

8FEATURES

- Support EV Charging Mode 2, Mode 3 according to IEC 61851-1
- PROTECTION: Over/Under voltage protection, AC/DC leakage protection, over current protection, Short circuit protection, PE lost protection, Over temperature protection and Relay welding detection
- Support self-test at system startup and when plug charging gun
- Vehicle communication: Control Pilot – PWM
- Relay control: PWM
- Configurable Max current (I_{max}) 6A/8A/10A/16A
- High accuracy measurement: 2% error for voltage, current, power, energy measurement.
- Frequency measurement
- Communications: CAN & UART
- Small form factor: 13.22 x 22.27 x 3.8 mm
- Over-the-air firmware / software updates

APPLICATIONS

- AC portable charger upto 3.5kW



OVERVIEW

ATM3009 is a compact solution for AC portable charger. Module provide high level of protection (Over/Under voltage, AC/DC residual current, Over/Short circuit current, PE lost detection, Relay welding detection and over temperature protection) and high accuracy current/voltage/power/energy measurement.

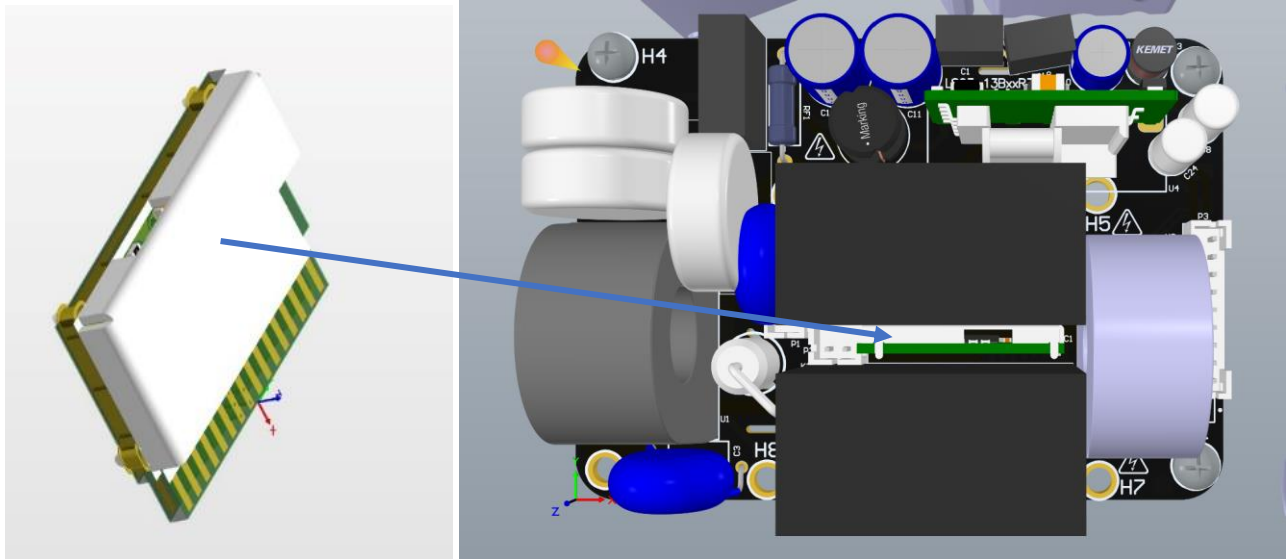


Figure 1: Module overview

ORDERING INFORMATION:

ATM3009 SH V314

Shield:

Nil: No shield
SH: With shield

Version:

