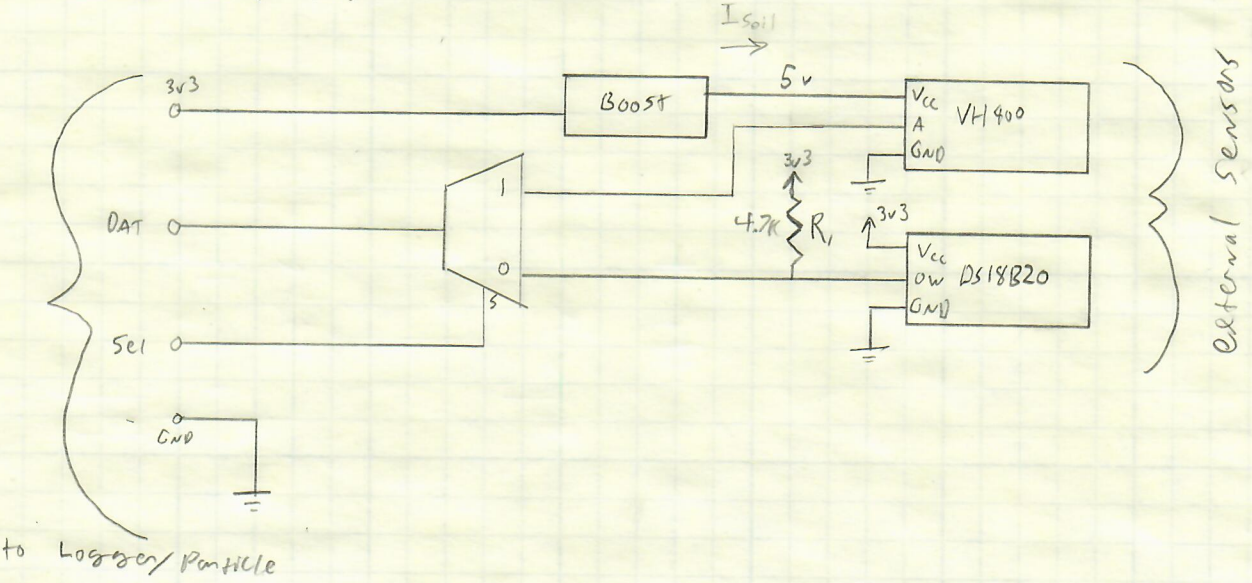
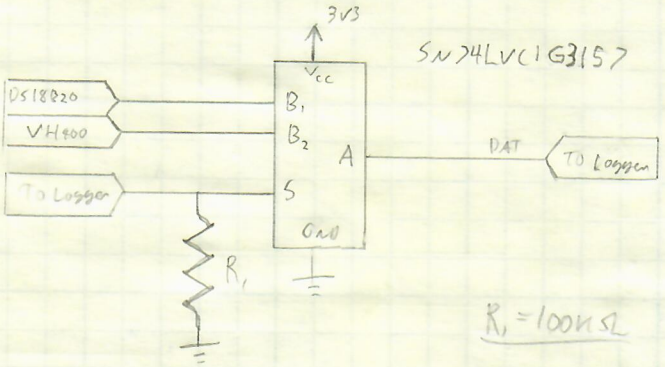
Overview (single)



