

Modern robotics device detection problems

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Problem

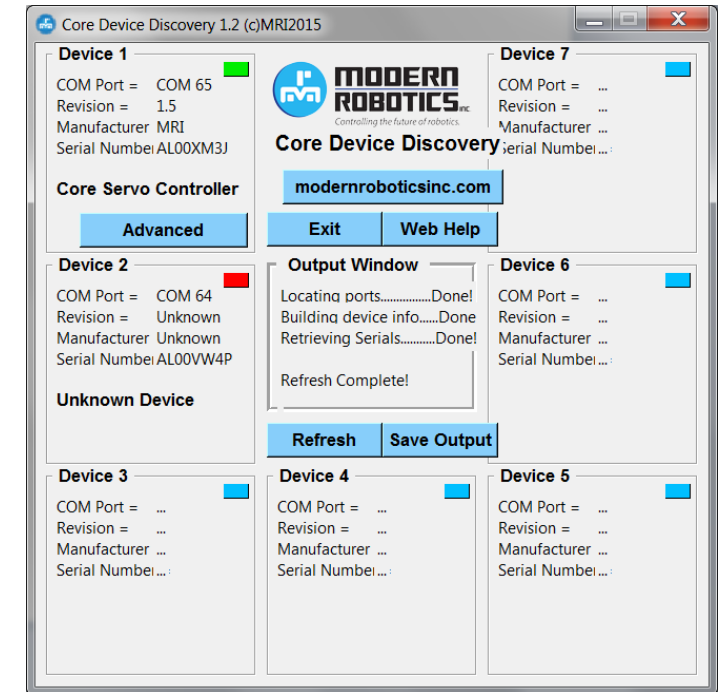
- During FTC Match in Prague (CZ) many teams observed USB problems
- Apart from USB connection problems, static and other issues some teams had consistent hardware detection problems after switch-on of robot
- Time between switch-off and switch-on of robot and battery charge seems of influence.
- Some teams only had sporadic detection of all hardware (more faulty startups than correct startups)
- Offline testing performed to analyze the issue. Results presented here

