HA Energy

Generated by Doxygen 1.9.4

Chapter 1

Data Structure Index

1.1 Data Structures

Here are the data structures with brief descriptions:

Chapter 2

File Index

2.1 File List

Here is a list of all files with brief descriptions:

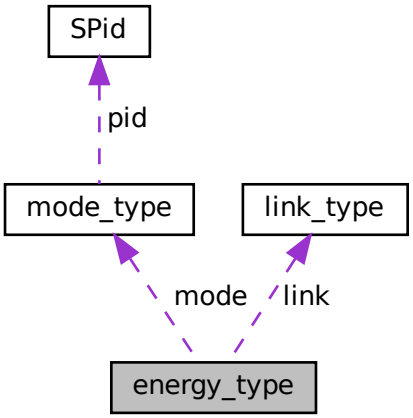
Chapter 3

Data Structure Documentation

3.1 energy_type Struct Reference

`#include <energy.h>`

Collaboration diagram for energy_type:



Data Fields

- volatile double print_vars [MAX_IM_VAR]
- volatile double im_vars [IA_LAST][PHASE_LAST]
- volatile double mvar [V_DLAST+1]
- 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 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 int32_t rc
- volatile int32_t sane
- volatile uint32_t ten_sec_clock
- volatile uint32_t log_spam
- volatile uint32_t log_time_reset
- pthread_mutex_t ha_lock
- struct mode_type mode
- struct link_type link
- MQTTClient client_p
- MQTTClient client_sd
- MQTTClient client_ha

3.1.1 Field Documentation

3.1.1.1 ac_low_adj

```
volatile double energy_type::ac_low_adj
```

3.1.1.2 ac_mismatch

```
volatile bool energy_type::ac_mismatch
```

3.1.1.3 ac_sw_on

```
volatile bool energy_type::ac_sw_on
```

3.1.1.4 ac_sw_status

```
volatile bool energy_type::ac_sw_status
```

3.1.1.5 client_ha

```
MQTTClient energy_type::client_ha
```

3.1.1.6 client_p

```
MQTTClient energy_type::client_p
```

3.1.1.7 client_sd

```
MQTTClient energy_type::client_sd
```

3.1.1.8 dc_mismatch

```
volatile bool energy_type::dc_mismatch
```

3.1.1.9 dl_excess

```
volatile bool energy_type::dl_excess
```

3.1.1.10 dl_excess_adj

```
volatile double energy_type::dl_excess_adj
```

3.1.1.11 dumpload

```
volatile bool energy_type::dumpload
```

3.1.1.12 fm80

```
volatile bool energy_type::fm80
```

3.1.1.13 gti_delay

```
volatile uint32_t energy_type::gti_delay
```

3.1.1.14 gti_low_adj

```
volatile double energy_type::gti_low_adj
```

3.1.1.15 gti_sw_on

```
volatile bool energy_type::gti_sw_on
```

3.1.1.16 gti_sw_status

```
volatile bool energy_type::gti_sw_status
```

3.1.1.17 ha_lock

```
pthread_mutex_t energy_type::ha_lock
```

3.1.1.18 homeassistant

```
volatile bool energy_type::homeassistant
```

3.1.1.19 iammeter

```
volatile bool energy_type::iammeter
```

3.1.1.20 im_delay

```
volatile uint32_t energy_type::im_delay
```

3.1.1.21 im_display

```
volatile uint32_t energy_type::im_display
```

3.1.1.22 im_vars

```
volatile double energy_type::im_vars[IA_LAST][PHASE_LAST]
```

3.1.1.23 link

```
struct link_type energy_type::link
```

3.1.1.24 log_spam

```
volatile uint32_t energy_type::log_spam
```

3.1.1.25 log_time_reset

```
volatile uint32_t energy_type::log_time_reset
```

3.1.1.26 mode

```
struct mode_type energy_type::mode
```

3.1.1.27 mode_mismatch

```
volatile bool energy_type::mode_mismatch
```

3.1.1.28 mvar

```
volatile double energy_type::mvar[V_DLAST+1]
```

3.1.1.29 once_ac

```
volatile bool energy_type::once_ac
```

3.1.1.30 once_gti

```
volatile bool energy_type::once_gti
```

3.1.1.31 once_gti_zero

```
volatile bool energy_type::once_gti_zero
```

3.1.1.32 print_vars

```
volatile double energy_type::print_vars[MAX_IM_VAR]
```

3.1.1.33 rc

```
volatile int32_t energy_type::rc
```

3.1.1.34 sane

```
volatile int32_t energy_type::sane
```

3.1.1.35 solar_mode

```
volatile bool energy_type::solar_mode
```

3.1.1.36 solar_shutdown

```
volatile bool energy_type::solar_shutdown
```

3.1.1.37 speed_go

```
volatile uint32_t energy_type::speed_go
```

3.1.1.38 startup

```
volatile bool energy_type::startup
```

3.1.1.39 ten_sec_clock

```
volatile uint32_t energy_type::ten_sec_clock
```

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

- ha_energy/energy.h

3.2 ha_flag_type Struct Reference

```
#include <mqtt_rec.h>
```

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

3.2.1 Field Documentation

3.2.1.1 deliveredtoken

```
volatile MQTTClient_deliveryToken ha_flag_type::deliveredtoken
```

3.2.1.2 energy_mode

```
volatile int32_t ha_flag_type::energy_mode
```

3.2.1.3 ha_id

```
int32_t ha_flag_type::ha_id
```

3.2.1.4 rec_ok

```
volatile bool ha_flag_type::rec_ok
```

3.2.1.5 receivedtoken

```
volatile MQTTClient_deliveryToken ha_flag_type::receivedtoken
```

3.2.1.6 runner

```
volatile bool ha_flag_type::runner
```

3.2.1.7 var_update

```
volatile int32_t ha_flag_type::var_update
```

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

- ha_energy/mqtt_rec.h

3.3 link_type Struct Reference

`#include <energy.h>`

Data Fields

- volatile uint32_t iammeter_error
- volatile uint32_t iammeter_count
- volatile uint32_t mqtt_error
- volatile uint32_t mqtt_count
- volatile uint32_t shutdown

3.3.1 Field Documentation

3.3.1.1 iammeter_count

`volatile uint32_t link_type::iammeter_count`

3.3.1.2 iammeter_error

`volatile uint32_t link_type::iammeter_error`

3.3.1.3 mqtt_count

`volatile uint32_t link_type::mqtt_count`

3.3.1.4 mqtt_error

`volatile uint32_t link_type::mqtt_error`

3.3.1.5 shutdown

`volatile uint32_t link_type::shutdown`

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

- ha_energy/energy.h

3.4 local_type Struct Reference

Data Fields

- volatile double ac_weight
- volatile double gti_weight
- volatile double pv_voltage
- volatile double bat_current
- volatile double batc_std_dev
- volatile double bat_voltage
- double bat_c_std_dev [DEV_SIZE]
- double coef

3.4.1 Field Documentation

3.4.1.1 ac_weight

```
volatile double local_type::ac_weight
```

3.4.1.2 bat_c_std_dev

```
double local_type::bat_c_std_dev[DEV_SIZE]
```

3.4.1.3 bat_current

```
volatile double local_type::bat_current
```

3.4.1.4 bat_voltage

```
volatile double local_type::bat_voltage
```

3.4.1.5 batc_std_dev

```
volatile double local_type::batc_std_dev
```

3.4.1.6 coef

```
double local_type::coef
```

3.4.1.7 gti_weight

```
volatile double local_type::gti_weight
```

3.4.1.8 pv_voltage

```
volatile double local_type::pv_voltage
```

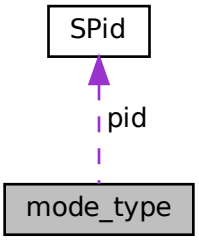
The documentation for this struct was generated from the following file:

- ha_energy/bsoc.c

3.5 mode_type Struct Reference

```
#include <energy.h>
```

Collaboration diagram for mode_type:



Data Fields

- volatile double error
- volatile double target
- volatile double total_system
- volatile double gti_dumpload
- volatile double pv_bias
- volatile double dl_mqtt_max
- volatile double off_grid
- volatile double sequence
- volatile bool mode
- volatile bool in_pid_control
- volatile bool con0
- volatile bool con1
- volatile bool con2
- volatile bool con3
- volatile bool con4
- volatile bool con5
- volatile bool con6
- volatile bool con7
- volatile bool no_float
- volatile bool data_error
- volatile bool bat_crit
- volatile uint32_t mode_tmr
- volatile struct SPid pid
- enum energy_state E
- enum running_state R

3.5.1 Field Documentation

3.5.1.1 bat_crit

```
volatile bool mode_type::bat_crit
```

3.5.1.2 con0

```
volatile bool mode_type::con0
```

3.5.1.3 con1

```
volatile bool mode_type::con1
```

3.5.1.4 con2

```
volatile bool mode_type::con2
```

3.5.1.5 con3

```
volatile bool mode_type::con3
```

3.5.1.6 con4

```
volatile bool mode_type::con4
```

3.5.1.7 con5

```
volatile bool mode_type::con5
```

3.5.1.8 con6

```
volatile bool mode_type::con6
```

3.5.1.9 con7

```
volatile bool mode_type::con7
```

3.5.1.10 data_error

```
volatile bool mode_type::data_error
```

3.5.1.11 dl_mqtt_max

```
volatile double mode_type::dl_mqtt_max
```

3.5.1.12 E

```
enum energy_state mode_type::E
```

3.5.1.13 error

```
volatile double mode_type::error
```

3.5.1.14 gti_dumpload

```
volatile double mode_type::gti_dumpload
```

3.5.1.15 in_pid_control

```
volatile bool mode_type::in_pid_control
```

3.5.1.16 mode

```
volatile bool mode_type::mode
```

3.5.1.17 mode_tmr

```
volatile uint32_t mode_type::mode_tmr
```

3.5.1.18 no_float

```
volatile bool mode_type::no_float
```

3.5.1.19 off_grid

```
volatile double mode_type::off_grid
```

3.5.1.20 pid

```
volatile struct SPid mode_type::pid
```

3.5.1.21 pv_bias

```
volatile double mode_type::pv_bias
```

3.5.1.22 R

```
enum running_state mode_type::R
```

3.5.1.23 sequence

```
volatile double mode_type::sequence
```

3.5.1.24 target

```
volatile double mode_type::target
```

3.5.1.25 total_system

```
volatile double mode_type::total_system
```

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

- ha_energy/energy.h

3.6 SPid Struct Reference

```
#include <pid.h>
```

Data Fields

- double dState
- double iState
- double iMax
- double iMin
- double iGain
- double pGain
- double dGain

3.6.1 Field Documentation

3.6.1.1 dGain

```
double SPid::dGain
```

3.6.1.2 dState

```
double SPid::dState
```

3.6.1.3 iGain

```
double SPid::iGain
```

3.6.1.4 iMax

```
double SPid::iMax
```

3.6.1.5 iMin

```
double SPid::iMin
```

3.6.1.6 iState

```
double SPid::iState
```

3.6.1.7 pGain

```
double SPid::pGain
```

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

- ha_energy/pid.h

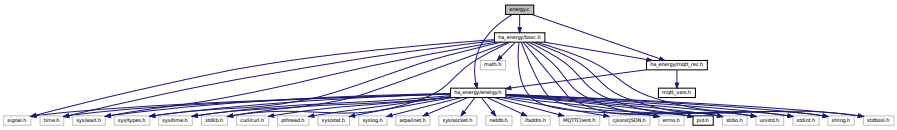
Chapter 4

File Documentation

4.1 energy.c File Reference

```
#include "ha_energy/energy.h"
#include "ha_energy/mqtt_rec.h"
#include "ha_energy/bsoc.h"
```

Include dependency graph for energy.c:



Macros

- #define _DEFAULT_SOURCE

Functions

- static bool solar_shutdown (void)
- void showIP (void)
- static void skeleton_daemon ()
- bool sanity_check (void)
- void timer_callback (int32_t signum)
- void connlost (void *context, char *cause)
- int main (int argc, char *argv[ ])
- void ramp_up_gti (MQTTClient client_p, bool start, bool excess)
- void ramp_down_gti (MQTTClient client_p, bool sw_off)
- void ramp_up_ac (MQTTClient client_p, bool start)
- void ramp_down_ac (MQTTClient client_p, bool sw_off)
- void ha_ac_off (void)
- void ha_ac_on (void)
- void ha_dc_off (void)
- void ha_dc_on (void)
- char * log_time (bool log)
- bool sync_ha (void)
- bool log_timer (void)

Variables

- struct ha_flag_type ha_flag_vars_pc
- struct ha_flag_type ha_flag_vars_ss
- struct ha_flag_type ha_flag_vars_sd
- struct ha_flag_type ha_flag_vars_ha
- const char * board_name = "NO_BOARD"
- const char * driver_name = "NO_DRIVER"
- FILE * fout
- struct energy_type E

4.1.1 Macro Definition Documentation

4.1.1.1 _DEFAULT_SOURCE

```
#define _DEFAULT_SOURCE
```

4.1.2 Function Documentation

4.1.2.1 connlost()

```
void connlost (
            void * context,
            char * cause )
298 {
299     struct ha_flag_type *ha_flag = context;
300     int32_t id_num;
301 
302     // bug-out if no context variables passed to callback
303     if (context == NULL) {
304         id_num = -1;
305     } else {
306         id_num = ha_flag->ha_id;
307     }
308     fprintf(fout, "\n%s Connection lost, exit ha_energy program\n", log_time(false));
309     fprintf(fout, "%s     cause:  %s, %d\n", log_time(false), cause, id_num);
310     fprintf(fout, "%sDAEMON failure  LOG Version %s :  MQTT Version %s\n", log_time(false), LOG_VERSION,
    MQTT_VERSION);
311     fflush(fout);
312     exit(EXIT_FAILURE);
313 }
```

4.1.2.2 ha_ac_off()

```
void ha_ac_off (
            void  )
947 {
948     mqtt_ha_switch(E.client_p, TOPIC_PACC, false);
949     E.ac_sw_status = false;
950 }
```

4.1.2.3 ha_ac_on()

```
void ha_ac_on (
              void  )
953 {
954     mqtt_ha_switch(E.client_p, TOPIC_PACC, true);
955     E.ac_sw_status = true;
956 }
```

4.1.2.4 ha_dc_off()

```
void ha_dc_off (
              void  )
962 {
963     mqtt_ha_switch(E.client_p, TOPIC_PDCC, false);
964     E.gti_sw_status = false;
965 }
```

4.1.2.5 ha_dc_on()

```
void ha_dc_on (
              void  )
968 {
969     mqtt_ha_switch(E.client_p, TOPIC_PDCC, true);
970     E.gti_sw_status = true;
971 }
```

4.1.2.6 log_time()

```
char * log_time (
              bool log )
1032 {
1033     static char time_log[RBUF_SIZ] = {0};
1034     static uint32_t len = 0, sync_time = TIME_SYNC_SEC - 1;
1035     time_t rawtime_log;
1036
1037     tzset();
1038     timezone = 0;
1039     daylight = 0;
1040     time(&rawtime_log);
1041     if (sync_time++ > TIME_SYNC_SEC) {
1042         sync_time = 0;
1043         snprintf(time_log, RBUF_SIZ - 1, "VT%lut", rawtime_log); // format for dumpload controller gti
    time commands
1044         mqtt_gti_time(E.client_p, TOPIC_P, time_log);
1045     }
1046
1047     sprintf(time_log, "%s", ctime(&rawtime_log));
1048     len = strlen(time_log);
1049     time_log[len - 1] = 0; // munge out the return character
1050     if (log) {
1051         fprintf(fout, "%s ", time_log);
1052         fflush(fout);
1053     }
1054
1055     return time_log;
1056 }
```

4.1.2.7 log_timer()

```
bool log_timer (
              void  )
1091 {
1092     bool itstime = false;
1093
1094     if (E.log_spam < LOW_LOG_SPAM) {
1095         E.log_time_reset = 0;
1096         itstime = true;
1097     }
1098     if (E.log_time_reset > RESET_LOG_SPAM) {
1099         E.log_spam = 0;
1100         itstime = true;
1101     }
1102     return itstime;
1103 }
```

