T state calculation

Monday, January 13, 2025 10:25 AM

```
Delay:
            LDI R16,0xFF //Loop 1
L1:         LDI R17,0xFF  // Loop 2
L2:         LDI R18,0x07  // Loop 3
L3:         NOP
            DEC R18
            BRNE L3       //Loop 3 End
            DEC R17
            BRNE L2       //Loop 2 End
            DEC R16
            BRNE L1       // Loop 1 End
            RET
```

T-states from datasheet

LDI R_d, K → 1T

NOP → 1T

DEC R_d → 1T

BRNE

Branch Taken → 2T

Branch NOT Taken → 1T

RET → 4T

For Loop 3:-

Before DEC operation { For R18 → 0x07 to 0x02, that means 6 times BRNE → 2T

For R18 → 0x01, BRNE → 1T

L3: NOP → 1T
DEC R18 → 1T
BRNE L3 → 2T / 1T

(1+1+2) X 6 + (1+1+1)

Total = 24+3 = 27T

For Loop 2:-

L2: LDI R18, 0x07 → 1T
Loop 3 → 27T
DEC R17 → 1T
BRNE L2 → 2T / 1T

(1+27+1+2) X 254 = 7874T

(1+27+1+1) = 30T

Total = 7904T

For Loop 1:-

L1: LDI R17, 0xFF → 1T
Loop2 → 7904T
DEC R16 → 1T
BRNE L1 → 2T / 1T

(1+7904+1+2) X 254 = 2008632T

(1+7904+1+1) = 7907T

∴ Total = 2016539T

T state calculation

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Therefore,

Delay : LDI R16, 0XFF ⟶ 1T

Loop L1 ⟶ 2016539 T

RET ⟶ 4T

∴ Total Delay T state = (1+2016539+4) = 2016544 T

If Clock of the microcontroller = 1 MHz

∴ 1T state = 1 μSec

∴ Delay loop takes = 2016544 x 1 μSec

= 2.016544 Sec