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SSI Serial Pump Control

Control Specifications:

Series 3	1K buffer
Series 1	16 command buffer

Protocol 9600, 8 N, 1

Command Strings:	See Below
Hardware connections:	See Below

Rx /Tx Overview:

The PC must initiate communications; the pump will respond to commands but will not initiate communication. An event driven protocol is as always the best method for a communication interface.
Care should be taken in remembering that the pump is a real time device, devoting it's primary function to the operation of the pump mechanism. That said the pumps firmware executes in several orders of magnitude faster than can be perceived by the user. A PC running MS Windows is however, NOT a real time device. Allowing the PC's buffer and the pumps buffer to handle the millisecond and microsecond timing issues will greatly reduce any communication issues.
It should also be noted that any communication, whether it's I2C, SPI, RS232, RS485, or USB require either a small delay or coding devoted to watching the received communication and continuing execution after complete commands have be received and verified. Typically small delays i.e. 50 mS and end checking for the end of string marker ("/") is sufficient for this. Code written in C++ or VB may appear to corrupt communication string reads if the coding does not including waiting for a complete string to be received. This does not happen automatically in an MSComm style control.

Communication to the pump can be sent as often as every 100 mS. However, care should be taken in understanding MS Windows application timers. It is a better approach to send information every 500 mS and shorten the cycle time after "solid " communication has been established in the code. The faster commands are sent the more code will be needed to control the transmitted and received strings, and the greater the problem solving expertise of the programmer.

Hardware handshaking is implemented in the pump interface. A preferred method of operating all modern serial communication is the use of an acknowledge string or bit. In the pumps case this is the "OK/", "ER/" or "/". As mentioned above, with MS Windows this allows the buffers on both ends to control the flow.

Typical Communication startup Issues:

1. No communication.
    - Check that the transmit of the pump is connected to the receive of the PC, and vice versa.
    - Has the cable been tested and is known to be functional.
    - Comm protocol set to 9600, 8, N, 1
    - If hardware handshaking is used (see above for recommendations) be sure connections are made the ocnnectors.

2. Communication strings not being read correctly.
    - The pump checks each received character against it's list of acceptable commands. Any character out of sequence or incorrect will generate an "ER/" response at the time that character is received. If the control PC does not "see" this, future commands may be "out of sequence", or not seen as the intended sting. Alternately the use of the "#" command to clear the pumps buffer can be sent prior to a string, to insure the sequence of commands is seen correctly.

    ** NOTE:

    The "#" command may appear to solve communication errors, but should not be used as a total solution. If a problem exists in received or transmitted strings, it may show up again later if not resolved. Try longer delays between commands until the errors can be traced back to the root cause.

3. Pump appears to delay it's reaction to a command.
    - This is probably related to # 2 above. The pump responds in milliseconds, but only to correct commands. The pumps timeout buffer is approximately 1.5 seconds after the last character is received.
    - Try using the "#" character prior to the command in question. If this clears the problem, some string error is responsible for the initial concern.
    - Be aware that a single piston pump will hold it's reply during the 140 mS refill phase of the pump stroke. The buffer will still receive commands but the reply will occur after the fast refill has completed.

4. Unrecognizable information being received from pump.
    - Make sure the ground wire in the communication wire is connected between the devices.
    - Wait for the "/" character before allowing a subroutine to reply to the main program. This will insure that the complete reply string has been received.
    - When decoding the string information, spit up the string using a comma delimited strategy. This will be better than simply counting characters. MS Windows controls will sometimes detect slight delays as spaces.

	COMMAND	DESCRIPTION	DISPLAY OR PC REPLY	NOTES
-----	**RU**	Run Pump		
-----	**ST**	Stop Pump		
-----	**FLXXX**	Flow rate 3 digits only (Actual Flowrate x 100) **	FL500 = 5.00ml/min	Not active for Microbore
-----	**FOXXXX**	Flow rate 4 digits (Actual Flowrate x 100)**	FO0500 = 5 ml/min	Microbore FO0500 = 5.000 ml/min see FM command for 0.001 ml/min accuracy
-----	**CC**	Read Actual Pressure & Flowrate	OK XXXX, XXX.X (or XX.XX)	Decimal version of flowrate no leading zeros
-----	**PR**	Read Actual Pressure	OK XXXX	
-----	**CS**	Read Flowrate	XXXX,	
		Over Pressure Setting	XXXX,	
		Under Pressure Setting	XXXX, PSI	Constant Pressure Pump will also print the Pressure Setting
		Head Type Number **	See chart	
		Pump Running or Stopped **	1 for Running, 0 for Stopped	
		Pressure Board installed	1 for Installed, 0 for none	
-----	**PI**	Read Flowrate		
		Pump Running or Stopped **	1 for Running, 0 for Stopped	
		Head Type Number **	See chart	
		Pressure Board installed	1 for Installed, 0 for none	
		External Voltage or Frequency Setup	1 for Voltage 0 for Frequency	
		Frequency Controlled & Running	1 if running under Frequency Flow Control, else 0	
		Voltage Controlled & Running	1 if running under Voltage Flow Control, else 0	
		Upper Pressure Faulted	1 if faulted, else 0	
		Under Pressure Faulted	2 if faulted, else 0	
		Priming	1 if priming, else 0	
		Keyboard Lockout	1 if Keyboard is locked out, 0 else	
		External Start	1 if running by external start, else 0	
		External Stop	1 if stopped by external stop else 0	
		External Enable	1 if External Control enabled, else 0	
		0	unused	
		Motor Stall Fault	1 if Stall Faulted, else 0	
-----	**UPXXXX**	Set the Upper Pressure Limit	Must be in the pumps limits else "ER/" is returned	*** See Ultra high pressure below