4.1.2.8 main()

```
int main (
              int argc,
              char * argv[] )
322 {
323     struct itimerval new_timer = {
324         .it_value.tv_sec = CMD_SEC,
325         .it_value.tv_usec = 0,
326         .it_interval.tv_sec = CMD_SEC,
327         .it_interval.tv_usec = 0,
328     };
329     struct itimerval old_timer;
330     time_t rawtime;
331     MQTTClient_connectOptions conn_opts_p = MQTTClient_connectOptions_initializer,
332         conn_opts_sd = MQTTClient_connectOptions_initializer,
333         conn_opts_ha = MQTTClient_connectOptions_initializer;
334     MQTTClient_message pubmsg = MQTTClient_message_initializer;
335     MQTTClient_deliveryToken token;
336     char hname[256], *hname_ptr = hname;
337     size_t hname_len = 12;
338
339     gethostname(hname, hname_len);
340     hname[12] = 0;
341     printf("\r\n  LOG Version %s :  MQTT Version %s :  Host Name %s\r\n", LOG_VERSION, MQTT_VERSION,
    hname);
342     showIP();
343     skeleton_daemon();
344
345     while (true) {
346         switch (E.mode.E) {
347         case E_INIT:
348
349 #ifdef LOG_TO_FILE
350             fout = fopen(LOG_TO_FILE, "a");
351             if (fout == NULL) {
352                 fout = fopen(LOG_TO_FILE_ALT, "a");
353                 if (fout == NULL) {
354                     fout = stdout;
355                     printf("\r\n%s Unable to open LOG file %s \r\n", log_time(false), LOG_TO_FILE_ALT);
356                 }
357             }
358 #else
359             fout = stdout;
360 #endif
361             fprintf(fout, "\r\n%s LOG Version %s :  MQTT Version %s\r\n", log_time(false), LOG_VERSION,
    MQTT_VERSION);
362             fflush(fout);
363
364             if (!bsoc_init()) {
365                 fprintf(fout, "\r\n%s bsoc_init failure \r\n", log_time(false));
366                 fflush(fout);
367                 exit(EXIT_FAILURE);
368             }
369             /*
370 * set the timer for MQTT publishing sample speed
371 * CMD_SEC         10
372 */
```

```
373             setitimer(ITIMER_REAL, &new_timer, &old_timer);
374             signal(SIGALRM, timer_callback);
375 
376             if (strncmp(hname, TNAME, 6) == 0) {
377                 MQTTClient_create(&E.client_p, LADDRESS, CLIENTID1,
378                     MQTTCLIENT_PERSISTENCE_NONE, NULL);
379                 conn_opts_p.keepAliveInterval = 20;
380                 conn_opts_p.cleansession = 1;
381                 hname_ptr = LADDRESS;
382             } else {
383                 MQTTClient_create(&E.client_p, ADDRESS, CLIENTID1,
384                     MQTTCLIENT_PERSISTENCE_NONE, NULL);
385                 conn_opts_p.keepAliveInterval = 20;
386                 conn_opts_p.cleansession = 1;
387                 hname_ptr = ADDRESS;
388             }
389 
390             fprintf(fout, "%s Connect MQTT server %s, %s\n", log_time(false), hname_ptr, CLIENTID1);
391             fflush(fout);
392             MQTTClient_setCallbacks(E.client_p, &ha_flag_vars_ss, connlost, msgarrvd, delivered);
393             if ((E.rc = MQTTClient_connect(E.client_p, &conn_opts_p)) != MQTTCLIENT_SUCCESS) {
394                 fprintf(fout, "%s Failed to connect MQTT server, return code %d %s, %s\n",
    log_time(false), E.rc, hname_ptr, CLIENTID1);
395                 fflush(fout);
396                 pthread_mutex_destroy(&E.ha_lock);
397                 exit(EXIT_FAILURE);
398             }
399 
400             if (strncmp(hname, TNAME, 6) == 0) {
401                 MQTTClient_create(&E.client_sd, LADDRESS, CLIENTID2,
402                     MQTTCLIENT_PERSISTENCE_NONE, NULL);
403                 conn_opts_sd.keepAliveInterval = 20;
404                 conn_opts_sd.cleansession = 1;
405                 hname_ptr = LADDRESS;
406             } else {
407                 MQTTClient_create(&E.client_sd, ADDRESS, CLIENTID2,
408                     MQTTCLIENT_PERSISTENCE_NONE, NULL);
409                 conn_opts_sd.keepAliveInterval = 20;
410                 conn_opts_sd.cleansession = 1;
411                 hname_ptr = ADDRESS;
412             }
413 
414             fprintf(fout, "%s Connect MQTT server %s, %s\n", log_time(false), hname_ptr, CLIENTID2);
415             fflush(fout);
416             MQTTClient_setCallbacks(E.client_sd, &ha_flag_vars_sd, connlost, msgarrvd, delivered);
417             if ((E.rc = MQTTClient_connect(E.client_sd, &conn_opts_sd)) != MQTTCLIENT_SUCCESS) {
418                 fprintf(fout, "%s Failed to connect MQTT server, return code %d %s, %s\n",
    log_time(false), E.rc, hname_ptr, CLIENTID2);
419                 fflush(fout);
420                 pthread_mutex_destroy(&E.ha_lock);
421                 exit(EXIT_FAILURE);
422             }
423 
424             /*
425 * Home Assistant MQTT receive messages
426 */
427             if (strncmp(hname, TNAME, 6) == 0) {
428                 MQTTClient_create(&E.client_ha, LADDRESS, CLIENTID3,
429                     MQTTCLIENT_PERSISTENCE_NONE, NULL);
430                 conn_opts_ha.keepAliveInterval = 20;
431                 conn_opts_ha.cleansession = 1;
432                 hname_ptr = LADDRESS;
433             } else {
434                 MQTTClient_create(&E.client_ha, ADDRESS, CLIENTID3,
435                     MQTTCLIENT_PERSISTENCE_NONE, NULL);
436                 conn_opts_ha.keepAliveInterval = 20;
437                 conn_opts_ha.cleansession = 1;
438                 hname_ptr = ADDRESS;
439             }
440 
441             fprintf(fout, "%s Connect MQTT server %s, %s\n", log_time(false), hname_ptr, CLIENTID3);
442             fflush(fout);
443             MQTTClient_setCallbacks(E.client_ha, &ha_flag_vars_ha, connlost, msgarrvd, delivered);
444             if ((E.rc = MQTTClient_connect(E.client_ha, &conn_opts_ha)) != MQTTCLIENT_SUCCESS) {
445                 fprintf(fout, "%s Failed to connect MQTT server, return code %d %s, %s\n",
    log_time(false), E.rc, hname_ptr, CLIENTID3);
446                 fflush(fout);
447                 pthread_mutex_destroy(&E.ha_lock);
448                 exit(EXIT_FAILURE);
449             }
450 
451             /*
452 * on topic received data will trigger the msgarrvd function
453 */
454             MQTTClient_subscribe(E.client_p, TOPIC_SS, QOS); // FM80 Q84
455             MQTTClient_subscribe(E.client_sd, TOPIC_SD, QOS); // DUMPLOAD K42
456             MQTTClient_subscribe(E.client_ha, TOPIC_HA, QOS); // Home Assistant Linux AMD64  and ARM64
```

```
457
458             pubmsg.payload = "online";
459             pubmsg.payloadlen = strlen("online");
460             pubmsg.qos = QOS;
461             pubmsg.retained = 0;
462             ha_flag_vars_ss.deliveredtoken = 0;
463             // notify HA we are running and controlling AC power plugs
464             MQTTClient_publishMessage(E.client_p, TOPIC_PACA, &pubmsg, &token);
465             MQTTClient_publishMessage(E.client_p, TOPIC_PDCA, &pubmsg, &token);
466
467             // sync HA power switches
468             mqtt_ha_switch(E.client_p, TOPIC_PDCC, false);
469             mqtt_ha_switch(E.client_p, TOPIC_PACC, false);
470             mqtt_ha_switch(E.client_p, TOPIC_PDCC, true);
471             mqtt_ha_switch(E.client_p, TOPIC_PACC, true);
472             mqtt_ha_switch(E.client_p, TOPIC_PDCC, false);
473             mqtt_ha_switch(E.client_p, TOPIC_PACC, false);
474
475             E.ac_sw_on = true; // can be switched on once
476             E.gti_sw_on = true; // can be switched on once
477
478             /*
479 * use libcurl to read AC power meter HTTP data
480 * iammeter connected for split single phase monitoring and one leg GTI power exporting
481 */
482             iammeter_read();
483
484             /*
485 * start the main energy monitoring loop
486 */
487             fprintf(fout, "\r\n%s Solar Energy AC power controller\r\n", log_time(false));
488
489 #ifdef FAKE_VPV
490             fprintf(fout, "\r\n Faking dumpload PV voltage\r\n");
491 #endif
492             ha_flag_vars_ss.energy_mode = NORM_MODE;
493             E.mode.E = E_WAIT;
494             break;
495         case E_WAIT:
496             if (ha_flag_vars_ss.runner || E.speed_go++ > 1500000) {
497                 E.speed_go = 0;
498                 ha_flag_vars_ss.runner = false;
499                 E.mode.E = E_RUN;
500             }
501
502             usleep(100);
503             /*
504 * main state-machine update sequence
505 */
506             bsoc_data_collect();
507             if (!sanity_check()) {
508                 fprintf(fout, "\r\n%s Sanity Check error %d %s \r\n", log_time(false), E.sane,
    mqtt_name[E.sane]);
509                 fflush(fout);
510             }
511
512             /*
513 * stop and restart the energy control processing
514 * from inside the program or from a remote Home Assistant command
515 */
516             if (solar_shutdown()) {
517                 if (!E.startup) {
518                     fprintf(fout, "%s SHUTDOWN Solar Energy Control ---> \r\n", log_time(false));
519                 }
520                 fflush(fout);
521                 ramp_down_gti(E.client_p, true);
522                 usleep(100000); // wait
523                 ramp_down_ac(E.client_p, true);
524                 usleep(100000); // wait
525                 ramp_down_gti(E.client_p, true);
526                 usleep(100000); // wait
527                 ramp_down_ac(E.client_p, true);
528                 usleep(100000); // wait
529                 if (!E.startup) {
530                     fprintf(fout, "%s Completed SHUTDOWN, Press again to RESTART.\r\n",
    log_time(false));
531                     fflush(fout);
532                 }
533                 fflush(fout);
534
535                 uint8_t iam_delay = 0;
536                 while (solar_shutdown()) {
537                     mqtt_ha_shutdown(E.client_p, TOPIC_SHUTDOWN);
538                     usleep(USEC_SEC); // wait
539                     if ((int32_t) E.mvar[V_HACSW]) {
540                         ha_ac_off();
541                     }
```

```
542                     if ((int32_t) E.mvar[V_HDCSW]) {
543                         ha_dc_off();
544                     }
545                     if ((iam_delay++ > IAM_DELAY) && E.link.shutdown) {
546                         E.fm80 = true;
547                         E.dumpload = true;
548                         E.iammeter = true;
549                         E.homeassistant = true;
550                     }
551                 }
552                 E.link.shutdown = 0;
553                 fprintf(fout, "%s RESTART Solar Energy Control\r\n", log_time(false));
554                 fflush(fout);
555                 bsoc_set_mode(E.mode.pv_bias, true, true);
556                 E.dl_excess = true;
557                 mqtt_gti_power(E.client_p, TOPIC_P, "Z#", 1); // zero power at startup
558                 E.dl_excess = false;
559 #ifdef AUTO_CHARGE
560                 mqtt_ha_switch(E.client_p, TOPIC_PDCC, true);
561 #endif
562                 usleep(100000); // wait
563                 E.gti_sw_status = true;
564                 ResetPI(&E.mode.pid);
565                 ha_flag_vars_ss.runner = true;
566                 E.fm80 = true;
567                 E.dumpload = true;
568                 E.iammeter = true;
569                 E.homeassistant = true;
570                 E.mode.in_pid_control = false; // shutdown auto energy control
571                 E.mode.R = R_INIT;
572             }
573             if (ha_flag_vars_ss.receivedtoken) {
574                 ha_flag_vars_ss.receivedtoken = false;
575             }
576             if (ha_flag_vars_sd.receivedtoken) {
577                 ha_flag_vars_sd.receivedtoken = false;
578             }
579             break;
580         case E_RUN:
581             usleep(100);
582             switch (E.mode.R) {
583             case R_INIT:
584                 E.once_ac = true;
585                 E.once_gti = true;
586                 E.ac_sw_on = true;
587                 E.gti_sw_on = true;
588                 E.mode.R = R_RUN;
589                 E.mode.no_float = true;
590                 break;
591             case R_FLOAT:
592                 if (E.mode.no_float) {
593                     E.once_ac = true;
594                     E.once_gti = true;
595                     E.ac_sw_on = true;
596                     E.gti_sw_on = true;
597                     E.gti_sw_status = false;
598                     E.ac_sw_status = false;
599                     E.mode.no_float = false;
600                 }
601                 if (!E.gti_sw_status) {
602                     if (gti_test() > MIN_BAT_KW_GTI_HI) {
603                         mqtt_ha_switch(E.client_p, TOPIC_PDCC, true);
604                         E.gti_sw_status = true;
605                         fprintf(fout, "%s R_FLOAT DC switch true \r\n", log_time(false));
606                     }
607                 }
608                 usleep(100000); // wait
609                 if (!E.ac_sw_status) {
610                     if (ac_test() > MIN_BAT_KW_AC_HI) {
611                         mqtt_ha_switch(E.client_p, TOPIC_PACC, true);
612                         E.ac_sw_status = true;
613                         fprintf(fout, "%s R_FLOAT AC switch true \r\n", log_time(false));
614                     }
615                 }
616                 E.mode.pv_bias = PV_BIAS;
617                 fm80_float(true);
618                 break;
619             case R_RUN:
620             default:
621                 E.mode.R = R_RUN;
622                 E.mode.no_float = true;
623                 break;
624             }
625             /*
626 * main state-machine update sequence and control logic
627 */
628             /*
```

```
629 * check for idle/data errors flags from sensors and HA
630 */
631             if (!E.mode.data_error) {
632                 bsoc_set_mode(E.mode.pv_bias, true, false);
633                 if (E.gti_delay++ >= GTI_DELAY) {
634                     char gti_str[SBUF_SIZ];
635                     int32_t error_drive;
636 
637                     /*
638 * reset the control mode from simple switched power to PID control
639 */
640                     if (!E.mode.in_pid_control) {
641                         mqtt_ha_switch(E.client_p, TOPIC_PDCC, true);
642                         E.gti_sw_status = true;
643                         usleep(100000); // wait
644                         mqtt_ha_switch(E.client_p, TOPIC_PACC, true);
645                         E.ac_sw_status = true;
646                         E.mode.pv_bias = PV_BIAS;
647                         fprintf(fout, "%s in_pid_mode AC/DC switch true \r\n", log_time(false));
648                         fm80_float(true);
649                     } else {
650                         if (!fm80_float(true)) {
651                             E.mode.pv_bias = (int32_t) E.mode.error - PV_BIAS;
652                         }
653                     }
654                     /*
655 * use PID style set-point error correction
656 */
657                     E.mode.in_pid_control = true;
658                     E.gti_delay = 0;
659                     /*
660 * adjust power balance if battery charging energy is low
661 */
662                     if (E.mvar[V_DPBAT] > PV_DL_BIAS_RATE) {
663                         error_drive = (int32_t) E.mode.error - E.mode.pv_bias; // PI feedback control
    signal
664                     } else {
665                         error_drive = (int32_t) E.mode.error - PV_BIAS_RATE;
666                     }
667                     /*
668 * when main battery is in float, crank-up the power draw from the solar panels
669 */
670                     if (fm80_float(true)) {
671                         error_drive = (int32_t) (E.mode.error + PV_BIAS);
672                     }
673                     /*
674 * don't drive to zero power
675 */
676                     if (error_drive < 0) {
677                         error_drive = PV_BIAS_LOW; // control wide power swings
678                         if (!fm80_sleep()) { // check for using sleep bias
679                             if ((E.mvar[V_FBEKW] > MIN_BAT_KW_BSOC_SLP) && (E.mvar[V_PWA] > PWA_SLEEP))
    {
680                                 error_drive = PV_BIAS_SLEEP; // use higher power when we still have sun
    for better inverter efficiency
681                             }
682                         }
683                     }
684 
685                     /*
686 * reduce charging/diversion power to safe PS limits
687 */
688                     if (E.mode.dl_mqtt_max > PV_DL_MPTT_MAX) {
689                         if (!E.dl_excess) {
690                             error_drive = PV_DL_MPTT_IDLE;
691                         } else {
692                             if (E.mode.dl_mqtt_max > PV_DL_MPTT_EXCESS) {
693                                 error_drive = PV_DL_MPTT_IDLE;
694                             }
695                         }
696                     } else {
697                         if (E.dl_excess) {
698                             error_drive = PV_DL_EXCESS + E.dl_excess_adj;
699                         }
700                     }
701 
702                     /*
703 * shutdown GTI power at low DL battery Ah or Voltage
704 */
705                     if ((E.mvar[V_DAHBAT] < PV_DL_B_AH_LOW) || (E.mvar[V_DVBAT] < PV_DL_B_V_LOW)) {
706                         error_drive = PV_BIAS_ZERO;
707                     }
708 
709                     snprintf(gti_str, SBUF_SIZ - 1, "V%04dX", error_drive); // format for dumpload
    controller gti power commands
710                     mqtt_gti_power(E.client_p, TOPIC_P, gti_str, 2);
711                 }
```

```
712
713 #ifndef  FAKE_VPV
714                 if (fm80_float(true) || ((ac1_filter(E.mvar[V_BEN]) > BAL_MAX_ENERGY_AC) && (ac_test() >
      MIN_BAT_KW_AC_HI))) {
715                     ramp_up_ac(E.client_p, E.ac_sw_on); // use once control
716 #ifdef PSW_DEBUG
717                     fprintf(fout, "%s MIN_BAT_KW_AC_HI AC switch %d \r\n", log_time(false), E.ac_sw_on);
718 #endif
719                     E.ac_sw_on = false; // once flag
720                 }
721 #endif
722                 if (((ac2_filter(E.mvar[V_BEN]) < BAL_MIN_ENERGY_AC) || ((ac_test() < (MIN_BAT_KW_AC_LO
      + E.ac_low_adj))))) {
723                     if (!fm80_float(true)) {
724                         ramp_down_ac(E.client_p, E.ac_sw_on);
725                         if (log_timer()) {
726                             fprintf(fout, "%s RAMP DOWN AC, MIN_BAT_KW_AC_LO AC switch %d \r\n",
      log_time(false), E.ac_sw_on);
727                         }
728                     }
729                     E.ac_sw_on = true;
730                 }
731
732
733                 /*
734 * Dump Load Excess testing
735 * send excess power into the home power grid taking care not to export energy to the utility grid
736 */
737                 if (((dc1_filter(E.mvar[V_BEN]) > BAL_MAX_ENERGY_GTI) && (gti_test() >
      MIN_BAT_KW_GTI_HI)) || E.dl_excess) {
738 #ifndef  FAKE_VPV
739 #ifdef B_DLE_DEBUG
740                     if (E.dl_excess) {
741                         fprintf(fout, "%s DL excess ramp_up_gti, DC switch %d\r\n", log_time(false),
      E.gti_sw_on);
742                     }
743 #endif
744                     ramp_up_gti(E.client_p, E.gti_sw_on, E.dl_excess);
745                     if (log_timer()) {
746                         fprintf(fout, "%s RAMP DOWN DC, MIN_BAT_KW_GTI_HI DC switch %d \r\n",
      log_time(false), E.gti_sw_on);
747                     }
748                     E.gti_sw_on = false; // once flag
749 #endif
750                 } else {
751                     if ((dc2_filter(E.mvar[V_BEN]) < BAL_MIN_ENERGY_GTI) || (gti_test() <
      (MIN_BAT_KW_GTI_LO + E.gti_low_adj))) {
752                         if (!E.dl_excess) {
753                             if (log_timer()) {
754                                 ramp_down_gti(E.client_p, true);
755 #ifdef PSW_DEBUG
756                                 fprintf(fout, "%s MIN_BAT_KW_GTI_LO DC switch %d \r\n", log_time(false),
      E.gti_sw_on);
757 #endif
758                             }
759                             E.gti_sw_on = true;
760                         }
761                     }
762                 }
763             };
764
765 #ifdef B_ADJ_DEBUG
766             fprintf(fout, "\r\n LO ADJ: AC %8.2fWh, GTI %8.2fWh\r\n", MIN_BAT_KW_AC_LO + E.ac_low_adj,
      MIN_BAT_KW_GTI_LO + E.gti_low_adj);
767 #endif
768 #ifdef B_DLE_DEBUG
769             if (E.dl_excess) {
770                 fprintf(fout, "%s DL excess vars from ha_energy %d %d :  Flag %d\r\n", log_time(false),
      E.mode.con4, E.mode.con5, E.dl_excess);
771             }
772 #endif
773
774             time(&rawtime);
775
776             if (E.im_delay++ >= IM_DELAY) {
777                 E.im_delay = 0;
778                 iammeter_read();
779             }
780             if (E.im_display++ >= IM_DISPLAY) {
781                 char buffer[SYSLOG_SIZ];
782                 uint32_t len;
783
784                 E.im_display = 0;
785                 mqtt_ha_pid(E.client_p, TOPIC_PPID);
786                 if (!(E.fm80 && E.dumpload && E.iammeter)) {
787                     if (!E.iammeter) {
788                         E.link.iammeter_error++;
```

```
789                     } else {
790                         E.link.mqtt_error++;
791                     }
792                     E.link.shutdown++;
793                     fprintf(fout, "\r\n%s !!!!  Source data update error !!!!  , check FM80 %i, DUMPLOAD
    %i, IAMMETER %i channels M %u,%u I %u,%u\r\n", log_time(false), E.fm80, E.dumpload, E.fm80,
794                         E.link.mqtt_count, E.link.mqtt_error, E.link.iammeter_count,
    E.link.iammeter_error);
795                     fflush(fout);
796                     snprintf(buffer, SYSLOG_SIZ - 1, "\r\n%s !!!!  Source data update error !!!!  ,
    check FM80 %i, DUMPLOAD %i, IAMMETER %i channels M %u,%u I %u,%u\r\n", log_time(false), E.fm80,
    E.dumpload, E.fm80,
797                         E.link.mqtt_count, E.link.mqtt_error, E.link.iammeter_count,
    E.link.iammeter_error);
798                     syslog(LOG_NOTICE, buffer);
799                     mqtt_ha_shutdown(E.client_p, TOPIC_SHUTDOWN);
800                     E.mode.data_error = true;
801                 } else {
802                     E.mode.data_error = false;
803                     E.link.shutdown = 0;
804                 }
805                 snprintf(buffer, RBUF_SIZ - 1, "%s", ctime(&rawtime));
806                 len = strlen(buffer);
807                 buffer[len - 1] = 0; // munge out the return character
808                 fprintf(fout, "%s ", buffer);
809                 fflush(fout);
810                 E.fm80 = false;
811                 E.dumpload = false;
812                 E.homeassistant = false;
813                 E.iammeter = false;
814                 sync_ha();
815                 print_im_vars();
816                 print_mvar_vars();
817                 fprintf(fout, "%s\r", ctime(&rawtime));
818             }
819             E.mode.E = E_WAIT;
820             fflush(fout);
821             if (E.mode.con6) {
822                 E.mode.R = R_IDLE;
823             }
824             if (E.mode.con7) {
825                 E.mode.E = E_STOP;
826             }
827             break;
828         case E_STOP:
829         default:
830             fflush(fout);
831             fprintf(fout, "\r\n%s HA Energy stopped and exited.\r\n", log_time(false));
832             fflush(fout);
833             return 0;
834             break;
835         }
836     }
837 }
```

4.1.2.9 ramp_down_ac()

```
void ramp_down_ac (
            MQTTClient client_p,
            bool sw_off )
937 {
938     if (sw_off) {
939         mqtt_ha_switch(client_p, TOPIC_PACC, false);
940         E.ac_sw_status = false;
941         usleep(500000);
942     }
943     E.once_ac = true;
944 }
```

4.1.2.10 ramp_down_gti()

```
void ramp_down_gti (
            MQTTClient client_p,
            bool sw_off )
```

```
904 {
905     if (sw_off) {
906         mqtt_ha_switch(client_p, TOPIC_PDCC, false);
907         E.once_gti_zero = true;
908         E.gti_sw_status = false;
909     }
910     E.once_gti = true;
911 
912     if (E.once_gti_zero) {
913         mqtt_gti_power(client_p, TOPIC_P, "Z#", 7); // zero power
914         E.once_gti_zero = false;
915     }
916 }
```

4.1.2.11 ramp_up_ac()

```
void ramp_up_ac (
            MQTTClient client_p,
            bool start )
```

```
922 {
923 
924     if (start) {
925         E.once_ac = true;
926     }
927 
928     if (E.once_ac) {
929         E.once_ac = false;
930         mqtt_ha_switch(client_p, TOPIC_PACC, true);
931         E.ac_sw_status = true;
932         usleep(500000); // wait for voltage to ramp
933     }
934 }
```

4.1.2.12 ramp_up_gti()

```
void ramp_up_gti (
            MQTTClient client_p,
            bool start,
            bool excess )
```

```
843 {
844     static uint32_t sequence = 0;
845 
846     if (start) {
847         E.once_gti = true;
848     }
849 
850     if (E.once_gti) {
851         E.once_gti = false;
852         sequence = 0;
853         if (!excess) {
854             mqtt_ha_switch(client_p, TOPIC_PDCC, true);
855             E.gti_sw_status = true;
856             usleep(500000); // wait for voltage to ramp
857         } else {
858             sequence = 1;
859         }
860     }
861 
862     switch (sequence) {
863     case 4:
864         E.once_gti_zero = true;
865         break;
```

```
866     case 3:
867     case 2:
868     case 1:
869         E.once_gti_zero = true;
870         if (bat_current_stable() || E.dl_excess) { // check battery current std dev, stop 'motorboating'
871             sequence++;
872             if (!mqtt_gti_power(client_p, TOPIC_P, "+#", 3)) {
873                 sequence = 0;
874             }; // +100W power
875         } else {
876             usleep(500000); // wait a bit more for power to be stable
877             sequence = 1; // do power ramps when ready
878             if (!mqtt_gti_power(client_p, TOPIC_P, "-#", 4)) {
879                 sequence = 0;
880             }; // - 100W power
881         }
882         break;
883     case 0:
884         sequence++;
885         if (E.once_gti_zero) {
886             mqtt_gti_power(client_p, TOPIC_P, "Z#", 5); // zero power
887             E.once_gti_zero = false;
888         }
889         break;
890     default:
891         if (E.once_gti_zero) {
892             mqtt_gti_power(client_p, TOPIC_P, "Z#", 6); // zero power
893             E.once_gti_zero = false;
894         }
895         sequence = 0;
896         break;
897     }
898 }
```

4.1.2.13 sanity_check()

```
bool sanity_check (
             void  )
254 {
255     if (E.mvar[V_PWA] > PWA_SANE) {
256         E.sane = S_PWA;
257         return false;
258     }
259     if (E.mvar[V_PAMPS] > PAMPS_SANE) {
260         E.sane = S_PAMPS;
261         return false;
262     }
263     if (E.mvar[V_PVOLTS] > PVOLTS_SANE) {
264         E.sane = S_PVOLTS;
265         return false;
266     }
267     if (E.mvar[V_FBAMPS] > BAMPS_SANE) {
268         E.sane = S_FBAMPS;
269         return false;
270     }
271     return true;
272 }
```

4.1.2.14 showIP()

```
void showIP (
             void  )
160 {
161     struct ifaddrs *ifaddr, *ifa;
162     int s;
163     char host[NI_MAXHOST];
164
165     if (getifaddrs(&ifaddr) == -1) {
166         perror("getifaddrs");
167         exit(EXIT_FAILURE);
168     }
```

```
169
170
171     for (ifa = ifaddr; ifa != NULL; ifa = ifa->ifa_next) {
172         if (ifa->ifa_addr == NULL)
173             continue;
174
175         s = getnameinfo(ifa->ifa_addr, sizeof(struct sockaddr_in), host, NI_MAXHOST, NULL, 0,
    NI_NUMERICHOST);
176
177         if (ifa->ifa_addr->sa_family == AF_INET) {
178             if (s != 0) {
179                 exit(EXIT_FAILURE);
180             }
181             printf("\tInterface :  <%s>\n", ifa->ifa_name);
182             printf("\t  Address :  <%s>\n", host);
183         }
184     }
185
186     freeifaddrs(ifaddr);
187 }
```

4.1.2.15 skeleton_daemon()

```
static void skeleton_daemon ( )  [static]
194 {
195     pid_t pid;
196
197     /* Fork off the parent process */
198     pid = fork();
199
200     /* An error occurred */
201     if (pid < 0) {
202         printf("\r\n%sDAEMON failure  LOG Version %s :  MQTT Version %s\r\n", log_time(false),
    LOG_VERSION, MQTT_VERSION);
203         exit(EXIT_FAILURE);
204     }
205
206     /* Success:  Let the parent terminate */
207     if (pid > 0) {
208         exit(EXIT_SUCCESS);
209     }
210
211     /* On success:  The child process becomes session leader */
212     if (setsid() < 0) {
213         exit(EXIT_FAILURE);
214     }
215
216     /* Catch, ignore and handle signals */
217     /*TODO: Implement a working signal handler */
218     //    signal(SIGCHLD, SIG_IGN);
219     //    signal(SIGHUP, SIG_IGN);
220
221     /* Fork off for the second time*/
222     pid = fork();
223
224     /* An error occurred */
225     if (pid < 0) {
226         exit(EXIT_FAILURE);
227     }
228
229     /* Success:  Let the parent terminate */
230     if (pid > 0) {
231         exit(EXIT_SUCCESS);
232     }
233
234     /* Set new file permissions */
235     umask(0);
236
237     /* Change the working directory to the root directory */
238     /* or another appropriated directory */
239     chdir("/");
240
241     /* Close all open file descriptors */
242     int x;
243     for (x = sysconf(_SC_OPEN_MAX); x >= 0; x--) {
244         close(x);
245     }
246
247 }
```

4.1.2.16 solar_shutdown()

```
static bool solar_shutdown (
              void  )  [static]
977 {
978     static bool ret = false;
979 
980     if (E.startup) {
981         ret = true;
982         E.startup = false;
983         return ret;
984     } else {
985         ret = false;
986 
987         /*
988 * FIXME
989 *
990 */
991     }
992 
993     if (E.solar_shutdown) {
994         ret = true;
995     } else {
996         ret = false;
997     }
998 
999     if ((E.mvar[V_FBEKW] < BAT_CRITICAL) && !E.startup) { // special case for low battery
1000         if (!E.mode.bat_crit) {
1001             ret = true;
1002 #ifdef CRITIAL_SHUTDOWN_LOG
1003             fprintf(fout, "%s Solar BATTERY CRITICAL shutdown comms check ret = %d \r\n",
      log_time(false), ret);
1004             fflush(fout);
1005 #endif
1006             E.mode.bat_crit = true;
1007             return ret;
1008         }
1009     } else {
1010         E.mode.bat_crit = false;
1011     }
1012 
1013     if (E.link.shutdown >= MAX_ERROR) {
1014         ret = true;
1015         if (E.fm80 && E.dumpload && E.iammeter) {
1016             ret = false;
1017             E.link.shutdown = 0;
1018         }
1019 
1020 #ifdef DEBUG_SHUTDOWN
1021         fprintf(fout, "%s Solar shutdown comms check ret = %d \r\n", log_time(false), ret);
1022         fflush(fout);
1023 #endif
1024     }
1025     return ret;
1026 }
```

4.1.2.17 sync_ha()

```
bool sync_ha (
              void  )
1062 {
1063     bool sync = false;
1064     if (E.gti_sw_status != (bool) ((int32_t) E.mvar[V_HDCSW])) {
1065         fprintf(fout, "DC_MM %d %d ", (bool) E.gti_sw_status, (bool) ((int32_t) E.mvar[V_HDCSW]));
1066         mqtt_ha_switch(E.client_p, TOPIC_PDCC, !E.gti_sw_status);
1067         E.dc_mismatch = true;
1068         fflush(fout);
1069         sync = true;
1070     } else {
1071         E.dc_mismatch = false;
1072     }
1073 
1074     E.ac_sw_status = (bool) ((int32_t) E.mvar[V_HACSW]); // TEMP FIX for MISmatch errors
1075     if (E.ac_sw_status != (bool) ((int32_t) E.mvar[V_HACSW])) {
1076         fprintf(fout, "AC_MM %d %d ", (bool) E.ac_sw_status, (bool) ((int32_t) E.mvar[V_HACSW]));
1077         mqtt_ha_switch(E.client_p, TOPIC_PACC, !E.ac_sw_status);
1078         E.ac_mismatch = true;
```

```
1079         fflush(fout);
1080         sync = true;
1081     } else {
1082         E.ac_mismatch = false;
1083     }
1084     return sync;
1085 }
```

