

Figure 1. Schematics of data-acquisition system.

Purpose/location   Purpose/location   Printed board circuit components and modules	<b>Table 1.</b> Electronic components of the data-acquisition system.			
P11, P13, P22         0.1μF electrolytic capacitor         Noise decoupling at power and serial lines           P18, P32         10 μF electrolytic capacitor         Noise filter           P12, P35, P36         10kΩ resistor         Pull-up or -down resistors           P09         16MHz crystal         16MHz external crystal oscillator           P15         28-pin socket         28-pin socket for the ATmega328p           P17, P23, P26, P30         220Ω resistor         Resistors to control current drainage           P06, P07         22pF ceramic capacitor         22pf ceramic capacitor for atmega328p           P19, P20         4.7kΩ resistor         Pull-up resistors for 12C lines           P01         ADS1115 module         Direct soldering the module can be substituted by 10 female pin headers for ADS1115           P39         DC input jack         Power input for a 9V-12V AC-DC voltage           P21a, P21b         DS3231 module         Direct soldering the module can be substituted by 6 female pin headers for DS3231           P25         LM7805         Voltage regulator           P27-29, P31, P3-3-34, P38, P40         Molex with 2 pins¹         Connectors for various panel buttons and connectors           P37, P02-05         Molex with 5 pins¹         Connection for LCD screen module²           P41         Molex with 5 pins¹         Connection for LCD screen modu	Id.	Description	Purpose/location	
P18, P32         10 μF electrolytic capacitor         Noise filter           P12, P35, P36         10kΩ resistor         Pull-up or -down resistors           P09         16MHz crystal         16MHz external crystal oscillator           P15         28-pin socket         28-pin socket for the ATmega328p           P17, P23, P26, P30         20Ω resistor         Resistors to control current drainage           P06, P07         22pF ceramic capacitor         22pf ceramic capacitor for atmega328p           P19, P20         4.7kΩ resistor         Pull-up resistors for I2C lines           P01         ADS1115 module         Direct soldering the module can be substituted by 10 female pin headers for ADS1115           P39         DC input jack         Power input for a 9V-12V AC-DC voltage           P21a, P21b         DS3231 module         Direct soldering the module can be substituted by 6 female pin headers for DS3231           P25         LM7805         Voltage regulator           P14, P24, P27-29, P31, P33-34, P38, P40         Molex with 3 pins¹         Connectors for various panel buttons and connectors           P41         Molex with 4 pins¹         Connection for temperature and humidity sensor and accelerometer channels           P08         Molex with 5 pins¹         Connection for LCD screen module²           P08         Molex with 6 pins¹         Connection for micr				
P12, P35, P36         10kΩ resistor         Pull-up or -down resistors           P09         16MHz crystal         16MHz external crystal oscillator           P15         28-pin socket         28-pin socket for the ATmega328p           P17, P23, P26, P30         220Ω resistor         Resistors to control current drainage           P06, P07         22pF ceramic capacitor         22pf ceramic capacitor for atmega328p           P19, P20         4.7kΩ resistor         Pull-up resistors for 12C lines           P01         ADS1115 module         Direct soldering the module can be substituted by 10 female pin headers for ADS1115           P39         DC input jack         Power input for a 9V-12V AC-DC voltage           P21a, P21b         DS3231 module         Direct soldering the module can be substituted by 6 female pin headers for DS3231           P25         LM7805         Voltage regulator           P14, P24, P24, P27-29, P31, P3-334, P38, P40         Connection for temperature and humidity sensor and accelerometer channels           P37, P02-05         Molex with 3 pins¹         Connection for LCD screen module²           P37, P02-05         Molex with 5 pins¹         Connection for LCD screen module²           P16         Molex with 6 pins¹         Connection for microSD module²           P08         Molex with 6 pins¹         Connection for microSD module²	P11, P13, P22	0.1μF electrolytic capacitor	Noise decoupling at power and serial lines	
