Micromint

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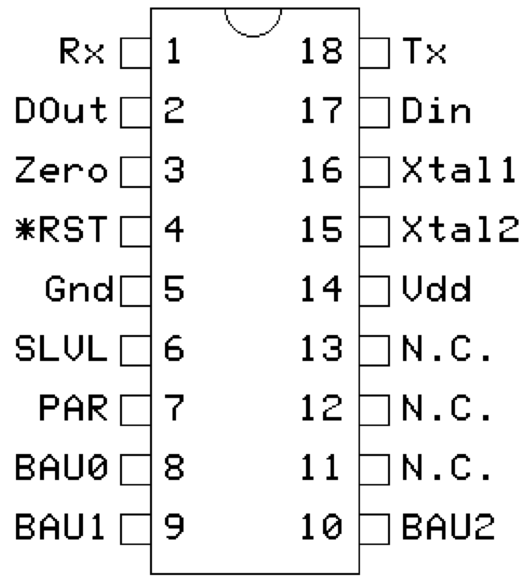
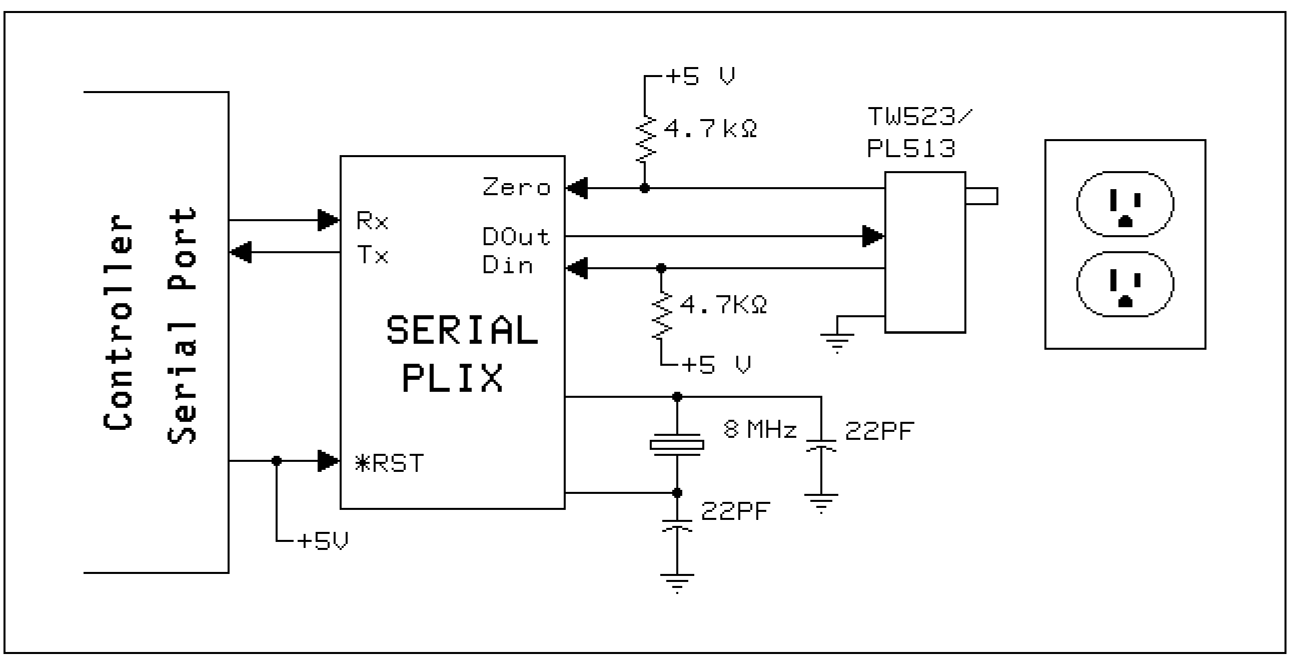
SERIAL PLIX™

Power Line Interface for X-10™

Features

- Complete interface between a microprocessor and an X-10 TW523 or PL513 module
- Performs all transmit functions that are currently supported by X-10™
- Interfaces to a serial port with configurable baud rate of up to 9600 BPS
- Communicates using either 7 data bits, even parity, and 1 stop bit (7E1) or 8 data bits, no parity, and 1 stop bit (8N1)
- Uses RS-232 true or inverted signals
- Requires just two resistor, two capacitors, and a crystal
- Low power consumption (1.8 mA typical @ 5 V)
- Voltage operating range: 4.0 V to 5.5 V
- Standard 18-pin, 0.30 DIP package





SERIAL PLIX™

The X-10 Power Line Control System

The X-10 system was first introduced in the late 1970s as a simple, power-line-based, remote control system. Commands are transmitted over the AC power lines already installed in virtually all houses in the United States and other countries, eliminating the need to pull extra wires.