4.1.2.18 timer_callback()

```
void timer_callback (
             int32_t signum )
283 {
284     signal(signum, timer_callback);
285     ha_flag_vars_ss.runner = true;
286     E.ten_sec_clock++;
287     E.log_spam++;
288     E.log_time_reset++;
289     if (E.log_spam > MAX_LOG_SPAM) {
290         E.log_spam = 0;
291     }
292 }
```

4.1.3 Variable Documentation

4.1.3.1 board_name

```
const char* board_name = "NO_BOARD"
```

4.1.3.2 driver_name

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

4.1.3.3 E

```
struct energy_type E
```

4.1.3.4 fout

```
FILE* fout
```

4.1.3.5 ha_flag_vars_ha

```
struct ha_flag_type ha_flag_vars_ha
```

Initial value:

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

4.1.3.6 ha_flag_vars_pc

```
struct ha_flag_type ha_flag_vars_pc
```

Initial value:

```
= {
    .runner = false,
    .receivedtoken = false,
    .deliveredtoken = false,
    .rec_ok = false,
    .ha_id = P8055_ID,
    .var_update = 0,
}
```

4.1.3.7 ha_flag_vars_sd

```
struct ha_flag_type ha_flag_vars_sd
```

Initial value:

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

4.1.3.8 ha_flag_vars_ss

```
struct ha_flag_type ha_flag_vars_ss
```

Initial value:

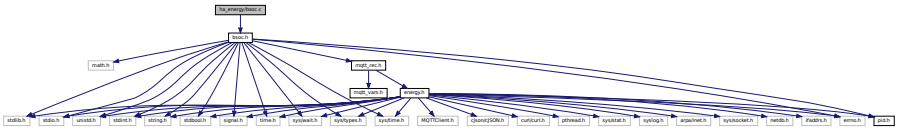
```
= {
    .runner = false,
    .receivedtoken = false,
    .deliveredtoken = false,
    .rec_ok = false,
    .ha_id = FM80_ID,
    .var_update = 0,
    .energy_mode = NORM_MODE,
}
```

4.2 ha_energy/.dep.inc File Reference

4.3 ha_energy/bsoc.c File Reference

```
#include "bsoc.h"
```

Include dependency graph for bsoc.c:



Data Structures

- struct local_type

Functions

- static double error_filter (const double)
- bool bsoc_init (void)
- void bsoc_set_std_dev (const double value, const uint32_t i)
- bool bsoc_data_collect (void)
- double bsoc_ac (void)
- double bsoc_gti (void)
- double gti_test (void)
- double ac_test (void)
- double get_batc_dev (void)
- double calculateStandardDeviation (const uint32_t N, const double data[ ])
- bool bat_current_stable (void)
- bool bsoc_set_mode (const double target, const bool mode, const bool init)
- double ac0_filter (const double raw)
- double ac1_filter (const double raw)
- double ac2_filter (const double raw)
- double dc0_filter (const double raw)
- double dc1_filter (const double raw)
- double dc2_filter (const double raw)
- double drive0_filter (const double raw)
- double drive1_filter (const double raw)

Variables

- const char ∗ mqtt_name [V_DLAST]
- static struct local_type L

4.3.1 Function Documentation

4.3.1.1 ac0_filter()

```
double ac0_filter (
              const double raw )
376 {
377     static double accum = 0.0f;
378     static double coef = COEFF;
379     accum = accum - accum / coef + raw;
380     return accum / coef;
381 }
```

4.3.1.2 ac1_filter()

```
double ac1_filter (
              const double raw )
384 {
385     static double accum = 0.0f;
386     static double coef = COEF;
387     accum = accum - accum / coef + raw;
388     return accum / coef;
389 }
```

4.3.1.3 ac2_filter()

```
double ac2_filter (
              const double raw )
392 {
393     static double accum = 0.0f;
394     static double coef = COEF;
395     accum = accum - accum / coef + raw;
396     return accum / coef;
397 }
```

4.3.1.4 ac_test()

```
double ac_test (
              void  )
191 {
192     return ac0_filter(L.ac_weight);
193 }
```

4.3.1.5 bat_current_stable()

```
bool bat_current_stable (
              void  )
240 {
241     static double gap = 0.0f;
242 
243     if (L.batc_std_dev <= (MAX_BATC_DEV + gap)) {
244         gap = MAX_BATC_DEV;
245         if (L.bat_c_std_dev[0] < BAT_C_DRAW) {
246             return true;
247         } else {
248             gap = 0.0f;
249             return false;
250         }
251     } else {
252         gap = 0.0f;
253         return false;
254     }
255 }
```

4.3.1.6 bsoc_ac()

```
double bsoc_ac (
              void  )
136 {
137
138     return ac0_filter(L.ac_weight);
139 };
```

4.3.1.7 bsoc_data_collect()

```
bool bsoc_data_collect (
              void  )
86 {
87     bool ret = false;
88     static uint32_t i = 0;
89     // lockout threaded updates
90     pthread_mutex_lock(&E.ha_lock); // lockout MQTT var updates
91
92     L.ac_weight = E.mvar[V_FBEKW];
93     L.gti_weight = E.mvar[V_FBEKW];
94 #ifdef FAKE_VPV // no DUMPLOAD AC charger
95     if (E.gti_sw_on) {
96         pv_voltage = PV_V_NOM;
97     } else {
98         pv_voltage = PV_V_FAKE;
99     }
100     E.mvar[V_DVPV] = pv_voltage;
101 #else
102     L.pv_voltage = E.mvar[V_DVPV];
103 #endif
104     L.bat_voltage = E.mvar[V_DVBAT];
105     L.bat_current = E.mvar[V_DCMPPT];
106     E.ac_low_adj = E.mvar[V_FSO]* -0.5f;
107     E.gti_low_adj = E.mvar[V_FACE] * -0.5f;
108     E.mode.dl_mqtt_max = E.mvar[V_DPMPPT];
109
110     pthread_mutex_unlock(&E.ha_lock); // resume remote MQTT var updates
111
112     if (E.ac_low_adj < -2000.0f) {
113         E.ac_low_adj = -2000.0f;
114     }
115     if (E.gti_low_adj < -2000.0f) {
116         E.gti_low_adj = -2000.0f;
117     }
118
119     L.bat_c_std_dev[i++] = L.bat_current;
120     if (i >= DEV_SIZE) {
121         i = 0;
122     }
123
124     calculateStandardDeviation(DEV_SIZE, L.bat_c_std_dev);
125
126 #ifdef BSOC_DEBUG
127     fprintf(fout, "\r\nmqtt var bsoc update\r\n");
128 #endif
129     return ret;
130 }
```

4.3.1.8 bsoc_gti()

```
double bsoc_gti (
              void  )
146 {
147 #ifdef BSOC_DEBUG
148     fprintf(fout, "pvp %f, gweight %f, aweight %f, batv %f, batc %f\r\n", pv_voltage, gti_weight,
      ac_weight, bat_voltage, bat_current);
149 #endif
```

```
150     // check for 48VDC AC charger powered from the Solar battery bank AC inverter unless E.dl_excess is
      TRUE
151     if (((L.pv_voltage < MIN_PV_VOLTS) && (!E.dl_excess)) || (L.bat_voltage < MIN_BAT_VOLTS)) {
152         L.gti_weight = 0.0f; // reduce power to zero
153     } else {
154         if (E.dl_excess) {
155             if (E.mvar[V_DAHBAT] > PV_DL_B_AH_MIN) {
156                 L.gti_weight = PV_DL_EXCESS + E.dl_excess_adj;
157             } else {
158                 L.gti_weight = 0.0f; // reduce power to zero
159             }
160         }
161     }
162
163
164     return dc0_filter(L.gti_weight);
165 };
```

4.3.1.9 bsoc_init()

```
bool bsoc_init (
              void  )
61 {
62     L.ac_weight = 0.0f;
63     L.gti_weight = 0.0f;
64     // use MUTEX locks for message passing between remote programs
65     if (pthread_mutex_init(&E.ha_lock, NULL) != 0) {
66         fprintf(fout, "\n%s mutex init has failed\n", log_time(false));
67         return false;
68     }
69     return true;
70 };
```

4.3.1.10 bsoc_set_mode()

```
bool bsoc_set_mode (
              const double target,
              const bool mode,
              const bool init )
262 {
263     static bool bsoc_mode = false;
264     static bool bsoc_high = false, ha_ac_mode = true;
265     static double accum = 0.0f, vpwa = 0.0f;
266
267     if (init) {
268         bsoc_mode = false;
269         bsoc_high = false;
270         ha_ac_mode = true;
271         accum = 0.0f;
272         vpwa = 0.0f;
273         return true;
274     }
275     /*
276 * running avg filter
277 */
278     accum = accum - accum / COEFN + E.mvar[V_PWA];
279     vpwa = accum / COEFN;
280
281     if ((vpwa >= PV_FULL_PWR) && (E.mvar[V_FBEKW] >= MIN_BAT_KW_BSOC_HI)) {
282         if (!bsoc_mode) {
283             ResetPI(&E.mode.pid);
284         }
285         bsoc_mode = true;
286         bsoc_high = true;
287         if (!ha_ac_mode) {
288             ha_ac_on();
289             ha_ac_mode = true;
290         }
291
292     } else {
```

```
293         if (bsoc_high) { // turn off at min limit power
294             if ((vpwa >= PV_MIN_PWR) && (E.mvar[V_FBEKW] >= MIN_BAT_KW_BSOC_HI)) {
295                 bsoc_mode = true;
296                 if (ha_ac_mode) {
297                     ha_ac_off();
298                     ha_ac_mode = false;
299                 }
300             } else {
301                 bsoc_mode = false;
302                 ha_ac_mode = false;
303             }
304         }
305     }
306 
307     E.mode.gti_dumpload = (E.print_vars[L3_P]* -1.0f) + E.mvar[V_DPPV]; // use as a temp variable
308     E.mode.total_system = (E.mvar[V_FLO] - E.mode.gti_dumpload) + E.mvar[V_DPPV] +(E.print_vars[L3_P]*
    -1.0f);
309     E.mode.gti_dumpload = (E.print_vars[L3_P]* -1.0f) - E.mvar[V_DPPV]; // use this value
310 
311     /*
312 * look at system energy balance for power control drive
313 */
314     if (mode) { // add GTI power from dumpload
315         E.mode.error = (int32_t) UpdatePI(&E.mode.pid, E.mvar[V_BEN] + E.mode.gti_dumpload +
    PBAL_OFFSET);
316     } else {
317         E.mode.error = (int32_t) UpdatePI(&E.mode.pid, E.mvar[V_BEN] + PBAL_OFFSET);
318     }
319 
320     if (E.mode.error > 0.0f) {
321         L.coef = COEF;
322     } else {
323         L.coef = COEFN;
324     }
325     E.mode.target = target;
326     E.mode.error = round(error_filter(E.mode.error));
327     /*
328 * check for idle flag from HA
329 */
330     if (E.mode.con6) {
331         ha_ac_mode = true;
332         bsoc_mode = false;
333     }
334 
335     /*
336 * HA start excess button pressed
337 */
338     if (E.mode.con4) {
339         E.dl_excess = true;
340         E.mode.con4 = false;
341     }
342 
343     /*
344 * HA stop excess button pressed
345 */
346     if (E.mode.con5) {
347         mqtt_gti_power(E.client_p, TOPIC_P, "Z#", 9); // zero power at excess shutdown
348         E.dl_excess = false;
349         E.mode.con5 = false;
350     }
351 
352     /*
353 * DL buffer battery low set-point excess load shutdown
354 */
355     if (E.mvar[V_DAHBAT] < PV_DL_B_AH_LOW) {
356         mqtt_gti_power(E.client_p, TOPIC_P, "Z#", 10); // zero power at excess shutdown
357         E.dl_excess = false;
358         E.mode.con4 = false;
359         E.mode.con5 = false;
360     }
361 
362     return bsoc_mode;
363 }
```

4.3.1.11 bsoc_set_std_dev()

```
void bsoc_set_std_dev (
            const double value,
            const uint32_t i )
```

```
76 {
77     L.bat_c_std_dev[i] = value;
78 }
```

4.3.1.12 calculateStandardDeviation()

```
double calculateStandardDeviation (
              const uint32_t N,
              const double data[] )
205 {
206     // variable to store sum of the given data
207     double sum = 0;
208 
209     for (int i = 0; i < N; i++) {
210         sum += data[i];
211     }
212 
213     // calculating mean
214     double mean = sum / N;
215 
216     // temporary variable to store the summation of square
217     // of difference between individual data items and mean
218     double values = 0;
219 
220     for (int i = 0; i < N; i++) {
221         values += pow(data[i] - mean, 2);
222     }
223 
224     // variance is the square of standard deviation
225     double variance = values / N;
226 
227     // calculating standard deviation by finding square root
228     // of variance
229     double standardDeviation = sqrt(variance);
230     L.batc_std_dev = standardDeviation;
231 
232 #ifdef BSOC_DEBUG
233     // printing standard deviation
234     fprintf(fout, "STD DEV of Current %.2f\r\n", standardDeviation);
235 #endif
236     return standardDeviation;
237 }
```

4.3.1.13 dc0_filter()

```
double dc0_filter (
              const double raw )
400 {
401     static double accum = 0.0f;
402     static double coef = COEFF;
403     accum = accum - accum / coef + raw;
404     return accum / coef;
405 }
```

4.3.1.14 dc1_filter()

```
double dc1_filter (
              const double raw )
408 {
409     static double accum = 0.0f;
410     static double coef = COEF;
411     accum = accum - accum / coef + raw;
412     return accum / coef;
413 }
```

4.3.1.15 dc2_filter()

```
double dc2_filter (
            const double raw )
416 {
417     static double accum = 0.0f;
418     static double coef = COEF;
419     accum = accum - accum / coef + raw;
420     return accum / coef;
421 }
```

4.3.1.16 drive0_filter()

```
double drive0_filter (
            const double raw )
424 {
425     static double accum = 0.0f;
426     static double coef = COEF;
427     accum = accum - accum / coef + raw;
428     return accum / coef;
429 }
```

4.3.1.17 drive1_filter()

```
double drive1_filter (
            const double raw )
432 {
433     static double accum = 0.0f;
434     static double coef = COEFF;
435     accum = accum - accum / coef + raw;
436     return accum / coef;
437 }
```

4.3.1.18 error_filter()

```
static double error_filter (
            const double raw )  [static]
369 {
370     static double accum = 0.0f;
371     accum = accum - accum / L.coef + raw;
372     return accum / L.coef;
373 }
```

4.3.1.19 get_batc_dev()

```
double get_batc_dev (
            void  )
196 {
197     return L.batc_std_dev;
198 }
```

4.3.1.20 gti_test()

```
double gti_test (
              void  )
171 {
172     // check for 48VDC AC charger powered from the Solar battery bank AC inverter
173     if (((L.pv_voltage < MIN_PV_VOLTS) && (!E.dl_excess)) || (L.bat_voltage < MIN_BAT_VOLTS)) {
174         L.gti_weight = 0.0f; // reduce power to zero
175 #ifdef BSOC_DEBUG
176         fprintf(fout, "pvp %8.2f, gweight %8.2f, aweight %8.2f, batv %8.2f, batc %8.2f\r\n", pv_voltage,
      gti_weight, ac_weight, bat_voltage, bat_current);
177 #endif
178     } else {
179         if (E.dl_excess) {
180             if (E.mvar[V_DAHBAT] > PV_DL_B_AH_MIN) {
181                 L.gti_weight = PV_DL_EXCESS + E.dl_excess_adj;
182             } else {
183                 L.gti_weight = 0.0f; // reduce power to zero
184             }
185         }
186     }
187     return dc0_filter(L.gti_weight);
188 }
```

4.3.2 Variable Documentation

4.3.2.1 L

```
struct local_type L  [static]
```

Initial value:

```
= {
    .ac_weight = 0.0f,
    .bat_current = 0.0f,
    .bat_voltage = 0.0f,
    .batc_std_dev = 0.0f,
    .coef = COEF,
    .gti_weight = 0.0f,
    .pv_voltage = 0.0f,
}
```

4.3.2.2 mqtt_name

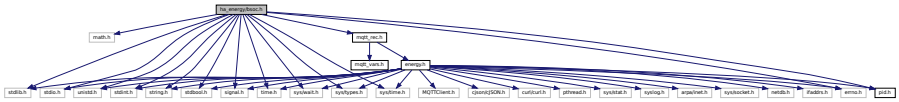
```
const char* mqtt_name[V_DLAST]
```

4.4 ha_energy/bsoc.h File Reference

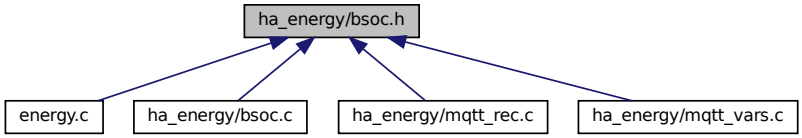
```
#include <math.h>
#include <stdlib.h>
#include <stdio.h>
#include <unistd.h>
#include <stdint.h>
#include <string.h>
#include <stdbool.h>
#include <signal.h>
```

```
#include <time.h>
#include <sys/wait.h>
#include <sys/types.h>
#include <sys/time.h>
#include <errno.h>
#include "pid.h"
#include "mqtt_rec.h"
```

Include dependency graph for bsoc.h:



This graph shows which files directly or indirectly include this file:



Macros

- #define MIN_PV_VOLTS 5.0f
- #define MIN_BAT_VOLTS 23.0f
- #define MIN_BAT_KW 4100.0f
- #define DEV_SIZE 10
- #define MAX_BATC_DEV 1.5f
- #define BAT_C_DRAW 3.0f
- #define PBAL_OFFSET -50.0f
- #define PV_FULL_PWR 300.0f
- #define PV_MIN_PWR 160.0f
- #define PV_V_NOM 60.0f
- #define PV_V_FAKE 0.336699f
- #define COEF 8.0f
- #define COEFN 4.0f
- #define COEFF 2.0f

Functions

- bool bsoc_init (void)
- bool bsoc_data_collect (void)
- double bsoc_ac (void)
- double bsoc_gti (void)
- double gti_test (void)
- double ac_test (void)
- double get_batc_dev (void)

- bool bat_current_stable (void)
- void bsoc_set_std_dev (const double, const uint32_t)
- double calculateStandardDeviation (const uint32_t, const double *)
- bool bsoc_set_mode (const double, const bool, const bool)
- double ac0_filter (const double)
- double ac1_filter (const double)
- double ac2_filter (const double)
- double dc0_filter (const double)
- double dc1_filter (const double)
- double dc2_filter (const double)
- double drive0_filter (const double)
- double drive1_filter (const double)

4.4.1 Macro Definition Documentation

4.4.1.1 BAT_C_DRAW

```
#define BAT_C_DRAW 3.0f
```

4.4.1.2 COEF

```
#define COEF 8.0f
```

4.4.1.3 COEFF

```
#define COEFF 2.0f
```

4.4.1.4 COEFN

```
#define COEFN 4.0f
```

4.4.1.5 DEV_SIZE

```
#define DEV_SIZE 10
```

4.4.1.6 MAX_BATC_DEV

```
#define MAX_BATC_DEV 1.5f
```

4.4.1.7 MIN_BAT_KW

```
#define MIN_BAT_KW 4100.0f
```

4.4.1.8 MIN_BAT_VOLTS

```
#define MIN_BAT_VOLTS 23.0f
```

4.4.1.9 MIN_PV_VOLTS

```
#define MIN_PV_VOLTS 5.0f
```

4.4.1.10 PBAL_OFFSET

```
#define PBAL_OFFSET -50.0f
```

4.4.1.11 PV_FULL_PWR

```
#define PV_FULL_PWR 300.0f
```

4.4.1.12 PV_MIN_PWR

```
#define PV_MIN_PWR 160.0f
```

4.4.1.13 PV_V_FAKE

```
#define PV_V_FAKE 0.336699f
```

4.4.1.14 PV_V_NOM

```
#define PV_V_NOM 60.0f
```

4.4.2 Function Documentation

4.4.2.1 ac0_filter()

```
double ac0_filter (
            const double raw )
376 {
377     static double accum = 0.0f;
378     static double coef = COEFF;
379     accum = accum - accum / coef + raw;
380     return accum / coef;
381 }
```

4.4.2.2 ac1_filter()

```
double ac1_filter (
            const double raw )
384 {
385     static double accum = 0.0f;
386     static double coef = COEF;
387     accum = accum - accum / coef + raw;
388     return accum / coef;
389 }
```

4.4.2.3 ac2_filter()

```
double ac2_filter (
            const double raw )
392 {
393     static double accum = 0.0f;
394     static double coef = COEF;
395     accum = accum - accum / coef + raw;
396     return accum / coef;
397 }
```

4.4.2.4 ac_test()

```
double ac_test (
            void  )
191 {
192     return ac0_filter(L.ac_weight);
193 }
```

4.4.2.5 bat_current_stable()

```
bool bat_current_stable (
              void  )
240 {
241     static double gap = 0.0f;
242 
243     if (L.batc_std_dev <= (MAX_BATC_DEV + gap)) {
244         gap = MAX_BATC_DEV;
245         if (L.bat_c_std_dev[0] < BAT_C_DRAW) {
246             return true;
247         } else {
248             gap = 0.0f;
249             return false;
250         }
251     } else {
252         gap = 0.0f;
253         return false;
254     }
255 }
```

4.4.2.6 bsoc_ac()

```
double bsoc_ac (
              void  )
136 {
137 
138     return ac0_filter(L.ac_weight);
139 };
```

4.4.2.7 bsoc_data_collect()

```
bool bsoc_data_collect (
              void  )
86 {
87     bool ret = false;
88     static uint32_t i = 0;
89     // lockout threaded updates
90     pthread_mutex_lock(&E.ha_lock); // lockout MQTT var updates
91 
92     L.ac_weight = E.mvar[V_FBEKW];
93     L.gti_weight = E.mvar[V_FBEKW];
94 #ifdef FAKE_VPV // no DUMPLOAD AC charger
95     if (E.gti_sw_on) {
96         pv_voltage = PV_V_NOM;
97     } else {
98         pv_voltage = PV_V_FAKE;
99     }
100     E.mvar[V_DVPV] = pv_voltage;
101 #else
102     L.pv_voltage = E.mvar[V_DVPV];
103 #endif
104     L.bat_voltage = E.mvar[V_DVBAT];
105     L.bat_current = E.mvar[V_DCMPPT];
106     E.ac_low_adj = E.mvar[V_FSO]* -0.5f;
107     E.gti_low_adj = E.mvar[V_FACE] * -0.5f;
108     E.mode.dl_mqtt_max = E.mvar[V_DPMPPT];
109 
110     pthread_mutex_unlock(&E.ha_lock); // resume remote MQTT var updates
111 
112     if (E.ac_low_adj < -2000.0f) {
113         E.ac_low_adj = -2000.0f;
114     }
115     if (E.gti_low_adj < -2000.0f) {
116         E.gti_low_adj = -2000.0f;
117     }
118 
119     L.bat_c_std_dev[i++] = L.bat_current;
120     if (i >= DEV_SIZE) {
```

```
121         i = 0;
122     }
123
124     calculateStandardDeviation(DEV_SIZE, L.bat_c_std_dev);
125
126 #ifdef BSOC_DEBUG
127     fprintf(fout, "\r\nmqtt var bsoc update\r\n");
128 #endif
129     return ret;
130 }
```

4.4.2.8 bsoc_gti()

```
double bsoc_gti (
              void  )
146 {
147 #ifdef BSOC_DEBUG
148     fprintf(fout, "pvp %f, gweight %f, aweight %f, batv %f, batc %f\r\n", pv_voltage, gti_weight,
      ac_weight, bat_voltage, bat_current);
149 #endif
150     // check for 48VDC AC charger powered from the Solar battery bank AC inverter unless E.dl_excess is
      TRUE
151     if (((L.pv_voltage < MIN_PV_VOLTS) && (!E.dl_excess)) || (L.bat_voltage < MIN_BAT_VOLTS)) {
152         L.gti_weight = 0.0f; // reduce power to zero
153     } else {
154         if (E.dl_excess) {
155             if (E.mvar[V_DAHBAT] > PV_DL_B_AH_MIN) {
156                 L.gti_weight = PV_DL_EXCESS + E.dl_excess_adj;
157             } else {
158                 L.gti_weight = 0.0f; // reduce power to zero
159             }
160         }
161     }
162
163
164     return dc0_filter(L.gti_weight);
165 };
```