CHART 1

-Flowrate is in ml/min
-For Microbore Flowrate
enter actual Flowrate x 1000
-All Pressure readings in PSI
- Head Type

1	Stainless Steel 10 ml	"S10"
2	PEEK 10 ml	"P10"
3	Stainless Steel 40 ml	"S40" or "S50"
4	PEEK 10 ml	"P40" or "P50"
5	Stainless Steel 10 ml	"S5" or "S6"
6	PEEK 10 ml	"P5" or "P6"

-----	**LPXXXX**	Set the Lower Pressure Limit	Must be in the pumps limits else "ER/" is returned	
CP Only	**SPXXXX**	Set Operational Pressure **on Constant Pressure Pump**	SP4500 = 4500 PSI Constant Pressure flow output	*** See Ultra high pressure below
	HTX	Set the Head Type	X = 1 thruogh 6 see chart	
	RH	Read Head Type	Returns a number 1 through 6 see chart	
	KD	Disable keypad - Stops Keypad Entry from altering pump settings		
	KE	Enable Keypad Entry		SR35V101 is SR35 EPROM version 101
	ID	Returns the software callout letters and version number	XXXXVXXX to PC	
	RE	Resets Pump to Factory Default Settings	res	Includes: Head type, Pressure Compensation, and External Control
	PCXX	Set pressure Compensation	XX is pressure / 100 3000 PSI is entered as "PC30"	
	RC	Returns the Pressure Compensation / 100	XX = Pressure Compensation /100	30 = 3000 PSI
	VC	Set for External Voltage Control		Does not enable External Control. Enable is an External Input Pin.
	FC	Set for External Frequency Control		Does not enable External Control. Enable is an External Input Pin.
	RF	Return the Fault Status bits	X,X,X for Stall Fault, 1 for Faulted, else 0	
			Upper Pressure Fault	
			UnderPressure Fault	
	CF	Clear all Faults		
Q-Grad Only	**EH**	Event High output (5 V TTL output)		**On Q-Grad Only** sets the Event bit high
Q-Grad Only	**EL**	Event Low output (0 Volt TTL Output)		**On Q-Grad Only** sets the Event bit Low

MicroBore Pumps

uBore Only	**FMXXXX**	Flow rate 4 digits (Actual Flowrate x 1000)**	FM5000 = 5.000 ml/min	Microbore FM0101 = 0.101 ml/min
				Note -- Read flowrate commands reply with 3 decimal places

Ultra High Pressure Pumps

	UQXXXXX	Set the Upper Pressure Limit (5 characters)	Must be in the pumps limits else "ER/" is returned	typical upper limit is "UQ18000" for 18,000 PSI
Constant Pressure Only	**SQXXXXX**	Set Operational Pressure **on Constant Pressure Pump**	SQ14500 = 14500 PSI pressure setting	

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Notes

*** **For backwards compatibility reasons**
On the Ultra high pressure pumps only

	UPXXXX	This 4 character command is multiplied by a factor of 10 I.e. UP1200 will set the upper limit to 12000 PSI	
Constant Pressure Only	**SPXXXX**	This 4 character command is multiplied by a factor of 10 I.e. SP1200 will set the Set Pressure to 12000 PSI	