to Logger/Particle

MUX Detail



$R_1 = 100k\Omega$ Pulldown

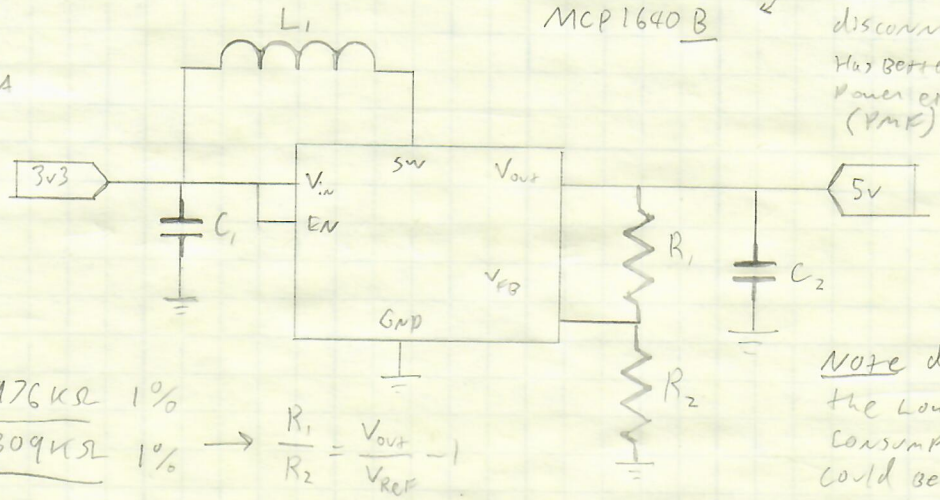
Default to connect to DS18B20 since this is ready for communication on startup and voltage is stable on startup (no signal) and only controlled by master (allows for graceful glitch free startup)

Boost Detail

$V_{IN} = 3.3v$
$V_{out} = 5v$
$I_{out} \leq 13mA$

MCP1640B

use B model since it has true output disconnect and has better low power efficiency (PMF)



$R_1 = 976k\Omega$ 1%
$R_2 = 309k\Omega$ 1%

$\rightarrow \frac{R_1}{R_2} = \frac{V_{out}}{V_{REF}} - 1$

$V_{REF} = 1.21v \rightarrow V_{out}$ (Actual) $= 5.03v$

Note due to the low power consumption, could be replaced with switched cap topology for potential cost savings

Boost Calculations

$C_1 \geq 4.7\mu F$ (Specified for stability by datasheet)

$C_1 = 10\mu F$, 16V X5R/X7R (Low ESR) — Choose Higher than standard value since connectivity across cable and unknown source impedance, allows for greater stability margin/noise reduction,

$C_2 = 10\mu F \times 2$, 16V X5R/X7R (two in parallel (increases CAP, Reduces ESR))

$10\mu F \leq C_2 \leq 100\mu F$ — increase from minimum to middle of Range to improve noise & transient Performance (cleaner line)

$L_1 = 4.7\mu H$ Recommended Balanced Value

$2.2\mu H \leq L_1 \leq 10\mu H$ $I_{sat} \geq 0.7A$

$DCR \leq 0.55\Omega$

PN, Wurth = 744 5024047 — 270mΩ, 1.9A Sat

PN, TDK = VLS252010HBX-4R7M-1 — 250mΩ, 1.6A Sat

Output Ripple Calc

$$\Delta I_L = \frac{V_{in}(V_{out} - V_{in})}{L \cdot f_s \cdot V_{out}} = \frac{3.3(5-3.3)}{(4.7\mu H)\cdot 500KHz \cdot 5V} = 0.477A$$

$$\Delta V_{out} = \Delta V_{CAP} + \Delta V_{ESR} = \frac{I_{out,max} \cdot D}{f_s \cdot C_{out}} + ESR_{eff}\left(\frac{I_{out,max}}{1-D} + \frac{\Delta I_L}{2}\right)$$

$\frac{V_{out}}{V_{in}} = \frac{1}{1-D} \rightarrow 1.515(1-D) = 1$

$D = 0.34$

$f_s = 500KHz$ (Given), $I_{out,max} = 20mA$ (Rated 13mA max sensor draw)

$ESR = 3m\Omega$ @ 500KHz For 10μF murata X5R capacitor (taken from SimSurfing)

$ESR_{eff} = 3m\Omega \,||\, 3m\Omega = 1.5m\Omega$

$C_{out} = 20\mu F$ (10μF || 10μF)

$$\Delta V_{out} = \frac{20mA \cdot 0.34}{500K \cdot 20\mu} + 1.5m\left(\frac{20mA}{1-0.34} + \frac{0.477}{2}\right) = 6.8\times10^{-9} + 4.032\times10^{-9} = 1.08mV$$

Can be Reduced by increasing inductance of L_1 and capacitance of C_2