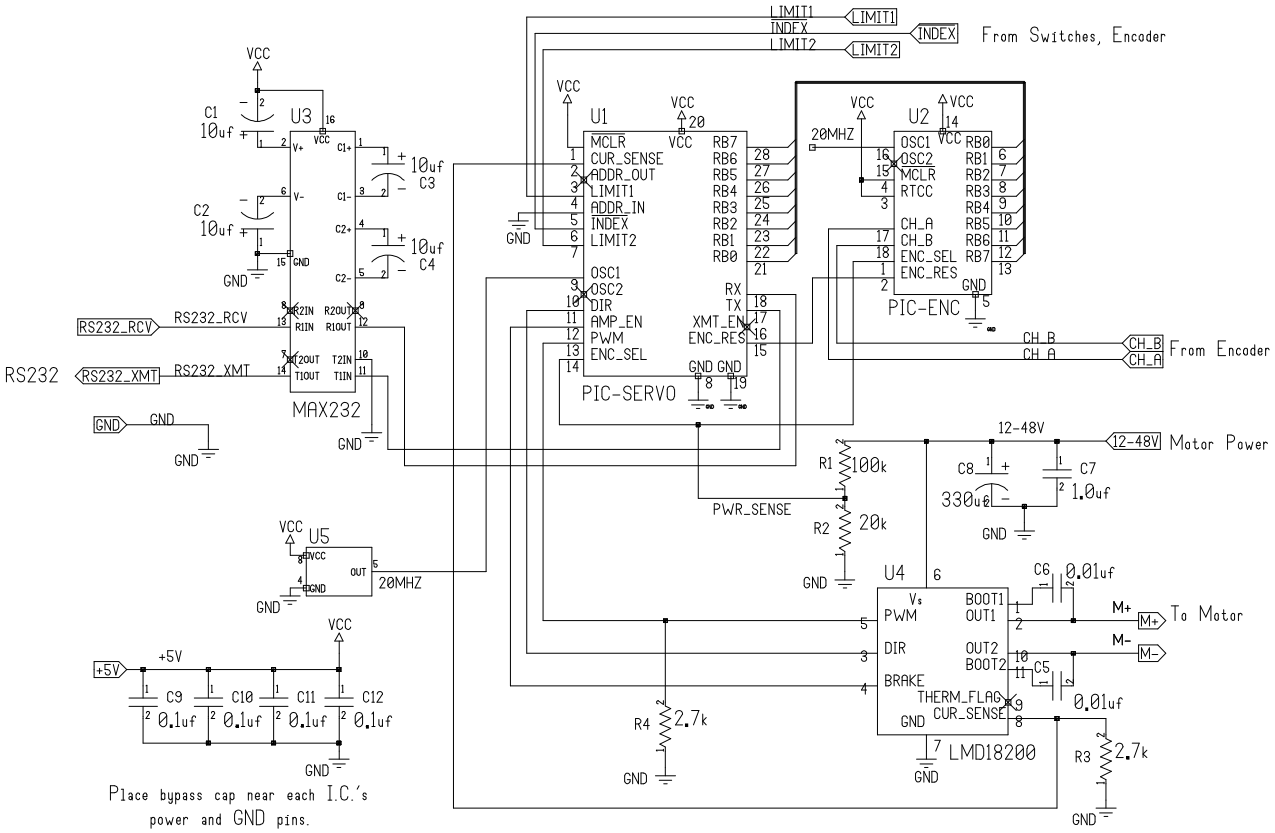
1.0 Basic RS232 Interface With Amplifier