4.4.2.9 bsoc_init()

```
bool bsoc_init (
              void  )
61 {
62     L.ac_weight = 0.0f;
63     L.gti_weight = 0.0f;
64     // use MUTEX locks for message passing between remote programs
65     if (pthread_mutex_init(&E.ha_lock, NULL) != 0) {
66         fprintf(fout, "\n%s mutex init has failed\n", log_time(false));
67         return false;
68     }
69     return true;
70 };
```

4.4.2.10 bsoc_set_mode()

```
bool bsoc_set_mode (
              const double target,
              const bool mode,
              const bool init )
262 {
263     static bool bsoc_mode = false;
264     static bool bsoc_high = false, ha_ac_mode = true;
```

```
265     static double accum = 0.0f, vpwa = 0.0f;
266
267     if (init) {
268         bsoc_mode = false;
269         bsoc_high = false;
270         ha_ac_mode = true;
271         accum = 0.0f;
272         vpwa = 0.0f;
273         return true;
274     }
275     /*
276 * running avg filter
277 */
278     accum = accum - accum / COEFN + E.mvar[V_PWA];
279     vpwa = accum / COEFN;
280
281     if ((vpwa >= PV_FULL_PWR) && (E.mvar[V_FBEKW] >= MIN_BAT_KW_BSOC_HI)) {
282         if (!bsoc_mode) {
283             ResetPI(&E.mode.pid);
284         }
285         bsoc_mode = true;
286         bsoc_high = true;
287         if (!ha_ac_mode) {
288             ha_ac_on();
289             ha_ac_mode = true;
290         }
291
292     } else {
293         if (bsoc_high) { // turn off at min limit power
294             if ((vpwa >= PV_MIN_PWR) && (E.mvar[V_FBEKW] >= MIN_BAT_KW_BSOC_HI)) {
295                 bsoc_mode = true;
296                 if (ha_ac_mode) {
297                     ha_ac_off();
298                     ha_ac_mode = false;
299                 }
300             } else {
301                 bsoc_high = false;
302                 ha_ac_mode = false;
303             }
304         }
305     }
306
307     E.mode.gti_dumpload = (E.print_vars[L3_P]* -1.0f) + E.mvar[V_DPPV]; // use as a temp variable
308     E.mode.total_system = (E.mvar[V_FLO] - E.mode.gti_dumpload) + E.mvar[V_DPPV] +(E.print_vars[L3_P]*
    -1.0f);
309     E.mode.gti_dumpload = (E.print_vars[L3_P]* -1.0f) - E.mvar[V_DPPV]; // use this value
310
311     /*
312 * look at system energy balance for power control drive
313 */
314     if (mode) { // add GTI power from dumpload
315         E.mode.error = (int32_t) UpdatePI(&E.mode.pid, E.mvar[V_BEN] + E.mode.gti_dumpload +
    PBAL_OFFSET);
316     } else {
317         E.mode.error = (int32_t) UpdatePI(&E.mode.pid, E.mvar[V_BEN] + PBAL_OFFSET);
318     }
319
320     if (E.mode.error > 0.0f) {
321         L.coef = COEF;
322     } else {
323         L.coef = COEFN;
324     }
325     E.mode.target = target;
326     E.mode.error = round(error_filter(E.mode.error));
327     /*
328 * check for idle flag from HA
329 */
330     if (E.mode.con6) {
331         ha_ac_mode = true;
332         bsoc_mode = false;
333     }
334
335     /*
336 * HA start excess button pressed
337 */
338     if (E.mode.con4) {
339         E.dl_excess = true;
340         E.mode.con4 = false;
341     }
342
343     /*
344 * HA stop excess button pressed
345 */
346     if (E.mode.con5) {
347         mqtt_gti_power(E.client_p, TOPIC_P, "Z#", 9); // zero power at excess shutdown
348         E.dl_excess = false;
349         E.mode.con5 = false;
```

```
350     }
351
352     /*
353 * DL buffer battery low set-point excess load shutdown
354 */
355     if (E.mvar[V_DAHBAT] < PV_DL_B_AH_LOW) {
356         mqtt_gti_power(E.client_p, TOPIC_P, "Z#", 10); // zero power at excess shutdown
357         E.dl_excess = false;
358         E.mode.con4 = false;
359         E.mode.con5 = false;
360     }
361
362     return bsoc_mode;
363 }
```

4.4.2.11 bsoc_set_std_dev()

```
void bsoc_set_std_dev (
              const double value,
              const uint32_t i )
76 {
77     L.bat_c_std_dev[i] = value;
78 }
```

4.4.2.12 calculateStandardDeviation()

```
double calculateStandardDeviation (
              const uint32_t ,
              const double *  )
```

4.4.2.13 dc0_filter()

```
double dc0_filter (
              const double raw )
400 {
401     static double accum = 0.0f;
402     static double coef = COEFF;
403     accum = accum - accum / coef + raw;
404     return accum / coef;
405 }
```

4.4.2.14 dc1_filter()

```
double dc1_filter (
              const double raw )
408 {
409     static double accum = 0.0f;
410     static double coef = COEF;
411     accum = accum - accum / coef + raw;
412     return accum / coef;
413 }
```

4.4.2.15 dc2_filter()

```
double dc2_filter (
            const double raw )
416 {
417     static double accum = 0.0f;
418     static double coef = COEF;
419     accum = accum - accum / coef + raw;
420     return accum / coef;
421 }
```

4.4.2.16 drive0_filter()

```
double drive0_filter (
            const double raw )
424 {
425     static double accum = 0.0f;
426     static double coef = COEF;
427     accum = accum - accum / coef + raw;
428     return accum / coef;
429 }
```

4.4.2.17 drive1_filter()

```
double drive1_filter (
            const double raw )
432 {
433     static double accum = 0.0f;
434     static double coef = COEFF;
435     accum = accum - accum / coef + raw;
436     return accum / coef;
437 }
```

4.4.2.18 get_batc_dev()

```
double get_batc_dev (
            void  )
196 {
197     return L.batc_std_dev;
198 }
```

4.4.2.19 gti_test()

```
double gti_test (
            void  )
171 {
172     // check for 48VDC AC charger powered from the Solar battery bank AC inverter
173     if (((L.pv_voltage < MIN_PV_VOLTS) && (!E.dl_excess)) || (L.bat_voltage < MIN_BAT_VOLTS)) {
174         L.gti_weight = 0.0f; // reduce power to zero
175 #ifdef BSOC_DEBUG
176         fprintf(fout, "pvp %8.2f, gweight %8.2f, aweight %8.2f, batv %8.2f, batc %8.2f\r\n", pv_voltage,
    gti_weight, ac_weight, bat_voltage, bat_current);
177 #endif
178     } else {
179         if (E.dl_excess) {
180             if (E.mvar[V_DAHBAT] > PV_DL_B_AH_MIN) {
181                 L.gti_weight = PV_DL_EXCESS + E.dl_excess_adj;
182             } else {
183                 L.gti_weight = 0.0f; // reduce power to zero
184             }
185         }
186     }
187     return dc0_filter(L.gti_weight);
188 }
```

4.5 bsoc.h

Go to the documentation of this file.

```
1 /*
2 * File:      bsoc.h
3 * Author:  root
4 *
5 * Created on February 10, 2024, 6:24 PM
6 */
7
8 #ifndef BSOC_H
9 #define BSOC_H
10
11 #ifdef __cplusplus
12 extern "C" {
13 #endif
14 #include <math.h>
15     //#define BSOC_DEBUG
16
17 #define MIN_PV_VOLTS    5.0f
18 #define MIN_BAT_VOLTS   23.0f
19 #define MIN_BAT_KW      4100.0f
20
21 #define DEV_SIZE        10
22 #define MAX_BATC_DEV    1.5f
23 #define BAT_C_DRAW      3.0f
24
25 #define PBAL_OFFSET     -50.0f // postive bias for control point
26 #define PV_FULL_PWR     300.0f
27 #define PV_MIN_PWR      160.0f
28 #define PV_V_NOM        60.0f
29 #define PV_V_FAKE       0.336699f
30
31 #define COEF            8.0f
32 #define COEFN           4.0f
33 #define COEFF           2.0f
34
35 #include <stdlib.h>
36 #include <stdio.h> /* for printf() */
37 #include <unistd.h>
38 #include <stdint.h>
39 #include <string.h>
40 #include <stdbool.h>
41 #include <signal.h>
42 #include <time.h>
43 #include <sys/wait.h>
44 #include <sys/types.h>
45 #include <sys/time.h>
46 #include <errno.h>
47 #include <math.h>
48 #include "pid.h"
49 #include "mqtt_rec.h"
50
51     bool bsoc_init(void);
52     bool bsoc_data_collect(void);
53     double bsoc_ac(void);
54     double bsoc_gti(void);
55     double gti_test(void);
56     double ac_test(void);
57     double get_batc_dev(void);
58     bool bat_current_stable(void);
59     void bsoc_set_std_dev(const double, const uint32_t);
60
61     double calculateStandardDeviation(const uint32_t, const double *);
62
63     bool bsoc_set_mode(const double, const bool, const bool);
64
65     double ac0_filter(const double);
66     double ac1_filter(const double);
67     double ac2_filter(const double);
68     double dc0_filter(const double);
69     double dc1_filter(const double);
70     double dc2_filter(const double);
71     double drive0_filter(const double);
72     double drive1_filter(const double);
73
74 #ifdef __cplusplus
75 }
76 #endif
77
78 #endif /* BSOC_H */
79
```

4.6 ha_energy/build/Debug/GNU-Linux/_ext/5c0/energy.o.d File Reference

4.7 ha_energy/build/Release/GNU-Linux/_ext/5c0/energy.o.d File Reference

4.8 ha_energy/build/Debug/GNU-Linux/bsoc.o.d File Reference

4.9 ha_energy/build/Release/GNU-Linux/bsoc.o.d File Reference

4.10 ha_energy/build/Debug/GNU-Linux/http_vars.o.d File Reference

4.11 ha_energy/build/Release/GNU-Linux/http_vars.o.d File Reference

4.12 ha_energy/build/Debug/GNU-Linux/mqtt_rec.o.d File Reference

4.13 ha_energy/build/Release/GNU-Linux/mqtt_rec.o.d File Reference

4.14 ha_energy/build/Debug/GNU-Linux/mqtt_vars.o.d File Reference

4.15 ha_energy/build/Release/GNU-Linux/mqtt_vars.o.d File Reference

4.16 ha_energy/build/Debug/GNU-Linux/pid.o.d File Reference

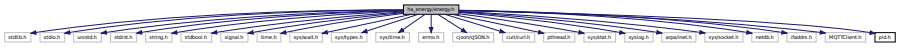
4.17 ha_energy/build/Release/GNU-Linux/pid.o.d File Reference

4.18 ha_energy/energy.h File Reference

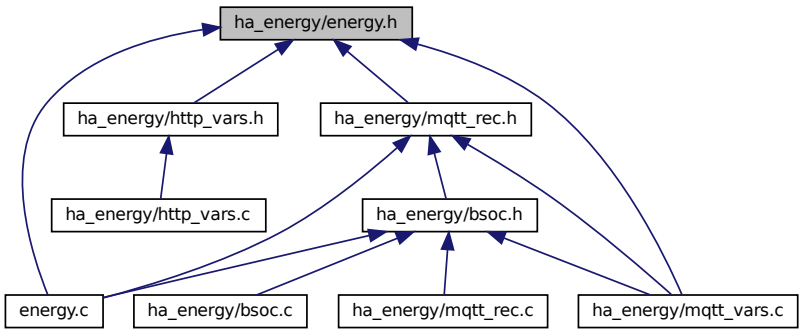
```
#include <stdlib.h>
#include <stdio.h>
#include <unistd.h>
#include <stdint.h>
#include <string.h>
#include <stdbool.h>
#include <signal.h>
#include <time.h>
#include <sys/wait.h>
#include <sys/types.h>
#include <sys/time.h>
#include <errno.h>
```

```
#include <cjson/cJSON.h>
#include <curl/curl.h>
#include <pthread.h>
#include <sys/stat.h>
#include <syslog.h>
#include <arpa/inet.h>
#include <sys/socket.h>
#include <netdb.h>
#include <ifaddrs.h>
#include "MQTTClient.h"
#include "pid.h"
```

Include dependency graph for energy.h:



This graph shows which files directly or indirectly include this file:



Data Structures

- struct link_type
- struct mode_type
- struct energy_type

Macros

- #define LOG_VERSION "V0.73"
- #define MQTT_VERSION "V3.11"
- #define TNAME "maint9"
- #define LADDRESS "tcp://127.0.0.1:1883"
- #define ADDRESS "tcp://10.1.1.30:1883"
- #define CLIENTID1 "Energy_Mqtt_HA1"
- #define CLIENTID2 "Energy_Mqtt_HA2"
- #define CLIENTID3 "Energy_Mqtt_HA3"
- #define TOPIC_P "mateq84/data/gticmd"
- #define TOPIC_SPAM "mateq84/data/spam"

- #define TOPIC_PACA "home-assistant/gtiac/availability"
- #define TOPIC_PDCA "home-assistant/gtidc/availability"
- #define TOPIC_PACC "home-assistant/gtiac/contact"
- #define TOPIC_PDCC "home-assistant/gtidc/contact"
- #define TOPIC_PPID "home-assistant/solar/pid"
- #define TOPIC_SHUTDOWN "home-assistant/solar/shutdown"
- #define TOPIC_SS "mateq84/data/solar"
- #define TOPIC_SD "mateq84/data/dumpload"
- #define TOPIC_HA "home-assistant/status/switch"
- #define QOS 1
- #define TIMEOUT 10000L
- #define SPACING_USEC 500 ∗ 1000
- #define USEC_SEC 1000000L
- #define DAQ_STR 32
- #define DAQ_STR_M DAQ_STR-1
- #define SBUF_SIZ 16
- #define RBUF_SIZ 82
- #define SYSLOG_SIZ 512
- #define MQTT_TIMEOUT 900
- #define SW_QOS 1
- #define NO_CYLON
- #define CRITIAL_SHUTDOWN_LOG
- #define UNIT_TEST 2
- #define NORM_MODE 0
- #define PID_MODE 1
- #define MAX_ERROR 5
- #define IAM_DELAY 120
- #define CMD_SEC 10
- #define TIME_SYNC_SEC 30
- #define BAT_M_KW 5120.0f
- #define BAT_SOC_TOP 0.98f
- #define BAT_SOC_HIGH 0.95f
- #define BAT_SOC_LOW 0.64f
- #define BAT_SOC_LOW_AC 0.70f
- #define BAT_CRITICAL 200.0f
- #define MIN_BAT_KW_BSOC_SLP 4000.0f
- #define MIN_BAT_KW_BSOC_HI 4550.0f
- #define MIN_BAT_KW_GTI_HI BAT_M_KW∗BAT_SOC_TOP
- #define MIN_BAT_KW_GTI_LO BAT_M_KW∗BAT_SOC_LOW
- #define MIN_BAT_KW_AC_HI BAT_M_KW∗BAT_SOC_HIGH
- #define MIN_BAT_KW_AC_LO BAT_M_KW∗BAT_SOC_LOW_AC
- #define PV_PGAIN 0.85f
- #define PV_IGAIN 0.12f
- #define PV_IMAX 1400.0f
- #define PV_BIAS 288.0f
- #define PV_BIAS_ZERO 0.0f
- #define PV_BIAS_LOW 222.0f
- #define PV_BIAS_FLOAT 399.0f
- #define PV_BIAS_SLEEP 480.0f
- #define PV_BIAS_RATE 320.0f
- #define PV_DL_MPTT_MAX 1200.0f
- #define PV_DL_MPTT_EXCESS 1300.0f
- #define PV_DL_MPTT_IDLE 57.0f
- #define PV_DL_BIAS_RATE 75.0f
- #define PV_DL_EXCESS 500.0f

- #define PV_DL_B_AH_LOW 100.0f
- #define PV_DL_B_AH_MIN 150.0f
- #define PV_DL_B_V_LOW 23.8f
- #define PWA_SLEEP 200.0f
- #define DL_AC_DC_EFF 1.24f
- #define BAL_MIN_ENERGY_AC -200.0f
- #define BAL_MAX_ENERGY_AC 200.0f
- #define BAL_MIN_ENERGY_GTI -1400.0f
- #define BAL_MAX_ENERGY_GTI 200.0f
- #define LOG_TO_FILE "/store/logs/energy.log"
- #define LOG_TO_FILE_ALT "/tmp/energy.log"
- #define MAX_LOG_SPAM 60
- #define LOW_LOG_SPAM 2
- #define RESET_LOG_SPAM 120
- #define IM_DELAY 1
- #define IM_DISPLAY 1
- #define GTI_DELAY 1
- #define PWA_SANE 1700.0f
- #define PAMPS_SANE 16.0f
- #define PVOLTS_SANE 150.0f
- #define BAMPS_SANE 70.0f
- #define MAX_IM_VAR IA_LAST∗PHASE_LAST
- #define L1_P IA_POWER
- #define L2_P L1_P+IA_LAST
- #define L3_P L2_P+IA_LAST

Enumerations

- enum energy_state {
  E_INIT , E_RUN , E_WAIT , E_IDLE ,
  E_STOP , E_LAST }
- enum running_state {
  R_INIT , R_FLOAT , R_SLEEP , R_RUN ,
  R_IDLE , R_LAST }
- enum iammeter_phase { PHASE_A , PHASE_B , PHASE_C , PHASE_LAST }
- enum iammeter_id {
  IA_VOLTAGE , IA_CURRENT , IA_POWER , IA_IMPORT ,
  IA_EXPORT , IA_FREQ , IA_PF , IA_LAST }
- enum mqtt_vars {
  V_FCCM , V_FBEKW , V_FRUNT , V_FBAMPS ,
  V_FBV , V_FLO , V_FSO , V_FACE ,
  V_BEN , V_PWA , V_PAMPS , V_PVOLTS ,
  V_FLAST , V_HDCSW , V_HACSW , V_HSHUT ,
  V_HMODE , V_HCON0 , V_HCON1 , V_HCON2 ,
  V_HCON3 , V_HCON4 , V_HCON5 , V_HCON6 ,
  V_HCON7 , V_DVPV , V_DPPV , V_DPBAT ,
  V_DVBAT , V_DCMPPT , V_DPMPPT , V_DAHBAT ,
  V_DCCMODE , V_DGTI , V_DLAST }
- enum sane_vars {
  S_FCCM , S_FBEKW , S_FRUNT , S_FBAMPS ,
  S_FBV , S_FLO , S_FSO , S_FACE ,
  S_BEN , S_PWA , S_PAMPS , S_PVOLTS ,
  S_FLAST , S_HDCSW , S_HACSW , S_HSHUT ,
  S_HMODE , S_DVPV , S_DPPV , S_DPBAT ,
  S_DVBAT , S_DCMPPT , S_DPMPPT , S_DAHBAT ,
  S_DCCMODE , S_DGTI , S_DLAST }

Functions

- void timer_callback (int32_t)
- void connlost (void *, char *)
- void ramp_up_gti (MQTTClient, bool, bool)
- void ramp_up_ac (MQTTClient, bool)
- void ramp_down_gti (MQTTClient, bool)
- void ramp_down_ac (MQTTClient, bool)
- void ha_ac_off (void)
- void ha_ac_on (void)
- void ha_dc_off (void)
- void ha_dc_on (void)
- size_t iammeter_write_callback (char *, size_t, size_t, void *)
- void iammeter_read (void)
- void print_im_vars (void)
- void print_mvar_vars (void)
- bool sanity_check (void)
- char * log_time (bool)
- bool sync_ha (void)
- bool log_timer (void)