P09         16MHz crystal         16MHz external crystal oscillator           P15         28-pin socket         28-pin socket for the ATmega328p           P17, P23, P26, P30         220Ω resistor         Resistors to control current drainage           P06, P07         22pF ceramic capacitor         22pf ceramic capacitor for atmega328p           P19, P20         4.7kΩ resistor         Pull-up resistors for I2C lines           P01         ADS1115 module         Direct soldering the module can be substituted by 10 female pin headers for ADS1115           P39         DC input jack         Power input for a 9V-12V AC-DC voltage           P21a, P21b         DS3231 module         Direct soldering the module can be substituted by 6 female pin headers for DS3231           P25         LM7805         Voltage regulator           P14, P24, P24, P27-29, P31, P33-34, P38, P40         Connectors for various panel buttons and connectors           P37, P02-05         Molex with 3 pins¹         Connection for temperature and humidity sensor and accelerometer channels           P41         Molex with 5 pins¹         Connection for LCD screen module²           P08         Molex with 6 pins¹         Connection for LCD screen module²           P08b         microSD module         MicroSD module with SPI connectors           P10         PCB push button         Push button to allow atmega328p hard r	P18, P32	10 μF electrolytic capacitor	Noise filter	
P09         16MHz crystal         16MHz external crystal oscillator           P15         28-pin socket         28-pin socket for the ATmega328p           P17, P23, P26, P30         220Ω resistor         Resistors to control current drainage           P06, P07         22pF ceramic capacitor         22pf ceramic capacitor for atmega328p           P19, P20         4.7kΩ resistor         Pull-up resistors for I2C lines           P01         ADS1115 module         Direct soldering the module can be substituted by 10 female pin headers for ADS1115           P39         DC input jack         Power input for a 9V-12V AC-DC voltage           P21a, P21b         DS3231 module         Direct soldering the module can be substituted by 6 female pin headers for DS3231           P25         LM7805         Voltage regulator           P14, P24, P24, P27-29, P31, P33-34, P38, P40         Connectors for various panel buttons and connectors           P37, P02-05         Molex with 3 pins¹         Connection for temperature and humidity sensor and accelerometer channels           P41         Molex with 5 pins¹         Connection for LCD screen module²           P08         Molex with 6 pins¹         Connection for LCD screen module²           P08b         microSD module         MicroSD module with SPI connectors           P10         PCB push button         Push button to allow atmega328p hard r	P12, P35, P36	10kΩ resistor	Pull-up or -down resistors	
P15         28-pin socket         28-pin socket for the ATmega328p           P17         P23         220Ω resistor         Resistors to control current drainage           P06         P07         22pF ceramic capacitor         22pf ceramic capacitor for atmega328p           P19         P20         4.7kΩ resistor         Pull-up resistors for I2C lines           P01         ADS1115 module         Direct soldering the module can be substituted by 10 female pin headers for ADS1115           P39         DC input jack         Power input for a 9V-12V AC-DC voltage           P21a, P21b         DS3231 module         Direct soldering the module can be substituted by 6 female pin headers for DS3231           P25         LM7805         Voltage regulator           P14, P24, P27-29, P31, P3-334, P38, P40         Connectors for various panel buttons and connectors           P41         Molex with 3 pins¹         Connection for temperature and humidity sensor and accelerometer channels           P41         Molex with 4 pins¹         Connection for LCD screen module²           P16         Molex with 5 pins¹         Connection for ILCD screen module²           P08         Molex with 6 pins¹         Connection for microSD module²           P08         Molex with 6 pins¹         Connection for microSD module²           P08b         microSD module         MicroSD mod		16MHz crystal		