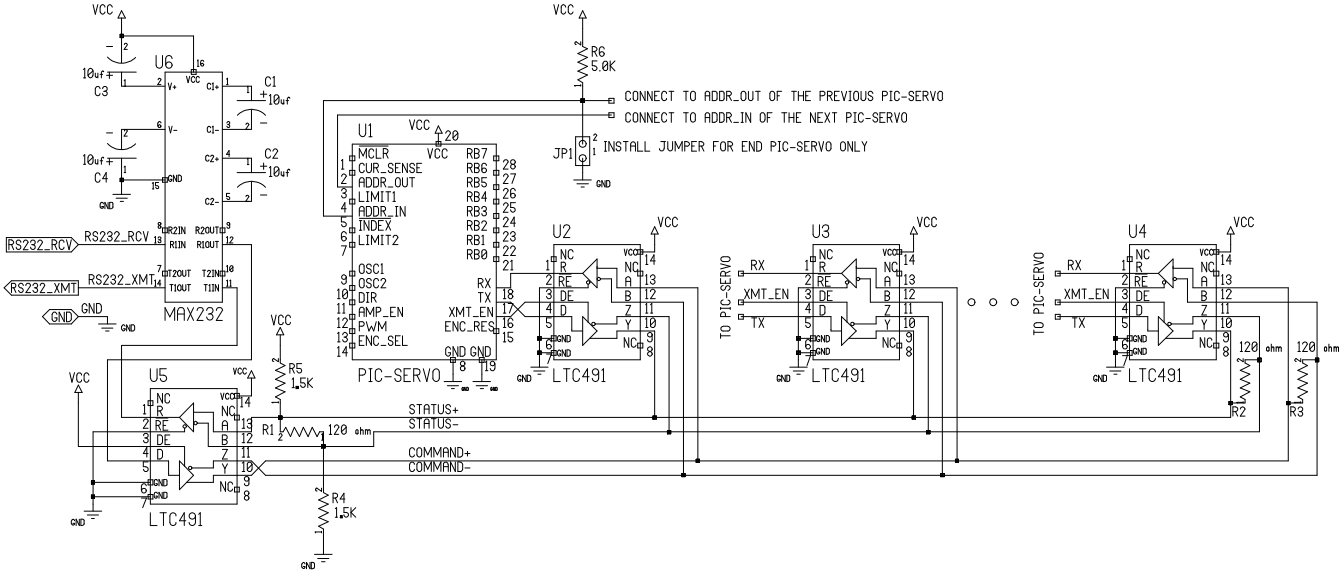
Part List			
Part No.	*Description*	*Jameco Part #*	*Digikey Part #*
U1 & U2	*PIC-SERVO (U1) & PIC-ENC(U2) chipset*	146472	---
U3	MAX232 +5v powered RS232 tranceiver	24811	MAX232CPE-ND
U4	LMD18201 (or LMD18200) PWM amplifier (3A cont., 6A peak)	144047	LMD18201T-ND
U5	20 MHz clock oscillator	27932	CTX169-ND
C1 - C4	10 uf capacitor (16v min)	94060	P2038-ND
C5, C6	0.01 uf capacitor	25507	P4914-ND
C7	1.0 uf ceramic capacitor (50v min)	81509	P4920-ND
C8	330 uf capacitor (50v min)	93825	P6285-ND
C9 - C12	0.1 uf capacitor	25523	P4917-ND
R1	100 K resistor, 1/8 w	29997	100KEBK-ND
R2	20 K resistor, 1/8 w	30453	20KEBK-ND
R3, R4	2.7 K resistor, 1/8 w	30390	2.7KEBK-ND

The schematic above constitutes a complete D.C. motor control system with and RS232 interface for driving a D.C. motor with a TTL compatible incremental encoder. The LMD18200 can drive up to 3 amps continuously and 6 amps peak. (Please refer to the *National* LMD18200 data sheet for specific details.)

Notes

1. The current sense output of U4, with R3 = 2.7 K, will give a voltage signal of approximately 1 volt per amp. If current sensing is not required, the less expensive LMD18201 may be used with pin 8 tied to ground. If current sensing is not used, the CUR_SENSE input of the *PIC-SERVO* may be used as a general purpose analog input (0-5v).
2. The LMD1820x has built in thermal overload protection and will shut down before overheating. Pin 9 is an open collector thermal warning flag output, lowered prior to shutdown, which may be connected to one of the limit inputs with a pull-up resistor, if desired.
3. The LMD1820x has a brake input rather than an enable input, inverting the behavior of the AMP_EN signal. The use of this signal may be inverted in your software, or an inverter gate may be added.
4. On some PC serial ports, time base errors, together with the bias in RS232 trigger levels, may prevent reliable operation at 115.2 KBaud. This can be fixed with the simple hack of placing a 2.0 K resistor between pins 2 and 13 of the MAX232.
5. The ENC_SEL line is multiplexed with the motor power sense function. The resistor values shown for R1 and R2 were chosen to be very large to accommodate a wide range of motor power voltages. At 48 volts, the PWR_SENSE line will try to rise to 8 volts, but because of the high impedance of the voltage divider, the PIC's clamping diodes will have no trouble clamping the voltage to 5v. If the motor power voltage is known, R2 can be set at 2.0 K, with R1 selected to give the proper voltage swing without exceeding +5v. This will give greater noise immunity to the PWR_SENSE signal. If power sensing is not required, ENC_SEL should pulled up to +5v through a 10K resistor.
6. For increased noise immunity on the encoder signals, it may be desirable to pass the CH_A and CH_B signals through Schmitt trigger buffers. In general, great care must be taken in running encoder signals more than a few inches in the presence of large motor switching currents. Ideally, individually shielded cables with CH_A and CH_B twisted with ground should be used.

2.0 Multiple PIC-SERVO's Using an RS485/RS232 Interface



The partial schematic above shows how several *PIC-SERVO*'s can be connected on a single RS485 network to take advantage of the master/slave network communications protocol. It also shows an

RS232 to RS485 converter section for communicating from a host's standard RS232 port. The Command and Status lines can also be driven directly from a full-duplex RS485 port.

