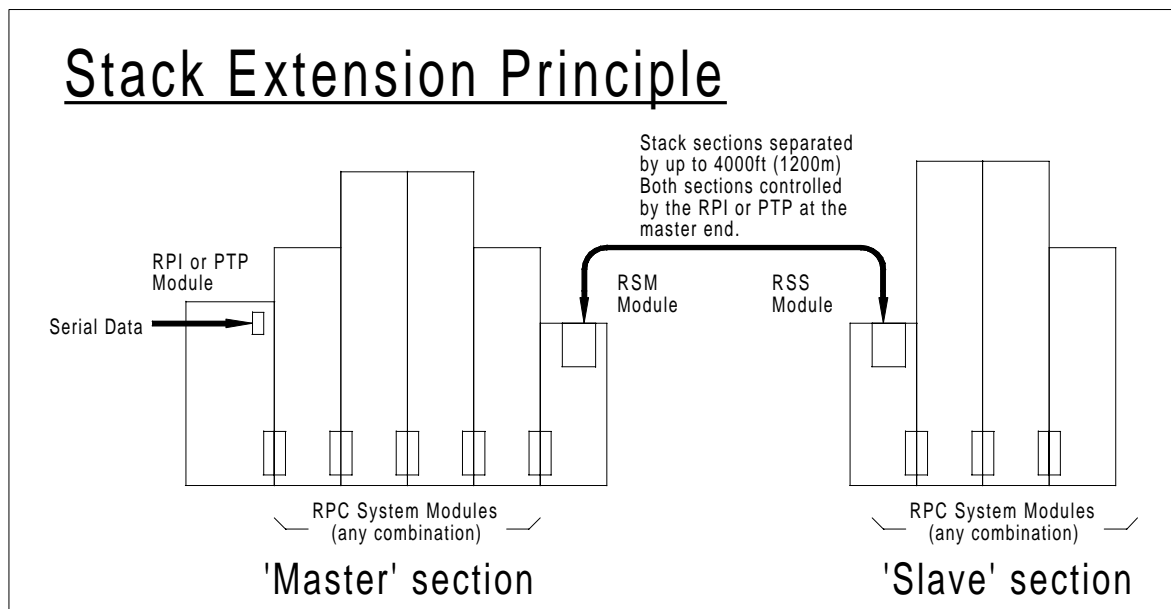**RSE Remote Stack
Extension System**

Introduction.

There can be occasions where it would be more convenient to locate RPC modules away from the conventional Panel mounted stack. For example, many fiddle yards are double-ended, having concentrated point and track control equipment at each end, with limited needs in the storage roads in between. In this situation, and especially if only one fiddle yard operator is available, it would be sensible to provide controls for the whole area from the operators location. Normally it would only be possible to achieve this with an RS485 RPC System, using a PC which would be required to transfer the information to and fro. If it were possible to split an RPC Module stack, modules could be placed at both ends, local to the areas they control, but would appear to the operator as a single entity. By using the Remote Stack Extension System (RSE) in conjunction the Point-to-Point (PTP) System and standard RPC System Modules, almost any control set-up can be constructed, from completely manual to fully automatic or any combination in between. A typical example of this arrangement is shown in the diagram on page 4.

The designs presented here resulted from some initial work on the PTP system (see TB G16/23) which originally used a four-pair 'Category 5' cable before it was changed to single-pair RS485 operation. These cables are readily available in various lengths from most computer and electronic suppliers.

It is assumed that the reader is familiar with the range of RPC modules and their functional capabilities. Please refer to the relevant G16 TB for information on specific items. The RPC Index Bulletin G16/2 lists the whole range available.

Interface Specifications.

- **Power Requirements**   +5V to +12V DC Regulated Supply, 1A Max, for 'Slave' end Modules only.
- **Module Control Signals**   RPC Shift Register Compatible.
- **Module Capacity**   Unlimited
- **Remote Connection**   Standard 4 pair Category 5 UTP Network Cable to EIA 568 or 258A spec.
- **Maximum Distance**   4000ft (maximum RS422 specification, depending on cable quality)
- **Connectors**   10 way Molex plug for existing RPC Module Stack (J1).
  10 way Molex socket for additional RPC Module Stack (J2).
  2 pin Unpluggable Screw Terminal for additional Power Input (J5).
  RJ45 8/8 for remote connections (J3 & J4)

Stack Extension Principle

System Operation

The Remote Stack Extension System uses two modules, one at each end of a 4 pair Category 5 UTP (Unscreened Twisted Pair) Network Cable. This carries the stack shift register information for both directions. The module at the end with the RPI (or PTP) is called a Remote Stack Master (RSM), and simply plugs into the last module in the stack, deriving its power and control signals from the stack connection. The module at the other end is called a Remote Stack Slave (RSS), and occupies the RPI (or PTP) position at the 'head' of the extended stack. This module also provides power to the extended stack in the absence of the RPI (or PTP). The modules simply act as buffers to the shift register control signals, and drive the four-pair cable differentially, using the RS422** electrical standard in simplex mode. Three signals - 'Clock', 'Strobe' and 'Data Out', are sent from the Master end, while 'Data In' is sent back from the Slave. Standard RPC modules such as the SRI4, SRO4, FTC, DPR etc. can then be plugged into the stacking connectors to provide the I/O functions required.