P30         220x resistor         Resistors to control current dramage           P06         P07         22pf ceramic capacitor         22pf ceramic capacitor for atmega328p           P19         P20         4.7kΩ resistor         Pull-up resistors for 12C lines           P01         ADS1115 module         Direct soldering the module can be substituted by 10 female pin headers for ADS1115           P39         DC input jack         Power input for a 9V-12V AC-DC voltage           P21a, P21b         DS3231 module         Direct soldering the module can be substituted by 6 female pin headers for DS3231           P25         LM7805         Voltage regulator           P14, P24, P27-29, P31, P33-34, P38, P40         Connection for various panel buttons and connectors           P37, P02-05         Molex with 3 pins¹         Connection for temperature and humidity sensor and accelerometer channels           P41         Molex with 4 pins¹         Connection for LCD screen module²           P16         Molex with 5 pins¹         Connection for microSD module²           P08         Molex with 6 pins¹         Connection for microSD module²           P08         microSD module         MicroSD module with SPI connectors           P10         PCB push button         Push button to allow atmega328p hard reset           Buttons, connectors, and modules to install in external case     <	P15	28-pin socket		
P19, P20         4.7kΩ resistor         Pull-up resistors for 12C lines           P01         ADS1115 module         Direct soldering the module can be substituted by 10 female pin headers for ADS1115           P39         DC input jack         Power input for a 9V-12V AC-DC voltage           P21a, P21b         DS3231 module         Direct soldering the module can be substituted by 6 female pin headers for DS3231           P25         LM7805         Voltage regulator           P27-29, P31, P33-34, P38, P40         Molex with 2 pins¹         Connectors for various panel buttons and connectors           P37, P02-05         Molex with 3 pins¹         Connection for temperature and humidity sensor and accelerometer channels           P41         Molex with 5 pins¹         Connection for LCD screen module²           P16         Molex with 6 pins¹         Connection for microSD module²           P08         Molex with 6 pins¹         Connection for microSD module²           P08b         microSD module         MicroSD module with SPI connectors           P10         PCB push button         Push button to allow atmega328p hard reset           Buttons, connectors, and modules to install in external case           P42-45         (On)-Off panel button         Momentary pushbutton, normally open and 12mm mounting hole diameter, at top panel and analog input/output at front panel           P46, P51-54	P30	220Ω resistor	Resistors to control current drainage	
P01 ADS1115 module Direct soldering the module can be substituted by 10 female pin headers for ADS1115 P39 DC input jack Power input for a 9V-12V AC-DC voltage P21a, P21b DS3231 module Direct soldering the module can be substituted by 6 female pin headers for DS3231 P25 LM7805 Voltage regulator P14, P24, P27-29, P31, P33-34, P38, P40 P37, P02-05 Molex with 2 pins¹ Connection for various panel buttons and connectors P41 Molex with 4 pins¹ Connection for LCD screen module² P16 Molex with 5 pins¹ Connection for LCD screen module² P17 Molex with 6 pins¹ Connection for microSD module² P08b microSD module MicroSD module with SPI connectors P10 PCB push button Push button to allow atmega328p hard reset Buttons, connectors, and modules to install in external case Momentary pushbutton, normally open and 12mm mounting hole diameter, at top panel P42-45 (On)-Off panel button Connector for a CP2102 module to enable serial communication at back panel P47-50 3 way panel connector P55 Sway panel connector Connector for a CP2102 module to enable serial communication at back panel P57 LED + Panel LED holder LED to indicate system is powered up P58 LCD screen module MicroSD card module with SPI interface	P06, P07	22pF ceramic capacitor	22pf ceramic capacitor for atmega328p	
