### **IV-Flow-Meter — Engineering Design Summary**

*(prepared for project supervisors, June 2025, Rev A board)*

## **1 Power-Supply Design**

| **Item** | **Part(s) / Value(s)** | **Rationale** | **Trade-offs** |
| --- | --- | --- | --- |
| **Primary cell** | 1 × AA Alkaline | Ubiquitous, low cost, 2 Ah typical | Large ESR at -10 °C → derate runtime |
| **Reverse-polarity** | P-MOS AO3401A, 100 kΩ gate pulldown | “Ideal diode” protection, < 50 mΩ drop | AO3401A ≈ US $0.45 |
| **Boost converter** | TPS610982DSET, L1 = 4.7 µH, C<sub>OUT</sub> = 22 µF | 300 nA IQ, starts at 0.7 V, integrated 2.8 V LDO | Costlier than discrete boost |
| **MODE pin logic** | R3 = 100 kΩ pulldown, MCU drives high for “Active” | Default Low-Power 300 nA; firmware can switch to fast mode | MCU crash still leaves device in low-power |
| **Battery gauge** | VIN\_RC\_FILTER → PC0/ADC\_IN10, R1 = 330 Ω, C4 = 100 nF | Measures VBAT with < 1 mV error, filters 1 MHz noise | 330 Ω adds negligible 0.33 mV drop |
|  |  |  | – |

## **2 Sensor & IR Sub-System Design**

### **2.1 Optical front-end**

| **Stage** | **Continuous-LED mode** | **Pulsed-LED low-power mode** |
| --- | --- | --- |
| Photodiode bias | R16 = 3.3 kΩ to 3.3 V (R17 DNP) | Same |
| AC coupling | C17 = 4.7 µF ‖ C18 = 100 nF → τ ≈ 4.7 s | **C17 depop** or 220 nF → τ ≈ 0.59 ms |
| Comparator | LMV331, V<sub>REF</sub> = 1.65 V ladder (47 k/47 k) | Same |
| Hysteresis | R11 = 330 kΩ → ±70 mV | Same |
| LED drive | Always-ON, ~18 mA DC | 150 µs pulse every 1.80 ms (8.3 %) via PB3→Q2 |

### **2.2 Performance**

* **Min detectable shadow**: 2.1 ms (neonatal set) with 14 % timing margin.
* **Throughput**: ≥ 10 drops s⁻¹ continuous; ≥ 40 drops s⁻¹ in pulsed mode.
* **Power**: LED **1.5 mA** average in pulsed mode (×12 saving).

## **3 User-Interface Design**

| **Element** | **Parts / Pins** | **Notes** |
| --- | --- | --- |
| **Display** | EA DOGS164W-A, SPI1 → PA5/PA7, CS = PB0, RST = PB1, D/C = PB2 | No back-light → zero display current; contrast caps C5 1 µF, C6 0.1 µF |
| **Buttons** | 4 × ITS005F tacts → PB4…PB7, internal pull-ups | Active-low, debounced in firmware |
| **Buzzer** | LS1 piezo + N-MOS Q1, gate PA8 | PWM via TIM1\_CH1 |
|  |  |  |
| **SWD / UART** | 5-pin J1 header (SWDIO, SWCLK, GND, 3 V3, TX) | Lifts above LCD bezel for easy probe |

## **4 Major Design-Choice Matrix**

| **Subsystem** | **Choice** | **Reason** | **Alternatives considered** |
| --- | --- | --- | --- |
| Power | TPS610982 vs. ME2108 | Ultra-low IQ (300 nA) extends standby to weeks | Cheaper boost but 50 µA IQ, rejected |
| Reverse protection | P-MOS ideal diode | Zero forward drop, minimal parts | Schottky diode (-200 mV loss) |
| Sensor coupling | 4.7 µF AC cap | Cancels ambient drift; proven in bench test | DC-coupled (kept as low-power option) |
| Comparator | HW LMV331 + hysteresis | Off-loads MCU polling; 6 µA supply | ADC-only solution (more code, higher MCU run-time) |
| LED timing | 150 µs @ 555 Hz | Meets 2.1 ms shadow spec with 8.3 % duty | Lower freq wastes power; higher freq tightens MCU timings |
| Display | DOGS164 transflective | Readable in sunlight, 0 µA idle | OLED (bright, but ≥ 5 mA even static) |
| Buttons | Direct GPIO, no matrix | No ghosting, simpler firmware | 2 × 2 matrix (saved 2 pins but added IO expander) |