**RS422 is only specified for unidirectional (simplex) operation, unlike RS485 which can also be used bidirectionally (duplex), although both standards are electrically very similar and both use differential pair principles to minimise electrical pick-up and noise problems.

Circuit Description.

The main components of the RSM and RSS Modules are the RS422 line drivers and receivers. To minimise the chip count and board size, the RSM uses a dual driver DS9638C (IC3) for Clock and Strobe, and a transmitter/receiver pair in the form of a DS8921N (IC1) for the bi-directional data. The RSS uses the equivalent dual receiver DS9637A (IC4) for Clock and Strobe, with the same DS8921N type (IC2) for the data. Each of the four wire pairs is terminated at the receiving end to mimimise transmission line effects (R1 to R4). The pinout of the RJ45 connectors used for the interconnection is arranged to meet EIA 568 or 258A cable specifications.

Power is connected to the RSS module using a standard 2 pin connector, with IC5 and associated components regulating down to +5V. All other capacitors provide supply line decoupling. RPC modules plug into J2 in the usual way in any combination. The power supply used for the Slave stack must share a common 0V or Ground connection with that of the Master stack. This is necessary to keep the signal line voltages within the operational range at both ends.
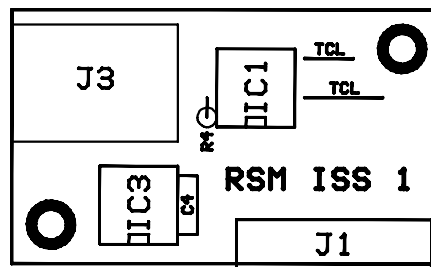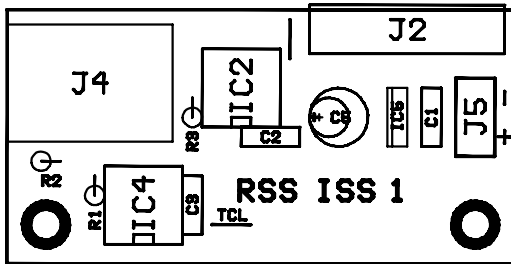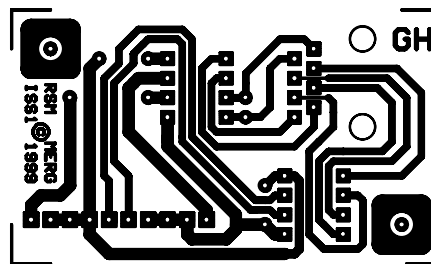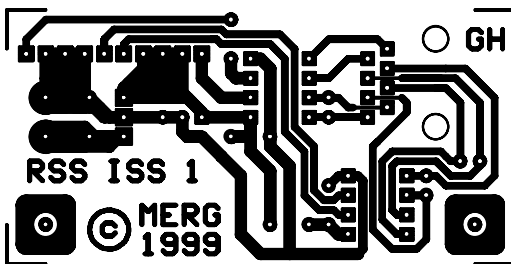
Circuit Diagram
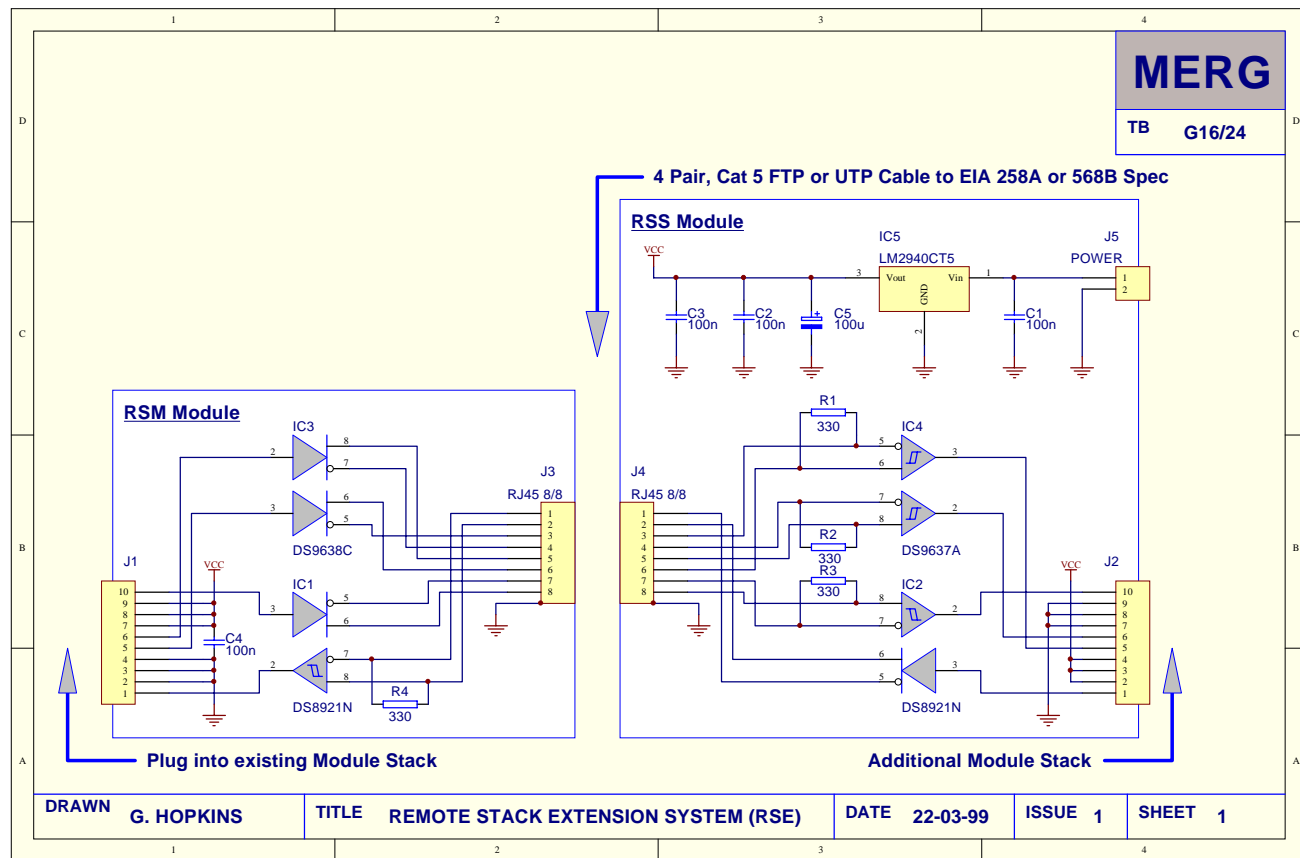
Parts List	**RSM**	**RSS**
Resistor, 330R 1/4W	R4	R1, R2, R3
Capacitor, 100n	C4	C1, C2, C3
Capacitor, 100u		C5
IC, DS8921N (RS422 Tx + Rx)	IC1	IC2
IC, DS9638C (RS422 Tx x 2)	IC3	
IC, DS9637A (RS422 Rx x 2)		IC4
IC, LM2940CT5 (+5V Regulator)	IC5	
Plug, Molex 10way R/A	J1	
Socket, Molex 10way R/A		J2
Socket, RJ45 8/8	J3	J4
Plug, 2 pin		J5