V314: V3.14
Nil: Newest version

BLOCK DIAGRAMS

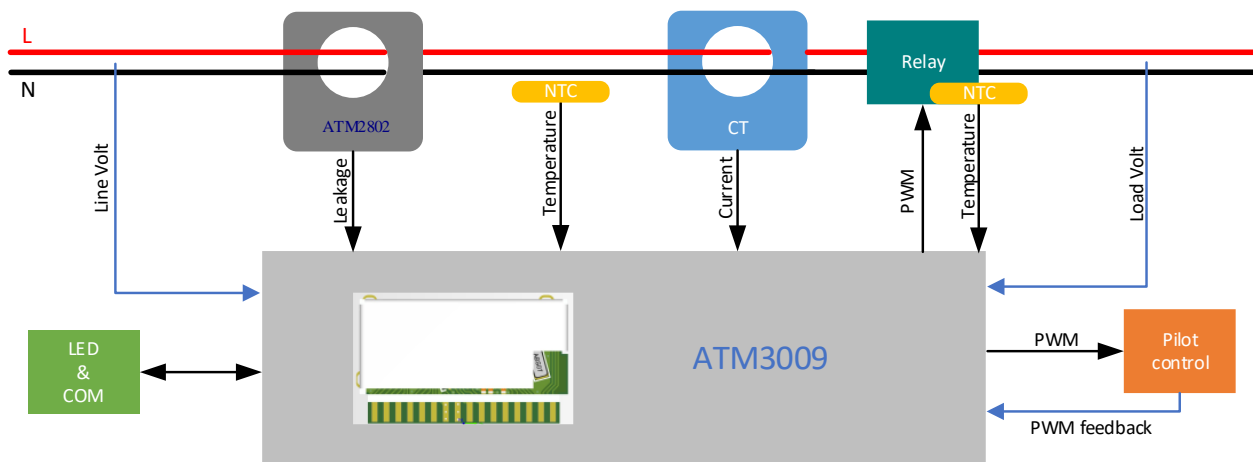


Figure 2: ATM3009 typical application diagram.

DIMENSIONS

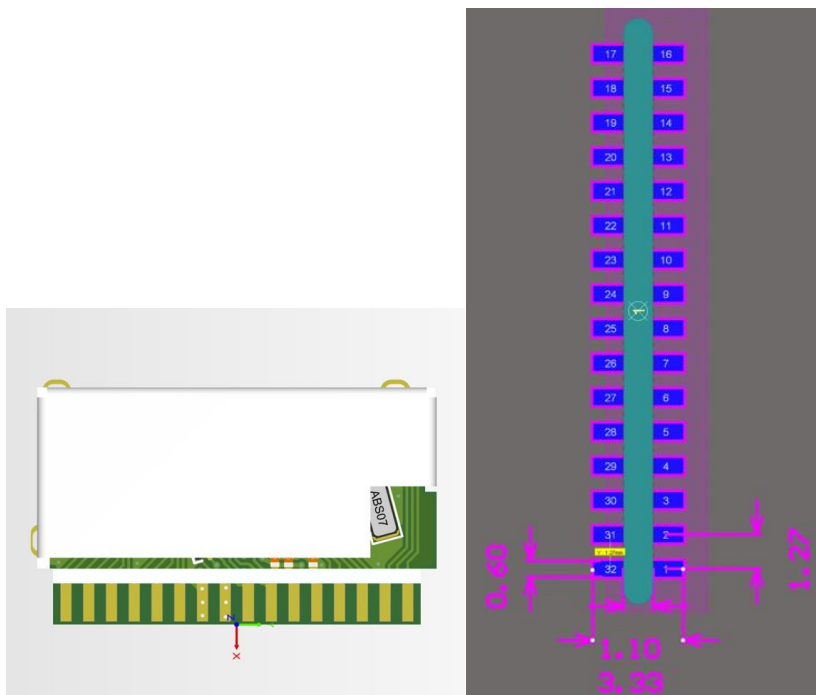


Figure 3: Module dimensions

PIN DESCRIPTION

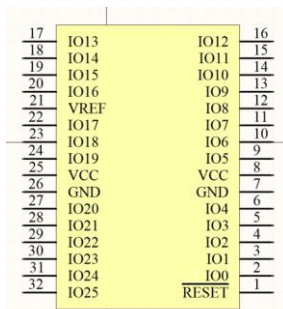


Figure 4: Module pinout

Pin	Name	Description	I _{OH} /I _{OL} (mA)
1	RESET	Reset pin	
2	IO0	GPIO (Support internal pull-up input and open-drain output)	-4.0/4.0
3	IO1	NC	
4	IO2	GPIO (Support internal pull-up)	-4.0/4.0
5	IO3	Load Line feedback voltage (After relay) (analog input)	-4.0/4.0
6	IO4	Current transformer input: Negative (analog input)	-4.0/4.0
7	GND	GND	
8	VCC	Isolated 5VDC (board's power supply)	
9	IO5	Current transformer input: Positive (analog input)	-4.0/4.0
10	IO6	AC voltage analog input: Line(analog input)	-4.0/4.0
11	IO7	NTC – Line temperature input (analog input)	-4.0/4.0
12	IO8	Relay control pin (PWM output)	-4.0/4.0
13	IO9	Residual sensor test pin	-4.0/4.0
14	IO10	Residual sensor out (ATM3009 input pin)	-4.0/4.0
15	IO11	CAN TX/GPIO (Support internal pull-up input and open-drain output)	-4.0/4.0
16	IO12	UART1 TX	-4.0/4.0
17	IO13	Pilot control PWM output: P	-4.0/4.0
18	IO14	CAN RX/GPIO (Support internal pull-up input and open-drain output)	-4.0/4.0
19	IO15	GPIO (Support internal pull-up input and open-drain output)	-4.0/4.0
20	IO16	GPIO (Support internal pull-up input and open-drain output)	-4.0/4.0
21	VREF	Referent voltage	-4.0/4.0
22	IO17	NTC – Relay temperature input (analog input)	-4.0/4.0
23	IO18	GPIO (Support internal pull-up)	-4.0/4.0
24	IO19	AC voltage analog input: Neutral (analog input)	-4.0/4.0
25	VCC	Isolated 5VDC (board's power supply)	
26	GND	GND	
27	IO20	Load Neutral feedback voltage (After relay) (analog input)	-4.0/4.0
28	IO21	Pilot control feedback voltage (analog input)	-4.0/4.0
29	IO22	UART1 RX	-4.0/4.0
30	IO23	NC	-4.0/4.0
31	IO24	Pilot control PWM output: N	-4.0/4.0
32	IO25	GPIO (Input only)	-4.0/4.0

