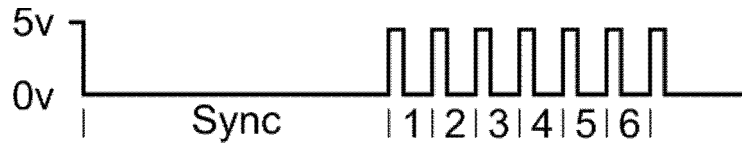


## VEX Receiver Decoder

Circuit / Firmware by Jon Williams (jwilliams@efx-tek.com)

### Theory of Operation

The output from the VEX receiver is an open collector PPM (pulse position modulation) stream that is common in the RC control world. The idle/spacing state of the output will be high via the R2 pull-up resistor. The PPM signal stream from the receiver into the processor looks like this:



A “cycle” begins with a low-going sync pulse that is about nine milliseconds in duration. At the end of the sync pulse the PPM pin will go high; this is the beginning of the Servo 1 timing. At this point the Servo 1 output is enabled and will stay on until the next low-to-high transition of the PPM pin; at this point the Servo 1 output is turned off and the Servo 2 output activated. Note that if you look at the PPM waveform on an oscilloscope only the low-going portion of each servo frame changes; the (high-going) framing pulse is constant (~500 uS); the low portion will vary from ~500 to ~1500 uS.

After four servos the firmware measures the low-going pulse of channels 5 and 6 to determine which button (top = short, bottom = long) was pressed for these channels. Pressing the top button on channels 5 or 6 activates the associated control output. Pressing the bottom button on channels 5 or 6 deactivates the output. The control outputs do not change state if neither or both buttons for a channel are pressed.

The firmware below was written for the Parallax ([www.parallax.com](http://www.parallax.com)) SX microcontroller using the [free] SX/B compiler. It is straightforward and easily translated to other processors/languages.

```
' =====
'
' File..... VEX_Demod-v2.SXB
' Purpose... Servo demodulator for VEX receiver
' Author.... Jon Williams
'           Copyright (c) 2007 Jon Williams
'           Some Rights Reserved
'           -- see http://creativecommons.org/licenses/by/2.5/
' E-mail.... jwilliams@efx-tek.com
' Started...
' Updated... 02 MAR 2007
'
' =====
'
' -----
' Program Description
' -----
'
' Simple program to convert PPM stream from VEX RC receiver to servo
' output pulses.
'
' See: http://www.vexfan.com/viewtopic.php?t=227
'
' Version 2: converts output of channels 5 and 6 to digital control; the
' upper button for these channels turns the output bit on, the lower
```

```

' button turns them off.

' -----
' Conditional Compilation Symbols
' -----

'{$DEFINE Use_SX20_OFF}
'{$DEFINE Test_Mode_OFF}

' -----
' Device Settings
' -----

DEVICE          SX28, OSCXT2, TURBO, STACKX, OPTIONX, BOR42
FREQ            50_000_000
ID              "VexDemod"

' -----
' IO Pins
' -----

PPM             PIN    RA.0 INPUT           ' PPM in (pull-up w/10k)

SvoPort        PIN    RB  OUTPUT
Servo1         PIN    RB.0
Servo2         PIN    RB.1
Servo3         PIN    RB.2
Servo4         PIN    RB.3
Control1       PIN    RB.4           ' digital control pins
Control2       PIN    RB.5

' -----
' Constants
' -----

SvoMask        CON    %11110000       ' preserve RB.7..RB.4

IsOn           CON    1
IsOff          CON    0

' -----
' Variables
' -----

pulseTmr       VAR    Word
svoPntr        VAR    Byte

tmpB1          VAR    Byte           ' work vars
tmpB2          VAR    Byte
tmpW1          VAR    Word

```

```

' =====
PROGRAM Start
' =====

Start:
'{$IFDEF Use_SX20_OFF}
  PLP_C = %00000000      ' pull up unused pins
'{$ENDIF}

PLP_A = %0001
SvoPort = %00000000

Wait_For_Sync:
  pulseTmr = 0
  DO WHILE PPM = 0
    PAUSEUS 1
    INC pulseTmr
  LOOP
  IF pulseTmr < 4000 THEN Wait_For_Sync

Main:
  svoPntr = %0000_0001
  DO
    SvoPort = SvoPort | svoPntr      ' start servo pulse
    DO WHILE PPM = 1                 ' complete framing pulse
      LOOP
    DO WHILE PPM = 0                 ' complete timing pulse
      LOOP
    SvoPort = SvoPort & SvoMask      ' clear servo outputs
    svoPntr = svoPntr << 1           ' point to next servo
  LOOP UNTIL svoPntr = %0001_0000

Ctrl_Port1:
  DO WHILE PPM = 1                   ' complete framing pulse
    LOOP
  pulseTmr = 0
  DO WHILE PPM = 0                   ' measure timing pulse
    PAUSEUS 5
    INC pulseTmr
  LOOP

'{$IFDEF Test_Mode}
  WATCH pulseTmr
  BREAK
  GOTO Start
'{$ENDIF}

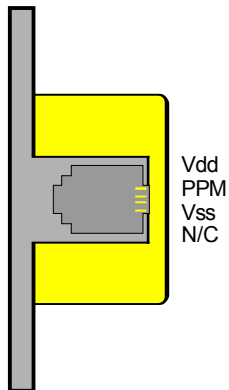
IF pulseTmr < 150 THEN                ' short pulse?
  Controll = IsOn
ELSE
  IF pulseTmr > 250 THEN              ' long pulse?
    Controll = IsOff
  ENDIF
ENDIF

Ctrl_Port2:
  DO WHILE PPM = 1