To use the X-10 system, the user sets a house code (A–P) and a unit number (1–16) on a control module and plugs the module into a wall outlet. The user then plugs a lamp or appliance into the module. To control the module, a remote control console is set to the same house code, then buttons are pressed to select the particular module and to issue it commands.

The X-10 system has been greatly expanded since it was first introduced. In addition to modules, there are also wall switches, switched outlets, chimes, relays, motion detectors, and other devices available that are X-10 compatible.

A natural extension to such a control system is to allow a computer to send and receive X-10 commands to and from the power line.

The PL513 and TW523 computer interface modules provide a safe, UL-approved, optoisolated connection to the power line and allows a computer to send and, in the case of the TW523, receive X-10 commands.

The main drawback of the PL513 and TW523 has been the code complexity needed to drive the modules. The modules provide a very basic interface, leaving all the complex timing, encoding, and decoding to the host microprocessor. In order to handle the tricky timing involved, assembly language routines are a virtual necessity.

SERIAL PLIX has been designed to remove the burden of complex programming from the designer. SERIAL PLIX uses a simple serial port interface that can be accessed from virtually any programming language. It takes care of all the complex timing involved in sending commands to the power line.

Pin Descriptions

Pin	Signal	Description
1	RX	TTL – level serial input
2	Dout	Data output to the PL513/ TW523 Connect to pin 4 on the module.
3	Zero	Zero-crossing detect input from the PL513.TW523. Connect to pin 1 on the module and pull up to Vdd through a 4.7 kΩ resistor.
4	*RST	Connect to Vdd or use controller output to reset the Serial Plix.
5	GND	Ground
6	SLVL	Used to select serial signal level. Vdd for inverted and GND for non-inverted.
7	PAR	Used to select parity. Vdd for 7E2 and GND for 8N1.
8-10	BAUx	Used to select baud rate.
14	Vdd	+5V
16-15	Xtalx	Crystal connection. An 8.0 MHz crystal must be connected across these pins. In addition, 22pF must be connected from each pin to GND.

Pin	Signal	Description	Pin	Signal	Description
17	Din	Data input from the TW523. Connect to pin 3 on the module and pull up to Vdd through a 4.7 kΩ resistor.	18	Tx	TTL-level serial output

Baud Rate Communications

Setting the baud rate for the Serial Plix is a simple task. The Baud Rate Selection table, shown below, indicates the logic levels needed to be applied to achieve the desired communications protocol.

Serial Plix allows the user to select the baud rate, parity, the number of data and stop bits as well as signal levels (TTL inverted or TTL true).

For example: if the desired baud rate is 1200 bps with 7 data bits, even parity and 1 stop bit with an inverted signal level, then Vdd must be applied to SLVL, PAR, BAU1, and BAU2. GND must be applied to BAU0. The baud rate must be selected upon power up. Please call for custom baud rate configurations.

Baud Rate Selection Table

Inverted = 1, True = 0	7E1 = 1, 8N1 = 0	1 = Vdd, 0 = GND			True Baud
SLVL	PAR	BAU0	BAU1	BAU2	Rate
1	1	0	0	0	9600
1	1	0	0	1	4800
1	1	0	1	0	2400
1	1	0	1	1	1200
1	1	1	0	0	600
1	1	1	0	1	300
1	0	0	0	0	9600
1	0	0	0	1	4800
1	0	0	1	0	2400
1	0	0	1	1	1200
1	0	1	0	0	600
1	0	1	0	1	300
0	1	0	0	0	9600
0	1	0	0	1	4800
0	1	0	1	0	2400
0	1	0	1	1	1200
0	1	1	0	0	600
0	1	1	0	1	300
0	0	0	0	0	9600
0	0	0	0	1	4800
0	0	0	1	0	2400
0	0	0	1	1	1200
0	0	1	0	0	600
0	0	1	0	1	300

Command Set

Command	X10 Function	Command	X10 Function
ALO	All Lights On	AUO	All Units Off
BRT	Bright	DIM	Dim
DINA	Receive X10 data over the power lines	OFF	Off
UON	On		

Command Format

The Serial Plix command sequence must begin with the unique identifying character of "$". All Serial Plix command strings must contain **capital letters**. The sequence begins with the command followed by the house code, then the unit code and lastly the repeat code. The house code is A-P and also must be a **capital letter.** The unit code is 1-16 and must be **two digits** (ex. 2=02). The repeat code tells the Serial Plix how many times to repeat the command and it must be **two digits** (ex. 8=08).