Table 1: Pin function table

TECHNICAL SPECIFICATIONS

Maximum Absolute Rating

Characteristic	Symbol	Notes	Rating	Units
Supply Voltage	V_{CC}		5.5	V
AC Input Voltage	V_{IN}	AC Voltage	275	V
Digital I/O Voltage	V_{DIO}		5	V
Maximum Continuous Current	I_{MAX}		16	A
Operating Ambient Temperature	TA		-25 to 55	°C
Junction Temperature	TJ (max)		100	°C
Storage Temperature	Tstg		-40 to 85	°C

ESD Ratings

Characteristic	Symbol	Notes	Value	Unit
Human Body Model	VHBM	Per JEDEC JS-001	±2	kV
Charged Device Model	VCDM	Per JEDEC JS-002	±1	kV

Common Electrical Characteristics

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
DC SPECIFICATION						
Supply Voltage	V_{CC}	5 V variant	4.5	5.0	5.5	V
Supply Current	I_{CC}	$V_{CC}(\min) \leq V_{CC} \leq V_{CC}(\max)$	-	20	25	mA
AC VOLTAGE MEASUREMENT SPECIFICATION						
Voltage	V_{IN}		90	-	380	V
Accuracy			-2	-	2	%
AC CURRENT MEASUREMENT SPECIFICATION						
Current	I_{XP}/I_{XN}		0.5	-	32	A
Accuracy			-2	-	2	%
POWER MEASUREMENT SPECIFICATION						
Power	P		45	-	12000	W
Accuracy			-2	-	2	%
UART INTERFACE						
Serial port			-	1	-	port ¹
Baudrate			-	19200	-	Bps
Voltage				5		V

Protection Characteristics

Characteristic		Symbol	Max.	Unit
Over voltage protect	Alarm	OVP	Configurable default 265	V
	Recover	OVP	Configurable default 260	V
	Detect time		Configurable default 3	s
Under voltage protect	Alarm	UVP	Configurable default 165	V
	Recover	UVP	Configurable default 170	V
	Detect time		Configurable default 3	s
Lost PE protect	Threshold		Configurable default 10	V
	Detect time		Configurable default 3	s
Overloads protect	Threshold		Configurable default 19	A
	Detect time		Configurable default 3	s
Relay temperature protect	Threshold		Configurable default 85	°C
	Detect time		Configurable default 3	S
Wire temperature protect	Threshold		Configurable default 90	°C
	Detect time		Configurable default 3	S

AT Commands

AT Command Syntax

Each AT command starts with "AT+" and ends with <CR><LF> (0x0D and 0x0A). There are three types of commands:

- Write command **AT+<x>=<...>**: This command sets user-definable parameters.
- Read command **AT+<x>?<...>**: This command gets parameters or statuses. It also provides an optional parameter to indicate which channel to get.
- Execution command **AT+<x>**: This command executes a function of the module.

Depend on the requested command, the meter may or may not return a response. If there is a response, it starts with +<x>; where <x> is the requested command. If the command does not need any specific reply, the meter returns **OK** instead.

If there is something wrong when the module is executing the command, it sends back an error message. The format of an error message is **ERROR:<reason>**.

The module also provides URC (Unsolicited Result Code) to notify users whenever an event occurs on the loads, and it needs users' attention.

TOTAL – Total Power

This command reads total parameters from all channels.

Syntax:

AT+TOTAL?\r\n

Response:

+TOTAL:<voltage>,<current>,<power>,<energy>\r\n

The format of the values in the response is the same as the **+READ** command.

OVERLOADTOTAL – Setting the Overload Protection Threshold

Set the overload protection limit for the module. The module switches off the relay if the current of a channel exceeds this value for the “**delay time**”. Users can disable this feature by setting the current threshold to the rating current.

Syntax:

AT+OVERLOADTOTAL=<current in mA>,<delay time in ms>\r\n

Users can check these parameters by using its query form.