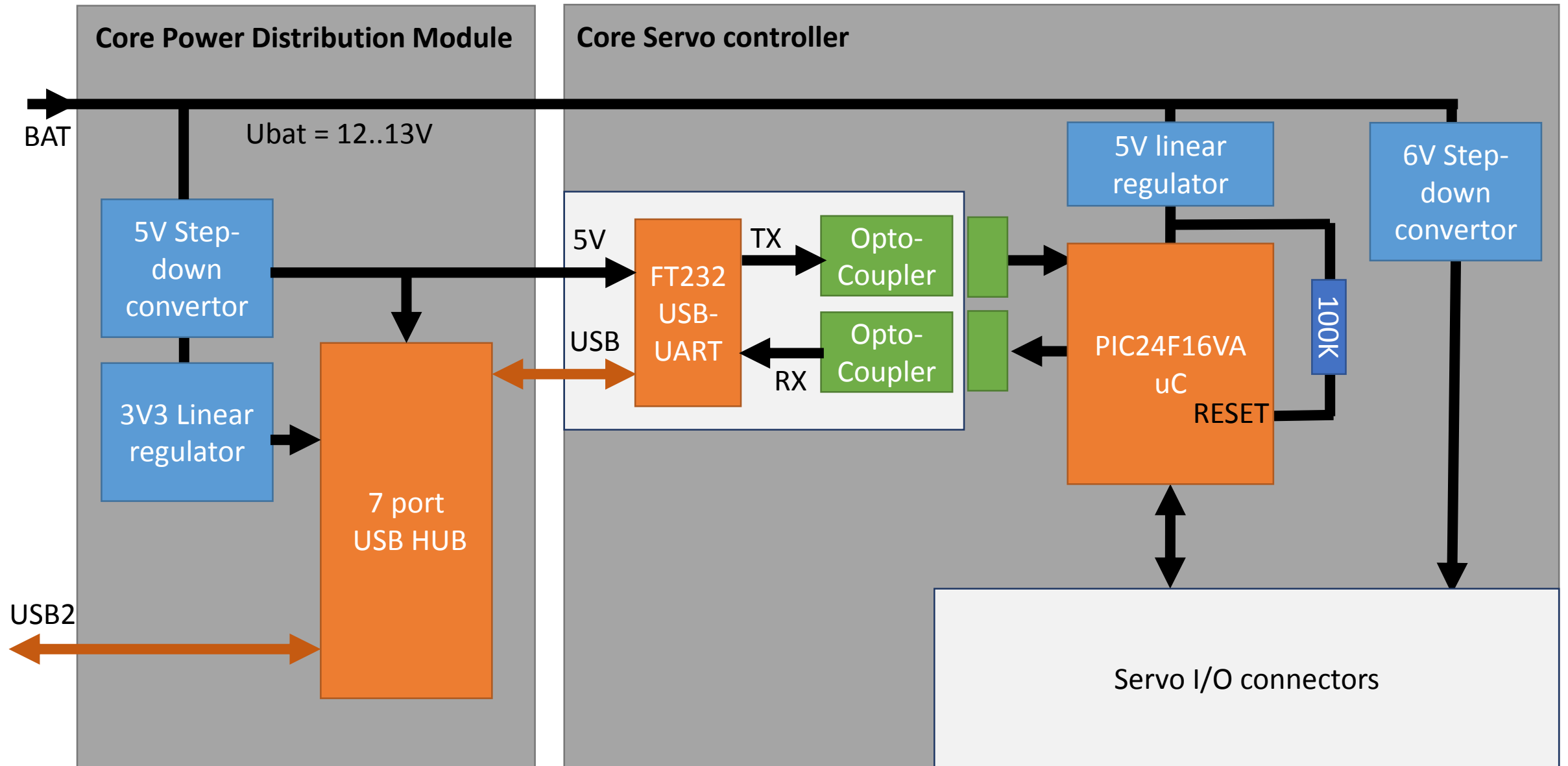
Modern robotics device detection problems

- Configuration: Typical robot configuration
 - Core Power distribution module
 - Core servo module
 - Core motor controller
 - Standard 12V 3000mAh battery, $U_{bat} = 12.5 \text{ V}$
- Battery/Servo/Motor connection made using standard cables with APP connectors (typical robot setup)
- No motors or servos connected
- USB connected to standard laptop for diagnostics

