Quasar Code 3190: 4 Channel Temperature Monitor & Controller (DS18S20)

General Guidelines for Electronic Kits and Assembled Modules

Thank you for choosing one of our products. Please take some time to carefully read the important information below concerning use of this product. The assembly and operating instructions are on the following pages. Help with component identification can be found on our website at www.quasarelectronics.com/componentid.htm. If you are unsure about any aspect of the assembly or use of this product please contact our Support Team before proceeding.

WEEE Directive (Waste Electrical and Electronic Equipment)
Notice To All European Union Citizens. Important environmental information about this product.
The crossed out wheeled bin symbol on this product, package or documentation indicates that disposal of this product after its lifecycle could harm the environment. Do not dispose of this product (or batteries if used) as unsorted municipal waste. It should be disposed by a specialized company for recycling.
The unit should be returned to your distributor or to a local recycling service. Please respect the local environmental rules. If in doubt contact your local authorities about waste disposal rules.

Safety: General rules concerning safe use of our Kits or Modules.
To ensure your safety, please observe these safety measures. In no way are these complete. As safety requirements vary, please check with your local authorities, in order to comply with local requirements. If in doubt, seek the help of a qualified person.

Battery or wall-adaptor operated devices are safe devices. They do not require special attention unless mains voltage is connected to an output e.g. a relay.

To ensure electrical safety, and also protection from fire or personal injury, make sure your mains operated equipment complies with these safety hints:

- Use a suitable plastic enclosure. If a metal enclosure is used, make sure it is properly earthed.
- Use a power switch if the device consumes more than 10W. Use a double pole switch for mains operated, transformer-less kits.
- Mount a fuse in series with the mains switch. Use a slow blow (T) 50mA fuse for transformers up to 10W and a 100mA fuse for transformers up to 20W.
- Use a mains input connector, or a robust power cord with a clamp.
- Internal wiring carrying mains voltages must have a minimum cross-sectional area of 0.5mm^2.

If supplied, attach the power rating label near the power cord of the device and fill-out the mains voltage, frequency, power consumption and fuse values.

Troubleshooting and Support

90% of non working kits are due to poor soldering.
We operate a Get-You-Going service for non-working kits but there is a charge based on the time and components needed to complete the repair. Quite often it is not economically viable for us to repair and it is cheaper to supply a new ready made product at full cost.

Disclaimer

Quasar Electronics reserves the right to change product specifications or to discontinue products without notice. Quasar Electronics cannot be held responsible for any loss or damage, direct or indirect, which might occur from the use of a product. Quasar Electronics Kits or Modules are intended for educational and demonstration purposes only. They are not intended for use in commercial applications. If they are used in such applications the purchaser assumes all responsibility for ensuring compliance with all local laws. In addition, they are not suitable for use as or as a part of life support systems, or systems that might create a hazardous situation of any kind.

Quasar Code 3190: 4 Channel Temperature Monitor & Controller (DS18S20)

Documentation updated April 18th, 2009

This kit is an 'extension' of our popular 3145 Temperature Logger kit. Like 3145 it features four (4) temperature inputs using the DS1820 digital sensor. We have also added four (4) relays to provide output control. Commands for reading temperatures or controlling relays are sent via the RS232 interface using simple text strings. The kit can be controlled by a simple terminal or communications program (such as Hyperterminal) or via the free Windows application (see page 4).
** **WARNING! The maximum connection voltage is 48Vac unless the screw terminal block connectors are insulated to prevent exposure to hazardous voltages.**

FEATURES & SPECIFICATIONS	
Operating Voltage	12VDC (nominal) 2.5mm DC jack, center positive
Operating Current	30mA (no relays operated) 120mA (all relays operated)
Inputs	4 x DS18S20 or DS18B20 Digital Temperature Sensors Range: -55°C to +125°C
Outputs	4 x SPDT relays, dry contacts 240Vac**/24Vdc @ 5A (resistive)
Connectors	2.5mm DC power jack DB9 female connector (RS232) 4 x 3-way pluggable screw terminals for relay contacts
	4 x 3-way pluggable screw terminals for temperature sensors
Cable Length	Up to 7.5 metres (~25 feet). See text (page 2) for longer lengths
Visual Indicators	**POWER LED** **DATA LED** - OFF when idle ON while processing commands
Case size	13cm (W) x 10cm (D) x 3cm (H) (5.1" x 4" x 1.3")

KIT ASSEMBLY

Before starting, check the components supplied in the kit against the parts list.

