
00036         uint32_t D1 : 1; //
00037         uint32_t D2 : 1; //
00038         uint32_t D3 : 1; //
00039         uint32_t D4 : 1; //
00040         uint32_t D5 : 1; //
00041         uint32_t D6 : 1; //
00042         uint32_t D7 : 1; //
00043     };
00044
00045     union dio_buf_type {
00046         uint32_t dio_buf;
00047         struct didata d;
00048     };
00049
00050     typedef struct bmcddata {
00051         double pv_voltage, cc_voltage, input_voltage, b1_voltage, b2_voltage, system_voltage,
logic_voltage;
00052         double pv_current, cc_current, battery_current;
00053         struct didata datain;
00054         union dio_buf_type dataout;
00055         int32_t adc_sample[32];
00056         int32_t dac_sample[32];
00057         int32_t utc;
00058     }
00059     bmctype;
00060
00061     extern volatile struct bmcddata bmc;
00062     extern struct didata datain;
00063     extern struct didata dataout;
00064
00065     extern int maxdata_ai, ranges_ai, channels_ai;
00066     extern int maxdata_ao, ranges_ao, channels_ao;
00067     extern int maxdata_di, ranges_di, channels_di, datain_di;
00068     extern int maxdata_do, ranges_do, channels_do, datain_do;
00069     extern int maxdata_counter, ranges_counter, channels_counter, datain_counter;
00070
00071     int init_daq(double, double, int);
00072     int init_dac(double, double, int);
00073     int init_dio(void);
00074     int adc_range(double, double);
00075     int dac_range(double, double);
00076     double get_adc_volts(int);
00077     int set_dac_volts(int, double);
00078     int set_dac_raw(int, lsampl_t);
00079     int get_dio_bit(int);
00080     int put_dio_bit(int, int);
00081     int set_dio_input(int);
00082     int set_dio_output(int);
00083     int get_data_sample(void);
00084     double lp_filter(double, int, int);
00085 #ifdef __cplusplus
00086 }
00087 #endif
00088
00089 #endif /* DAQ_H */
00090

```

## 4.16 mqtt\_rec.h

```

00001
00002
00003 #ifndef MQTT_REC_H
00004 #define MQTT_REC_H
00005
00006 #ifdef __cplusplus
00007 extern "C" {
00008 #endif
00009
00010 #include "mqtt_vars.h"
00011
00012 #define RDEV_SIZE          10
00013
00014 #define SLEEP_CODE        0

```

```

00015 #define FLOAT_CODE      1
00016     //#define DEBUG_REC
00017     //#define GET_DEBUG
00018
00019 #define MBMQTT  1024
00020
00021     enum mqtt_id {
00022         P8055_ID,
00023         FM80_ID,
00024         DUMPLOAD_ID,
00025         HA_ID,
00026         COMEDI_ID,
00027         LAST_MQTT_ID,
00028     };
00029
00030     struct ha_flag_type {
00031         volatile MQTTClient_deliveryToken deliveredtoken, receivedtoken;
00032         volatile bool runner, rec_ok;
00033         int32_t ha_id;
00034         volatile int32_t var_update, energy_mode;
00035     };
00036
00037     extern FILE* fout;
00038
00039     int32_t msgarrvd(void *, char *, int, MQTTClient_message *);
00040     void delivered(void *, MQTTClient_deliveryToken);
00041
00042     bool json_get_data(cJSON *, const char *, cJSON *, uint32_t);
00043     bool fm80_float(const bool set_bias);
00044     bool fm80_sleep(void);
00045
00046
00047 #ifdef __cplusplus
00048 }
00049 #endif
00050
00051 #endif /* MQTT_REC_H */
00052

```

## 4.17 mqtt\_vars.h

```

00001
00002
00003 #ifndef MQTT_VARS_H
00004 #define MQTT_VARS_H
00005
00006 #ifdef __cplusplus
00007 extern "C" {
00008 #endif
00009
00010 #define HA_SW_DELAY      400000 // usecs
00011 #define TOKEN_DELAY      600
00012 #define GTI_TOKEN_DELAY  300
00013
00014 #define MAIN_DELAY      1000 // 1msec comedi sample rate max
00015
00016 #define QOS              1
00017
00018     void mqtt_ha_switch(MQTTClient, const char *, const bool);
00019     void mqtt_ha_pid(MQTTClient, const char *);
00020     void mqtt_ha_shutdown(MQTTClient, const char *);
00021     bool mqtt_gti_power(MQTTClient, const char *, char *, uint32_t);
00022     bool mqtt_gti_time(MQTTClient, const char *, char *);
00023
00024
00025 #ifdef __cplusplus
00026 }
00027 #endif
00028
00029 #endif /* MQTT_VARS_H */
00030

```

## 4.18 c\_standard\_headers\_indexer.c