For example: if the DIM command is sent to light module A1 and dim it by a factor of 8 the following packet must be sent to the Serial Plix:

$DIMA0108

DINA Command

The DINA command polls the power line for data. When there is data present, it returns the house code followed by the unit code ending in a carriage return – line feed. For example if the house code A and unit code 15 were transmitted over the power lines then the Serial Plix will return the following: **!A15**

The DINA command format is as follows:

$DINAxxyy

Where xx (01 to 99) is the number of times you want Serial Plix to execute the DINA command, and yy (01 to 99) is the time out for the DINA command. The time out is specified in AC power line half cycles. If 01 is entered for the time out, then Serial Plix will wait for approximately 8.33 milliseconds to receive data. If is no data received then the Serial Plix will transmit **!Z99** followed by a carriage return - line feed.

When there is a transmission over the power line the Serial Plix transmits the house code followed by the unit code ending in the house code then the command. The following chart lists the decimal equivalent to each of Serial Plix commands.

Command	Decimal Number
ALO	22
AUO	30
BRT	24
DIM	32
OFF	28
UON	20

For example if the command $UONA1602 was sent over the power lines by one Serial Plix, and a different Serial Plix was monitoring the power lines for data using the $DINA0399 command, the Serial Plix monitoring the line should send out the following information.

!Z99
!A16
!A20

Where A16 is the house code and unit code and A20 is the house code and the command UON.

PL513/TW523 Connection

The PL513/TW523 uses a standard RJ11-type modular jack to connect to the computer. Figure 1 shows how the connector on the module is numbered. When making the connection to the module, be very careful of modular phone cords that swap conductors end for end. Since most modern telephones are not polarized, manufacturers of phone cords don't pay any attention when making the cables. When you wire the modular phone connector on the computer end, so it matches the wiring of the PL513/TW523, be sure the cable you use passes all signals straight through with no swaps.

One way to check cords that use colored wire internally is to hold both ends side by side with the tabs down so you can see through the plastic connector. If the wire colors go in the same order from left to right, then the cable passes the signals straight through. If the colors of the wires in the connectors go in opposite order, then the cable will swap signal order and it won't work.

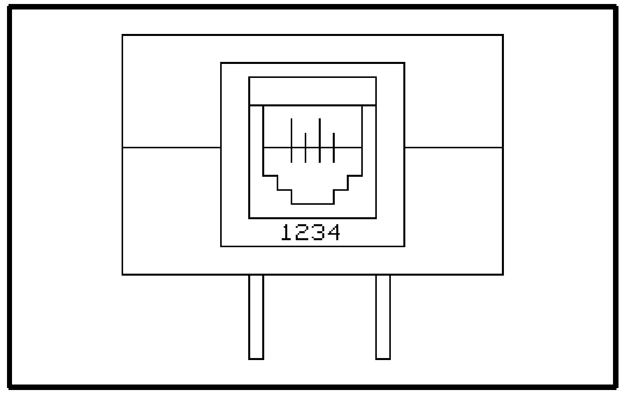


Figure 1 – PL513/TW523 connector numbering. Pin 1 is the zero crossing output. Pin 2 is ground. Pin 3 is the receiver output on TW523 or ground on a PL513. Pin 4 is the transmit input.