Variables

- struct energy_type E
- struct ha_flag_type ha_flag_vars_ss
- FILE * fout

4.18.1 Macro Definition Documentation

4.18.1.1 ADDRESS

```
#define ADDRESS "tcp://10.1.1.30:1883"
```

4.18.1.2 BAL_MAX_ENERGY_AC

```
#define BAL_MAX_ENERGY_AC 200.0f
```

4.18.1.3 BAL_MAX_ENERGY_GTI

```
#define BAL_MAX_ENERGY_GTI 200.0f
```

4.18.1.4 BAL_MIN_ENERGY_AC

```
#define BAL_MIN_ENERGY_AC -200.0f
```

4.18.1.5 BAL_MIN_ENERGY_GTI

```
#define BAL_MIN_ENERGY_GTI -1400.0f
```

4.18.1.6 BAMPS_SANE

```
#define BAMPS_SANE 70.0f
```

4.18.1.7 BAT_CRITICAL

```
#define BAT_CRITICAL 200.0f
```

4.18.1.8 BAT_M_KW

```
#define BAT_M_KW 5120.0f
```

4.18.1.9 BAT_SOC_HIGH

```
#define BAT_SOC_HIGH 0.95f
```

4.18.1.10 BAT_SOC_LOW

```
#define BAT_SOC_LOW 0.64f
```

4.18.1.11 BAT_SOC_LOW_AC

```
#define BAT_SOC_LOW_AC 0.70f
```

4.18.1.12 BAT_SOC_TOP

```
#define BAT_SOC_TOP 0.98f
```

4.18.1.13 CLIENTID1

```
#define CLIENTID1 "Energy_Mqtt_HA1"
```

4.18.1.14 CLIENTID2

```
#define CLIENTID2 "Energy_Mqtt_HA2"
```

4.18.1.15 CLIENTID3

```
#define CLIENTID3 "Energy_Mqtt_HA3"
```

4.18.1.16 CMD_SEC

```
#define CMD_SEC 10
```

4.18.1.17 CRITIAL_SHUTDOWN_LOG

```
#define CRITIAL_SHUTDOWN_LOG
```

4.18.1.18 DAQ_STR

```
#define DAQ_STR 32
```

4.18.1.19 DAQ_STR_M

```
#define DAQ_STR_M DAQ_STR-1
```

4.18.1.20 DL_AC_DC_EFF

```
#define DL_AC_DC_EFF 1.24f
```

4.18.1.21 GTI_DELAY

```
#define GTI_DELAY 1
```

4.18.1.22 IAM_DELAY

```
#define IAM_DELAY 120
```

4.18.1.23 IM_DELAY

```
#define IM_DELAY 1
```

4.18.1.24 IM_DISPLAY

```
#define IM_DISPLAY 1
```

4.18.1.25 L1_P

```
#define L1_P IA_POWER
```

4.18.1.26 L2_P

```
#define L2_P L1_P+IA_LAST
```

4.18.1.27 L3_P

```
#define L3_P L2_P+IA_LAST
```

4.18.1.28 LADDRESS

```
#define LADDRESS "tcp://127.0.0.1:1883"
```

4.18.1.29 LOG_TO_FILE

```
#define LOG_TO_FILE "/store/logs/energy.log"
```

4.18.1.30 LOG_TO_FILE_ALT

```
#define LOG_TO_FILE_ALT "/tmp/energy.log"
```

4.18.1.31 LOG_VERSION

```
#define LOG_VERSION "V0.73"
```

4.18.1.32 LOW_LOG_SPAM

```
#define LOW_LOG_SPAM 2
```

4.18.1.33 MAX_ERROR

```
#define MAX_ERROR 5
```

4.18.1.34 MAX_IM_VAR

```
#define MAX_IM_VAR IA_LAST*PHASE_LAST
```

4.18.1.35 MAX_LOG_SPAM

```
#define MAX_LOG_SPAM 60
```

4.18.1.36 MIN_BAT_KW_AC_HI

```
#define MIN_BAT_KW_AC_HI BAT_M_KW*BAT_SOC_HIGH
```

4.18.1.37 MIN_BAT_KW_AC_LO

```
#define MIN_BAT_KW_AC_LO BAT_M_KW*BAT_SOC_LOW_AC
```

4.18.1.38 MIN_BAT_KW_BSOC_HI

```
#define MIN_BAT_KW_BSOC_HI 4550.0f
```

4.18.1.39 MIN_BAT_KW_BSOC_SLP

```
#define MIN_BAT_KW_BSOC_SLP 4000.0f
```

4.18.1.40 MIN_BAT_KW_GTI_HI

```
#define MIN_BAT_KW_GTI_HI BAT_M_KW*BAT_SOC_TOP
```

4.18.1.41 MIN_BAT_KW_GTI_LO

```
#define MIN_BAT_KW_GTI_LO BAT_M_KW*BAT_SOC_LOW
```

4.18.1.42 MQTT_TIMEOUT

```
#define MQTT_TIMEOUT 900
```

4.18.1.43 MQTT_VERSION

```
#define MQTT_VERSION "V3.11"
```

4.18.1.44 NO_CYLON

```
#define NO_CYLON
```

4.18.1.45 NORM_MODE

```
#define NORM_MODE 0
```

4.18.1.46 PAMPS_SANE

```
#define PAMPS_SANE 16.0f
```

4.18.1.47 PID_MODE

```
#define PID_MODE 1
```

4.18.1.48 PV_BIAS

```
#define PV_BIAS 288.0f
```

4.18.1.49 PV_BIAS_FLOAT

```
#define PV_BIAS_FLOAT 399.0f
```

4.18.1.50 PV_BIAS_LOW

```
#define PV_BIAS_LOW 222.0f
```

4.18.1.51 PV_BIAS_RATE

```
#define PV_BIAS_RATE 320.0f
```

4.18.1.52 PV_BIAS_SLEEP

```
#define PV_BIAS_SLEEP 480.0f
```

4.18.1.53 PV_BIAS_ZERO

```
#define PV_BIAS_ZERO 0.0f
```

4.18.1.54 PV_DL_B_AH_LOW

```
#define PV_DL_B_AH_LOW 100.0f
```

4.18.1.55 PV_DL_B_AH_MIN

```
#define PV_DL_B_AH_MIN 150.0f
```

4.18.1.56 PV_DL_B_V_LOW

```
#define PV_DL_B_V_LOW 23.8f
```

4.18.1.57 PV_DL_BIAS_RATE

```
#define PV_DL_BIAS_RATE 75.0f
```

4.18.1.58 PV_DL_EXCESS

```
#define PV_DL_EXCESS 500.0f
```

4.18.1.59 PV_DL_MPTT_EXCESS

```
#define PV_DL_MPTT_EXCESS 1300.0f
```

4.18.1.60 PV_DL_MPTT_IDLE

```
#define PV_DL_MPTT_IDLE 57.0f
```

4.18.1.61 PV_DL_MPTT_MAX

```
#define PV_DL_MPTT_MAX 1200.0f
```

4.18.1.62 PV_IGAIN

```
#define PV_IGAIN 0.12f
```

4.18.1.63 PV_IMAX

```
#define PV_IMAX 1400.0f
```

4.18.1.64 PV_PGAIN

```
#define PV_PGAIN 0.85f
```

4.18.1.65 PVOLTS_SANE

```
#define PVOLTS_SANE 150.0f
```

4.18.1.66 PWA_SANE

```
#define PWA_SANE 1700.0f
```

4.18.1.67 PWA_SLEEP

```
#define PWA_SLEEP 200.0f
```

4.18.1.68 QOS

```
#define QOS 1
```

4.18.1.69 RBUF_SIZ

```
#define RBUF_SIZ 82
```

4.18.1.70 RESET_LOG_SPAM

```
#define RESET_LOG_SPAM 120
```

4.18.1.71 SBUF_SIZ

```
#define SBUF_SIZ 16
```

4.18.1.72 SPACING_USEC

```
#define SPACING_USEC 500 * 1000
```

4.18.1.73 SW_QOS

```
#define SW_QOS 1
```

4.18.1.74 SYSLOG_SIZ

```
#define SYSLOG_SIZ 512
```

4.18.1.75 TIME_SYNC_SEC

```
#define TIME_SYNC_SEC 30
```

4.18.1.76 TIMEOUT

```
#define TIMEOUT 10000L
```

4.18.1.77 TNAME

```
#define TNAME "maint9"
```

4.18.1.78 TOPIC_HA

```
#define TOPIC_HA "home-assistant/status/switch"
```

4.18.1.79 TOPIC_P

```
#define TOPIC_P "mateq84/data/gticmd"
```

4.18.1.80 TOPIC_PACA

```
#define TOPIC_PACA "home-assistant/gtiac/availability"
```

4.18.1.81 TOPIC_PACC

```
#define TOPIC_PACC "home-assistant/gtiac/contact"
```

4.18.1.82 TOPIC_PDCA

```
#define TOPIC_PDCA "home-assistant/gtidc/availability"
```

4.18.1.83 TOPIC_PDCC

```
#define TOPIC_PDCC "home-assistant/gtidc/contact"
```

4.18.1.84 TOPIC_PPID

```
#define TOPIC_PPID "home-assistant/solar/pid"
```

4.18.1.85 TOPIC_SD

```
#define TOPIC_SD "mateq84/data/dumpload"
```

4.18.1.86 TOPIC_SHUTDOWN

```
#define TOPIC_SHUTDOWN "home-assistant/solar/shutdown"
```

4.18.1.87 TOPIC_SPAM

```
#define TOPIC_SPAM "mateq84/data/spam"
```

4.18.1.88 TOPIC_SS

```
#define TOPIC_SS "mateq84/data/solar"
```

4.18.1.89 UNIT_TEST

```
#define UNIT_TEST 2
```

4.18.1.90 USEC_SEC

```
#define USEC_SEC 1000000L
```

4.18.2 Enumeration Type Documentation

4.18.2.1 energy_state

```
enum energy_state
```

Enumerator

E_INIT	
E_RUN	
E_WAIT	
E_IDLE	
E_STOP	
E_LAST	

```
194                         {
195         E_INIT,
196         E_RUN,
197         E_WAIT,
198         E_IDLE,
199         E_STOP,
200         E_LAST,
201     };
```

4.18.2.2 iammeter_id

```
enum iammeter_id
```

Enumerator

IA_VOLTAGE	
IA_CURRENT	
IA_POWER	
IA_IMPORT	
IA_EXPORT	
IA_FREQ	
IA_PF	
IA_LAST	

```
219                         {
220         IA_VOLTAGE,
221         IA_CURRENT,
222         IA_POWER,
223         IA_IMPORT,
224         IA_EXPORT,
225         IA_FREQ,
226         IA_PF,
227         IA_LAST,
228     };
```

4.18.2.3 iammeter_phase

```
enum iammeter_phase
```

Enumerator

PHASE_A	
PHASE_B	
PHASE_C	
PHASE_LAST	

```
212                         {
213         PHASE_A,
214         PHASE_B,
215         PHASE_C,
216         PHASE_LAST,
217     };
```

4.18.2.4 mqtt_vars

```
enum mqtt_vars
```

Enumerator

V_FCCM	
V_FBEKW	
V_FRUNT	
V_FBAMPS	
V_FBV	
V_FLO	
V_FSO	
V_FACE	
V_BEN	
V_PWA	
V_PAMPS	
V_PVOLTS	
V_FLAST	
V_HDCSW	
V_HACSW	
V_HSHUT	
V_HMODE	
V_HCON0	
V_HCON1	
V_HCON2	
V_HCON3	
V_HCON4	
V_HCON5	
V_HCON6	
V_HCON7	
V_DVPV	
V_DPPV	
V_DPBAT	
V_DVBAT	
V_DCMPPT	
V_DPMPPT	
V_DAHBAT	
V_DCCMODE	
V_DGTI	
V_DLAST	

```
230                 {
231         V_FCCM,
232         V_FBEKW,
```

```
233         V_FRUNT,
234         V_FBAMPS,
235         V_FBV,
236         V_FLO,
237         V_FSO,
238         V_FACE,
239         V_BEN,
240         V_PWA,
241         V_PAMPS,
242         V_PVOLTS,
243         V_FLAST,
244         V_HDCSW,
245         V_HACSW,
246         V_HSHUT,
247         V_HMODE,
248         V_HCON0,
249         V_HCON1,
250         V_HCON2,
251         V_HCON3,
252         V_HCON4,
253         V_HCON5,
254         V_HCON6,
255         V_HCON7,
256         // add other data ranges here
257         V_DVPV,
258         V_DPPV,
259         V_DPBAT,
260         V_DVBAT,
261         V_DCMPPT,
262         V_DPMPPT,
263         V_DAHBAT,
264         V_DCCMODE,
265         V_DGTI,
266         V_DLAST,
267     };
```

4.18.2.5 running_state

```
enum running_state
```

Enumerator

R_INIT	
R_FLOAT	
R_SLEEP	
R_RUN	
R_IDLE	
R_LAST	

```
203                         {
204         R_INIT,
205         R_FLOAT,
206         R_SLEEP,
207         R_RUN,
208         R_IDLE,
209         R_LAST,
210     };
```

4.18.2.6 sane_vars

```
enum sane_vars
```

Enumerator

S_FCCM	
S_FBEKW	
S_FRUNT	
S_FBAMPS	
S_FBV	
S_FLO	
S_FSO	
S_FACE	
S_BEN	
S_PWA	
S_PAMPS	
S_PVOLTS	
S_FLAST	
S_HDCSW	
S_HACSW	
S_HSHUT	
S_HMODE	
S_DVPV	
S_DPPV	
S_DPBAT	
S_DVBAT	
S_DCMPPT	
S_DPMPPT	
S_DAHBAT	
S_DCCMODE	
S_DGTI	
S_DLAST	

```
269                     {
270         S_FCCM,
271         S_FBEKW,
272         S_FRUNT,
273         S_FBAMPS,
274         S_FBV,
275         S_FLO,
276         S_FSO,
277         S_FACE,
278         S_BEN,
279         S_PWA,
280         S_PAMPS,
281         S_PVOLTS,
282         S_FLAST,
283         S_HDCSW,
284         S_HACSW,
285         S_HSHUT,
286         S_HMODE,
287         // add other data ranges here
288         S_DVPV,
289         S_DPPV,
290         S_DPBAT,
291         S_DVBAT,
292         S_DCMPPT,
293         S_DPMPPT,
294         S_DAHBAT,
295         S_DCCMODE,
296         S_DGTI,
297         S_DLAST,
298     };
```

4.18.3 Function Documentation

4.18.3.1 connlost()

```
void connlost (
             void * context,
             char * cause )
298 {
299     struct ha_flag_type *ha_flag = context;
300     int32_t id_num;
301
302     // bug-out if no context variables passed to callback
303     if (context == NULL) {
304         id_num = -1;
305     } else {
306         id_num = ha_flag->ha_id;
307     }
308     fprintf(fout, "\n%s Connection lost, exit ha_energy program\n", log_time(false));
309     fprintf(fout, "%s     cause:  %s, %d\n", log_time(false), cause, id_num);
310     fprintf(fout, "%sDAEMON failure  LOG Version %s :  MQTT Version %s\n", log_time(false), LOG_VERSION,
    MQTT_VERSION);
311     fflush(fout);
312     exit(EXIT_FAILURE);
313 }
```

4.18.3.2 ha_ac_off()

```
void ha_ac_off (
             void  )
947 {
948     mqtt_ha_switch(E.client_p, TOPIC_PACC, false);
949     E.ac_sw_status = false;
950 }
```

4.18.3.3 ha_ac_on()

```
void ha_ac_on (
             void  )
953 {
954     mqtt_ha_switch(E.client_p, TOPIC_PACC, true);
955     E.ac_sw_status = true;
956 }
```

4.18.3.4 ha_dc_off()

```
void ha_dc_off (
             void  )
962 {
963     mqtt_ha_switch(E.client_p, TOPIC_PDCC, false);
964     E.gti_sw_status = false;
965 }
```

4.18.3.5 ha_dc_on()

```
void ha_dc_on (
              void  )
968 {
969     mqtt_ha_switch(E.client_p, TOPIC_PDCC, true);
970     E.gti_sw_status = true;
971 }
```

4.18.3.6 iammeter_read()

```
void iammeter_read (
              void  )
76 {
77
78     curl = curl_easy_init();
79     if (curl) {
80         E.link.iammeter_count++;
81         curl_easy_setopt(curl, CURLOPT_URL, "http://10.1.1.101/monitorjson");
82         curl_easy_setopt(curl, CURLOPT_WRITEFUNCTION, iammeter_write_callback);
83         curl_easy_setopt(curl, CURLOPT_WRITEDATA, E.print_vars); // external data array for iammeter
     values
84
85         res = curl_easy_perform(curl);
86         /* Check for errors */
87         if (res != CURLE_OK) {
88             fprintf(fout, "curl_easy_perform() failed in iammeter_read:  %s\n",
89                 curl_easy_strerror(res));
90             E.iammeter = false;
91             E.link.iammeter_error++;
92         } else {
93             E.iammeter = true;
94         }
95         curl_easy_cleanup(curl);
96     }
97 }
```

4.18.3.7 iammeter_write_callback()

```
size_t iammeter_write_callback (
              char * buffer,
              size_t size,
              size_t nitems,
              void * stream )
14 {
15     cJSON *json = cJSON_ParseWithLength(buffer, strlen(buffer));
16     struct energy_type * e = stream;
17     uint32_t next_var = 0;
18
19     E.link.iammeter_count++;
20
21     if (json == NULL) {
22         const char *error_ptr = cJSON_GetErrorPtr();
23         E.link.iammeter_error++;
24         if (error_ptr != NULL) {
25             fprintf(fout, "Error in iammeter_write_callback %u:  %s\n", E.link.iammeter_error,
     error_ptr);
26         }
27         goto iammeter_exit;
28     }
29 #ifdef IM_DEBUG
30     fprintf(fout, "\n iammeter_read_callback %s \n", buffer);
31 #endif
32
33     cJSON *data_result = cJSON_GetObjectItemCaseSensitive(json, "Datas");
34
35     if (!data_result) {
```

```
36          size = 0;
37          nitems = 0;
38          goto iammeter_exit;
39      }
40
41      cJSON *jname;
42      uint32_t phase = PHASE_A;
43
44      cJSON_ArrayForEach(jname, data_result)
45      {
46          cJSON *ianame;
47  #ifdef IM_DEBUG
48          fprintf(fout, "\n iammeter variables ");
49  #endif
50
51          cJSON_ArrayForEach(ianame, jname)
52          {
53              uint32_t phase_var = IA_VOLTAGE;
54              iammeter_get_data(ianame->valuedouble, phase_var, phase);
55              e->print_vars[next_var++] = ianame->valuedouble;
56  #ifdef IM_DEBUG
57              fprintf(fout, "%8.2f ", im_vars[phase_var][phase]);
58  #endif
59              phase_var++;
60          }
61          phase++;
62      }
63  #ifdef IM_DEBUG
64      fprintf(fout, "\n");
65  #endif
66
67  iammeter_exit:
68      cJSON_Delete(json);
69      return size * nitems;
70  }
```

4.18.3.8 log_time()

```
char * log_time (
            bool log )
1032 {
1033      static char time_log[RBUF_SIZ] = {0};
1034      static uint32_t len = 0, sync_time = TIME_SYNC_SEC - 1;
1035      time_t rawtime_log;
1036
1037      tzset();
1038      timezone = 0;
1039      daylight = 0;
1040      time(&rawtime_log);
1041      if (sync_time++ > TIME_SYNC_SEC) {
1042          sync_time = 0;
1043          snprintf(time_log, RBUF_SIZ - 1, "VT%lut", rawtime_log); // format for dumpload controller gti
      time commands
1044          mqtt_gti_time(E.client_p, TOPIC_P, time_log);
1045      }
1046
1047      sprintf(time_log, "%s", ctime(&rawtime_log));
1048      len = strlen(time_log);
1049      time_log[len - 1] = 0; // munge out the return character
1050      if (log) {
1051          fprintf(fout, "%s ", time_log);
1052          fflush(fout);
1053      }
1054
1055      return time_log;
1056  }
```

4.18.3.9 log_timer()

```
bool log_timer (
            void  )
```

```
1091 {
1092     bool itstime = false;
1093 
1094     if (E.log_spam < LOW_LOG_SPAM) {
1095         E.log_time_reset = 0;
1096         itstime = true;
1097     }
1098     if (E.log_time_reset > RESET_LOG_SPAM) {
1099         E.log_spam = 0;
1100         itstime = true;
1101     }
1102     return itstime;
1103 }
```

4.18.3.10 print_im_vars()

```
void print_im_vars (
             void  )
111 {
112     static char time_log[RBUF_SIZ] = {0};
113     static uint32_t sync_time = TIME_SYNC_SEC - 1;
114     time_t rawtime_log;
115     char imvars[SYSLOG_SIZ];
116 
117     fflush(fout);
118     snprintf(imvars, SYSLOG_SIZ-1, "House L1 %7.2fW, House L2 %7.2fW, GTI L1 %7.2fW",
      E.print_vars[L1_P], E.print_vars[L2_P], E.print_vars[L3_P]);
119     fprintf(fout, "%s", imvars);
120     fflush(fout);
121     time(&rawtime_log);
122     if (sync_time++ > TIME_SYNC_SEC) {
123         sync_time = 0;
124         snprintf(time_log, RBUF_SIZ - 1, "VT%lut", rawtime_log); // format for dumpload controller gti
      time commands
125         mqtt_gti_time(E.client_p, TOPIC_P, time_log);
126     }
127 }
```

4.18.3.11 print_mvar_vars()

```
void print_mvar_vars (
             void  )
237 {
238     fprintf(fout, ", AC Inverter %7.2fW, BAT Energy %7.2fWh, Solar E %7.2fWh, AC E %7.2fWh, PERR %7.2fW,
      PBAL %7.2fW, ST %7.2f, GDL %7.2f, %d,%d,%d %d,%d,%d\r",
239         E.mvar[V_FLO], E.mvar[V_FBEKW], E.mvar[V_FSO], E.mvar[V_FACE], E.mode.error, E.mvar[V_BEN],
      E.mode.total_system, E.mode.gti_dumpload, (int32_t) E.mvar[V_HDCSW], (int32_t) E.mvar[V_HACSW],
      (int32_t) E.mvar[V_HMODE],
240         (int32_t) E.dc_mismatch, (int32_t) E.ac_mismatch, (int32_t) E.mode_mismatch);
241 }
```

4.18.3.12 ramp_down_ac()

```
void ramp_down_ac (
             MQTTClient client_p,
             bool sw_off )
937 {
938     if (sw_off) {
939         mqtt_ha_switch(client_p, TOPIC_PACC, false);
940         E.ac_sw_status = false;
941         usleep(500000);
942     }
943     E.once_ac = true;
944 }
```

4.18.3.13 ramp_down_gti()

```
void ramp_down_gti (
            MQTTClient client_p,
            bool sw_off )
904 {
905     if (sw_off) {
906         mqtt_ha_switch(client_p, TOPIC_PDCC, false);
907         E.once_gti_zero = true;
908         E.gti_sw_status = false;
909     }
910     E.once_gti = true;
911
912     if (E.once_gti_zero) {
913         mqtt_gti_power(client_p, TOPIC_P, "Z#", 7); // zero power
914         E.once_gti_zero = false;
915     }
916 }
```

4.18.3.14 ramp_up_ac()

```
void ramp_up_ac (
            MQTTClient client_p,
            bool start )
922 {
923
924     if (start) {
925         E.once_ac = true;
926     }
927
928     if (E.once_ac) {
929         E.once_ac = false;
930         mqtt_ha_switch(client_p, TOPIC_PACC, true);
931         E.ac_sw_status = true;
932         usleep(500000); // wait for voltage to ramp
933     }
934 }
```

4.18.3.15 ramp_up_gti()

```
void ramp_up_gti (
            MQTTClient client_p,
            bool start,
            bool excess )
843 {
844     static uint32_t sequence = 0;
845
846     if (start) {
847         E.once_gti = true;
848     }
849
850     if (E.once_gti) {
851         E.once_gti = false;
852         sequence = 0;
853         if (!excess) {
854             mqtt_ha_switch(client_p, TOPIC_PDCC, true);
855             E.gti_sw_status = true;
856             usleep(500000); // wait for voltage to ramp
857         } else {
858             sequence = 1;
859         }
860     }
861
862     switch (sequence) {
863     case 4:
864         E.once_gti_zero = true;
865         break;
```

```
866     case 3:
867     case 2:
868     case 1:
869         E.once_gti_zero = true;
870         if (bat_current_stable() || E.dl_excess) { // check battery current std dev, stop 'motorboating'
871             sequence++;
872             if (!mqtt_gti_power(client_p, TOPIC_P, "+#", 3)) {
873                 sequence = 0;
874             }; // +100W power
875         } else {
876             usleep(500000); // wait a bit more for power to be stable
877             sequence = 1; // do power ramps when ready
878             if (!mqtt_gti_power(client_p, TOPIC_P, "-#", 4)) {
879                 sequence = 0;
880             }; // - 100W power
881         }
882         break;
883     case 0:
884         sequence++;
885         if (E.once_gti_zero) {
886             mqtt_gti_power(client_p, TOPIC_P, "Z#", 5); // zero power
887             E.once_gti_zero = false;
888         }
889         break;
890     default:
891         if (E.once_gti_zero) {
892             mqtt_gti_power(client_p, TOPIC_P, "Z#", 6); // zero power
893             E.once_gti_zero = false;
894         }
895         sequence = 0;
896         break;
897     }
898 }
```

4.18.3.16 sanity_check()

```
bool sanity_check (
             void  )
254 {
255     if (E.mvar[V_PWA] > PWA_SANE) {
256         E.sane = S_PWA;
257         return false;
258     }
259     if (E.mvar[V_PAMPS] > PAMPS_SANE) {
260         E.sane = S_PAMPS;
261         return false;
262     }
263     if (E.mvar[V_PVOLTS] > PVOLTS_SANE) {
264         E.sane = S_PVOLTS;
265         return false;
266     }
267     if (E.mvar[V_FBAMPS] > BAMPS_SANE) {
268         E.sane = S_FBAMPS;
269         return false;
270     }
271     return true;
272 }
```

4.18.3.17 sync_ha()

```
bool sync_ha (
             void  )
1062 {
1063     bool sync = false;
1064     if (E.gti_sw_status != (bool) ((int32_t) E.mvar[V_HDCSW])) {
1065         fprintf(fout, "DC_MM %d %d ", (bool) E.gti_sw_status, (bool) ((int32_t) E.mvar[V_HDCSW]));
1066         mqtt_ha_switch(E.client_p, TOPIC_PDCC, !E.gti_sw_status);
1067         E.dc_mismatch = true;
1068         fflush(fout);
1069         sync = true;
1070     } else {
```

```
1071         E.dc_mismatch = false;
1072     }
1073
1074     E.ac_sw_status = (bool) ((int32_t) E.mvar[V_HACSW]); // TEMP FIX for MISmatch errors
1075     if (E.ac_sw_status != (bool) ((int32_t) E.mvar[V_HACSW])) {
1076         fprintf(fout, "AC_MM %d %d ", (bool) E.ac_sw_status, (bool) ((int32_t) E.mvar[V_HACSW]));
1077         mqtt_ha_switch(E.client_p, TOPIC_PACC, !E.ac_sw_status);
1078         E.ac_mismatch = true;
1079         fflush(fout);
1080         sync = true;
1081     } else {
1082         E.ac_mismatch = false;
1083     }
1084     return sync;
1085 }
```

4.18.3.18 timer_callback()

```
void timer_callback (
              int32_t signum )
283 {
284     signal(signum, timer_callback);
285     ha_flag_vars_ss.runner = true;
286     E.ten_sec_clock++;
287     E.log_spam++;
288     E.log_time_reset++;
289     if (E.log_spam > MAX_LOG_SPAM) {
290         E.log_spam = 0;
291     }
292 }
```

