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For Microchip Technology Inc

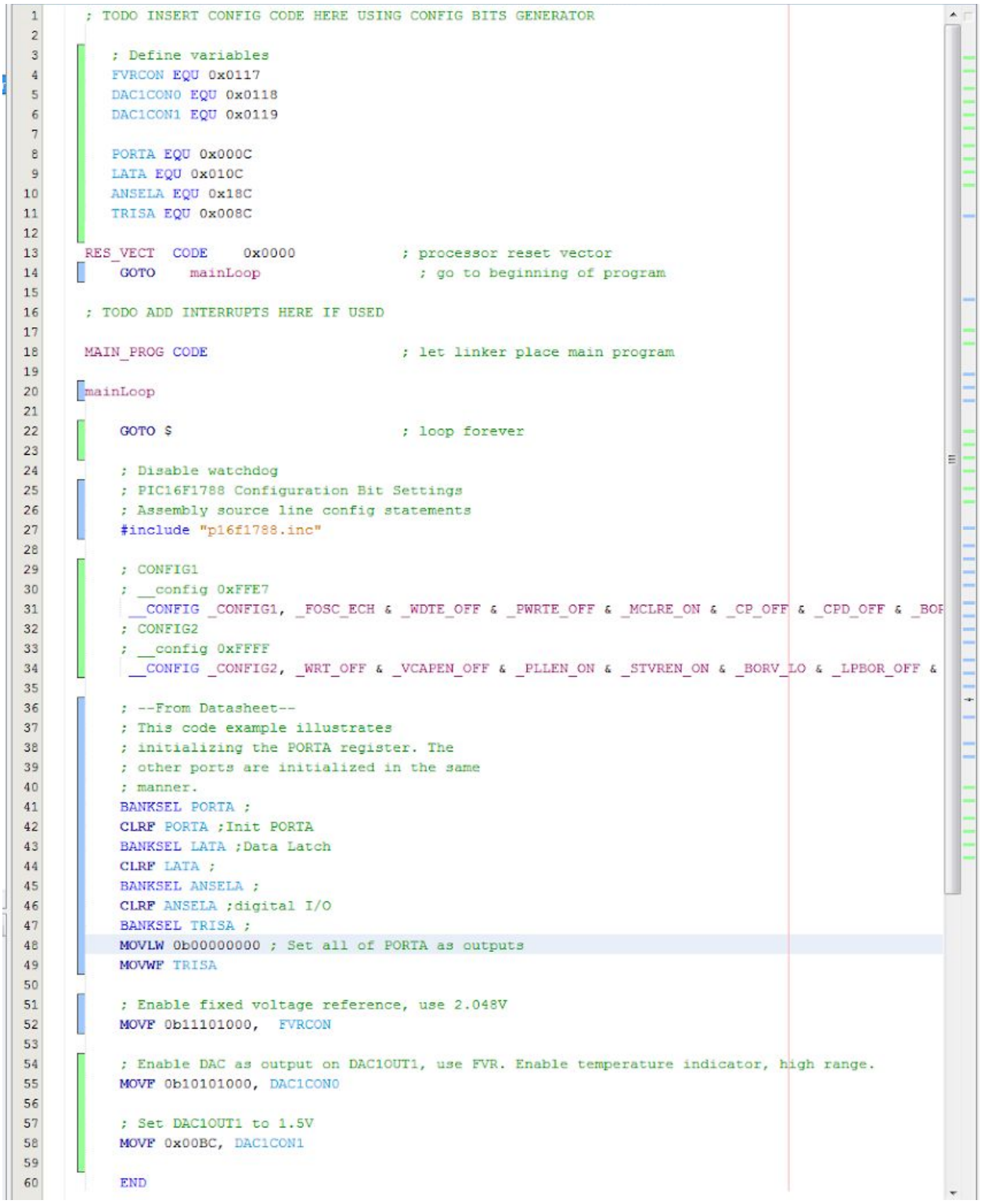
Engineering Project - Constant Voltage Driver

https://github.com/louisrosenblum/Microchip

```
CLEAN SUCCESSFUL (total time: 56ms)
"C:\Program Files (x86)\Microchip\MPLABX\v5.30\mpasmx\mpasmx.exe" -q -p16f1788 -l"build/default/production/newpic_8b
Warning[207] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 4 : Found label after column
Warning[207] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 5 : Found label after column
Warning[207] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 6 : Found label after column
Warning[207] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 8 : Found label after column
Warning[207] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 9 : Found label after column
Warning[207] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 10 : Found label after column
Warning[207] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 11 : Found label after column
Message[302] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 44 : Register in operand not
Message[302] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 46 : Register in operand not
Message[302] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 49 : Register in operand not
Warning[202] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 52 : Argument out of range.
Warning[219] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 52 : Invalid RAM location spe
Message[302] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 52 : Register in operand not
Warning[202] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 55 : Argument out of range.
Warning[219] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 55 : Invalid RAM location spe
Message[302] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 55 : Register in operand not
Warning[202] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 58 : Argument out of range.
Message[302] C:\USERS\LOUIS\DESKTOP\MICROCHIP\INTERVIEW PROJECT.X\NEWPIC_8B_SIMPLE.ASM 58 : Register in operand not

BUILD SUCCESSFUL (total time: 757ms)
```