```

```
LOOP
pulseTmr = 0
DO WHILE PPM = 0
  PAUSEUS 5
  INC pulseTmr
LOOP
IF pulseTmr < 150 THEN
  Control2 = IsOn
ELSE
  IF pulseTmr > 250 THEN
    Control2 = IsOff
  ENDIF
ENDIF
GOTO Wait_For_Sync
```

## VEX Receiver Connections

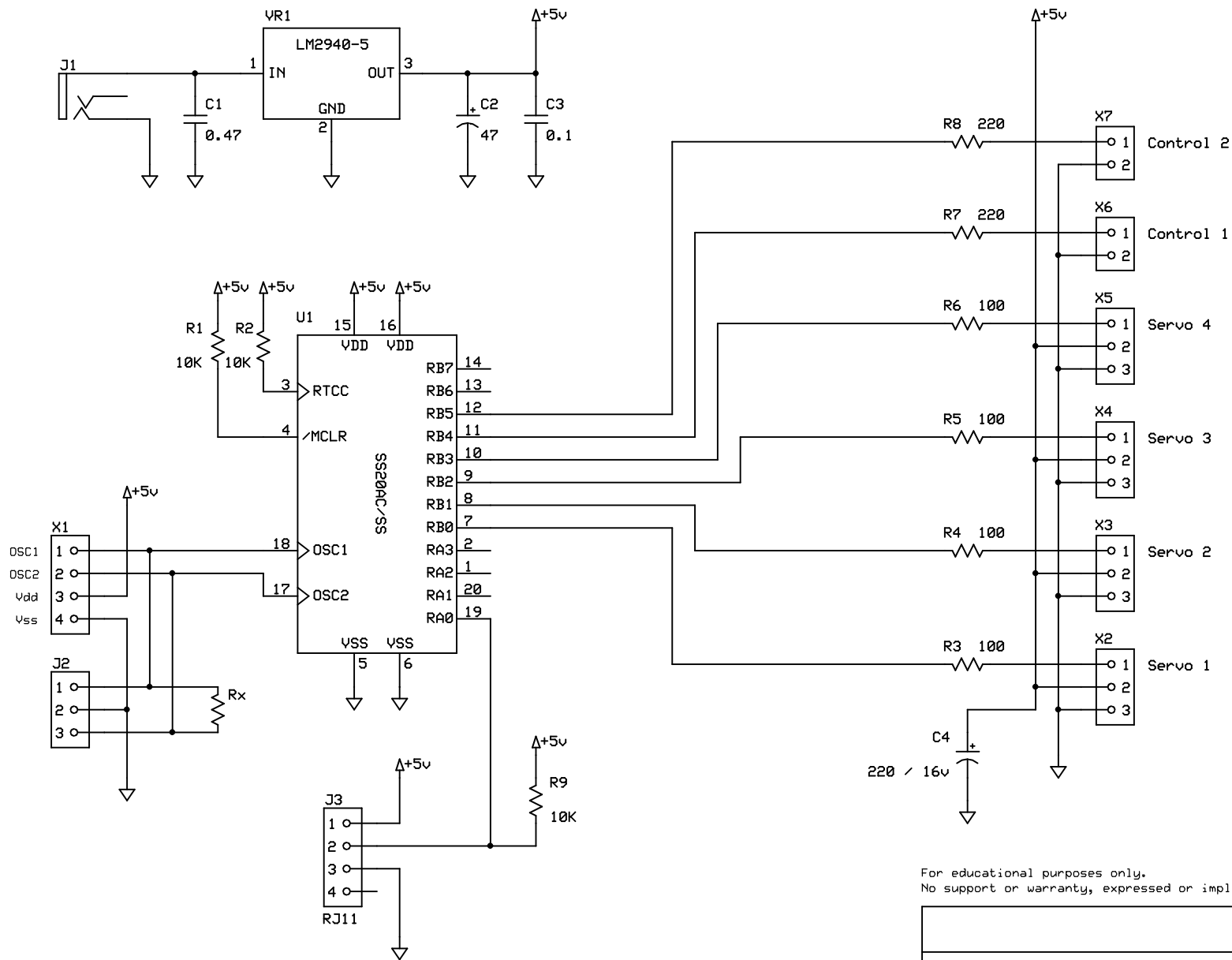


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## About the Author

In addition to his work with EFX-TEK, Jon Williams writes for Nuts & Volts magazine ("Stamp Applications" column) and is a free-lance electronics engineer who lives and works in the Los Angeles area. He can be reached at [jwilliams@efx-tek.com](mailto:jwilliams@efx-tek.com).



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