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RAPID WIRING WITH ROADRUNNER

These notes provide detailed guidance on how to assemble and wire circuits (logic/ microprocessor) when using the Roadrunner Wiring System Products.

INTRODUCTION

The Roadrunner Wiring System is a high quality, but low cost, quick and easy prototyping method. Utilising its proven point-to-point interconnection technique, the user can assemble an accurate, compact prototype or pre-production circuit board that will drastically cut development costs and eliminate the need for an initial Printed Circuit Board (PCB) prototype.

The keys to the System are the Roadrunner Wiring Pencil and the Wire Distribution Strips. The Wiring Pencil dispenses Solderable Enamel Wire to the connection points. The wire 'runs' are held in place by moulded Wire Distribution Strips (WDS).

The circuit connections are made using a temperature controlled soldering iron and resin cord solder.

PLANNING

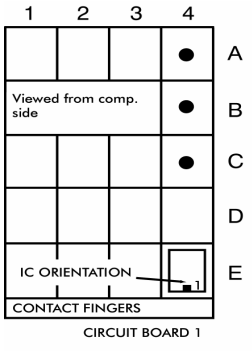
Wiring Schedule

Sig.No.	1stConn(a/p)	2nd Conn.	3rd Conn.
0	A4-6	B4-3	C4-2
1			

A4-6 ≡ 1C A4 pin 6

- Prepare a Wiring Schedule to gain maximum benefit from the Roadrunner System. (This obviously depends on complexity of circuit).
  - First, it may be necessary to prepare the diagram, i.e. uniquely identify all components and identify each connection point by number.
  - Check the size and lead-outs of each component (14, 16, 24 etc pin device).
  - Identify all Ground (Gnd) and Power connections.
  - Mark 2-lead discrete components (resistors, capacitors) at either end with a or b. For transistors c. b. e etc.
- Refer to the Schedule
  - The first column is the signal number. The second column is the first connection, which is the source of the signal.
    - Power or Ground
    - Logic output
    - Input signal via the edge connector from an external source
    - Place all connections to that source in the 3rd and subsequent columns
    - This method is useful when checking and testing (in conjunction with the diagram), as only the second column needs to be 'scanned' to find all other connections to that signal line.
- Check the Wiring Schedule against the diagram – ideally using two people.
- Alternative Method – Wiring from the Circuit Diagram
  2 people, one to read off (and mark) the circuit connections, and one to wire the circuit.

Component Layout and Assembly

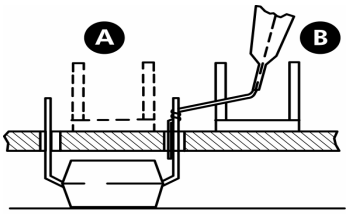


CIRCUIT BOARD 1

- Roadrunner High Density Eurocard (RRB-107) designed specifically for use with The System.
- Any other boards can be used.
- Recommend use of Low Profile Integrated circuit (IC holders – although wiring direct to IC's may be acceptable.
- Observe good engineering practice to keep the length of wiring 'runs' to a minimum.
- When placing and marking components – temporarily use strips on topside of the board to help with optimising wire routing and to ensure spaces between components allow all wires to pass from strip to strip unobstructed. Sufficient space must be left between components to allow unobstructed wiring between strips (Wire Distribution Strips).
- Use the format of the Roadrunner Board to aid component identification or mark the position of components on the underside of the board with a permanent marker.
- Prepare component layout diagram and mark Power and Ground connections on each component position.
- Assemble IC sockets and bend Power and Ground pins for retention.
- On the Roadrunner Board bend the pin to connect to the relevant supply lines eliminating unnecessary wiring. If extra voltage rails are required, cut out part of the neighbouring earth plane on the component side to simplify wiring.
- If using a different style of board, create the Power and Ground lines using Tinned Copper Wire. Dependent on the size and type of circuit being constructed wire using 22swg TCW or TCW from the Roadrunner Bobbins (33swg). If possible create a matrix of power connections for good performance. (Experiments have been carried on small circuits, say 10-12 IC's where the wiring to the Power and Ground connections has been effected using 1/0.19mm Roadrunner Pencil Wire – If decoupled at each device, these circuits will function adequately).

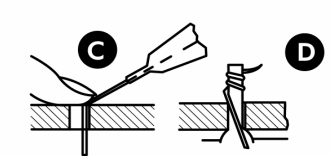
- **Discrete Components** (Resistors, capacitors, diodes, transistors etc.)
- Several options:
  - Place component in position on the board and bend leads to retain it. Cut lead to length. Wire direct to component leads.
  - Mount components on IC headers
  - Connect components to solder pins

STRIPS

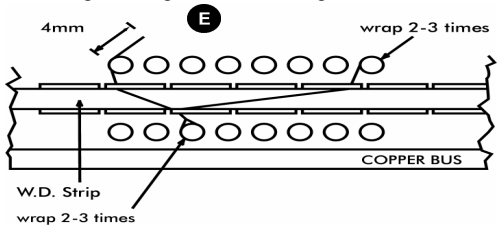


- Prevent wire breakage.
- Retain large numbers of wires.
- Simply fitted.
- For High Density applications, (A) place strips between IC legs.
- For Low Density packing (B) place strips between IC holders.
- Consider strip placement – take care to align the dovetail recess in the strip with IC pins or copper pads.
- Ensure alignment of castellations allows wires to pass unobstructed across the board to neighbouring strips, which are similarly aligned.
- The strip is designed to butt up against another whilst maintaining pitch in the castellations.
- Cut to length using side cutters.
- When ready to assemble to the board – apply quickset impact adhesive to the base of the strip.
  - Place in position and allow time to set.