NOTE: Please set aside the extra 4 x 1K resistors and 4 x 10uF tantalum capacitors for now. These are only required if using 'long' cables to connect sensors to the kit. See the section '**CABLE LENGTHS'** on page 2 for details.

It is recommended that components be inserted and soldered in the following order:

1. All the resistors.

2. Diodes D1 & D2. Match up the bar on the diodes with the bar on the overlay. **Note:** When installing D2 use the two outer holes. The 'middle' hole is actually a pin through – do not use that.

3. All the 100nF mono capacitors

4. The crystal and 27pF ceramice capacitors

5. All the IC sockets

6. Resistor network RP1. The 'dot' at one end is to the right towards the 'K190' PCB designation.

7. The 78L05 regulator and 2-pin header J1

8. The 12 way connectors X3 & X4. Make sure they are sitting right down flat on the PCB before soldering.

9. 7805 voltage regulator. Measure and bend the leads at 90 degrees and fit to the PCB. Fix to the PCB using the supplied 3mm nut and bolt before soldering.

10. Electrolytic capacitors C2, C4 and C6. These are polarized - the positive lead is marked on the overlay, the negative is marked on the body of the capacitor.

    NOTE: Capacitor C6 is laid down flat on the PCB. Bend the leads at 90 degreees close to the body using needle nose pliers before inserting. Make sure

11. DC power jack X2 and DB9 connector X1

12. The four (4) relays

13. **Pre-test.** Do not insert any ICs into their sockets yet. Connect a 12VDC supply the DC jack X2 and measure the voltage across pin 20 (+) and pin 10 (-) of IC1. It should read approximately 5 volts.

    If OK then remove power and insert the ICs. Take care not to bend any of the IC pins when doing so.

14. **Now comes assembly of the front panel.** Start by inserting a LED clip into each hole, pushing it in from the front. Now insert a LED into each clip **from the rear**. The LED should "click" into place.

    The long LED lead is the positive lead – the flat edge on the LED body indicates the negative lead. This flat edge is indicated on the PCB overlay.

    Turn the LEDs in the clip so that the long lead is to the left (as viewed from the front). **This is very important so make sure it is right.** Now bend the leads down at right angles, about 3mm from the LED body, as shown below. Use a pair of long nose pliers to hold the leads while bending. Cut the leads off to a length of about 9mm from the bend.
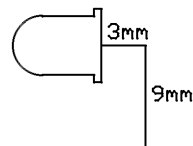
15. **We are now going to fit the assembled PCB into the plastic case.** Before that check all your work carefully. Look for unsoldered joints and any solder bridges or splashes that may be shorting out adjacent pins.

    Fit the front panel to the PCB. Be sure that the LED leads are inserted into their matching holes on the PCB. This can be a bit awkward – you may need to use long nose pliers to position the leads into the holes.

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Now fit the rear panel and, while holding the panels in place, slowly position the PCB into the base of the plastic case. Make sure the front and rear panels slide into the slots provided. Secure the PCB to the case using the self-tapping screws then solder the LED leads **from the top of the PCB.**

TESTING

1. Insert the shorting plug on header J1. This sets the communications rate to 9600 baud.

2. Connect the kit to a PC serial port using a straight-through 9-way cable. The cable should have a male DB9 connector at one end and a female DB9 connector at the other.

3. Connect a 12VDC supply to the kit – the POWER LED should be **on** and the DATA LED **off**.

4. On the PC start a terminal or communications program. Most Windows PCs (up to XP) have a program called 'Hyperterminal' which can be found under 'Start – Programs – Accessories – Communications'.