Syntax:

AT+ OVERLOADTOTAL?\r\n

Response:

+OVERLOAD=<current in mA>,<delay time in ms>\r\n

WIROVERTEMP – Setting the Over-Temperature Protection Threshold for Wire

Set the over-temperature protection threshold for wire. The module switches off the relay if the temperature of the wire exceeds this value for the “**delay time**”.

Syntax:

AT+WIROVERTEMP=<temp in °C>,<delay time in ms>\r\n

Users can check these parameters by using its query form.

Syntax:

AT+ WIROVERTEMP?\r\n

Response:

+ WIROVERTEMP =<temp in °C>,<delay time in ms>\r\n

RELAYOVERTEMP – Setting the Over-Temperature Protection Threshold for Relay

Set the over-temperature protection threshold for the relay. The module switches off the relay if the temperature of the relay exceeds this value for the “**delay time**”.

Syntax:

AT+RELAYOVERTEMP=<temp in °C>,<delay time in ms>\r\n

Users can check these parameters by using its query form.

Syntax:

AT+ RELAYOVERTEMP?\r\n

Response:

+ RELAYOVERTEMP=<temp in °C>,<delay time in ms>\r\n

UNDERVOLT – Setting Under-Voltage Threshold

Set the under-voltage protection threshold for the module. The module switches off all relays if the voltage is smaller than a threshold after the “**delay time**”. And it will stop alert if the voltage larger than the recover threshold. Users can disable this feature by setting the threshold to 0V. The default threshold is 0V.

Syntax:

AT+UNDERVOLT=<threshold>,<recover threshold>,<delay time in ms>\r\n

Syntax:

AT+UNDERVOLT?\r\n

Response:

+UNDERVOLT:<threshold>,<recover threshold>,<delay time in ms>\r\n

Example:

AT+UNDERVOLT=2000,2100,1000\r\n

After executing the command, the module sends a **+UNDERVOLTALERT** message if the voltage is smaller than 200V for 1s. The alert will stop if the voltage is larger than 210V.

OVERVOLT – Setting Over-Voltage Threshold

Set the over-voltage protection threshold for the module. The module switches off all relays if the voltage is bigger than a threshold after the “delay time”. Users can disable this feature by setting the threshold to a large value. The default threshold is 400V.

Syntax:

```
AT+OVERVOLT=<threshold>,<recover threshold>,<delay time in ms>\r\n
```

Syntax:

```
AT+OVERVOLT?\r\n
```

Response:

```
+OVERVOLT:<threshold>,<recover threshold>,<delay time in ms>\r\n
```

Example:

```
AT+OVERVOLT=30000,25000,1000\r\n
```

After executing the command, the module sends a +OVERVOLTALERT message if the voltage is larger than 300V for 1s. The alert will stop if the voltage is smaller than 250V.

FREQ – Getting the Frequency

This command gets the current frequency of the voltage signal. The scale factor of the frequency is 100.

Syntax:

```
AT+FREQ?\r\n
```

Response:

```
+FREQ:<frequency>\r\n
```

Example:

```
+FREQ:5000\r\n
```

The response means the frequency of the voltage signal is 50 Hz.

SAVE – Save settings

This command saves the current settings to non-volatile memory.

Syntax:

```
AT+SAVE\r\n
```

VER – Getting the version number

This command gets the unique 128-bit ID number of the module. The result of this command is in the hexadecimal format.

Syntax:

```
AT+VER?\r\n
```

Response:

```
+VER:<verion number>\r\n
```

Example:

```
+VER:1.0.0\r\n
```

ID – Getting the identify number

This command gets the unique 128-bit ID number of the module. The result of this command is in the hexadecimal format.

Syntax:

```
AT+ID?\r\n
```

Response:

```
+ID:<id number in hexadecimal>\r\n
```

Example:

```
+ID:F151000054EA00260025200331534E42\r\n
```

UGAIN – Voltage Calibration Factors

This command gets the calibration factors of the voltage measurement.

Syntax:

```
AT+UGAIN=<factor 1>,<factor 2>,<factor 3>\r\n
```


Users can check these factors by using the query form.

Syntax:

AT+UGAIN?\r\n

Response:

+UGAIN:<factor 1>,<factor 2>,<factor3>\r\n

Examples:

+UGAIN:2072134208,1752,-4992\r\n

IGAIN – Current Calibration Factors

This command gets the calibration factors of the current measurement.

Syntax:

AT+IGAIN=<channel>,<factor 1>,<factor 2>,<factor 3>\r\n

Users can check these factors by using the query form.