4.18.4 Variable Documentation

4.18.4.1 E

```
struct energy_type E  [extern]
```

4.18.4.2 fout

```
FILE* fout  [extern]
```

4.18.4.3 ha_flag_vars_ss

```
struct ha_flag_type ha_flag_vars_ss  [extern]
```

4.19 energy.h

Go to the documentation of this file.

```
1 /*
2 * File:      bmc.h
3 * Author:  root
4 *
5 * Created on September 21, 2012, 12:54 PM
6 */
7
8 #ifndef BMC_H
9 #define BMC_H
10
11 #ifdef __cplusplus
12 extern "C" {
13 #endif
14 #include <stdlib.h>
15 #include <stdio.h> /* for printf() */
16 #include <unistd.h>
17 #include <stdint.h>
18 #include <string.h>
19 #include <stdbool.h>
20 #include <signal.h>
21 #include <time.h>
22 #include <sys/wait.h>
23 #include <sys/types.h>
24 #include <sys/time.h>
25 #include <errno.h>
26 #include <cjson/cJSON.h>
27 #include <curl/curl.h>
28 #include <pthread.h>
29 #include <sys/stat.h>
30 #include <syslog.h>
31 #include <arpa/inet.h>
32 #include <sys/socket.h>
33 #include <netdb.h>
34 #include <ifaddrs.h>
35 #include "MQTTClient.h"
36 #include "pid.h"
37
38
39 #define LOG_VERSION     "V0.73"
40 #define MQTT_VERSION    "V3.11"
41 #define TNAME  "maint9"
42 #define LADDRESS        "tcp://127.0.0.1:1883"
43 #ifdef __amd64
44 #define ADDRESS         "tcp://10.1.1.172:1883"
45 #else
46 #define ADDRESS         "tcp://10.1.1.30:1883"
47 #endif
48 #define CLIENTID1       "Energy_Mqtt_HA1"
49 #define CLIENTID2       "Energy_Mqtt_HA2"
50 #define CLIENTID3       "Energy_Mqtt_HA3"
51 #define TOPIC_P         "mateq84/data/gticmd"
52 #define TOPIC_SPAM      "mateq84/data/spam"
53 #define TOPIC_PACA      "home-assistant/gtiac/availability"
54 #define TOPIC_PDCA      "home-assistant/gtidc/availability"
55 #define TOPIC_PACC      "home-assistant/gtiac/contact"
56 #define TOPIC_PDCC      "home-assistant/gtidc/contact"
57 #define TOPIC_PPID      "home-assistant/solar/pid"
58 #define TOPIC_SHUTDOWN  "home-assistant/solar/shutdown"
59 #define TOPIC_SS        "mateq84/data/solar"
60 #define TOPIC_SD        "mateq84/data/dumpload"
61 #define TOPIC_HA        "home-assistant/status/switch"
62 #define QOS             1
63 #define TIMEOUT         10000L
64 #define SPACING_USEC    500 * 1000
65 #define USEC_SEC        1000000L
66
67 #define DAQ_STR 32
68 #define DAQ_STR_M DAQ_STR-1
69
70 #define SBUF_SIZ        16  // short buffer string size
71 #define RBUF_SIZ        82
72 #define SYSLOG_SIZ      512
73
74 #define MQTT_TIMEOUT    900
75 #define SW_QOS          1
76
77 #define NO_CYLON
78 #define CRITIAL_SHUTDOWN_LOG
79
80 #define UNIT_TEST       2
81 #define NORM_MODE       0
82 #define PID_MODE        1
```

```
83 #define MAX_ERROR       5
84 #define IAM_DELAY       120
85
86 #define CMD_SEC         10
87 #define TIME_SYNC_SEC   30
88
89     /*
90 * Battery SoC cycle limits parameters
91 */
92 #define BAT_M_KW            5120.0f
93 #define BAT_SOC_TOP         0.98f
94 #define BAT_SOC_HIGH        0.95f
95 #define BAT_SOC_LOW         0.64f
96 #define BAT_SOC_LOW_AC      0.70f
97 #define BAT_CRITICAL        200.0f
98 #define MIN_BAT_KW_BSOC_SLP 4000.0f
99 #define MIN_BAT_KW_BSOC_HI  4550.0f
100
101 #define MIN_BAT_KW_GTI_HI   BAT_M_KW*BAT_SOC_TOP
102 #define MIN_BAT_KW_GTI_LO   BAT_M_KW*BAT_SOC_LOW
103
104 #define MIN_BAT_KW_AC_HI    BAT_M_KW*BAT_SOC_HIGH
105 #define MIN_BAT_KW_AC_LO    BAT_M_KW*BAT_SOC_LOW_AC
106
107     /*
108 * PV panel cycle limits parameters
109 */
110 #define PV_PGAIN            0.85f
111 #define PV_IGAIN            0.12f
112 #define PV_IMAX             1400.0f
113 #define PV_BIAS             288.0f
114 #define PV_BIAS_ZERO          0.0f
115 #define PV_BIAS_LOW         222.0f
116 #define PV_BIAS_FLOAT       399.0f
117 #define PV_BIAS_SLEEP       480.0f
118 #define PV_BIAS_RATE        320.0f
119 #define PV_DL_MPTT_MAX     1200.0f
120 #define PV_DL_MPTT_EXCESS  1300.0f
121 #define PV_DL_MPTT_IDLE     57.0f
122 #define PV_DL_BIAS_RATE     75.0f
123 #define PV_DL_EXCESS       500.0f
124 #define PV_DL_B_AH_LOW     100.0f
125 #define PV_DL_B_AH_MIN     150.0f // DL battery should be at least 175Ah
126 #define PV_DL_B_V_LOW       23.8f // Battery low-voltqage cutoff
127 #define PWA_SLEEP          200.0f
128 #define DL_AC_DC_EFF        1.24f
129
130     /*
131 * Energy control loop parameters
132 */
133 #define BAL_MIN_ENERGY_AC   -200.0f
134 #define BAL_MAX_ENERGY_AC   200.0f
135 #define BAL_MIN_ENERGY_GTI  -1400.0f
136 #define BAL_MAX_ENERGY_GTI  200.0f
137
138 #define LOG_TO_FILE         "/store/logs/energy.log"
139 #define LOG_TO_FILE_ALT     "/tmp/energy.log"
140
141 #define MAX_LOG_SPAM  60
142 #define LOW_LOG_SPAM  2
143 #define RESET_LOG_SPAM  120
144
145     //#define IM_DEBUG                      // WEM3080T LOGGING
146     //#define B_ADJ_DEBUG                   // debug printing
147     //#define FAKE_VPV                      // NO AC CHARGER for DUMPLOAD, batteries are cross-connected
      to a parallel bank
148     //#define PSW_DEBUG
149     //#define DEBUG_SHUTDOWN
150
151     //#define AUTO_CHARGE                   // turn on dumpload charger during restarts
152     //#define B_DLE_DEBUG    // Dump Load debugging
153     //#define BSOC_DEGUB
154     //#define DEBUG_HA_CMD
155
156 #define IM_DELAY            1   // tens of second updates
157 #define IM_DISPLAY          1
158 #define GTI_DELAY           1
159
160     /*
161 * sane limits for system data elements
162 */
163 #define PWA_SANE            1700.0f
164 #define PAMPS_SANE          16.0f
165 #define PVOLTS_SANE         150.0f
166 #define BAMPS_SANE          70.0f
167
168     /*
```

```
169 Three Phase WiFi Energy Meter (WEM3080T)
170 name    Unit    Description
171 wem3080t_voltage_a  V   A phase voltage
172 wem3080t_current_a  A   A phase current
173 wem3080t_power_a    W   A phase active power
174 wem3080t_importenergy_a kWh A phase import energy
175 wem3080t_exportgrid_a   kWh A phase export energy
176 wem3080t_frequency_a    kWh A phase frequency
177 wem3080t_pf_a   kWh A phase power factor
178 wem3080t_voltage_b  V   B phase voltage
179 wem3080t_current_b  A   B phase current
180 wem3080t_power_b    W   B phase active power
181 wem3080t_importenergy_b kWh B phase import energy
182 wem3080t_exportgrid_b   kWh B phase export energy
183 wem3080t_frequency_b    kWh B phase frequency
184 wem3080t_pf_b   kWh B phase power factor
185 wem3080t_voltage_c  V   C phase voltage
186 wem3080t_current_c  A   C phase current
187 wem3080t_power_c    W   C phase active power
188 wem3080t_importenergy_c kWh C phase import energy
189 wem3080t_exportgrid_c   kWh C phase export energy
190 wem3080t_frequency_c    kWh C phase frequency
191 wem3080t_pf_c   kWh C phase power factor
192 */
193
194     enum energy_state {
195         E_INIT,
196         E_RUN,
197         E_WAIT,
198         E_IDLE,
199         E_STOP,
200         E_LAST,
201     };
202
203     enum running_state {
204         R_INIT,
205         R_FLOAT,
206         R_SLEEP,
207         R_RUN,
208         R_IDLE,
209         R_LAST,
210     };
211
212     enum iammeter_phase {
213         PHASE_A,
214         PHASE_B,
215         PHASE_C,
216         PHASE_LAST,
217     };
218
219     enum iammeter_id {
220         IA_VOLTAGE,
221         IA_CURRENT,
222         IA_POWER,
223         IA_IMPORT,
224         IA_EXPORT,
225         IA_FREQ,
226         IA_PF,
227         IA_LAST,
228     };
229
230     enum mqtt_vars {
231         V_FCCM,
232         V_FBEKW,
233         V_FRUNT,
234         V_FBAMPS,
235         V_FBV,
236         V_FLO,
237         V_FSO,
238         V_FACE,
239         V_BEN,
240         V_PWA,
241         V_PAMPS,
242         V_PVOLTS,
243         V_FLAST,
244         V_HDCSW,
245         V_HACSW,
246         V_HSHUT,
247         V_HMODE,
248         V_HCON0,
249         V_HCON1,
250         V_HCON2,
251         V_HCON3,
252         V_HCON4,
253         V_HCON5,
254         V_HCON6,
255         V_HCON7,
```

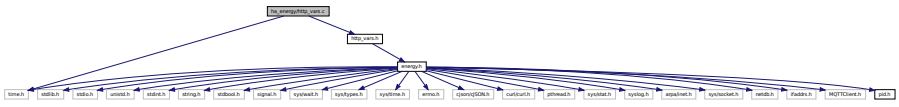
```
256         // add other data ranges here
257         V_DVPV,
258         V_DPPV,
259         V_DPBAT,
260         V_DVBAT,
261         V_DCMPPT,
262         V_DPMPPT,
263         V_DAHBAT,
264         V_DCCMODE,
265         V_DGTI,
266         V_DLAST,
267     };
268
269     enum sane_vars {
270         S_FCCM,
271         S_FBEKW,
272         S_FRUNT,
273         S_FBAMPS,
274         S_FBV,
275         S_FLO,
276         S_FSO,
277         S_FACE,
278         S_BEN,
279         S_PWA,
280         S_PAMPS,
281         S_PVOLTS,
282         S_FLAST,
283         S_HDCSW,
284         S_HACSW,
285         S_HSHUT,
286         S_HMODE,
287         // add other data ranges here
288         S_DVPV,
289         S_DPPV,
290         S_DPBAT,
291         S_DVBAT,
292         S_DCMPPT,
293         S_DPMPPT,
294         S_DAHBAT,
295         S_DCCMODE,
296         S_DGTI,
297         S_DLAST,
298     };
299
300 #define MAX_IM_VAR  IA_LAST*PHASE_LAST
301
302 #define L1_P    IA_POWER
303 #define L2_P    L1_P+IA_LAST
304 #define L3_P    L2_P+IA_LAST
305
306     struct link_type {
307         volatile uint32_t iammeter_error, iammeter_count;
308         volatile uint32_t mqtt_error, mqtt_count;
309         volatile uint32_t shutdown;
310     };
311
312     struct mode_type {
313         volatile double error, target, total_system, gti_dumpload, pv_bias, dl_mqtt_max, off_grid,
    sequence;
314         volatile bool mode, in_pid_control, con0, con1, con2, con3, con4, con5, con6, con7, no_float,
    data_error, bat_crit;
315         volatile uint32_t mode_tmr;
316         volatile struct SPid pid;
317         volatile enum energy_state E;
318         volatile enum running_state R;
319     };
320
321     struct energy_type {
322         volatile double print_vars[MAX_IM_VAR];
323         volatile double im_vars[IA_LAST][PHASE_LAST];
324         volatile double mvar[V_DLAST + 1];
325         volatile bool once_gti, once_ac, iammeter, fm80, dumpload, homeassistant, once_gti_zero;
326         volatile double gti_low_adj, ac_low_adj, dl_excess_adj;
327         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;
328         volatile uint32_t speed_go, im_delay, im_display, gti_delay;
329         volatile int32_t rc, sane;
330         volatile uint32_t ten_sec_clock, log_spam, log_time_reset;
331         pthread_mutex_t ha_lock;
332         struct mode_type mode;
333         struct link_type link;
334         MQTTClient client_p, client_sd, client_ha;
335     };
336
337     extern struct energy_type E;
338     extern struct ha_flag_type ha_flag_vars_ss;
339     extern FILE* fout;
```

```
340
341     void timer_callback(int32_t);
342     void connlost(void *, char *);
343
344     void ramp_up_gti(MQTTClient, bool, bool);
345     void ramp_up_ac(MQTTClient, bool);
346     void ramp_down_gti(MQTTClient, bool);
347     void ramp_down_ac(MQTTClient, bool);
348     void ha_ac_off(void);
349     void ha_ac_on(void);
350     void ha_dc_off(void);
351     void ha_dc_on(void);
352
353     size_t iammeter_write_callback(char *, size_t, size_t, void *);
354     void iammeter_read(void);
355     void print_im_vars(void);
356     void print_mvar_vars(void);
357
358     bool sanity_check(void);
359     char * log_time(bool);
360     bool sync_ha(void);
361     bool log_timer(void);
362
363 #ifdef __cplusplus
364 }
365 #endif
366
367 #endif /* BMC_H */
368
```

4.20 ha_energy/http_vars.c File Reference

```
#include "http_vars.h"
#include <time.h>
```

Include dependency graph for http_vars.c:



Functions

- static void iammeter_get_data (const double, const uint32_t, const uint32_t)
- bool mqtt_gti_time (MQTTClient, const char *, char *)
- size_t iammeter_write_callback (char *buffer, size_t size, size_t nitems, void *stream)
- void iammeter_read (void)
- void print_im_vars (void)

Variables

- static CURL * curl
- static CURLcode res

4.20.1 Function Documentation

4.20.1.1 iammeter_get_data()

```
static void iammeter_get_data (
              const double valuedouble,
              const uint32_t i,
              const uint32_t j )  [static]
103 {
104     E.im_vars[i][j] = valuedouble;
105 }
```

4.20.1.2 iammeter_read()

```
void iammeter_read (
              void  )
76 {
77
78     curl = curl_easy_init();
79     if (curl) {
80         E.link.iammeter_count++;
81         curl_easy_setopt(curl, CURLOPT_URL, "http://10.1.1.101/monitorjson");
82         curl_easy_setopt(curl, CURLOPT_WRITEFUNCTION, iammeter_write_callback);
83         curl_easy_setopt(curl, CURLOPT_WRITEDATA, E.print_vars); // external data array for iammeter
      values
84
85         res = curl_easy_perform(curl);
86         /* Check for errors */
87         if (res != CURLE_OK) {
88             fprintf(fout, "curl_easy_perform() failed in iammeter_read:  %s\n",
89                 curl_easy_strerror(res));
90             E.iammeter = false;
91             E.link.iammeter_error++;
92         } else {
93             E.iammeter = true;
94         }
95         curl_easy_cleanup(curl);
96     }
97 }
```

4.20.1.3 iammeter_write_callback()

```
size_t iammeter_write_callback (
              char * buffer,
              size_t size,
              size_t nitems,
              void * stream )
14 {
15     cJSON *json = cJSON_ParseWithLength(buffer, strlen(buffer));
16     struct energy_type * e = stream;
17     uint32_t next_var = 0;
18
19     E.link.iammeter_count++;
20
21     if (json == NULL) {
22         const char *error_ptr = cJSON_GetErrorPtr();
23         E.link.iammeter_error++;
24         if (error_ptr != NULL) {
25             fprintf(fout, "Error in iammeter_write_callback %u:  %s\n", E.link.iammeter_error,
      error_ptr);
26         }
27         goto iammeter_exit;
28     }
29 #ifdef IM_DEBUG
30     fprintf(fout, "\n iammeter_read_callback %s \n", buffer);
31 #endif
32
33     cJSON *data_result = cJSON_GetObjectItemCaseSensitive(json, "Datas");
```

```
34
35      if (!data_result) {
36          size = 0;
37          nitems = 0;
38          goto iammeter_exit;
39      }
40
41      cJSON *jname;
42      uint32_t phase = PHASE_A;
43
44      cJSON_ArrayForEach(jname, data_result)
45      {
46          cJSON *ianame;
47  #ifdef IM_DEBUG
48          fprintf(fout, "\n iammeter variables ");
49  #endif
50
51          cJSON_ArrayForEach(ianame, jname)
52          {
53              uint32_t phase_var = IA_VOLTAGE;
54              iammeter_get_data(ianame->valuedouble, phase_var, phase);
55              e->print_vars[next_var++] = ianame->valuedouble;
56  #ifdef IM_DEBUG
57              fprintf(fout, "%8.2f ", im_vars[phase_var][phase]);
58  #endif
59              phase_var++;
60          }
61          phase++;
62      }
63  #ifdef IM_DEBUG
64      fprintf(fout, "\n");
65  #endif
66
67  iammeter_exit:
68      cJSON_Delete(json);
69      return size * nitems;
70  }
```

4.20.1.4 mqtt_gti_time()

```
bool mqtt_gti_time (
              MQTTClient client_p,
              const char * topic_p,
              char * msg )
249 {
250     bool ret = true;
251     MQTTClient_message pubmsg = MQTTClient_message_initializer;
252     MQTTClient_deliveryToken token;
253     ha_flag_vars_ss.deliveredtoken = 0;
254
255     E.link.mqtt_count++;
256     pubmsg.payload = msg;
257     pubmsg.payloadlen = strlen(msg);
258     pubmsg.qos = QOS;
259     pubmsg.retained = 0;
260
261     MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token); // run time commands
262
263     // a busy, wait loop for the async delivery thread to complete
264     {
265         uint32_t waiting = 0;
266         while (ha_flag_vars_ss.deliveredtoken != token) {
267             usleep(GTI_TOKEN_DELAY);
268             if (waiting++ > MQTT_TIMEOUT) {
269                 fprintf(fout, "\r\n%s GTI Time Still Waiting, timeout\r\n", log_time(false));
270                 break;
271             }
272         };
273     }
274     usleep(HA_SW_DELAY);
275     return ret;
276 }
```

4.20.1.5 print_im_vars()

```
void print_im_vars (
            void  )
111 {
112     static char time_log[RBUF_SIZ] = {0};
113     static uint32_t sync_time = TIME_SYNC_SEC - 1;
114     time_t rawtime_log;
115     char imvars[SYSLOG_SIZ];
116
117     fflush(fout);
118     snprintf(imvars, SYSLOG_SIZ-1, "House L1 %7.2fW, House L2 %7.2fW, GTI L1 %7.2fW",
      E.print_vars[L1_P], E.print_vars[L2_P], E.print_vars[L3_P]);
119     fprintf(fout, "%s", imvars);
120     fflush(fout);
121     time(&rawtime_log);
122     if (sync_time++ > TIME_SYNC_SEC) {
123         sync_time = 0;
124         snprintf(time_log, RBUF_SIZ - 1, "VT%lut", rawtime_log); // format for dumpload controller gti
      time commands
125         mqtt_gti_time(E.client_p, TOPIC_P, time_log);
126     }
127 }
```

4.20.2 Variable Documentation

4.20.2.1 curl

```
CURL* curl  [static]
```

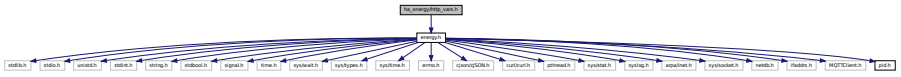
4.20.2.2 res

```
CURLcode res  [static]
```

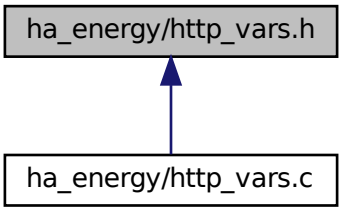
4.21 ha_energy/http_vars.h File Reference

```
#include "energy.h"
```

Include dependency graph for http_vars.h:



This graph shows which files directly or indirectly include this file:



Variables

- FILE * fout

4.21.1 Variable Documentation

4.21.1.1 fout

```
FILE* fout  [extern]
```

4.22 http_vars.h

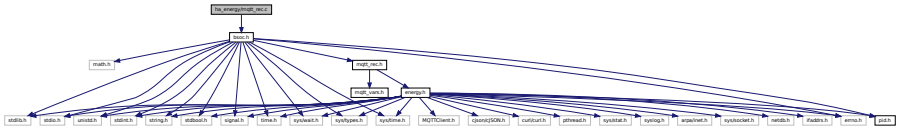
Go to the documentation of this file.

```
1 /*
2 * File:      http_vars.h
3 * Author:  root
4 *
5 * Created on February 16, 2024, 8:37 AM
6 */
7
8 #ifndef HTTP_VARS_H
9 #define HTTP_VARS_H
10
11 #ifdef __cplusplus
12 extern "C" {
13 #endif
14
15 #include "energy.h"
16
17     extern FILE* fout;
18
19 #ifdef __cplusplus
20 }
21 #endif
22
23 #endif /* HTTP_VARS_H */
24
```

4.23 ha_energy/mqtt_rec.c File Reference

```
#include "bsoc.h"
```

Include dependency graph for mqtt_rec.c:



Functions

- int32_t msgarrvd (void *context, char *topicName, int topicLen, MQTTClient_message *message)
- void delivered (void *context, MQTTClient_deliveryToken dt)
- bool json_get_data (cJSON *json_src, const char *data_id, cJSON *name, uint32_t i)
- void print_mvar_vars (void)
- bool fm80_float (const bool set_bias)
- bool fm80_sleep (void)

4.23.1 Function Documentation

4.23.1.1 delivered()

```
void delivered (
            void * context,
            MQTTClient_deliveryToken dt )
123 {
124     struct ha_flag_type *ha_flag = context;
125
126     // bug-out if no context variables passed to callback
127     if (context == NULL) {
128         return;
129     }
130     ha_flag->deliveredtoken = dt;
131 }
```

4.23.1.2 fm80_float()

```
bool fm80_float (
            const bool set_bias )
247 {
248     if ((uint32_t) E.mvar[V_FCCM] == FLOAT_CODE) {
249         if (set_bias) {
250             E.mode.pv_bias = PV_BIAS_FLOAT;
251         }
252         if (E.mode.R != R_IDLE) {
253             E.mode.R = R_FLOAT;
254         }
255         return true;
256     } else {
257         if (E.mode.R == R_FLOAT) {
258             E.mode.R = R_RUN;
259         }
260     }
261     return false;
262 }
```

4.23.1.3 fm80_sleep()

```
bool fm80_sleep (
            void  )
269 {
270     if ((uint32_t) E.mvar[V_FCCM] == SLEEP_CODE) {
271         return true;
272     }
273     return false;
274 }
```

4.23.1.4 json_get_data()

```
bool json_get_data (
            cJSON * json_src,
            const char * data_id,
            cJSON * name,
            uint32_t i )
138 {
139     bool ret = false;
140     static uint32_t j = 0;
141 
142     // access the JSON data using the lookup string passed in data_id
143     name = cJSON_GetObjectItemCaseSensitive(json_src, data_id);
144 
145     /*
146 * process string values
147 */
148     if (cJSON_IsString(name) && (name->valuestring != NULL)) {
149 #ifdef GET_DEBUG
150         fprintf(fout, "%s Name:  %s\n", data_id, name->valuestring);
151 #endif
152         ret = true;
153     }
154 
155     /*
156 * process numeric values
157 */
158     if (cJSON_IsNumber(name)) {
159 #ifdef GET_DEBUG
160         fprintf(fout, "%s Value:  %f\n", data_id, name->valuedouble);
161 #endif
162         if (i > V_DLAST) { // check for out-of-range index
163             i = V_DLAST;
164         }
165 
166         // lock the main value array during updates
167         pthread_mutex_lock(&E.ha_lock);
168         E.mvar[i] = name->valuedouble;
169         pthread_mutex_unlock(&E.ha_lock);
170 
171         /*
172 * special processing for variable data received
173 */
174         if (i == V_DCMPPT) {
175             /*
176 * load battery current standard deviation array bat_c_std_dev with data
177 */
178             bsoc_set_std_dev(E.mvar[i], j++);
179             if (j >= RDEV_SIZE) {
180                 j = 0;
181             }
182         }
183         /*
184 * update local MATTER switch status from HA
185 */
186         if (i == V_HDCSW) {
187             E.gti_sw_status = (bool) ((int32_t) E.mvar[i]);
188             E.dc_mismatch = false;
189         }
190 
191         if (i == V_HACSW) {
192             E.ac_sw_status = (bool) ((int32_t) E.mvar[i]);
193             E.ac_mismatch = false;
194         }
```

```
195
196         // command HA_ENERGY to shutdown mode
197         if (i == V_HSHUT) {
198             E.solar_shutdown = (bool) ((int32_t) E.mvar[i]);
199         }
200         // set HA_ENERGY energy processing mode
201         if (i == V_HMODE) {
202             ha_flag_vars_ss.energy_mode = (bool) ((int32_t) E.mvar[i]);
203         }
204         if (i == V_HCON0) {
205             E.mode.con0 = (bool) ((int32_t) E.mvar[i]);
206         }
207         if (i == V_HCON1) {
208             E.mode.con1 = (bool) ((int32_t) E.mvar[i]);
209         }
210         if (i == V_HCON2) {
211             E.mode.con2 = (bool) ((int32_t) E.mvar[i]);
212         }
213         if (i == V_HCON3) {
214             E.mode.con3 = (bool) ((int32_t) E.mvar[i]);
215         }
216         if (i == V_HCON4) { // set DL GTI excess load MODE
217             E.mode.con4 = (bool) ((int32_t) E.mvar[i]);
218         }
219         if (i == V_HCON5) { // clear DL GTI excess load MODE
220             E.mode.con5 = (bool) ((int32_t) E.mvar[i]);
221         }
222         if (i == V_HCON6) { // HA Energy program idle
223             E.mode.con6 = (bool) ((int32_t) E.mvar[i]);
224         }
225         if (i == V_HCON7) { // HA Energy program exit
226             E.mode.con7 = (bool) ((int32_t) E.mvar[i]);
227         }
228         ret = true;
229     }
230     return ret;
231 }
```