WIRING TECHNIQUE



- When beginning a run from an IC holder leg, the technique is as follows:
  - Extend approximately 4mm of wire from Pencil tip
  - Bend wire to suitable angle and insert into IC holder leg hole
  - Push the Pencil tip close to the board – at the same time – moving the Pencil around the IC holder leg, so beginning the first wrap (D)
  - Wrap 2-3 times around leg and lead wire off into the strip (E)
  - Wire to next connection and wrap 2-3 times, then onto the next connection and so on (Daisy Chain or 'run')
  - At the end of the 'run', extend say 4mm of wire and cut the wire close to the IC leg, leaving the correct length of wire for the next connection
  - Get into the habit of extending 4mm of wire from the tip for the next connection
  - When cutting wire with side cutters, it is important to cut the wire close to the component leg and within the area of the solder pad as viewed from above



- Wire edge connectors (DIN 41216), discrete components or wiring pins in the same manner.
- If the 'run'/'net' includes a component side connection, make this the first connection.
  - Extend approximately 12mm of wire from the Pencil tip, bend to an angle and pass through the hole. Use your finger to trap the wire as you dispense the wire into the strip and off to the next connection point (C).
  - Bend the wire against the board on the component side and continue wiring. Soldering will be carried out later

Alternative Method of Cutting Wire

The Wiring Pencil tip can be used to cut the wire.

- After wrapping stand the Pencil upright, trap the wire between the Pencil tip and the copper pad, and then apply downward pressure to the pad area, thus cutting the wire.
- The cut wire is kept within the solder area.
- Wind on the bobbin until a few mm of wire appears from the Pencil tip, ready for the next connection (4mm)
- Occasional use of tweezers at the bobbin end of the Pencil may be required to ensure smooth movement of wire through to the Pencil tip.

Wire Tension

- If using the Wiring Pencil without brake (RRP-103), wire tension is adjusted simply by adjusting the angle of the Pencil – when close to a pin to be wired, the Pencil is raised to a more vertical position for increased tension.
- When running the wire in the strips, tilt the Pencil in the direction of travel.
- Tilting the Pencil hard against the direction of travel may damage the wire insulation.

- Tension on the wire to suit the user, is adjusted by releasing the bobbin and firmly moving the bobbin supports.
  - A hot air blower will assist this process
  - If using the Wiring Pencil with Brake (RRP-123) apply finger pressure to the brake and adjust tension as required

WIRING

- Refer to the Wiring Schedule.
- Wire voltage and bussbar connections first.
- Wire to edge connectors next.
- Commence wiring of board using list.
- Optimise wire routings to keep wire length to a minimum.
- Use random routing to minimise crosstalk and evenly distribute wires.
- Avoid doubling back to make a (forgotten) connection.
- Optimised component layout will minimise wiring runs.
- Consider whether to wrap clockwise or anti-clockwise. This may affect the proximity of wires to adjacent connections as the wires cross from the wrapped leg to the Strip.
  - Look out for short circuits, this is when they may occur
  - Also do not push more wire down the component leg than is necessary, the bare end may make contact with an adjacent leg
- Avoid concentrations of wire in a strip or crossing (to an adjacent strip).
- When using the original Glue Strip, there should be no more than 3 connections made from one castellation.
- Wiring using a Wiring Schedule is self-checking: The wiring process will uncover any anomalies in the connection of components, on the diagram.
- Each wiring operation should be carried out on a 'clear' pin/leg.
- If a wire is already there, then there is a mistake, either in a previous run/net, the wiring diagram or the current net and as soldering is not carried out until all connections are made, corrections are very easily effected (see Corrections and Modifications).

Signal Cross Talk

- Theoretically, signal cross talk is higher than 'handwiring' methods but in practice is not a problem up to 10MHz. (It can cope with higher frequencies if care is taken with routing of wires. If problems do occur re-route the wires.
- Keep runs short and avoid, if possible, higher frequency wires running parallel with each other in channels or from strip to strip.
- Although the system presents a compact 'organised' finished product – the wiring should be as 'random' as possible.

SOLDERING

On completion of wiring solder and joints:

- Use a temperature controlled soldering iron set to 400°C (min). Experiment to get the best quick joint.
- Action of iron and solder removes solderable enamel insulation, which acts as a flux.
- Too low a temperature will make the effective insulation creep up the wire causing short circuits.
- **Important Safety Notice**: Ventilate the area well and/or use a fume extractor as the enamel coating gives off small amounts of toxic vapour TDI (Toluene di-isocyanate) when heated.