5. Configure the selected COM port for 9600 baud, 8 data bits, 1 stop bit, no parity, no handshaking.

6. Enable connection to the COM port. Some programs such as Hyperterminal require this step.

7. Press the 'Enter' key – the kit will respond with a '?' character.

8. If all is well, press the '?' key. The kit will respond with a banner message which includes the firmware version.

If steps 7 and 8 did not work then proceed to the '**TROUBLESHOOTING**' section.

CONNECTING SENSORS
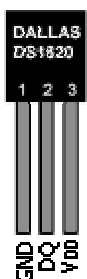
The diagram at left shows the pinout of the DS1820 sensor. The sensor pins connect to the kit's screw terminals as follows:

Sensor	Screw Terminal
1 GND	**-**
2 DQ	**D**
3 VDD	**+**

CABLE LENGTHS

Cables have inherent capacitance between conductors which tend to degrade digital signals. The longer the length of cable the greater the capacitance and the more the signal is degraded.

Some types of cable have lower capacitance than others. It **is recommended to use CAT5 cable** when connecting sensors over long cable lengths. Flat telephone type cable is not quite as good as CAT5 but is better than twin-shielded audio cable.

For cable lengths up to 7.5 metres (25 feet), sensors can be simply connected at the end of the cable, as described. However for longer cables we need to add an extra resistor and capacitor **at the sensor end of the cable**.

The resistor provides a 'harder' pullup which helps overcome the cable capacitance and 'squares up' the digital signal enough to allow the sensor to operate. The capacitor provides power supply filtering and removes voltage fluctuations as the sensor outputs data.

These extra resistors and capacitors are provided in the parts list to be used for this purpose.

The 1K resistors are soldered across the DQ (pin 2) and VDD (pin 3) pins of the sensor. The 10uF tantalum capacitors are soldered across the VDD (pin 3) and GND(pin 1) pins of the sensor.

> **With the resistors and capacitors added the following cable lengths were used successfully:**
>
> **Twin-shielded audio cable - 15 metres (~50 feet)**
> **Flat telephone type cable - 75 metres (~245 feet)**
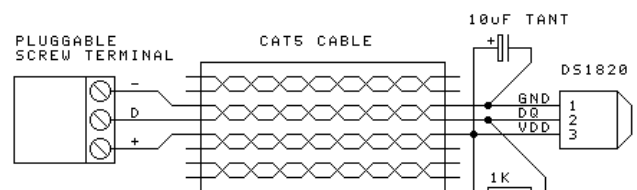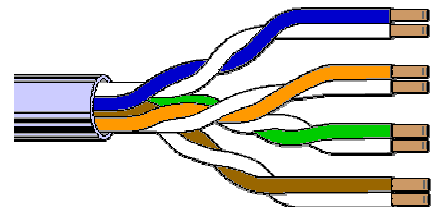> **CAT5 cable - 100 metres (~325 feet)**

CABLE WIRING

> **NOTE:**
> **All unused wires should be connected to ground (-) at the screw terminal end to prevent them acting like antennas and picking up noise.**

CAT 5 CABLE

CAT5 cable has eight (8) wires consisting of four (4) twisted pairs. Only three (3) wires are used as per the following diagram:
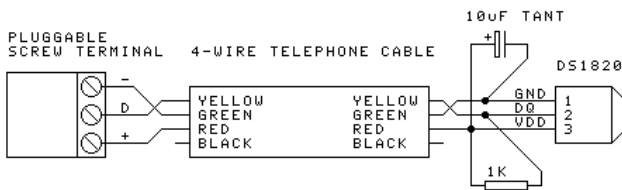

4-WIRE TELEPHONE CABLE

As the name suggests this cable has only four (4) wires coloured black, red, green and yellow. Only three (3) wires are used as per the following diagram:

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Note: The GND wire runs between the VDD and DQ wires. This reduces the potential of noise being induced into the data line from the power supply.