```

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```

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00035  * Version 2 license, then the option applies only if the new code is
00036  * made subject to such option by the copyright holder.
00037  *
00038  * Contributor(s):
00039  */
00040
00041 // List of standard headers was taken in http://en.cppreference.com/w/c/header
00042
00043 #include <assert.h> // Conditionally compiled macro that compares its argument to zero
00044 #include <ctype.h> // Functions to determine the type contained in character data
00045 #include <errno.h> // Macros reporting error conditions
00046 #include <float.h> // Limits of float types
00047 #include <limits.h> // Sizes of basic types
00048 #include <locale.h> // Localization utilities
00049 #include <math.h> // Common mathematics functions
00050 #include <setjmp.h> // Nonlocal jumps
00051 #include <signal.h> // Signal handling
00052 #include <stdarg.h> // Variable arguments
00053 #include <stddef.h> // Common macro definitions
00054 #include <stdio.h> // Input/output
00055 #include <string.h> // String handling
00056 #include <stdlib.h> // General utilities: memory management, program utilities, string
    conversions, random numbers
00057 #include <time.h> // Time/date utilities
00058 #include <iso646.h> // (since C95) Alternative operator spellings
00059 #include <wchar.h> // (since C95) Extended multibyte and wide character utilities
00060 #include <wctype.h> // (since C95) Wide character classification and mapping utilities
00061 #ifdef _STDC_C99
00062 #include <complex.h> // (since C99) Complex number arithmetic
00063 #include <fenv.h> // (since C99) Floating-point environment
00064 #include <inttypes.h> // (since C99) Format conversion of integer types
00065 #include <stdbool.h> // (since C99) Boolean type
00066 #include <stdint.h> // (since C99) Fixed-width integer types
00067 #include <tgmath.h> // (since C99) Type-generic math (macros wrapping math.h and complex.h)
00068 #endif
00069 #ifdef _STDC_C11
00070 #include <stdalign.h> // (since C11) alignas and alignof convenience macros
00071 #include <stdatomic.h> // (since C11) Atomic types
00072 #include <stdnoreturn.h> // (since C11) noreturn convenience macros
00073 #include <threads.h> // (since C11) Thread library
00074 #include <uchar.h> // (since C11) UTF-16 and UTF-32 character utilities
00075 #endif

```

## 4.19 cpp\_standard\_headers\_indexer.cpp

```

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00035  * Version 2 license, then the option applies only if the new code is
00036  * made subject to such option by the copyright holder.
00037  *
00038  * Contributor(s):
00039  */
00040
00041 // List of standard headers was taken in http://en.cppreference.com/w/cpp/header
00042
00043 #include <cstdlib> // General purpose utilities: program control, dynamic memory allocation,
random numbers, sort and search
00044 #include <csignal> // Functions and macro constants for signal management
00045 #include <setjmp> // Macro (and function) that saves (and jumps) to an execution context
00046 #include <stdarg> // Handling of variable length argument lists
00047 #include <typeinfo> // Runtime type information utilities
00048 #include <bitset> // std::bitset class template
00049 #include <functional> // Function objects, designed for use with the standard algorithms
00050 #include <utility> // Various utility components
00051 #include <ctime> // C-style time/date utilities
00052 #include <stddef> // typedefs for types such as size_t, NULL and others
00053 #include <new> // Low-level memory management utilities
00054 #include <memory> // Higher level memory management utilities
00055 #include <climits> // limits of integral types
00056 #include <float> // limits of float types
00057 #include <limits> // standardized way to query properties of arithmetic types
00058 #include <exception> // Exception handling utilities
00059 #include <stdexcept> // Standard exception objects
00060 #include <cassert> // Conditionally compiled macro that compares its argument to zero
00061 #include <cerrno> // Macro containing the last error number
00062 #include <cctype> // functions to determine the type contained in character data
00063 #include <cwctype> // functions for determining the type of wide character data
00064 #include <cstring> // various narrow character string handling functions
00065 #include <wchar> // various wide and multibyte string handling functions
00066 #include <string> // std::basic_string class template
00067 #include <vector> // std::vector container
00068 #include <deque> // std::deque container
00069 #include <list> // std::list container
00070 #include <set> // std::set and std::multiset associative containers
00071 #include <map> // std::map and std::multimap associative containers
00072 #include <stack> // std::stack container adaptor
00073 #include <queue> // std::queue and std::priority_queue container adaptors
00074 #include <algorithm> // Algorithms that operate on containers
00075 #include <iterator> // Container iterators
00076 #include <cmath> // Common mathematics functions
00077 #include <complex> // Complex number type
00078 #include <valarray> // Class for representing and manipulating arrays of values
00079 #include <numeric> // Numeric operations on values in containers
00080 #include <iosfwd> // forward declarations of all classes in the input/output library
00081 #include <ios> // std::ios_base class, std::basic_ios class template and several typedefs
00082 #include <istream> // std::basic_istream class template and several typedefs
00083 #include <ostream> // std::basic_ostream, std::basic_iostream class templates and several
typedefs
00084 #include <iostream> // several standard stream objects
00085 #include <fstream> // std::basic_fstream, std::basic_ifstream, std::basic_ofstream class
templates and several typedefs
00086 #include <sstream> // std::basic_stringstream, std::basic_istringstream,
std::basic_ostringstream class templates and several typedefs
00087 #include <strstream> // std::strstream, std::istrstream, std::ostrstream(deprecated)
00088 #include <iomanip> // Helper functions to control the format or input and output
00089 #include <streambuf> // std::basic_streambuf class template
00090 #include <cstdio> // C-style input-output functions
00091 #include <locale> // Localization utilities

```