The LTC491 is used at the master end (U5) to send commands to all controllers over a single differential command line and to receive status data back over the shared differential status line. An additional LTC491 is used at each *PIC-SERVO* to interface to the RS485 network. The XMT_EN signal from the *PIC-SERVO* is used to control the output of each driver so that only one controller at a time is speaking on the status line.

The total cable length of the RS485 network may be up to 4000 feet, with up to 32 *PIC-SERVO* controllers distributed anywhere along its length. The end of the cable most distant from the master should have 120 ohm termination resistors across both the Status and Command lines. At the master end, the Status line should also have a 120 ohm termination resistor. (The command line does not need one because it is always acting as a low-impedance driver.) If rather long cable lengths are used, care should be taken with the type of cable used. Please refer to the *Linear Technology* LTC491 data sheet for notes on the finer points of RS485 data transmission.

The status line should have biasing resistors (R5, R5) as shown to prevent noise from generating false signals when all *PIC-SERVO*'s have their XMT_EN low.

If several *PIC-SERVO*'s are placed on a the same board, the LTC491 tranceivers may not be needed at all. Instead, the RX pins of all of the slave *PIC-SERVO*'s may be tied to the master's logic level transmit signal. Each TX pin, however, must be fed through a tri-state buffer such as the 74126 with XMT_EN controlling the output mode of the buffer. The outputs of each buffer can then all be connected to the host's logic level receive input.

The ADDR_IN and ADDR_OUT signals are daisy-chained from one *PIC-SERVO* to the next, with the end *PIC-SERVO* having its ADDR_IN line pulled low. This end *PIC-SERVO* will be the first unit addressed over the network. (Please refer to the *PIC-SERVO* data sheet for a full description of addressing issues.) All other *PIC-SERVO*'s should have their ADDR_IN lines pulled up to +5v through a 5.0K resistor to prevent a false ADDR_IN reading should one of them power up before the one upstream has had time to initialize its value for ADDR_OUT.

3.0 Use With Other Amplifier Modules

Several companies, such as Advanced Motion Controls or Copley Controls make PWM servo amplifiers with a wide range of output currents and voltages. Some of these, even though PWM amplifiers, only take an analog voltage as input. Models with PWM and Direction inputs, however, are available.

For the most part, the PWM, DIR, and AMP_EN outputs of the *PIC-SERVO* should be directly compatible with most units, but check carefully the logic voltage levels used and whether the signals are inverted from the *PIC-SERVO* definitions. Some minor signal level conversion or inversion may be required.

Some amplifiers do not put out an analog current measurement signal, but they do have a logic level signal which indicates when current limiting is imminent. This signal can still be connected to the CUR_SENSE input to take advantage of the *PIC-SERVO*'s current limiting option. This is a good

thing to do, because when many amplifiers actually hit their current limit, they go into a low-frequency enable/disable cycle which effectively limits the average current output to only a small fraction of the advertised current capacity. The *PIC-SERVO*'s current limiting, however, will continuously adjust the output to prevent the amplifier from ever hitting its current limit.

4.0 Other References

The following Companies' Web sites may provide useful information and data sheets for developing complete motor control systems using the *PIC-SERVO* and *PIC-ENC*:

Microchip **http://www.microchip.com/**

The *PIC-SERVO* is based on the Microchip PIC16C73 microcontroller and the *PIC-ENC* is based on the PIC16C54 microcontroller. Please refer to the Microchip data sheets for these devices for complete electrical, timing, dimensional and environmental specifications.

National Semiconductor **http://www.nsc.com/**

Although there are some significant differences, the *PIC-SERVO* operates in a manner similar to the National LM629 motor control I.C. The National data sheets and application notes are a useful comparison and may provide additional useful information. Also, the LMD18200 /LMD18201 PWM amplifiers, featured in the *PIC-SERVO* application notes, are particularly well suited for driving small D.C. motors.

Jameco **http://www.jameco.com**

Carries the *PIC-SERVO* chipset and also a general electronics supplier with a wide variety of parts and excellent service. They carry all the parts used in the sample applications. Call 1-800-831-4242 for orders or to get a copy of their catalog.

Digikey **http://www.digikey.com**

General electronics supplier with a wide variety of parts and excellent service. They carry all the parts used in the sample applications. Call 1-800-344-4539 for orders or to get a copy of their catalog.

Servo Systems **1-800-922-1103**

They have a large selection of surplus motors, some with gearheads, some with encoders, as well as some new equipment. They also carry several lines of PWM amplifiers. Most of what they have is in their catalog, but they get in new stock continuously.

HdB Electronics **1-800-287-9432**

Carries the entire line of *PIC-SERVO* products, as well as other electronic components, accessories and tools.

J R Kerr Prototype Development **http://www.jrkerr.com**

Application notes, new products, and useful links can be found at this site. Technical support is via e-mail. Please send questions to "techsupport@jrkerr.com".