4.23.1.5 msgarrvd()

```
int32_t msgarrvd (
              void * context,
              char * topicName,
              int topicLen,
              MQTTClient_message * message )
8 {
9     int32_t i, ret = 1;
10     const char* payloadptr;
11     char buffer[MBMQTT];
12     struct ha_flag_type *ha_flag = context;
13
14     E.link.mqtt_count++;
15     // bug-out if no context variables passed to callback
16     if (context == NULL) {
17         ret = -1;
18         goto null_exit;
19     }
20
21 #ifdef DEBUG_REC
22     fprintf(fout, "Message arrived\n");
23 #endif
24     /*
25 * move the received message into a processing holding buffer
26 */
27     payloadptr = message->payload;
28     for (i = 0; i < message->payloadlen; i++) {
29         buffer[i] = *payloadptr++;
30     }
31     buffer[i] = 0; // make a null terminated C string
32
33     // parse the JSON data in the holding buffer
34     cJSON *json = cJSON_ParseWithLength(buffer, message->payloadlen);
35     if (json == NULL) {
36         const char *error_ptr = cJSON_GetErrorPtr();
37         if (error_ptr != NULL) {
38             fprintf(fout, "%s Error:  %s NULL cJSON pointer\n", log_time(false), error_ptr);
39         }
40         ret = -1;
```

```
41          ha_flag->rec_ok = false;
42          E.fm80 = false;
43          E.dumpload = false;
44          E.homeassistant = false;
45          E.link.mqtt_error++;
46          goto error_exit;
47      }
48
49      /*
50  * MQTT messages from the FM80 Q84 interface
51  */
52      if (ha_flag->ha_id == FM80_ID) {
53  #ifdef DEBUG_REC
54          fprintf(fout, "FM80 MQTT data\r\n");
55  #endif
56          cJSON *data_result = json;
57
58          for (uint32_t ii = V_FCCM; ii < V_FLAST; ii++) {
59              if (json_get_data(json, mqtt_name[ii], data_result, ii)) {
60                  ha_flag->var_update++;
61              }
62          }
63          E.fm80 = true;
64      }
65
66      /*
67  * MQTT messages from the K42 dumpload/gti interface
68  */
69      if (ha_flag->ha_id == DUMPLOAD_ID) {
70  #ifdef DEBUG_REC
71          fprintf(fout, "DUMPLOAD MQTT data\r\n");
72  #endif
73          cJSON *data_result = json;
74
75          for (uint32_t ii = V_HDCSW; ii < V_DLAST; ii++) {
76              if (json_get_data(json, mqtt_name[ii], data_result, ii)) {
77                  ha_flag->var_update++;
78              }
79          }
80          E.dumpload = true;
81      }
82
83      /*
84  * MQTT messages from the Linux HA_ENERGY interface
85  */
86      if (ha_flag->ha_id == HA_ID) {
87  #ifdef DEBUG_REC
88          fprintf(fout, "Home Assistant MQTT data\r\n");
89  #endif
90          cJSON *data_result = json;
91
92          if (json_get_data(json, mqtt_name[V_HACSW], data_result, V_HACSW)) {
93              ha_flag->var_update++;
94          }
95          data_result = json;
96          if (json_get_data(json, mqtt_name[V_HDCSW], data_result, V_HDCSW)) {
97              ha_flag->var_update++;
98          }
99
100          E.homeassistant = true;
101      }
102
103      // done with processing MQTT async message, set state flags
104      ha_flag->receivedtoken = true;
105      ha_flag->rec_ok = true;
106      /*
107  * exit and delete/free resources.  In steps depending of possible error conditions
108  */
109  error_exit:
110      // delete the JSON object
111      cJSON_Delete(json);
112  null_exit:
113      // free the MQTT objects
114      MQTTClient_freeMessage(&message);
115      MQTTClient_free(topicName);
116      return ret;
117  }
```

4.23.1.6 print_mvar_vars()

```
void print_mvar_vars (
            void  )
```

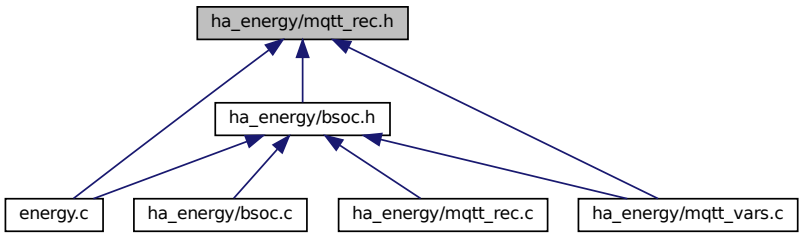
```
237 {
238     fprintf(fout, ", AC Inverter %7.2fW, BAT Energy %7.2fWh, Solar E %7.2fWh, AC E %7.2fWh, PERR %7.2fW,
      PBAL %7.2fW, ST %7.2f, GDL %7.2f, %d,%d,%d %d,%d,%d\r",
239         E.mvar[V_FLO], E.mvar[V_FBEKW], E.mvar[V_FSO], E.mvar[V_FACE], E.mode.error, E.mvar[V_BEN],
      E.mode.total_system, E.mode.gti_dumpload, (int32_t) E.mvar[V_HDCSW], (int32_t) E.mvar[V_HACSW],
      (int32_t) E.mvar[V_HMODE],
240         (int32_t) E.dc_mismatch, (int32_t) E.ac_mismatch, (int32_t) E.mode_mismatch);
241 }
```

4.24 ha_energy/mqtt_rec.h File Reference

```
#include "energy.h"
#include "mqtt_vars.h"
```

Include dependency graph for mqtt_rec.h:

This graph shows which files directly or indirectly include this file:



Data Structures

- struct ha_flag_type

Macros

- #define RDEV_SIZE 10
- #define SLEEP_CODE 0
- #define FLOAT_CODE 1
- #define MBMQTT 1024

Enumerations

- enum mqtt_id {
  P8055_ID , FM80_ID , DUMPLOAD_ID , HA_ID ,
  LAST_MQTT_ID }

Functions

- int32_t msgarrvd (void *, char *, int, MQTTClient_message *)
- void delivered (void *, MQTTClient_deliveryToken)
- bool json_get_data (cJSON *, const char *, cJSON *, uint32_t)
- bool fm80_float (const bool set_bias)
- bool fm80_sleep (void)

Variables

- FILE * fout

4.24.1 Macro Definition Documentation

4.24.1.1 FLOAT_CODE

```
#define FLOAT_CODE 1
```

4.24.1.2 MBMQTT

```
#define MBMQTT 1024
```

4.24.1.3 RDEV_SIZE

```
#define RDEV_SIZE 10
```

4.24.1.4 SLEEP_CODE

```
#define SLEEP_CODE 0
```

4.24.2 Enumeration Type Documentation

4.24.2.1 mqtt_id

```
enum mqtt_id
```

Enumerator

P8055_ID	
FM80_ID	
DUMPLOAD_ID	
HA_ID	
LAST_MQTT_ID	

```
27                  {
28          P8055_ID,
29          FM80_ID,
30          DUMPLOAD_ID,
31      HA_ID,
32          LAST_MQTT_ID,
33      };
```

4.24.3 Function Documentation

4.24.3.1 delivered()

```
void delivered (
              void * context,
              MQTTClient_deliveryToken dt )
123 {
124     struct ha_flag_type *ha_flag = context;
125
126     // bug-out if no context variables passed to callback
127     if (context == NULL) {
128         return;
129     }
130     ha_flag->deliveredtoken = dt;
131 }
```

4.24.3.2 fm80_float()

```
bool fm80_float (
              const bool set_bias )
247 {
248     if ((uint32_t) E.mvar[V_FCCM] == FLOAT_CODE) {
249         if (set_bias) {
250             E.mode.pv_bias = PV_BIAS_FLOAT;
251         }
252         if (E.mode.R != R_IDLE) {
253             E.mode.R = R_FLOAT;
254         }
255         return true;
256     } else {
257         if (E.mode.R == R_FLOAT) {
258             E.mode.R = R_RUN;
259         }
260     }
261     return false;
262 }
```

4.24.3.3 fm80_sleep()

```
bool fm80_sleep (
            void  )
269 {
270     if ((uint32_t) E.mvar[V_FCCM] == SLEEP_CODE) {
271         return true;
272     }
273     return false;
274 }
```

4.24.3.4 json_get_data()

```
bool json_get_data (
            cJSON * json_src,
            const char * data_id,
            cJSON * name,
            uint32_t i )
138 {
139     bool ret = false;
140     static uint32_t j = 0;
141 
142     // access the JSON data using the lookup string passed in data_id
143     name = cJSON_GetObjectItemCaseSensitive(json_src, data_id);
144 
145     /*
146 * process string values
147 */
148     if (cJSON_IsString(name) && (name->valuestring != NULL)) {
149 #ifdef GET_DEBUG
150         fprintf(fout, "%s Name:  %s\n", data_id, name->valuestring);
151 #endif
152         ret = true;
153     }
154 
155     /*
156 * process numeric values
157 */
158     if (cJSON_IsNumber(name)) {
159 #ifdef GET_DEBUG
160         fprintf(fout, "%s Value:  %f\n", data_id, name->valuedouble);
161 #endif
162         if (i > V_DLAST) { // check for out-of-range index
163             i = V_DLAST;
164         }
165 
166         // lock the main value array during updates
167         pthread_mutex_lock(&E.ha_lock);
168         E.mvar[i] = name->valuedouble;
169         pthread_mutex_unlock(&E.ha_lock);
170 
171         /*
172 * special processing for variable data received
173 */
174         if (i == V_DCMPPT) {
175             /*
176 * load battery current standard deviation array bat_c_std_dev with data
177 */
178             bsoc_set_std_dev(E.mvar[i], j++);
179             if (j >= RDEV_SIZE) {
180                 j = 0;
181             }
182         }
183         /*
184 * update local MATTER switch status from HA
185 */
186         if (i == V_HDCSW) {
187             E.gti_sw_status = (bool) ((int32_t) E.mvar[i]);
188             E.dc_mismatch = false;
189         }
190 
191         if (i == V_HACSW) {
192             E.ac_sw_status = (bool) ((int32_t) E.mvar[i]);
193             E.ac_mismatch = false;
194         }
```

```
195
196         // command HA_ENERGY to shutdown mode
197         if (i == V_HSHUT) {
198             E.solar_shutdown = (bool) ((int32_t) E.mvar[i]);
199         }
200         // set HA_ENERGY energy processing mode
201         if (i == V_HMODE) {
202             ha_flag_vars_ss.energy_mode = (bool) ((int32_t) E.mvar[i]);
203         }
204         if (i == V_HCON0) {
205             E.mode.con0 = (bool) ((int32_t) E.mvar[i]);
206         }
207         if (i == V_HCON1) {
208             E.mode.con1 = (bool) ((int32_t) E.mvar[i]);
209         }
210         if (i == V_HCON2) {
211             E.mode.con2 = (bool) ((int32_t) E.mvar[i]);
212         }
213         if (i == V_HCON3) {
214             E.mode.con3 = (bool) ((int32_t) E.mvar[i]);
215         }
216         if (i == V_HCON4) { // set DL GTI excess load MODE
217             E.mode.con4 = (bool) ((int32_t) E.mvar[i]);
218         }
219         if (i == V_HCON5) { // clear DL GTI excess load MODE
220             E.mode.con5 = (bool) ((int32_t) E.mvar[i]);
221         }
222         if (i == V_HCON6) { // HA Energy program idle
223             E.mode.con6 = (bool) ((int32_t) E.mvar[i]);
224         }
225         if (i == V_HCON7) { // HA Energy program exit
226             E.mode.con7 = (bool) ((int32_t) E.mvar[i]);
227         }
228         ret = true;
229     }
230     return ret;
231 }
```

4.24.3.5 msgarrvd()

```
int32_t msgarrvd (
              void * context,
              char * topicName,
              int topicLen,
              MQTTClient_message * message )
8 {
9     int32_t i, ret = 1;
10     const char* payloadptr;
11     char buffer[MBMQTT];
12     struct ha_flag_type *ha_flag = context;
13
14     E.link.mqtt_count++;
15     // bug-out if no context variables passed to callback
16     if (context == NULL) {
17         ret = -1;
18         goto null_exit;
19     }
20
21 #ifdef DEBUG_REC
22     fprintf(fout, "Message arrived\n");
23 #endif
24     /*
25 * move the received message into a processing holding buffer
26 */
27     payloadptr = message->payload;
28     for (i = 0; i < message->payloadlen; i++) {
29         buffer[i] = *payloadptr++;
30     }
31     buffer[i] = 0; // make a null terminated C string
32
33     // parse the JSON data in the holding buffer
34     cJSON *json = cJSON_ParseWithLength(buffer, message->payloadlen);
35     if (json == NULL) {
36         const char *error_ptr = cJSON_GetErrorPtr();
37         if (error_ptr != NULL) {
38             fprintf(fout, "%s Error:  %s NULL cJSON pointer\n", log_time(false), error_ptr);
39         }
40         ret = -1;
```

```
41          ha_flag->rec_ok = false;
42          E.fm80 = false;
43          E.dumpload = false;
44          E.homeassistant = false;
45          E.link.mqtt_error++;
46          goto error_exit;
47      }
48
49      /*
50  * MQTT messages from the FM80 Q84 interface
51  */
52      if (ha_flag->ha_id == FM80_ID) {
53  #ifdef DEBUG_REC
54          fprintf(fout, "FM80 MQTT data\r\n");
55  #endif
56          cJSON *data_result = json;
57
58          for (uint32_t ii = V_FCCM; ii < V_FLAST; ii++) {
59              if (json_get_data(json, mqtt_name[ii], data_result, ii)) {
60                  ha_flag->var_update++;
61              }
62          }
63          E.fm80 = true;
64      }
65
66      /*
67  * MQTT messages from the K42 dumpload/gti interface
68  */
69      if (ha_flag->ha_id == DUMPLOAD_ID) {
70  #ifdef DEBUG_REC
71          fprintf(fout, "DUMPLOAD MQTT data\r\n");
72  #endif
73          cJSON *data_result = json;
74
75          for (uint32_t ii = V_HDCSW; ii < V_DLAST; ii++) {
76              if (json_get_data(json, mqtt_name[ii], data_result, ii)) {
77                  ha_flag->var_update++;
78              }
79          }
80          E.dumpload = true;
81      }
82
83      /*
84  * MQTT messages from the Linux HA_ENERGY interface
85  */
86      if (ha_flag->ha_id == HA_ID) {
87  #ifdef DEBUG_REC
88          fprintf(fout, "Home Assistant MQTT data\r\n");
89  #endif
90          cJSON *data_result = json;
91
92          if (json_get_data(json, mqtt_name[V_HACSW], data_result, V_HACSW)) {
93              ha_flag->var_update++;
94          }
95          data_result = json;
96          if (json_get_data(json, mqtt_name[V_HDCSW], data_result, V_HDCSW)) {
97              ha_flag->var_update++;
98          }
99
100          E.homeassistant = true;
101      }
102
103      // done with processing MQTT async message, set state flags
104      ha_flag->receivedtoken = true;
105      ha_flag->rec_ok = true;
106      /*
107  * exit and delete/free resources.  In steps depending of possible error conditions
108  */
109  error_exit:
110      // delete the JSON object
111      cJSON_Delete(json);
112  null_exit:
113      // free the MQTT objects
114      MQTTClient_freeMessage(&message);
115      MQTTClient_free(topicName);
116      return ret;
117  }
```

4.24.4 Variable Documentation

4.24.4.1 fout

```
FILE* fout  [extern]
```

4.25 mqtt_rec.h

Go to the documentation of this file.

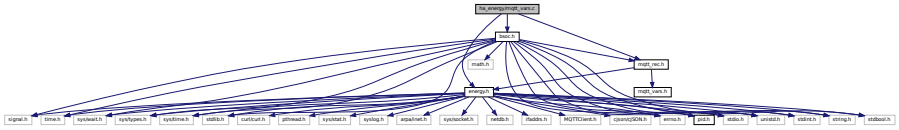
```
1 /*
2 * File:      mqtt_rec.h
3 * Author:  root
4 *
5 * Created on February 5, 2024, 2:54 PM
6 */
7
8 #ifndef MQTT_REC_H
9 #define MQTT_REC_H
10
11 #ifdef __cplusplus
12 extern "C" {
13 #endif
14
15 #include "energy.h"
16 #include "mqtt_vars.h"
17
18 #define RDEV_SIZE        10
19
20 #define SLEEP_CODE      0
21 #define FLOAT_CODE      1
22     //#define DEBUG_REC
23     //#define GET_DEBUG
24
25 #define MBMQTT      1024
26
27     enum mqtt_id {
28         P8055_ID,
29         FM80_ID,
30         DUMPLOAD_ID,
31     HA_ID,
32         LAST_MQTT_ID,
33     };
34
35     struct ha_flag_type {
36         volatile MQTTClient_deliveryToken deliveredtoken, receivedtoken;
37         volatile bool runner, rec_ok;
38         int32_t ha_id;
39         volatile int32_t var_update, energy_mode;
40     };
41
42     extern FILE* fout;
43
44     int32_t msgarrvd(void *, char *, int, MQTTClient_message *);
45     void delivered(void *, MQTTClient_deliveryToken);
46
47     bool json_get_data(cJSON *, const char *, cJSON *, uint32_t);
48     bool fm80_float(const bool set_bias);
49     bool fm80_sleep(void);
50
51 #ifdef __cplusplus
52 }
53 #endif
54
55 #endif /* MQTT_REC_H */
56
```

4.26 ha_energy/mqtt_vars.c File Reference

```
#include "mqtt_rec.h"
#include "energy.h"
```

```
#include "bsoc.h"
```

Include dependency graph for mqtt_vars.c:



Macros

- #define _DEFAULT_SOURCE

Functions

- void mqtt_ha_shutdown (MQTTClient client_p, const char ∗topic_p)
- void mqtt_ha_pid (MQTTClient client_p, const char ∗topic_p)
- void mqtt_ha_switch (MQTTClient client_p, const char ∗topic_p, const bool sw_state)
- bool mqtt_gti_power (MQTTClient client_p, const char ∗topic_p, char ∗msg, uint32_t trace)
- bool mqtt_gti_time (MQTTClient client_p, const char ∗topic_p, char ∗msg)

Variables

- static const char ∗const FW_Date = __DATE__
- static const char ∗const FW_Time = __TIME__

4.26.1 Macro Definition Documentation

4.26.1.1 _DEFAULT_SOURCE

```
#define _DEFAULT_SOURCE
```

4.26.2 Function Documentation

4.26.2.1 mqtt_gti_power()

```
bool mqtt_gti_power (
             MQTTClient client_p,
             const char * topic_p,
             char * msg,
             uint32_t trace )
187 {
188     bool ret = true;
189     MQTTClient_message pubmsg = MQTTClient_message_initializer;
190     MQTTClient_deliveryToken token;
191     ha_flag_vars_ss.deliveredtoken = 0;
192     static bool spam = false;
193 
194     E.link.mqtt_count++;
195     pubmsg.payload = msg;
196     pubmsg.payloadlen = strlen(msg);
197     pubmsg.qos = QOS;
198     pubmsg.retained = 0;
199 
200     if (E.dl_excess) { // always run excess commands
201         spam = false;
202     }
203 #ifdef GTI_NO_POWER
204     MQTTClient_publishMessage(client_p, "mateq84/data/gticmd_nopower", &pubmsg, &token);
205 #else
206     if (bsoc_gti() > MIN_BAT_KW || E.dl_excess) {
207 #ifdef DEBUG_HA_CMD
208         log_time(true);
209         fprintf(fout, "HA GTI power command %s, SDEV %5.2f trace %u\r\n", msg, get_batc_dev(), trace);
210         fflush(fout);
211         spam = true;
212 #endif
213         MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token); // run power commands
214     } else {
215         ret = false;
216         pubmsg.payload = "Z#";
217         pubmsg.payloadlen = strlen("Z#");
218         if (!spam) {
219             MQTTClient_publishMessage(client_p, TOPIC_SPAM, &pubmsg, &token);
220         } else {
221             MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token); // only shutdown GTI power
222         }
223 #ifdef DEBUG_HA_CMD
224         if (spam) {
225             log_time(true);
226             fprintf(fout, "HA GTI power set to zero, trace %u\r\n", trace);
227             fflush(fout);
228             spam = false;
229         }
230 #endif
231     }
232 #endif
233     // a busy, wait loop for the async delivery thread to complete
234     {
235         uint32_t waiting = 0;
236         while (ha_flag_vars_ss.deliveredtoken != token) {
237             usleep(TOKEN_DELAY);
238             if (waiting++ > MQTT_TIMEOUT) {
239                 fprintf(fout, "\r\n%s GTI Power Still Waiting, timeout\r\n", log_time(false));
240                 break;
241             }
242         };
243     }
244     usleep(HA_SW_DELAY);
245     return ret;
246 }
```

4.26.2.2 mqtt_gti_time()

```
bool mqtt_gti_time (
             MQTTClient client_p,
             const char * topic_p,
             char * msg )
```

```
249 {
250     bool ret = true;
251     MQTTClient_message pubmsg = MQTTClient_message_initializer;
252     MQTTClient_deliveryToken token;
253     ha_flag_vars_ss.deliveredtoken = 0;
254 
255     E.link.mqtt_count++;
256     pubmsg.payload = msg;
257     pubmsg.payloadlen = strlen(msg);
258     pubmsg.qos = QOS;
259     pubmsg.retained = 0;
260 
261     MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token); // run time commands
262 
263     // a busy, wait loop for the async delivery thread to complete
264     {
265         uint32_t waiting = 0;
266         while (ha_flag_vars_ss.deliveredtoken != token) {
267             usleep(GTI_TOKEN_DELAY);
268             if (waiting++ > MQTT_TIMEOUT) {
269                 fprintf(fout, "\r\n%s GTI Time Still Waiting, timeout\r\n", log_time(false));
270                 break;
271             }
272         };
273     }
274     usleep(HA_SW_DELAY);
275     return ret;
276 }
```

4.26.2.3 mqtt_ha_pid()

```
void mqtt_ha_pid (
              MQTTClient client_p,
              const char * topic_p )
46 {
47     cJSON *json;
48     time_t rawtime;
49 
50     MQTTClient_message pubmsg = MQTTClient_message_initializer;
51     MQTTClient_deliveryToken token;
52     ha_flag_vars_ss.deliveredtoken = 0;
53 
54     E.link.mqtt_count++;
55     E.mode.sequence++;
56     json = cJSON_CreateObject();
57     cJSON_AddStringToObject(json, "name", CLIENTID1);
58     cJSON_AddNumberToObject(json, "sequence", E.mode.sequence);
59     cJSON_AddNumberToObject(json, "mqtt_count", (double) E.link.mqtt_count);
60     cJSON_AddNumberToObject(json, "http_count", (double) E.link.iammeter_count);
61     cJSON_AddNumberToObject(json, "piderror", E.mode.error);
62     cJSON_AddNumberToObject(json, "totalsystem", E.mode.total_system);
63     cJSON_AddNumberToObject(json, "gtinet", E.mode.gti_dumpload);
64     cJSON_AddNumberToObject(json, "energy_state", (double) E.mode.E);
65     cJSON_AddNumberToObject(json, "run_state", (double) E.mode.R);
66     // correct for power sensed by GTI metering
67     E.mode.off_grid = (E.mvar[V_FLO] - (E.mvar[V_DPPV] * DL_AC_DC_EFF));
68     E.mode.off_grid = drive1_filter(E.mode.off_grid);
69     if (E.mode.off_grid < 0.0f) { // only see power removed from grid usage
70         E.mode.off_grid = 0.0f;
71     }
72     cJSON_AddNumberToObject(json, "off_grid", E.mode.off_grid);
73     cJSON_AddNumberToObject(json, "excess_mode", (double) E.dl_excess);
74     cJSON_AddStringToObject(json, "build_date", FW_Date);
75     cJSON_AddStringToObject(json, "build_time", FW_Time);
76     time(&rawtime);
77     cJSON_AddNumberToObject(json, "sequence_time", (double) rawtime);
78     // convert the cJSON object to a JSON string
79     char *json_str = cJSON_Print(json);
80 
81     pubmsg.payload = json_str;
82     pubmsg.payloadlen = strlen(json_str);
83     pubmsg.qos = QOS;
84     pubmsg.retained = 0;
85 
86     MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token);
87     // a busy, wait loop for the async delivery thread to complete
88     {
89         uint32_t waiting = 0;
90         while (ha_flag_vars_ss.deliveredtoken != token) {
```

```
91              usleep(TOKEN_DELAY);
92              if (waiting++ > MQTT_TIMEOUT) {
93                  fprintf(fout, "\r\n%s SW Still Waiting, timeout\r\n", log_time(false));
94                  break;
95              }
96          };
97      }
98
99      cJSON_free(json_str);
100      cJSON_Delete(json);
101 }
```