```

00092 #include <clocale>           // C localization utilities
00093 #include <ciso646>           // empty header. The macros that appear in iso646.h in C are keywords in
    C++
00094 #if __cplusplus >= 201103L
00095 #include <typeindex>         // (since C++11)    std::type_index
00096 #include <type_traits>       // (since C++11)    Compile-time type information
00097 #include <chrono>            // (since C++11)    C++ time utilites
00098 #include <initializer_list>  // (since C++11)    std::initializer_list class template
00099 #include <tuple>             // (since C++11)    std::tuple class template
00100 #include <scoped_allocator>  // (since C++11)    Nested allocator class
00101 #include <cstdint>           // (since C++11)    fixed-size types and limits of other types
00102 #include <cstdint>           // (since C++11)    formatting macros , intmax_t and uintmax_t math and
    conversions
00103 #include <system_error>      // (since C++11)    defines std::error_code, a platform-dependent error
    code
00104 #include <cuchar>            // (since C++11)    C-style Unicode character conversion functions
00105 #include <array>             // (since C++11)    std::array container
00106 #include <forward_list>      // (since C++11)    std::forward_list container
00107 #include <unordered_set>     // (since C++11)    std::unordered_set and std::unordered_multiset
    unordered associative containers
00108 #include <unordered_map>     // (since C++11)    std::unordered_map and std::unordered_multimap
    unordered associative containers
00109 #include <random>            // (since C++11)    Random number generators and distributions
00110 #include <ratio>             // (since C++11)    Compile-time rational arithmetic
00111 #include <cfenv>             // (since C++11)    Floating-point environment access functions
00112 #include <codecvt>           // (since C++11)    Unicode conversion facilities
00113 #include <regex>             // (since C++11)    Classes, algorithms and iterators to support regular
    expression processing
00114 #include <atomic>            // (since C++11)    Atomic operations library
00115 #include <ccomplex>          // (since C++11) (deprecated in C++17)    simply includes the header
    <complex>
00116 #include <ctgmath>           // (since C++11) (deprecated in C++17)    simply includes the headers
    <ccomplex> (until C++17)<complex> (since C++17) and <cmath>: the overloads equivalent to the contents
    of the C header tgmath.h are already provided by those headers
00117 #include <cstdalign>         // (since C++11) (deprecated in C++17)    defines one compatibility macro
    constant
00118 #include <cstdbool>          // (since C++11) (deprecated in C++17)    defines one compatibility macro
    constant
00119 #include <thread>            // (since C++11)    std::thread class and supporting functions
00120 #include <mutex>             // (since C++11)    mutual exclusion primitives
00121 #include <future>            // (since C++11)    primitives for asynchronous computations
00122 #include <condition_variable> // (since C++11)    thread waiting conditions
00123 #endif
00124 #if __cplusplus >= 201300L
00125 #include <shared_mutex>      // (since C++14)    shared mutual exclusion primitives
00126 #endif
00127 #if __cplusplus >= 201500L
00128 #include <any>               // (since C++17)    std::any class template
00129 #include <optional>          // (since C++17)    std::optional class template
00130 #include <variant>           // (since C++17)    std::variant class template
00131 #include <memory_resource>    // (since C++17)    Polymorphic allocators and memory resources
00132 #include <string_view>       // (since C++17)    std::basic_string_view class template
00133 #include <execution>         // (since C++17)    Predefined execution policies for parallel versions of
    the algorithms
00134 #include <filesystem>        // (since C++17)    std::path class and supporting functions
00135 #endif

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