CHECKING WIRING

- Use Wiring Schedule, which shows all connections.
- Use audible continuity tester.
- Mark off each tested net on the schedule.

CORRECTIONS AND MODIFICATIONS

- To remove a wire, cut it close to the pin.
- Push the clean end into the Strip, forming an easily detected loop.
- Using tweezers, trace the looped wire along the Strip channel.
- Desolder the joint and remove the unwanted wire. Use desolder braid or desolder pump.
- The pin/leg is now clean and ready for subsequent connection(s).

WIRING DIRECT TO IC's AND COMPONENTS

- With multi-leaded components make certain that all leads are soldered to pads.
- Replacement is simply carried out by carefully cutting the component leads at the shoulder. The new component may be connected to the existing leads/pins.

MISCELLANEOUS

Decoupling

For best results use decoupling capacitors on each IC.

If necessary, and if layout allows it, connect each capacitor directly to the Power and Ground connections on the component.

Colour Coding

- If required, colour coding of wire may be used to assist in wire/signal identification when checking the wiring and testing the circuit.
- Here is a suggestion:
  - GREEN Connections on the IC
  - GOLD One connection from one IC to another. (There could be several single wire connections to other IC's).
  - RED Interconnections ('Daisy Chain'/'run') to many IC's.

  It is advisable to carry out the connection to one IC first (green), otherwise all other interconnections will be held down, which will inhibit tracking and modifications.

Too Many Wires in the Strip Channels

- If there are areas of high density wiring, which may not be retained by the strip castellations, use the Pencil to create a retaining strap across the strip to hold in the offending wires – create a figure of eight across a pair of castellations, or, if a more robust solution is required, create a 'U' shape Tinned Copper Wire link and drop it over the strip, through the board, then lightly twist it for retention on the component side of the board – taking care to avoid power lines!

RELIABILITY

Failure rates of Roadrunner System boards are no different to other techniques, which depends on the skills of the user. For best results, practice first and be sure to use a hot soldering iron, in excess of 400°C! Roadrunner wired products have been used in many harsh environments; some have been conformally coated and used in military applications.

SUMMARY: DO'S AND DON'TS

DO'S

- **Prepare Wiring Diagram** to create Wire Schedule, which is used to check against the diagram, carryout the wiring, continuity testing and functional testing.
- **Placement and Making of Components**
  - Physically position the components on the board to optimise wire routing.
  - Use the Strip on component side to ensure wiring runs between Strips and will be free from obstruction
  - Prepare a diagram of the component layout. Identify all components and indicate Power and Ground connections
  - Bend Power and Ground logs to retain components

Assembling the Strips

Take care to align the gaps in the castellations for runs between Strips.

Power and Ground Connections
Refer to the IC layout/Wiring Schedule.

Turn the board over – if using a Roadrunner Board, the leads will bend to touch the Power and Ground bussbars – solder to effect the connection.

Wiring
Refer to the Wire Schedule, which is self-checking. No new connection point is to have a wire on it otherwise there could be a mistake on the diagram, Wiring Schedule or with the wiring. Use short runs with random routing.

Discrete Components

Mount directly to the board, on IC headers or on solder pins.

Wiring Technique

- Lean the Pencil forward to dispense wire.
- Raise to vertical position for added tension and manoeuvrability.
- Only 2 or 3 exit/entry points from castellations to component leads.

Soldering

- When wiring is complete use temperature controlled soldering iron with temperature of 420°C plus.

Checking

Check joints and connections with audible continuity tester.

DON'TS

- Place components down anywhere on the board and expect the underside wiring to be free flowing.
- Misalign gaps in strips otherwise untidy runs and obstructions to wiring will result.
- Take too many wires from one gap in the strip castellations to connection points – could result in short circuits and difficult to modify.
- Don't lean the Pencil too far back against the flow for extra tension as this will damage the insulation.
- Have the temperature too low on the soldering iron, dry points and short circuits will result.

Tools, Components and Materials – Checklist

Tools

- Roadrunner Wiring Pencil, **RRP-103/RRP-123**
- Temperature controlled soldering iron
- Pair side cutters
- Pair of tweezers, **RR-TW**
- Fume Extractor or Electric Fan
  Plus a general purpose Impact Adhesive

Materials & Components

Roadrunner Wiring System – Introkit Part No. RRS-K-106 comprises the following Roadrunner Products:

- 1 x Wiring Pencil with brake and full bobbin of Solderable Enamel Wire, **RRP-123**
- 1 x High Density Eurocard – Double Sided (100x 160mm), **RRB-107**
- 7 x Wire Distribution Strips (Glue fix), **RRS-G-102**
- 30 x Wire Distribution Strips (Press fix), **RRS-P-102**
- 3 x Bobbins of Solderable Enamel Wire – different colours, **RRP-A-105**
- 1 x Bobbin of tinned Copper Wire (TCW), **RRP-T-104**
- 100 x Solder Pins, **RR-SP**

Other Useful Items

- Magnifying glass
- Pin insertion tool
- Scalpel, **RR-KN**
- Desoldering tool
- Continuity tester, preferably audible