4.26.2.4 mqtt_ha_shutdown()

```
void mqtt_ha_shutdown (
              MQTTClient client_p,
              const char * topic_p )
13 {
14      cJSON *json;
15      MQTTClient_message pubmsg = MQTTClient_message_initializer;
16      MQTTClient_deliveryToken token;
17      ha_flag_vars_ss.deliveredtoken = 0;
18
19      json = cJSON_CreateObject();
20      cJSON_AddStringToObject(json, "shutdown", CLIENTID1);
21      char *json_str = cJSON_Print(json);
22
23      pubmsg.payload = json_str;
24      pubmsg.payloadlen = strlen(json_str);
25      pubmsg.qos = QOS;
26      pubmsg.retained = 0;
27
28      MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token);
29      // a busy, wait loop for the async delivery thread to complete
30      {
31          uint32_t waiting = 0;
32          while (ha_flag_vars_ss.deliveredtoken != token) {
33              usleep(TOKEN_DELAY);
34              if (waiting++ > MQTT_TIMEOUT) {
35                  fprintf(fout, "\r\n%s SW Still Waiting, timeout\r\n", log_time(false));
36                  break;
37              }
38          };
39      }
40 }
```

4.26.2.5 mqtt_ha_switch()

```
void mqtt_ha_switch (
              MQTTClient client_p,
              const char * topic_p,
              const bool sw_state )
107 {
108      cJSON *json;
109 #ifdef DEBUG_HA_CMD
110      static bool spam = false;
111      static uint32_t less_spam = 0;
112 #endif
113
114      MQTTClient_message pubmsg = MQTTClient_message_initializer;
115      MQTTClient_deliveryToken token;
116      ha_flag_vars_ss.deliveredtoken = 0;
117
118      E.link.mqtt_count++;
119      json = cJSON_CreateObject();
120      if (sw_state) {
121          cJSON_AddStringToObject(json, "state", "ON");
122 #ifdef DEBUG_HA_CMD
123          spam = true;
```

```
124         less_spam = 0;
125 #endif
126     } else {
127         if ((uint32_t) E.mvar[V_FCCM] != FLOAT_CODE) { // use max power in FLOAT mode
128             cJSON_AddStringToObject(json, "state", "OFF");
129         } else {
130             cJSON_AddStringToObject(json, "state", "ON");
131 #ifdef DEBUG_HA_CMD
132             spam = true;
133             less_spam = 0;
134 #endif
135         }
136     }
137     // convert the cJSON object to a JSON string
138     char *json_str = cJSON_Print(json);
139 
140     pubmsg.payload = json_str;
141     pubmsg.payloadlen = strlen(json_str);
142     pubmsg.qos = QOS;
143     pubmsg.retained = 0;
144 
145 #ifdef DEBUG_HA_CMD
146     if (spam) {
147         log_time(true);
148         fflush(fout);
149         fprintf(fout, "HA switch command %s, %d\r\n", topic_p, sw_state);
150         fflush(fout);
151         if (!sw_state) {
152             if (less_spam++ > 3) {
153                 spam = false;
154                 less_spam = 0;
155             }
156         }
157     }
158 #endif
159 
160     MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token);
161     // a busy, wait loop for the async delivery thread to complete
162     {
163         uint32_t waiting = 0;
164         while (ha_flag_vars_ss.deliveredtoken != token) {
165             usleep(TOKEN_DELAY);
166             if (waiting++ > MQTT_TIMEOUT) {
167 #ifdef DEBUG_HA_CMD
168                 fflush(fout);
169                 fprintf(fout, "\r\nSW Still Waiting, timeout\r\n");
170                 fflush(fout);
171 #endif
172                 break;
173             }
174         };
175     }
176 
177     cJSON_free(json_str);
178     cJSON_Delete(json);
179     usleep(HA_SW_DELAY);
180     fflush(fout);
181 }
```

4.26.3 Variable Documentation

4.26.3.1 FW_Date

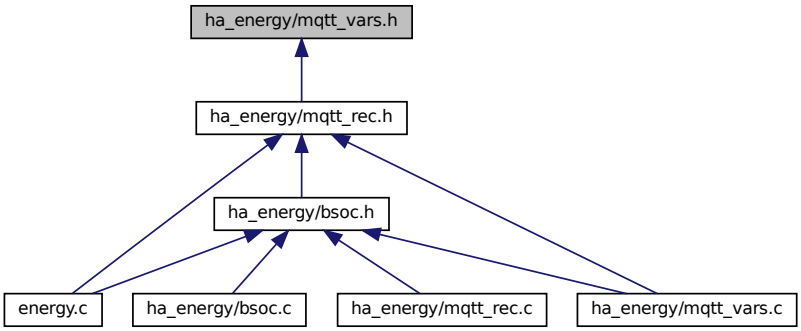
```
const char* const FW_Date = __DATE__  [static]
```

4.26.3.2 FW_Time

```
const char* const FW_Time = __TIME__  [static]
```

4.27 ha_energy/mqtt_vars.h File Reference

This graph shows which files directly or indirectly include this file:



Macros

- #define HA_SW_DELAY 400000
- #define TOKEN_DELAY 250
- #define GTI_TOKEN_DELAY 300
- #define QOS 1

Functions

- void mqtt_ha_switch (MQTTClient, const char *, const bool)
- void mqtt_ha_pid (MQTTClient, const char *)
- void mqtt_ha_shutdown (MQTTClient, const char *)
- bool mqtt_gti_power (MQTTClient, const char *, char *, uint32_t)
- bool mqtt_gti_time (MQTTClient, const char *, char *)

Variables

- const char * mqtt_name [V_DLAST]

4.27.1 Macro Definition Documentation

4.27.1.1 GTI_TOKEN_DELAY

```
#define GTI_TOKEN_DELAY 300
```

4.27.1.2 HA_SW_DELAY

```
#define HA_SW_DELAY 400000
```

4.27.1.3 QOS

```
#define QOS 1
```

4.27.1.4 TOKEN_DELAY

```
#define TOKEN_DELAY 250
```

4.27.2 Function Documentation

4.27.2.1 mqtt_gti_power()

```
bool mqtt_gti_power (
            MQTTClient client_p,
            const char * topic_p,
            char * msg,
            uint32_t trace )
187 {
188     bool ret = true;
189     MQTTClient_message pubmsg = MQTTClient_message_initializer;
190     MQTTClient_deliveryToken token;
191     ha_flag_vars_ss.deliveredtoken = 0;
192     static bool spam = false;
193 
194     E.link.mqtt_count++;
195     pubmsg.payload = msg;
196     pubmsg.payloadlen = strlen(msg);
197     pubmsg.qos = QOS;
198     pubmsg.retained = 0;
199 
200     if (E.dl_excess) { // always run excess commands
201         spam = false;
202     }
203 #ifdef GTI_NO_POWER
204     MQTTClient_publishMessage(client_p, "mateq84/data/gticmd_nopower", &pubmsg, &token);
205 #else
206     if (bsoc_gti() > MIN_BAT_KW || E.dl_excess) {
207 #ifdef DEBUG_HA_CMD
208         log_time(true);
209         fprintf(fout, "HA GTI power command %s, SDEV %5.2f trace %u\r\n", msg, get_batc_dev(), trace);
210         fflush(fout);
211         spam = true;
212 #endif
213         MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token); // run power commands
214     } else {
215         ret = false;
216         pubmsg.payload = "Z#";
217         pubmsg.payloadlen = strlen("Z#");
218         if (!spam) {
219             MQTTClient_publishMessage(client_p, TOPIC_SPAM, &pubmsg, &token);
220         } else {
221             MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token); // only shutdown GTI power
222         }
```

```
223 #ifdef DEBUG_HA_CMD
224         if (spam) {
225             log_time(true);
226             fprintf(fout, "HA GTI power set to zero, trace %u\r\n", trace);
227             fflush(fout);
228             spam = false;
229         }
230 #endif
231     }
232 #endif
233     // a busy, wait loop for the async delivery thread to complete
234     {
235         uint32_t waiting = 0;
236         while (ha_flag_vars_ss.deliveredtoken != token) {
237             usleep(TOKEN_DELAY);
238             if (waiting++ > MQTT_TIMEOUT) {
239                 fprintf(fout, "\r\n%s GTI Power Still Waiting, timeout\r\n", log_time(false));
240                 break;
241             }
242         };
243     }
244     usleep(HA_SW_DELAY);
245     return ret;
246 }
```

4.27.2.2 mqtt_gti_time()

```
bool mqtt_gti_time (
              MQTTClient client_p,
              const char * topic_p,
              char * msg )
249 {
250     bool ret = true;
251     MQTTClient_message pubmsg = MQTTClient_message_initializer;
252     MQTTClient_deliveryToken token;
253     ha_flag_vars_ss.deliveredtoken = 0;
254 
255     E.link.mqtt_count++;
256     pubmsg.payload = msg;
257     pubmsg.payloadlen = strlen(msg);
258     pubmsg.qos = QOS;
259     pubmsg.retained = 0;
260 
261     MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token); // run time commands
262 
263     // a busy, wait loop for the async delivery thread to complete
264     {
265         uint32_t waiting = 0;
266         while (ha_flag_vars_ss.deliveredtoken != token) {
267             usleep(GTI_TOKEN_DELAY);
268             if (waiting++ > MQTT_TIMEOUT) {
269                 fprintf(fout, "\r\n%s GTI Time Still Waiting, timeout\r\n", log_time(false));
270                 break;
271             }
272         };
273     }
274     usleep(HA_SW_DELAY);
275     return ret;
276 }
```

4.27.2.3 mqtt_ha_pid()

```
void mqtt_ha_pid (
              MQTTClient client_p,
              const char * topic_p )
46 {
47     cJSON *json;
48     time_t rawtime;
49 
```

```
50      MQTTClient_message pubmsg = MQTTClient_message_initializer;
51      MQTTClient_deliveryToken token;
52      ha_flag_vars_ss.deliveredtoken = 0;
53
54      E.link.mqtt_count++;
55      E.mode.sequence++;
56      json = cJSON_CreateObject();
57      cJSON_AddStringToObject(json, "name", CLIENTID1);
58      cJSON_AddNumberToObject(json, "sequence", E.mode.sequence);
59      cJSON_AddNumberToObject(json, "mqtt_count", (double) E.link.mqtt_count);
60      cJSON_AddNumberToObject(json, "http_count", (double) E.link.iammeter_count);
61      cJSON_AddNumberToObject(json, "piderror", E.mode.error);
62      cJSON_AddNumberToObject(json, "totalsystem", E.mode.total_system);
63      cJSON_AddNumberToObject(json, "gtinet", E.mode.gti_dumpload);
64      cJSON_AddNumberToObject(json, "energy_state", (double) E.mode.E);
65      cJSON_AddNumberToObject(json, "run_state", (double) E.mode.R);
66      // correct for power sensed by GTI metering
67      E.mode.off_grid = (E.mvar[V_FLO] - (E.mvar[V_DPPV] * DL_AC_DC_EFF));
68      E.mode.off_grid = drive1_filter(E.mode.off_grid);
69      if (E.mode.off_grid < 0.0f) { // only see power removed from grid usage
70          E.mode.off_grid = 0.0f;
71      }
72      cJSON_AddNumberToObject(json, "off_grid", E.mode.off_grid);
73      cJSON_AddNumberToObject(json, "excess_mode", (double) E.dl_excess);
74      cJSON_AddStringToObject(json, "build_date", FW_Date);
75      cJSON_AddStringToObject(json, "build_time", FW_Time);
76      time(&rawtime);
77      cJSON_AddNumberToObject(json, "sequence_time", (double) rawtime);
78      // convert the cJSON object to a JSON string
79      char *json_str = cJSON_Print(json);
80
81      pubmsg.payload = json_str;
82      pubmsg.payloadlen = strlen(json_str);
83      pubmsg.qos = QOS;
84      pubmsg.retained = 0;
85
86      MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token);
87      // a busy, wait loop for the async delivery thread to complete
88      {
89          uint32_t waiting = 0;
90          while (ha_flag_vars_ss.deliveredtoken != token) {
91              usleep(TOKEN_DELAY);
92              if (waiting++ > MQTT_TIMEOUT) {
93                  fprintf(fout, "\r\n%s SW Still Waiting, timeout\r\n", log_time(false));
94                  break;
95              }
96          };
97      }
98
99      cJSON_free(json_str);
100      cJSON_Delete(json);
101 }
```

4.27.2.4 mqtt_ha_shutdown()

```
void mqtt_ha_shutdown (
              MQTTClient client_p,
              const char * topic_p )
13 {
14      cJSON *json;
15      MQTTClient_message pubmsg = MQTTClient_message_initializer;
16      MQTTClient_deliveryToken token;
17      ha_flag_vars_ss.deliveredtoken = 0;
18
19      json = cJSON_CreateObject();
20      cJSON_AddStringToObject(json, "shutdown", CLIENTID1);
21      char *json_str = cJSON_Print(json);
22
23      pubmsg.payload = json_str;
24      pubmsg.payloadlen = strlen(json_str);
25      pubmsg.qos = QOS;
26      pubmsg.retained = 0;
27
28      MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token);
29      // a busy, wait loop for the async delivery thread to complete
30      {
31          uint32_t waiting = 0;
32          while (ha_flag_vars_ss.deliveredtoken != token) {
33              usleep(TOKEN_DELAY);
```

```
34             if (waiting++ > MQTT_TIMEOUT) {
35                 fprintf(fout, "\r\n%s SW Still Waiting, timeout\r\n", log_time(false));
36                 break;
37             }
38         };
39     }
40 }
```

4.27.2.5 mqtt_ha_switch()

```
void mqtt_ha_switch (
             MQTTClient client_p,
             const char * topic_p,
             const bool sw_state )
107 {
108     cJSON *json;
109 #ifdef DEBUG_HA_CMD
110     static bool spam = false;
111     static uint32_t less_spam = 0;
112 #endif
113
114     MQTTClient_message pubmsg = MQTTClient_message_initializer;
115     MQTTClient_deliveryToken token;
116     ha_flag_vars_ss.deliveredtoken = 0;
117
118     E.link.mqtt_count++;
119     json = cJSON_CreateObject();
120     if (sw_state) {
121         cJSON_AddStringToObject(json, "state", "ON");
122 #ifdef DEBUG_HA_CMD
123         spam = true;
124         less_spam = 0;
125 #endif
126     } else {
127         if ((uint32_t) E.mvar[V_FCCM] != FLOAT_CODE) { // use max power in FLOAT mode
128             cJSON_AddStringToObject(json, "state", "OFF");
129         } else {
130             cJSON_AddStringToObject(json, "state", "ON");
131 #ifdef DEBUG_HA_CMD
132             spam = true;
133             less_spam = 0;
134 #endif
135         }
136     }
137     // convert the cJSON object to a JSON string
138     char *json_str = cJSON_Print(json);
139
140     pubmsg.payload = json_str;
141     pubmsg.payloadlen = strlen(json_str);
142     pubmsg.qos = QOS;
143     pubmsg.retained = 0;
144
145 #ifdef DEBUG_HA_CMD
146     if (spam) {
147         log_time(true);
148         fflush(fout);
149         fprintf(fout, "HA switch command %s, %d\r\n", topic_p, sw_state);
150         fflush(fout);
151         if (!sw_state) {
152             if (less_spam++ > 3) {
153                 spam = false;
154                 less_spam = 0;
155             }
156         }
157     }
158 #endif
159
160     MQTTClient_publishMessage(client_p, topic_p, &pubmsg, &token);
161     // a busy, wait loop for the async delivery thread to complete
162     {
163         uint32_t waiting = 0;
164         while (ha_flag_vars_ss.deliveredtoken != token) {
165             usleep(TOKEN_DELAY);
166             if (waiting++ > MQTT_TIMEOUT) {
167 #ifdef DEBUG_HA_CMD
168                 fflush(fout);
169                 fprintf(fout, "\r\nSW Still Waiting, timeout\r\n");
170                 fflush(fout);
```

```
171 #endif
172                 break;
173             }
174         };
175     }
176
177     cJSON_free(json_str);
178     cJSON_Delete(json);
179     usleep(HA_SW_DELAY);
180     fflush(fout);
181 }
```

4.27.3 Variable Documentation

4.27.3.1 mqtt_name

```
const char* mqtt_name[V_DLAST]  [extern]
```

4.28 mqtt_vars.h

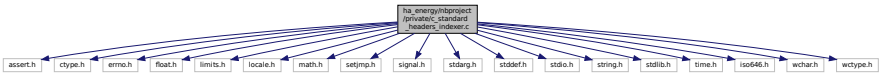
Go to the documentation of this file.

```
1 /*
2 * File:      mqtt_vars.h
3 * Author:  root
4 *
5 * Created on February 9, 2024, 6:50 AM
6 */
7
8 #ifndef MQTT_VARS_H
9 #define MQTT_VARS_H
10
11 #ifdef __cplusplus
12 extern "C" {
13 #endif
14
15     //#define GTI_NO_POWER      // do we actually run power commands
16
17     //#define DEBUG_HA_CMD    // show debug text
18 #define HA_SW_DELAY     400000  // usecs
19 #define TOKEN_DELAY     250
20 #define GTI_TOKEN_DELAY 300
21
22 #define QOS             1
23
24     extern const char* mqtt_name[V_DLAST];
25
26     void mqtt_ha_switch(MQTTClient, const char *, const bool);
27     void mqtt_ha_pid(MQTTClient, const char *);
28     void mqtt_ha_shutdown(MQTTClient, const char *);
29     bool mqtt_gti_power(MQTTClient, const char *, char *, uint32_t);
30     bool mqtt_gti_time(MQTTClient, const char *, char *);
31
32 #ifdef __cplusplus
33 }
34 #endif
35
36 #endif /* MQTT_VARS_H */
37
```

4.29 ha_energy/nbproject/private/c_standard_headers_indexer.c File Reference

```
#include <assert.h>
#include <ctype.h>
#include <errno.h>
#include <float.h>
#include <limits.h>
#include <locale.h>
#include <math.h>
#include <setjmp.h>
#include <signal.h>
#include <stdarg.h>
#include <stddef.h>
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <time.h>
#include <iso646.h>
#include <wchar.h>
#include <wctype.h>
```

Include dependency graph for c_standard_headers_indexer.c:



4.30 ha_energy/nbproject/private/cpp_standard_headers_indexer.cpp File Reference

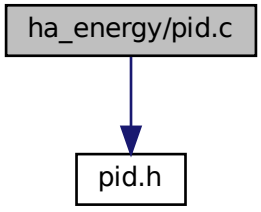
```
#include <cstdlib>
#include <csignal>
#include <csetjmp>
#include <cstdarg>
#include <typeinfo>
#include <bitset>
#include <functional>
#include <utility>
#include <ctime>
#include <cstddef>
#include <new>
#include <memory>
#include <climits>
#include <cfloat>
#include <limits>
#include <exception>
#include <stdexcept>
#include <cassert>
#include <cerrno>
#include <cctype>
#include <cwctype>
#include <cstring>
```

```
#include <cwchar>
#include <string>
#include <vector>
#include <deque>
#include <list>
#include <set>
#include <map>
#include <stack>
#include <queue>
#include <algorithm>
#include <iterator>
#include <cmath>
#include <complex>
#include <valarray>
#include <numeric>
#include <iosfwd>
#include <ios>
#include <istream>
#include <ostream>
#include <iostream>
#include <fstream>
#include <sstream>
#include <strstream>
#include <iomanip>
#include <streambuf>
#include <cstdio>
#include <locale>
#include <clocale>
#include <ciso646>
```

4.31 ha_energy/pid.c File Reference

```
#include "pid.h"
```

Include dependency graph for pid.c:



Functions

- double UpdatePI (volatile struct SPid *const pid, double const error)
- void ResetPI (volatile struct SPid *const pid)

4.31.1 Function Documentation

4.31.1.1 ResetPI()

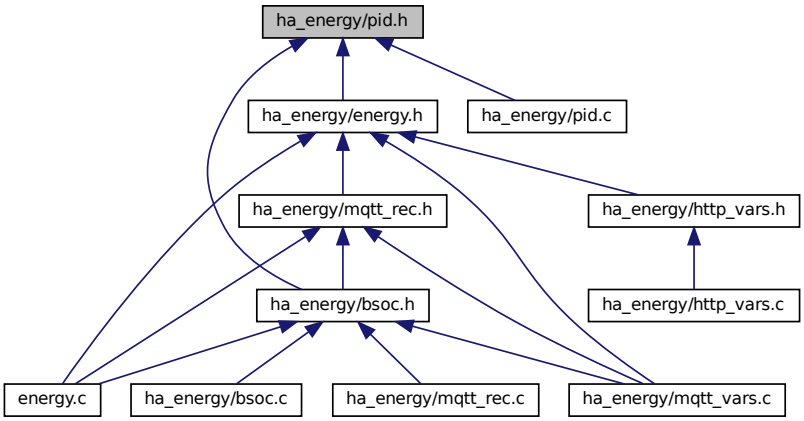
```
void ResetPI (
              volatile struct SPid *const pid )
30                                                {
31     pid->dState = 0.0; // not used but cleared
32     pid->iState = 0.0;
33 }
```

4.31.1.2 UpdatePI()

```
double UpdatePI (
              volatile struct SPid *const pid,
              double const error )
6                                                                    {
7     double pTerm, iTerm;
8
9     pTerm = pid->pGain * error; // calculate the proportional term
10     // calculate the integral state with appropriate limiting
11     pid->iState += error;
12
13     if (pid->iState > pid->iMax) {
14         pid->iState = pid->iMax;
15     } else if (pid->iState < pid->iMin) {
16         pid->iState = pid->iMin;
17     } else {
18
19     }
20
21     iTerm = (pid->iGain * pid->iState); // calculate the integral term
22
23     if ((pTerm + iTerm) > pid->iMax) {
24         iTerm = 0.0f;
25         pTerm = pid->iMax;
26     }
27     return pTerm + iTerm;
28 }
```

4.32 ha_energy/pid.h File Reference

This graph shows which files directly or indirectly include this file:



Data Structures

- struct SPid

Functions

- double UpdatePI (volatile struct SPid ∗const, const double)
- void ResetPI (volatile struct SPid ∗const)

4.32.1 Function Documentation

4.32.1.1 ResetPI()

```
void ResetPI (
              volatile struct SPid * const pid )
30                                             {
31     pid->dState = 0.0; // not used but cleared
32     pid->iState = 0.0;
33 }
```

4.32.1.2 UpdatePI()

```
double UpdatePI (
             volatile struct SPid * const pid,
             const double error )
6                                                                    {
7     double pTerm, iTerm;
8
9     pTerm = pid->pGain * error; // calculate the proportional term
10     // calculate the integral state with appropriate limiting
11     pid->iState += error;
12
13     if (pid->iState > pid->iMax) {
14         pid->iState = pid->iMax;
15     } else if (pid->iState < pid->iMin) {
16         pid->iState = pid->iMin;
17     } else {
18
19     }
20
21     iTerm = (pid->iGain * pid->iState); // calculate the integral term
22
23     if ((pTerm + iTerm) > pid->iMax) {
24         iTerm = 0.0f;
25         pTerm = pid->iMax;
26     }
27     return pTerm + iTerm;
28 }
```

4.33 pid.h

Go to the documentation of this file.

```
1 /*
2 * File:      pid.h
3 * Author:  root
4 *
5 * Created on March 6, 2024, 7:03 AM
6 */
7
8 #ifndef PID_H
9 #define PID_H
10
11 #ifdef __cplusplus
12 extern "C" {
13 #endif
14
15     struct SPid {
16         double dState; // Last position input
17         double iState; // Integrator state
18         double iMax, iMin; // Maximum and minimum allowable integrator state
19         double iGain, // integral gain
20         pGain, // proportional gain
21         dGain; // derivative gain
22     };
23
24     double UpdatePI(volatile struct SPid * const, const double);
25     void ResetPI(volatile struct SPid * const);
26
27
28 #ifdef __cplusplus
29 }
30 #endif
31
32 #endif /* PID_H */
33
```

Index