P21a, P21b DS3231 module Direct soldering the module can be substituted by 6 female pin headers for ADS1115  P25 LM7805 Voltage regulator  P14, P24, P27-29, P31, P33-34, P38, P40  P37, P02-05 Molex with 3 pins¹ Connection for temperature and humidity sensor and accelerometer channels  P41 Molex with 4 pins¹ Connection for LCD screen module²  P16 Molex with 5 pins¹ Connection for LCD screen module²  P17 Connection for LCD screen module²  P18 Molex with 6 pins¹ Connection for microSD module²  P19 Molex with 6 pins¹ Connection for microSD module²  P10 PCB push button Push button to allow atmega328p hard reset  P24-45 (On)-Off panel button  P46, P51-54 S way panel connector  P55 S way panel connector  P56 On-Off panel button  P57 LED + Panel LED holder  P58 LCD screen module with SPI interface  P10 Direct soldering the module and substituted by 6 female pin headers for ADS1115  Power input for a 9V-12V AC-DC voltage  Direct soldering the module can be substituted by 6 female pin headers for DS3231  Power input for a 9V-12V AC-DC voltage  Direct soldering the module can be substituted by 6 female pin headers for DS3231  Pole temale pin headers for DS3231  Connectors for various panel buttons and connectors for accelerometer channels  Connection for temperature and humidity sensors  Connection for LCD screen module vith SPI connectors  P10 Descreen module MicroSD card module with SPI interface	P19, P20	4.7kΩ resistor		
P21a, P21b DS3231 module Direct soldering the module can be substituted by 6 female pin headers for DS3231  P25 LM7805 Voltage regulator  P14, P24, P27-29, P31, P33-34, P38, P40  P37, P02-05 Molex with 3 pins¹ Connectors for various panel buttons and connectors  P41 Molex with 4 pins¹ Connection for LCD screen module²  P16 Molex with 5 pins¹ Connection for LCD screen module²  P16 Molex with 6 pins¹ Connection for LCD screen module²  P08 Molex with 6 pins¹ Connection for microSD module MicroSD module with SPI connectors  P10 PCB push button Push button to allow atmega328p hard reset  Buttons, connectors, and modules to install in external case  P42-45 (On)-Off panel button  P46, P51-54 3.5 mm jack PJ-301M temperature and humidity sensor at top panel and analog input/output at front panel  P47-50 3 way panel connector  P55 Sway panel connector  P56 On-Off panel button  P57 LED + Panel LED holder LED to indicate system is powered up  P58 LCD screen module MicroSD card module with SPI interface  P65 MicroSD card module MicroSD card module with SPI interface	P01	ADS1115 module		
P25 LM7805 Voltage regulator P14, P24, P27-29, P31, P33-34, P38, P40  P37, P02-05 Molex with 3 pins¹ Connectors for various panel buttons and connectors  P41 Molex with 4 pins¹ Connection for temperature and humidity sensor and accelerometer channels  P41 Molex with 5 pins¹ Connection for LCD screen module² P16 Molex with 5 pins¹ Connection for LCD screen module² P08 Molex with 6 pins¹ Connection for microSD module² P08b microSD module MicroSD module with SPI connectors P10 PCB push button Push button to allow atmega328p hard reset  Buttons, connectors, and modules to install in external case  P42-45 (On)-Off panel button Stereo audio panel connector with 3 pins for temperature and humidity sensor at top panel Stereo audio panel connector with 3 pins for temperature and plumidity sensor at top panel P47-50 3 way panel connector Connectors for accelerometer at front panel P47-50 Sway panel connector Connectors for accelerometer at front panel P55 Sway panel connector Connectors for accelerometer at front panel P56 On-Off panel button Self-lock button, 12mm mounting hole diameter, at back panel P57 LED + Panel LED holder LED to indicate system is powered up P58 LCD screen module MicroSD card module with SPI interface	P39	DC input jack	Power input for a 9V-12V AC-DC voltage	
P14, P24, P27-29, P31, P33-34, P38, P40	P21a, P21b	DS3231 module		
P27-29, P31, P33-34, P38, P40  P37, P02-05 Molex with 3 pins¹ Connection for temperature and humidity sensor and accelerometer channels  P41 Molex with 4 pins¹ Connection for LCD screen module²  P16 Molex with 5 pins¹ CP2102 connector for USB/UART communication with ATmega328p  P08 Molex with 6 pins¹ Connection for microSD module²  P08b microSD module MicroSD module with SPI connectors  P10 PCB push button Push button to allow atmega328p hard reset  Buttons, connectors, and modules to install in external case  P42-45 (On)-Off panel button Stereo audio panel connector with 3 pins for temperature and humidity sensor at top panel and analog input/output at front panel  P47-50 3 way panel connector Connectors for accelerometer at front panel  P55 Sway panel connector Self-lock button, 12mm mounting hole diameter, at back panel  P56 On-Off panel button Self-lock button, 12mm mounting hole diameter, at back panel  P57 LED + Panel LED holder LED to indicate system is powered up  P58 LCD screen module MicroSD card module with SPI interface		LM7805	Voltage regulator	