1) Assembly Implementation. https://github.com/louisrosenblum/Microchip



```
; TODO INSERT CONFIG CODE HERE USING CONFIG BITS GENERATOR

    ; Define variables
    FVRCON EQU 0x0117
    DAC1CON0 EQU 0x0118
    DAC1CON1 EQU 0x0119

    PORTA EQU 0x000C
    LATA EQU 0x010C
    ANSELA EQU 0x18C
    TRISA EQU 0x008C

RES_VECT  CODE    0x0000            ; processor reset vector
    GOTO    mainLoop                ; go to beginning of program

; TODO ADD INTERRUPTS HERE IF USED

MAIN_PROG CODE                      ; let linker place main program

mainLoop

    GOTO $                          ; loop forever

    ; Disable watchdog
    ; PIC16F1788 Configuration Bit Settings
    ; Assembly source line config statements
    #include "p16f1788.inc"

    ; CONFIG1
    ; __config 0xFFE7
     __CONFIG _CONFIG1, _FOSC_ECH & _WDTE_OFF & _PWRTE_OFF & _MCLRE_ON & _CP_OFF & _CPD_OFF & _BOR
    ; CONFIG2
    ; __config 0xFFFF
     __CONFIG _CONFIG2, _WRT_OFF & _VCAPEN_OFF & _PLLEN_ON & _STVREN_ON & _BORV_LO & _LPBOR_OFF &

    ; --From Datasheet--
    ; This code example illustrates
    ; initializing the PORTA register. The
    ; other ports are initialized in the same
    ; manner.
    BANKSEL PORTA ;
    CLRF PORTA ;Init PORTA
    BANKSEL LATA ;Data Latch
    CLRF LATA ;
    BANKSEL ANSELA ;
    CLRF ANSELA ;digital I/O
    BANKSEL TRISA ;
    MOVLW 0b00000000 ; Set all of PORTA as outputs
    MOVWF TRISA

    ; Enable fixed voltage reference, use 2.048V
    MOVF 0b11101000,  FVRCON

    ; Enable DAC as output on DAC1OUT1, use FVR. Enable temperature indicator, high range.
    MOVF 0b10101000, DAC1CON0

    ; Set DAC1OUT1 to 1.5V
    MOVF 0x00BC, DAC1CON1

    END
```

2a) Peripherals used:

DAC - Used to generate an intermediate voltage between Vref and supply voltage.

FVR - Used as the DAC input in order to avoid changes in supply voltage affecting the output voltage.

TIM - Used in conjunction with the FVR in order to avoid changes in temperature affecting the output voltage.

2b) The design meets all requested parameters. As long as the supply voltage is above 1.8V the temperature indicator module will function properly in the low range mode. Neither the supply voltage nor the temperature will affect the fixed voltage reference while the TIM is enabled.

2c) Limitations of this design include a 200 microsecond ADC acquisition time from the TIM. This method can also only produce a maximum DC voltage of 4.096 V. In order to go higher than this I would likely look further into the operational amplifier modules within the microcontroller. In addition I had to disable the watchdog to prevent the program from being reset.

2d) The output voltage should remain constant across all supply voltages between 1.8 and 5.5V.

2e) The output voltage should remain constant across all temperatures between 0 C to 85 C. I would test the TIM on both ends of this spectrum to make sure the internal TIM feedback is functioning in this range.

2f) The maximum sink/source current for the I/O pins is 25 mA. Because the output voltage is coming from the DAC1OUT1 pin there current should be sourced if a load is attached. The voltage above the load should remain steady as long as the load doesn't attempt to draw more than 25 mA of current.

2g)

Specification	PIC16F1788	PIC16LF1788
Operating voltage	2.3 to 5.5 V	1.8 to 3.6 V
Device ID	0x302B	0x302D
Pin voltage relative to Vss	-0.3 to 6.5 V	-0.3 to 4 V

The PIC16LF1788 offers Extreme Low-Power Management:

- Sleep mode: 50 nA @ 1.8V, typical
- Watchdog Timer: 500 nA @ 1.8V, typical
- Timer1 Oscillator: 500 nA @ 32 kHz
- Operating Current: - 8 A @ 32 kHz, 1.8V, typical - 32 A/MHz @ 1.8V, typical

I think the PIC16LF would be a better choice for this design. The FVR is being used and therefore a supply voltage significantly above 1.8V isn't necessary for proper function. The device would also consume less power in operation.