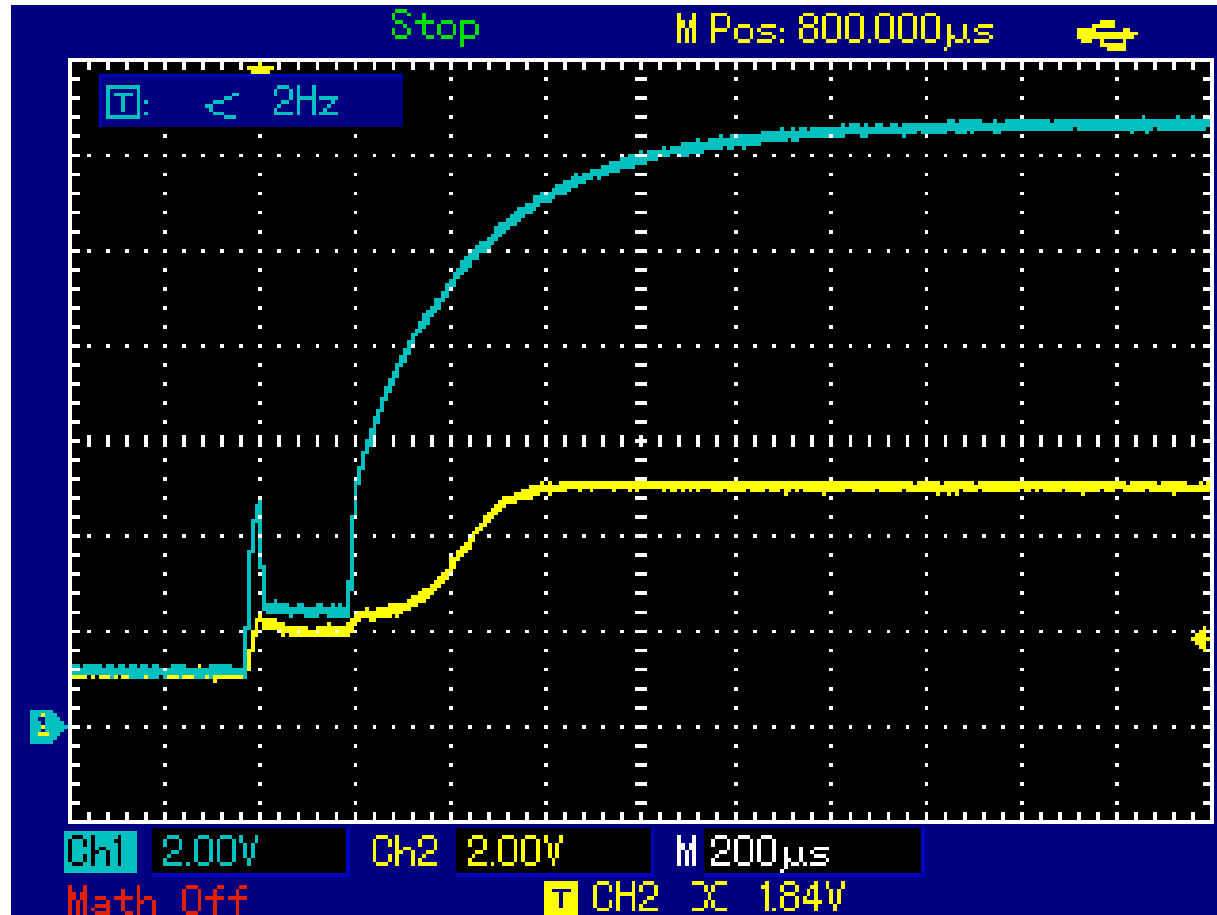
Observed effect

- After switch-on of the core power distribution module not all (motor/servo) modules are detected
- Observed using core device discovery program
- USB ports are enumerated, but core devices do not respond (PIC microcontroller locked up?)
- See block schematic of power distribution in next sheet for possible cause