P37, P02-05 Molex with 3 pins¹ Connection for temperature and humidity sensor and accelerometer channels  P41 Molex with 4 pins¹ Connection for LCD screen module²  P16 Molex with 5 pins¹ CP2102 connector for USB/UART communication with ATmega328p  P08 Molex with 6 pins¹ Connection for microSD module²  P08b microSD module MicroSD module with SPI connectors  P10 PCB push button Push button to allow atmega328p hard reset  Buttons, connectors, and modules to install in external case  P42-45 (On)-Off panel button Stereo audio panel connector with 3 pins for temperature and humidity sensor at top panel and analog input/output at front panel  P46, P51-54 3.5 mm jack PJ-301M temperature and humidity sensor at top panel and analog input/output at front panel  P47-50 3 way panel connector Connectors for accelerometer at front panel  P55 Sway panel connector Connector for a CP2102 module to enable serial communication at back panel  P56 On-Off panel button Self-lock button, 12mm mounting hole diameter, at back panel  P57 LED + Panel LED holder LED to indicate system is powered up  P58 LCD screen module MicroSD card module with SPI interface	P27-29, P31, P33-34, P38,	Molex with 2 pins <sup>1</sup>	-	
P16 Molex with 5 pins¹ CP2102 connector for USB/UART communication with ATmega328p  P08 Molex with 6 pins¹ Connection for microSD module²  P08b microSD module MicroSD module with SPI connectors  P10 PCB push button Push button to allow atmega328p hard reset  Buttons, connectors, and modules to install in external case  P42-45 (On)-Off panel button Stereo audio panel connector with 3 pins for temperature and humidity sensor at top panel and analog input/output at front panel  P46, P51-54 3.5 mm jack PJ-301M Connectors for accelerometer at front panel  P47-50 3 way panel connector Connectors for accelerometer at front panel  P55 5 5 way panel connector Connector for a CP2102 module to enable serial communication at back panel  P56 On-Off panel button Self-lock button, 12mm mounting hole diameter, at back panel  P57 LED + Panel LED holder LED to indicate system is powered up  P58 LCD screen module MicroSD card module with SPI interface  P59 microSD card module MicroSD card module with SPI interface	P37, P02-05	Molex with 3 pins <sup>1</sup>		
P16 Molex with 5 pins¹ CP2102 connector for USB/UART communication with ATmega328p  P08 Molex with 6 pins¹ Connection for microSD module²  P08b microSD module MicroSD module with SPI connectors  P10 PCB push button Push button to allow atmega328p hard reset  Buttons, connectors, and modules to install in external case  P42-45 (On)-Off panel button Stereo audio panel connector with 3 pins for temperature and humidity sensor at top panel and analog input/output at front panel  P46, P51-54 3.5 mm jack PJ-301M Connectors for accelerometer at front panel  P47-50 3 way panel connector Connectors for accelerometer at front panel  P55 5 5 way panel connector Connector for a CP2102 module to enable serial communication at back panel  P56 On-Off panel button Self-lock button, 12mm mounting hole diameter, at back panel  P57 LED + Panel LED holder LED to indicate system is powered up  P58 LCD screen module MicroSD card module with SPI interface  P59 microSD card module MicroSD card module with SPI interface	P41	Molex with 4 pins <sup>1</sup>	Connection for LCD screen module <sup>2</sup>	
P08Molex with 6 pins¹Connection for microSD module²P08bmicroSD moduleMicroSD module with SPI connectorsP10PCB push buttonPush button to allow atmega328p hard resetButtons, connectors, and modules to install in external caseP42-45(On)-Off panel buttonMomentary pushbutton, normally open and 12mm mounting hole diameter, at top panelP46, P51-543.5 mm jack PJ-301MStereo audio panel connector with 3 pins for temperature and humidity sensor at top panel and analog input/output at front panelP47-503 way panel connectorConnectors for accelerometer at front panelP555 way panel connectorConnector for a CP2102 module to enable serial communication at back panelP56On-Off panel buttonSelf-lock button, 12mm mounting hole diameter, at back panelP57LED + Panel LED holderLED to indicate system is powered upP58LCD screen module16x2 LCD screen module with I2C interfaceP59microSD card moduleMicroSD card module with SPI interface	P16			