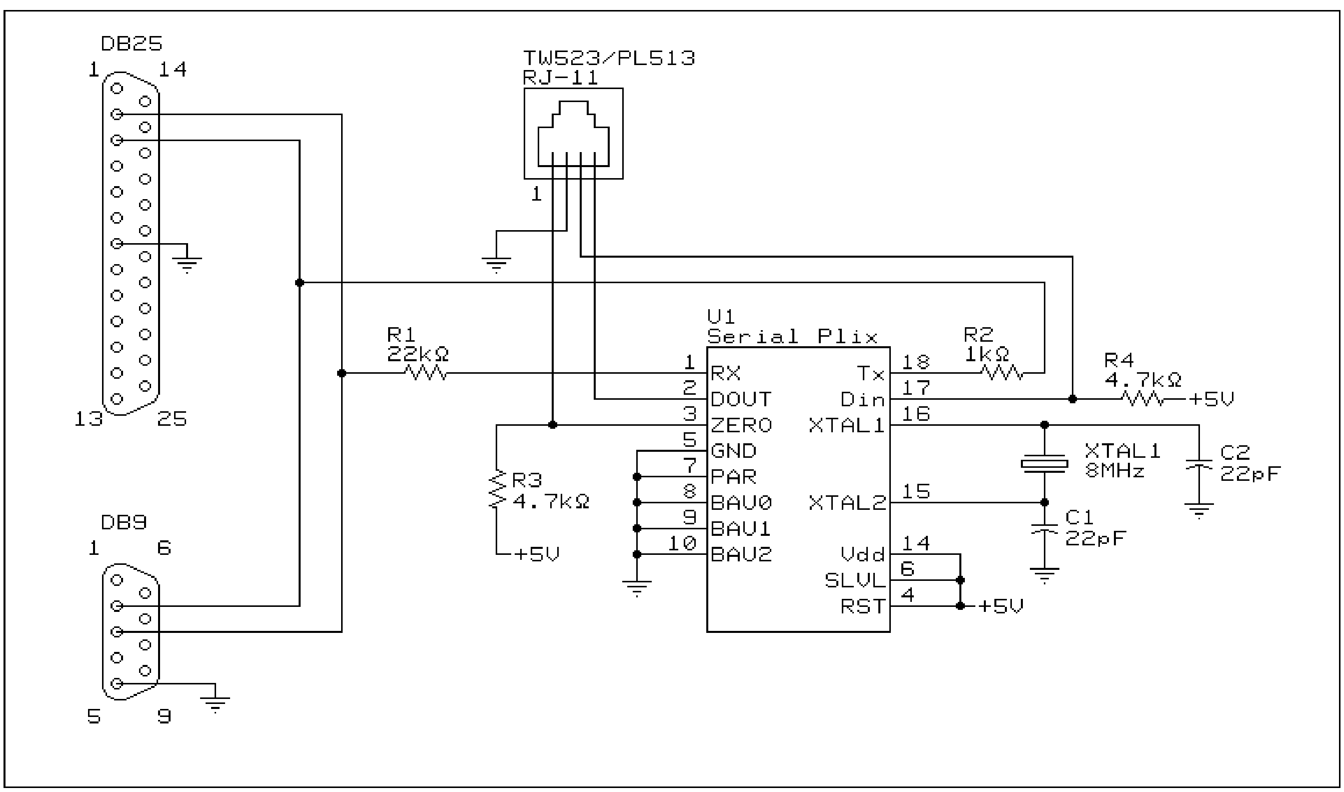


Figure 2 – Connecting Serial Plix to a Personnel Computer using 8N1 9600 bps. Current limiting resistors are required on the receive and transmit pins of Serial Plix when connecting to a computer. All of the parts except the DB9, DB25, and the RJ11 are included in the Serial Plix Kit.

DC Characteristics					
Operating Temperature 0°C ≤ Ta ≤ +70°C					
Operating voltage Vdd = 4.0V to 5.5V					
Characteristic	Min	Typ	Max	Units	Conditions
Supply Voltage	4.0		6.0	V	
Supply Current		1.8	3.3	mA	Fosc=4Mhz, Vdd=5.5V
Input Low Voltage	Vss		0.2Vdd	V	
Input High Voltage	.85Vdd	+1	Vdd	V	
Input Leakage Current	-1		+1	μA	
Output Low Voltage			0.6	V	Iol=1.6mA, Vdd=4.5V
Output High Voltage	Vdd-0.7			V	Ioh=-1.3mA, Vdd=4.5V

Absolute Maximum Ratings	
Storage Temperature -65°C ≤ Ta ≤ +150°C	
Characteristic	Ratings
Voltage on any pin with respect to Gnd (except Vdd)	-0.6 V to Vdd +0.6
Voltage on Vdd with respect to Gnd	0 to 7.5V
Total power dissipation	1W
Max. current out of Gnd pin	300 mA
Max. current into Vdd pin	250 mA
Max. output current sinked by any I/O pin	25 mA
Max. output current sourced by any I/O pin	25 mA