TROUBLESHOOTING

Most faults are due to assembly or soldering errors. Verify that you have the right components in the right place.

Inspect your work carefully under a bright light. The solder joints should have a 'shiny' look about them. Check that there are no solder bridges between adjacent pads.

Check that no IC pins are bent up under the body of the ICs. This can sometimes happen when inserting ICs into sockets.

Is the POWER LED on? If not then check that diode D1 is inserted correctly. Also the DC power plug should be center positive.

Does the DATA LED blink on when you press the 'Enter' key? If not then this indicates a problem with the microcontroller IC1. The microcontroller turns this LED on in software. Either the microcontroller is not running, there is a comms problem (see below) or there was a programming error at the factory.

Have you inserted the link on J1? Have you configured the other comms parameters correctly? Have you enabled the program to connect to the selected COM port?

If the hardware assembly seems OK and the 5V test was OK (as described in the **ASSEMBLY** section) then there could be a communication problem between the kit and the PC.

Are you using a straight-through serial cable rather than a crossover cable? **You must use a straight-through cable.** You can test your cable – pin 2 at each end should be connected to each other. Same for pin 3.

If the cable is OK then we can test the communications link. Plug the cable into the PC serial port and short pins 2 and 3 together at the other end (not connected to kit). Run your comms program and press some keys on the keyboard. They should appear on the screen. If not then there is a problem with either the cable itself or the comms program configuration.

KIT OPERATION AND COMMANDS

The kit is controlled via the serial port using a set of simple text commands. The serial communication rate can be set to either 2400 or 9600 baud via jumper J1.

Commands are not terminated by an 'enter' key – they are processed character by character as they are received. This means the kit will immediately abort the command if an incorrect or invalid character is received.

The kit will output a response to **all** commands. In the case of an invalid or incorrect command the response will be a '?' character to indicate an error condition.

The kit also features a two second command timeout. This means that once a valid command sequence is started, each subsequent character must be received within 2 seconds of the previous one. If not the command sequence will be aborted and the kit will output a '?' character. This helps to prevent a command 'lock up' if the kit receives a spurious character.

Note:
- Commands can be in upper or lower case.
- Each character received is echoed back.
- Relays are numbered 1 to 4. Relay number '0' (zero) indicates **all** relays.
- Temperature sensors are numbered 1 to 4. Sensor number '0' (zero) indicates **all** sensors.

? – Prints banner and firmware version number

Nx – Turn ON relay 'x' (where x = 0,1,2,3,4)

Eg. N3 – turn on relay 3
    N0 – turn on **all** relays

Fx – Turn OFF relay 'x' (where x = 0,1,2,3,4)

Eg. F3 – turn off relay 3
    F0 – turn off **all** relays

Note: The 'N' and 'F' commands do not need to return any data so the kit will output a '#' character to indicate that the command executed correctly.

Sx – Get status of relay 'x' (where x = 0,1,2,3,4)

Eg. S3 – returns the status of relay 3
    S0 – returns the status of **all** relays

Returns '1' if operated – '0' if released

The **S0** command returns the status of **all** relays. In this case a hex byte is returned. Each bit within the byte indicates the status of the corresponding relay as follows:

Bit	7	6	5	4	3	2	1	0
Relay	-	-	-	-	4	3	2	1

Bits 4-7 are unused and always return '0'.

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Tx – Get temperature from sensor 'x' (where x = 0,1,2,3,4)

Temperatures are returned in degrees Centigrade (°C) to one decimal place.

Eg. T3 – read temperature from sensor 3
    T0 – read temperature from **all** sensors

If a sensor is not present a '**?**' is returned instead.

For the T0 command the temperatures are returned as a comma separated string.