Syntax:

AT+IGAIN?<channel>\r\n

Response:

+IGAIN:<channel>,<factor 1>,<factor 2>,<factor 3>\r\n

Example:

+IGAIN:0,1289960380,1024,143409\r\n

AUTOCALIB – Start Auto-calibration Process

This command starts the auto-calibration process of the module. Once this mode is activated, users can only stop it by resetting the module or the wait for the calibration success. **Users should not use this command.**

Syntax:

AT+AUTOCALIB\r\n

REBOOT – Reboot the Module

When a module receives this command, it resets immediately and does not give any feedback.

Syntax:

AT+REBOOT\r\n

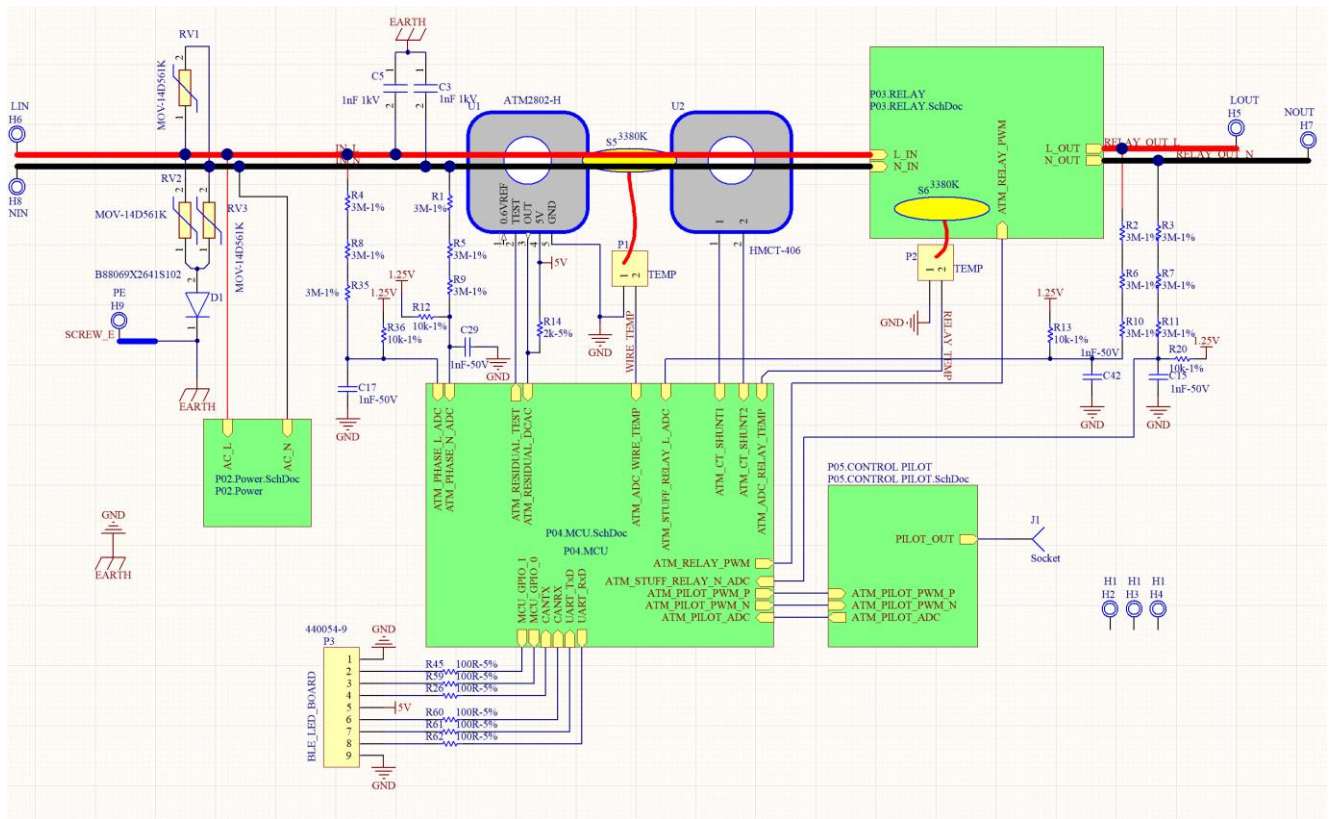
Error Codes

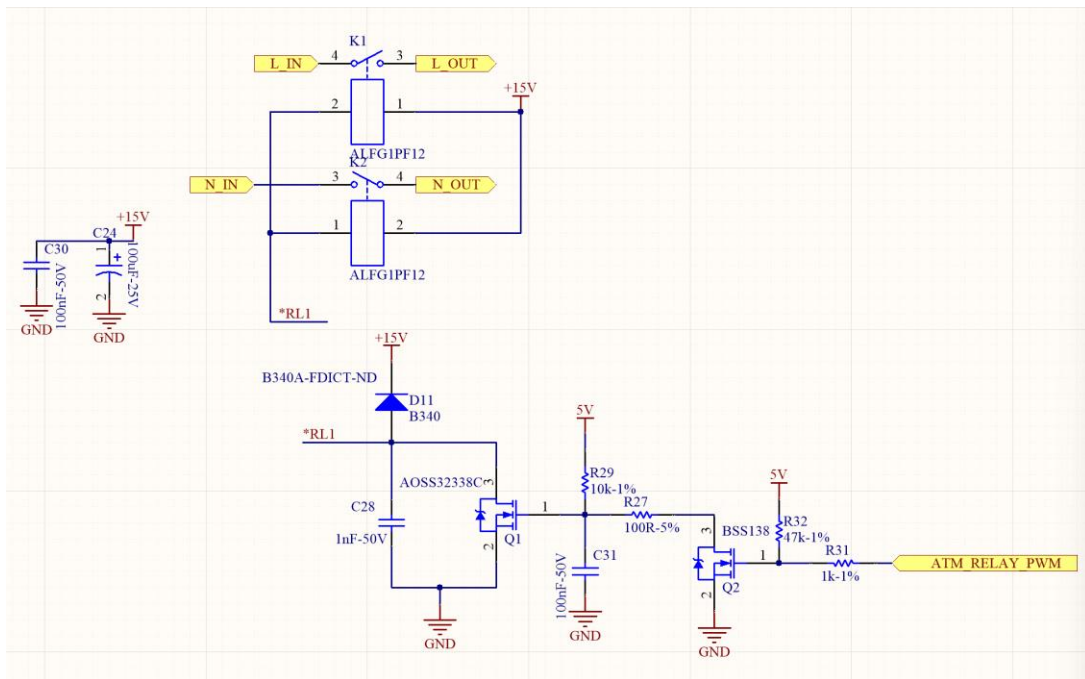
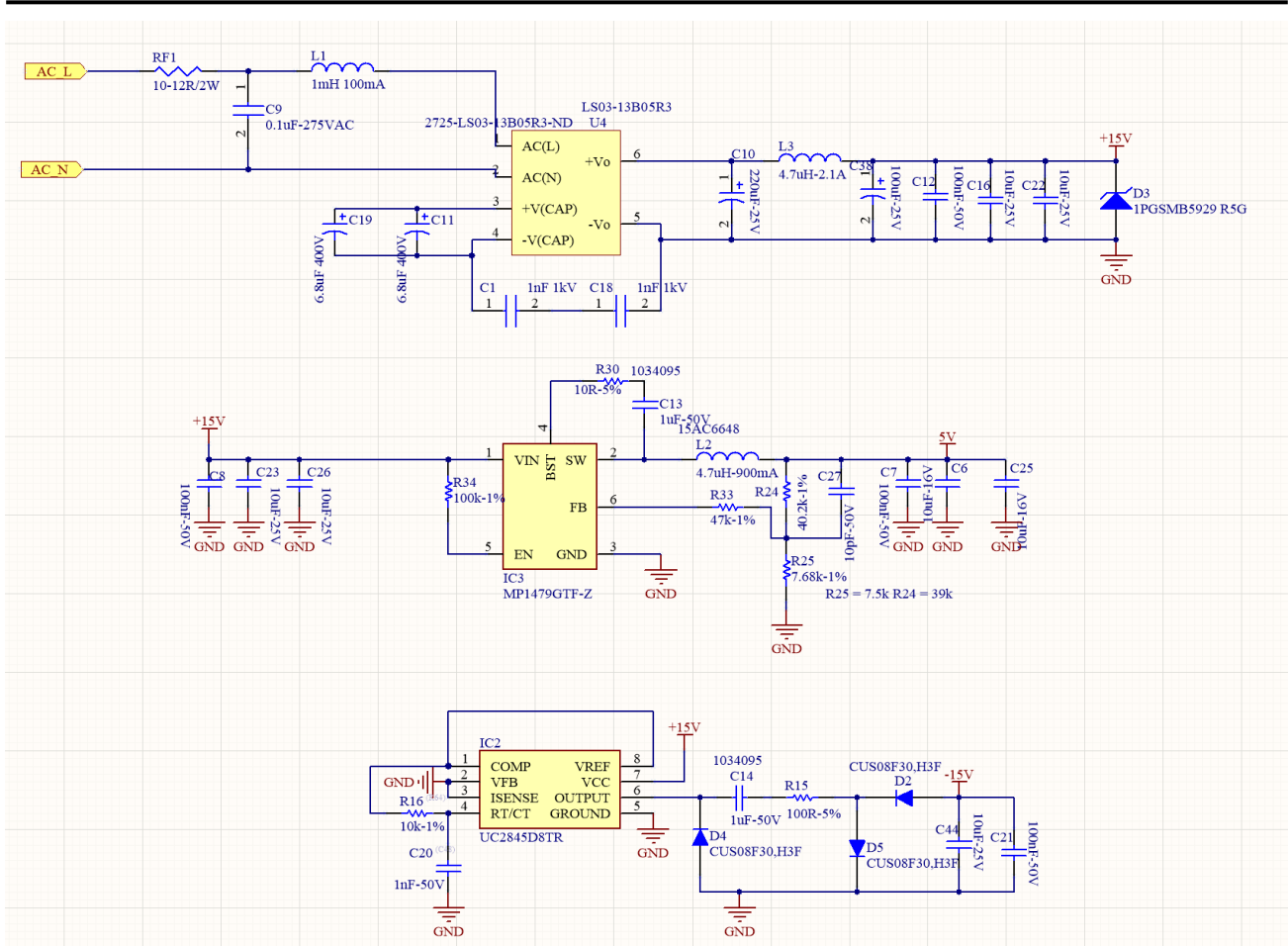
Error string	Problems	Resolve
NOT-FOUND	The command is wrong.	Users should check the input commands.
TOO-LONG	The line is too long to process (more than 128 bytes).	Make sure all commands end with “\r\n”.
INVALID-PARAM	The parameters for the requested command are invalid.	Users should check the parameters.
INVALID-CHARACTER	The command contains an invalid character.	If the module sends this code rapidly without any input, users should check the serial port connection. If the module sends this code after executing a command, retry the command. If the error code appears frequently, users should check the serial port connection.
RELAY-CONTROL-FAILED	The module cannot control the relay because the module cannot detect zero-crosses.	Replace another module.
USED-PIN	The module cannot assign a function to a defined pin.	Check the settings.