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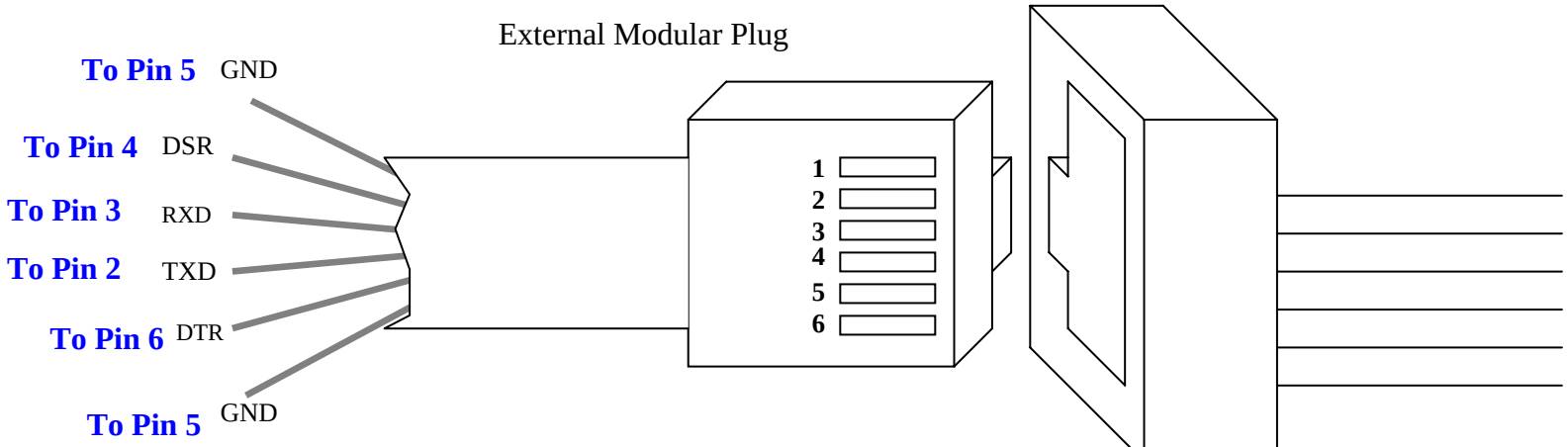
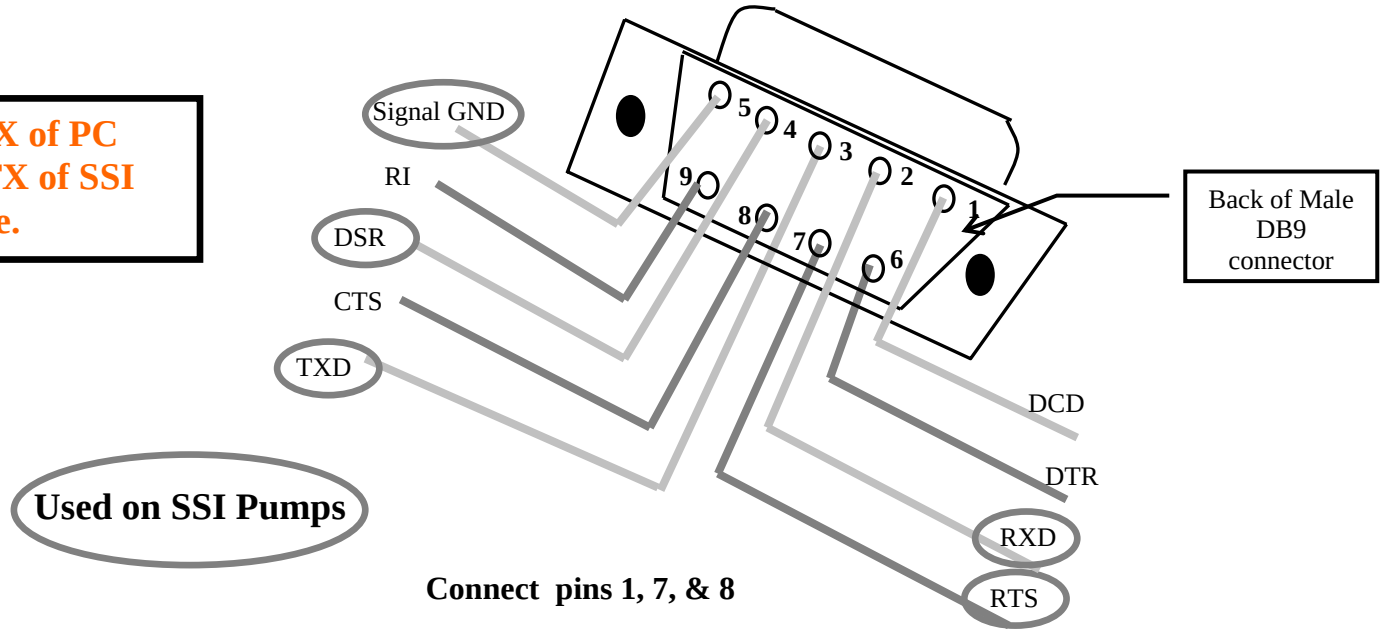
Engineering Preliminary Documentation
8/8/00 PJG

Wiring Diagram for SSI RJ11 RS232 Connection



Test Connection Adapter RS232 to DB9 PC Connection

Note that RX of PC connects to TX of SSI Device.



Used on SSI Pumps

Connect pins 1, 7, & 8