P08b   microSD module   MicroSD module with SPI connectors	P08	Molex with 6 pins <sup>1</sup>		
Buttons, connectors, and modules to install in external case  P42-45  (On)-Off panel button  P46, P51-54  3.5 mm jack PJ-301M  P47-50  Button  Button  P47-50  Connector  Stereo audio panel connector with 3 pins for temperature and humidity sensor at top panel and analog input/output at front panel  P55  Suay panel connector  Connectors for a CP2102 module to enable serial communication at back panel  P56  On-Off panel button  P57  LED + Panel LED holder  P58  LCD screen module  P59  microSD card module  MicroSD card module with SPI interface	P08b			
Buttons, connectors, and modules to install in external case  P42-45  (On)-Off panel button  P46, P51-54  3.5 mm jack PJ-301M  P47-50  Button  Button  P47-50  Connector  Stereo audio panel connector with 3 pins for temperature and humidity sensor at top panel and analog input/output at front panel  P55  Suay panel connector  Connectors for a CP2102 module to enable serial communication at back panel  P56  On-Off panel button  P57  LED + Panel LED holder  P58  LCD screen module  P59  microSD card module  MicroSD card module with SPI interface	P10	PCB push button	Push button to allow atmega328p hard reset	
P42-45  (On)-Off panel button  12mm mounting hole diameter, at top panel  Stereo audio panel connector with 3 pins for temperature and humidity sensor at top panel and analog input/output at front panel  P47-50  3 way panel connector  Connectors for accelerometer at front panel  Connector for a CP2102 module to enable serial communication at back panel  P56  On-Off panel button  P57  LED + Panel LED holder  P58  LCD screen module  P59  microSD card module  MicroSD card module with SPI interface				
P46, P51-54  3.5 mm jack PJ-301M temperature and humidity sensor at top panel and analog input/output at front panel  P47-50  3 way panel connector  Connectors for accelerometer at front panel  Connector for a CP2102 module to enable serial communication at back panel  P56  On-Off panel button  P57  LED + Panel LED holder  P58  LCD screen module  P59  microSD card module  MicroSD card module with SPI interface	P42-45	(On)-Off panel button	12mm mounting hole diameter, at top panel	
P55   5 way panel connector   Connector for a CP2102 module to enable serial communication at back panel   P56   On-Off panel button   Self-lock button, 12mm mounting hole diameter, at back panel   P57   LED + Panel LED holder   LED to indicate system is powered up   P58   LCD screen module   16x2 LCD screen module with I2C interface   P59   microSD card module   MicroSD card module with SPI interface	P46, P51-54	3.5 mm jack PJ-301M	temperature and humidity sensor at top panel	
P55 Sway panel connector rial communication at back panel P56 On-Off panel button Self-lock button, 12mm mounting hole diameter, at back panel P57 LED + Panel LED holder LED to indicate system is powered up P58 LCD screen module 16x2 LCD screen module with I2C interface P59 microSD card module MicroSD card module with SPI interface	P47-50	3 way panel connector		
P56 Un-Off panel button ter, at back panel P57 LED + Panel LED holder LED to indicate system is powered up P58 LCD screen module 16x2 LCD screen module with I2C interface P59 microSD card module MicroSD card module with SPI interface	P55	5 way panel connector		
P57 LED + Panel LED holder LED to indicate system is powered up P58 LCD screen module 16x2 LCD screen module with I2C interface P59 microSD card module MicroSD card module with SPI interface	P56	On-Off panel button		
P58 LCD screen module 16x2 LCD screen module with I2C interface P59 microSD card module MicroSD card module with SPI interface	P57	LED + Panel LED holder		
	P59	microSD card module	MicroSD card module with SPI interface	

–Molex connectors comprise the header, the wire-board receptacle, and crimp terminals.

<sup>2 –</sup> The LCD screen and microSD card modules are not directly soldered on the PCB. Therefore, an extra pair of connectors are needed to connect the PCB to the modules.