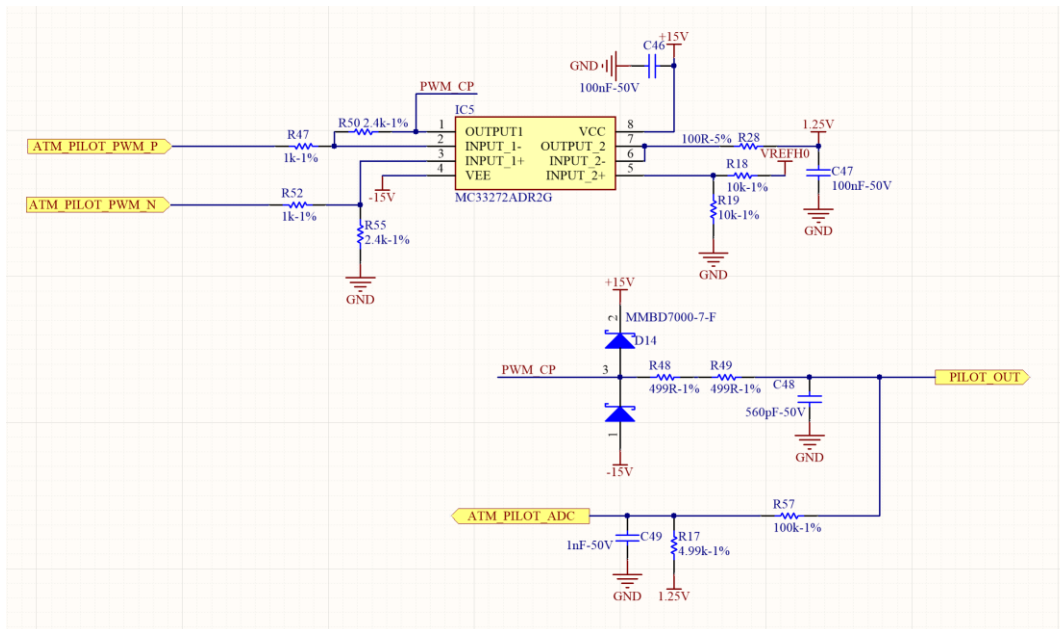
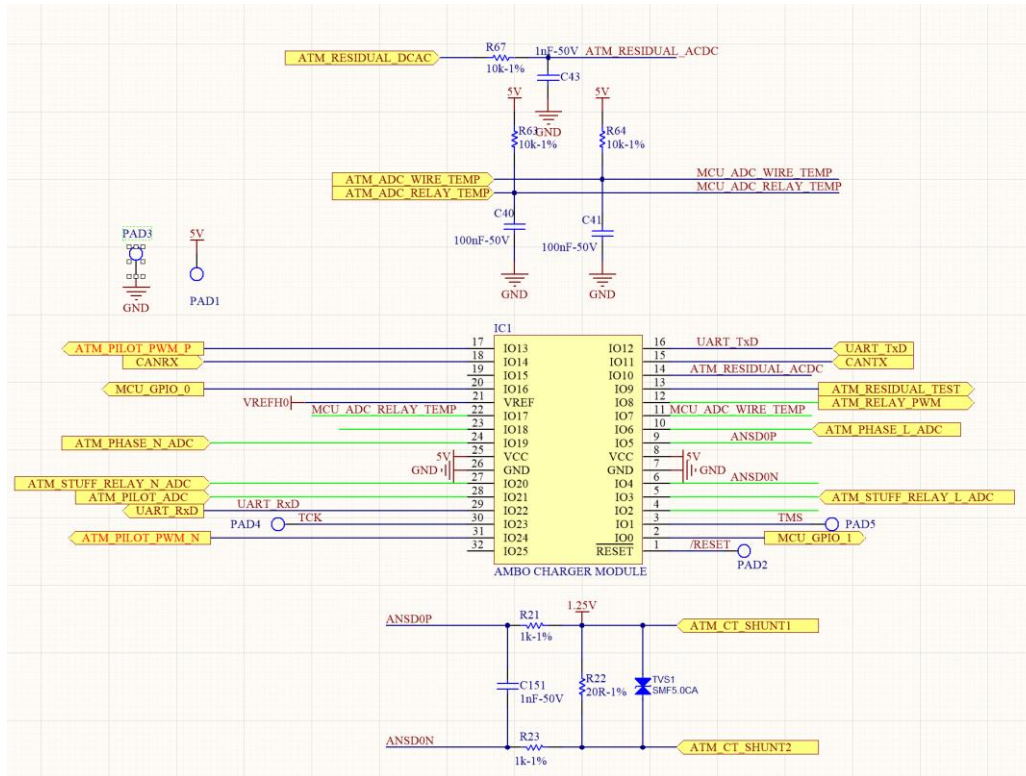
<p>DENIED</p>	<p>The module does not allow to execute the command.</p>	<p>If users receive this error after executing a RELAY, a RELAYPINS, or an ADC command, make sure the channel is disabled. If users receive this error after an IOCLEAR command, make sure the parameter is not one of the pins the serial port (IO4 and IO5).</p>
---------------	--	---