WINDOWS CONTROL SOFTWARE

A free Windows application for controlling the kit is available for downloading from:
http://www.quasarelectronics.com/zip/3190tcstd.zip
The software provides 4 channels of temperature monitoring (deg C or deg F), with the option to enable/disable thermostat (relay) control individually for each channel. SetPoint and Dropout (hystersis) are configured separately for each channel. Thermostat action can be set for Heat or Cool mode. Manual override of thermostat action as well as manual operation of the relays is possible. A logging function is included
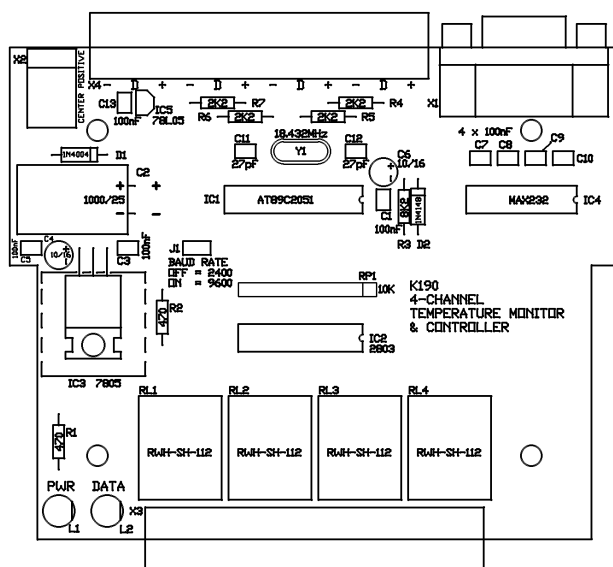
The software was written specially for the 3190 by John Gray.

CONTACT DETAILS

For our full range visit: **http://www.quasarelectronics.com**

Tech Support Email: **support@quasarelectronics.com**
Sales Team Email: **sales@quasarelectronics.com**

PARTS LIST – 3190

Resistors (0.25W carbon film unless specified)

470R	R1,2	6
2K2	R4,5,6,7	4
10K	R3	1
1K	extra – see text	4
10K Resistor Network SIL 10P9R	RP1	1

Capacitors

27pF ceramic, 0.1"	C11,12	2
100nF mono, 0.1"	C1,3,5,7,8,9,10,13	8
10uF 16V electrolytic	C4,6	2
1000uF electrolytic 25V or 35V	C2	1
10uF 16V tantalum	extra – see text	4

Semiconductors

LED, 5mm, red	L1,2	2
1N4004	D1	1
1N4148	D2	1
AT89C2051 MCU With 3190 firmware	IC1	1
ULN-2803A Relay driver	IC2	1
MAX232, RS232 driver	IC4	1
7805, 5V regulator	IC3	1
78L05, 5V regulator	IC5	1
DS1820 sensor		1

Miscellaneous

Crystal, 20.2752MHz	Y1	1
Header, 2 pin	J1	1
Shorting plug	for J1	1
LED holder, panel mtg	for L1,2	2
DB9 connector, PCB mtg. Right angle, female	X1	1
DC jack, 2.5mm PCB mtg	X2	1
Pluggable header 12 way, 'Dinkle' 2EHDRC-12P or similar	X3,4	2
Pluggable screw socket 3 way, 'Dinkle' 2ESDV-03P or similar	for X3,4	8
Relay, DPDT 'Goodsky' RWH-SH-112 or similar	RL1,2,3,4	4
IC socket, 16 pin	for IC4	1
IC socket, 18 pin	for IC2	1
IC socket, 20 pin	for IC1	1
Screw, 3mm x 8mm	for IC3	1
Nut, 3mm	for IC3	1
PCB 3190		1
Set of front & rear panels, 3190P		1
Plastic case, 130(W) x 100(D) x 30(H)mm		1

GENERAL RELAY INFORMATION

<div style="border: 1px solid red">

Warning! Risk of Electric Shock!

This information concerns kits and modules with relay outputs. TO USE THE RELAY OUTPUTS SAFELY YOU MUST OBSERVE THE MAXIMUM VOLTAGE AND CURRENT LIMITS QUOTED IN THE **PRODUCT DOCUMENTATION** (this is because the board design may not be rated to switch the maximum voltage and current limits printed on the relay itself or specified in the relay manufacturer's data sheet).