PCB Component Overlays (not to scale)

PCB Track Layouts (not to scale)

Serial Interface Connectors J3 and J4

J3/J4 Pin	1	2	3	4	5	6	7	8
Function	D In -	D In +	Clk -	Str -	Str +	Clk +	D Out -	D Out +

This table shows the connections used by the UTP cable, using the standard RS422 terminology of + and - for the differential signal wires. The cable should be wired pin-to-pin at both ends. The pin allocations match the pairings provided on EIA 568 or 258A cables.

Shift Register Interfaces J1 and J2

Pin	1	2	3	4	5	6	7	8	9	10
Function	D In	0V	0V	0V	CLK	STB	+5V	+5V	+5V	D Out

The Shift Register Interface is used to pass data between the RPC Module Stacks attached to the RSM and RSS Modules. The Interface uses a 10 Way connector, with Clock, Strobe, Data In, Data Out and Logic Power available (see table above for connection details).

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Example of RSE Application in conjunction with a PTP System

Operator Control Panel

Inputs
(Controls & Manual Switches)　　Outputs
(Panel Lamps etc.)

SRI4　SRI4　SRI4　SRI4　SRO4　SRO4　SRO4

PTP
Module

Additional Modules
plug in as required

RPC System Modules
(any combination)

Fiddle Yard Area 'A'

Serial Data
Screened Twisted Pair Cable
(RS485 - up to 4000ft)

SRO4　DPR　DPR　SRI4　FTC　FTC

PTP
Module

RSM
Module

RPC System Modules
(any combination)

Fiddle Yard Area 'B'

Shift Register Signals & Data
4 Pair Cat. 5 Cable to
EIA 568 or 258A Spec.
(RS422 - up to 4000ft)

SRO4　SRO4　DPR　SRI4　FTC　FTC

RSS
Module

RPC System Modules
(any combination)