Table 2: Error codes

Reference Design





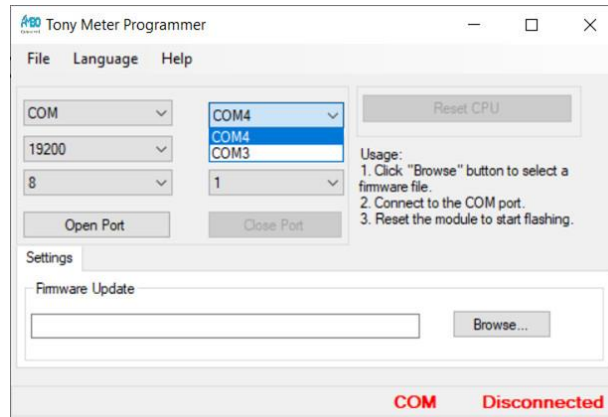


FIRMWARE UPDATE

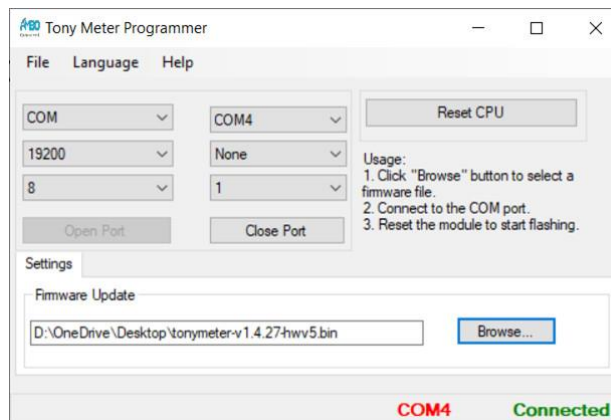
1. Download and extract Tonymeter-programmer.zip
2. Open TonyMeterProgrammer.exe file

Name	Status	Date modified
app.publish		09/22/21 23:0
TonyMeterProgrammer.application		09/22/21 22:3
TonyMeterProgrammer.exe		09/22/21 22:3
TonyMeterProgrammer.exe.config		09/22/21 22:3
TonyMeterProgrammer.exe.manifest		09/22/21 22:3
TonyMeterProgrammer.pdb		09/22/21 22:3

3. Select a correct COM port.



4. Press "Browse..." to select a binary file.
5. Press "Open Port" to connect to the COM port.
6. Reset the module by re-apply power or press reset CPU to start updating.



REVISION HISTORY

Version	Date	Description
0.1	18/01/2022	First version
0.2	28/03/2022	Modify schematic and firmware