Controlling mains equipment with relay outputs must be treated with extreme caution. Electric shocks can cause severe and permanent injury or even death. Construction, installation, testing and commissioning should only be attempted by suitably qualified persons, or under the supervision of a suitably qualified person. These products are not suitable for children. Before connecting mains powered equipment to the relay outputs please check with the relevant authorities in order to ensure compliance with all current safety regulations.

Many areas of the assembly may operate at mains voltage. A suitable isolating enclosure must be used. Exposed screw terminal blocks on some products must be insulated to prevent contact with exposed metallic parts at mains potential. Connected equipment should be suitably fused.

</div>

You will find relay outputs on many of the kits and modules that we sell. A relay is an electrically operated on/off switch. The voltage and current limits specified in the product documentation generally relate to resistive or light inductive loads.
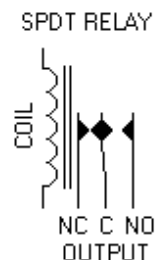
Relay Terminals

Most boards have SPDT (Single Pole Double Throw) style relays. These have three outputs:

C = Common

NO = Normally-Open contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. It is also called a Form A contact or "make" contact.

NC = Normally-Closed contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. It is also called a Form B contact or "break" contact.

Connecting the Device you want to Control

You must provide an external power source to the device you want to control. No voltage is present at the relay terminals (remember it is just a switch). The relay is normally connected in *series* with the positive (+) power wire of the device you want to control.
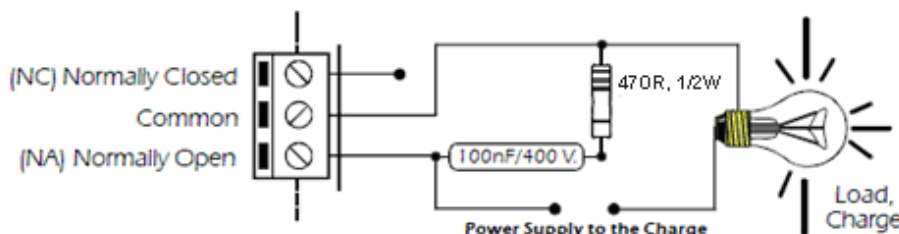
In this case, the positive wire from the power source should be connected to Common. Then either the NO or NC terminal (as appropriate for your purpose) is connected to the positive (+) wire going to the device you want to control. The negative (-) wire does not connect to the relay at all. It goes directly from the power source negative output to the device negative (-) terminal.

Typical SPDT Relay Connection Diagrams
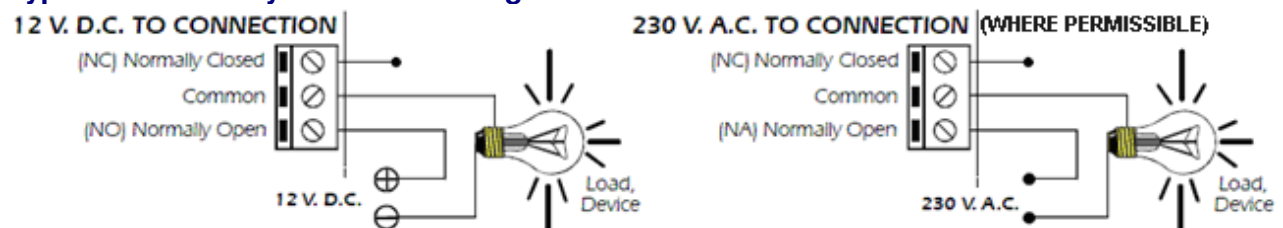
Anti-Spark SPDT Relay Connection Diagram

Sometimes the connected equipment can cause arcing across the relay contacts. This must be corrected by installing a resistor and capacitor (not supplied) between the two contacts of the relay as shown below. Component values are for 230Vac mains.

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