12V and 5V measurement on core module



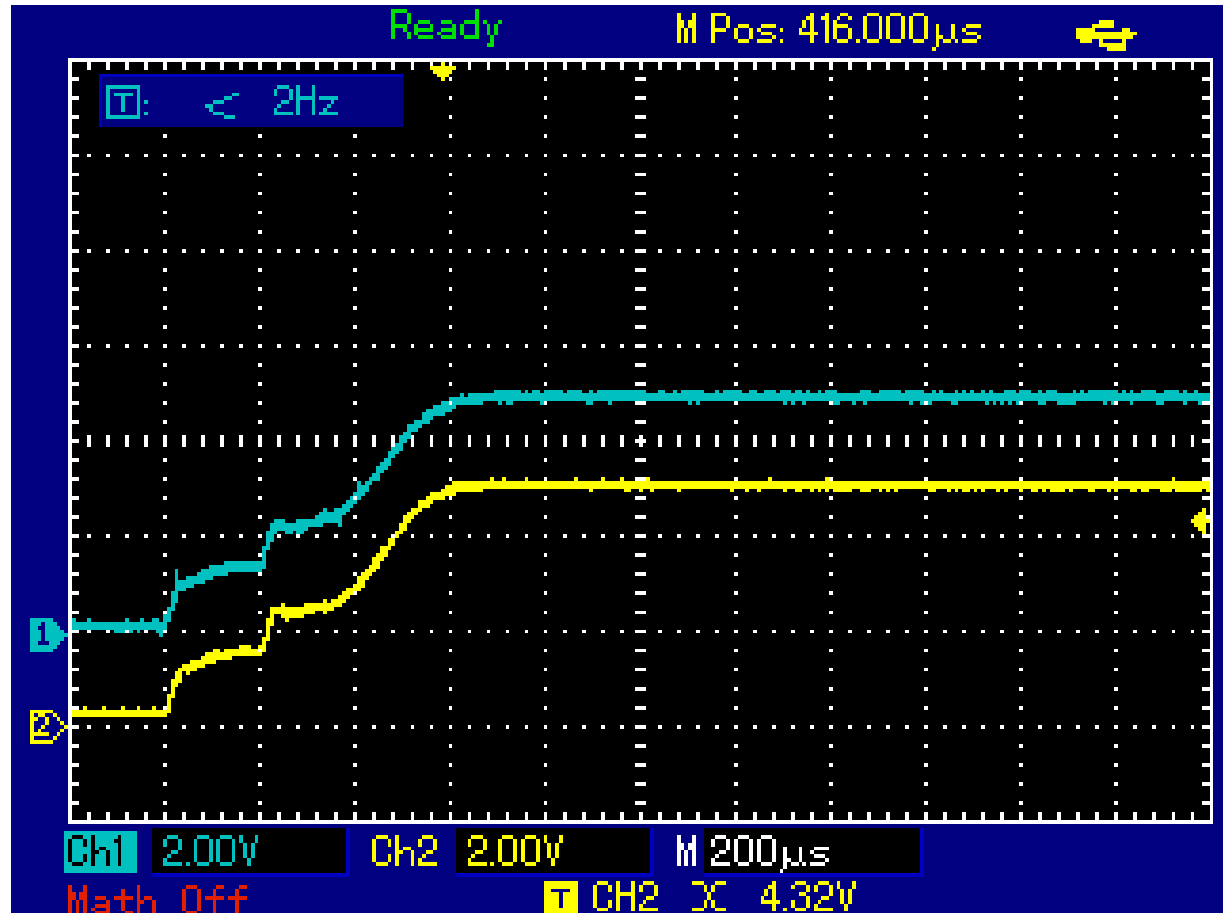
Slow rise of 12V with plateau

5V takes 600usec to stabilize

Initial voltage not zero
(due to remaining charge in capacitors)

Note: Takes > 20 seconds to fully drain
capacitors in this setup

5V and RESET voltage measurement on PIC



No delay in reset line!

Reset connected to 5V via $R=100\text{k}\Omega$

No capacitor

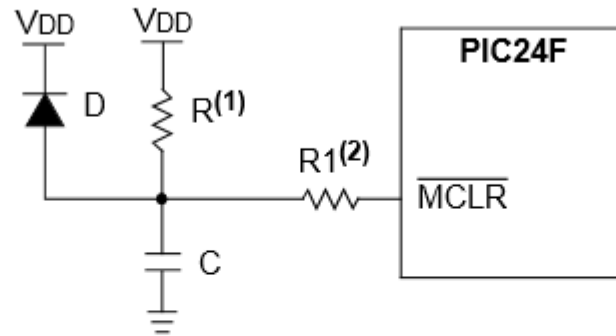
(datasheet suggests $500\ \Omega < R < 10\text{k}\Omega$)

Is the 64msec power up reset timer active?

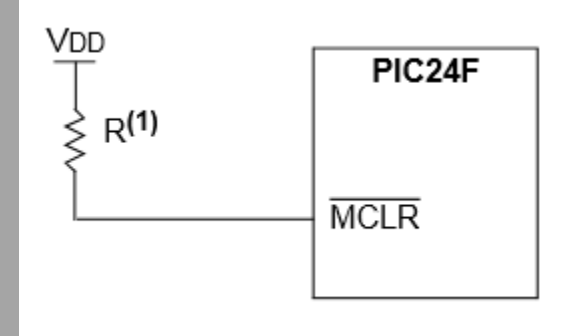
If not: can cause problems at reset!

Suggested PIC24 Reset circuit

Figure 40-3: External Power-on Reset Circuit (for Slow VDD Rise Time)



- Note 1:** The value of R should be low enough so that the voltage drop across it does not violate the V_{IH} specification of the \overline{MCLR} pin.
- Note 2:** R1 limits any current flowing into \overline{MCLR} from external capacitor C in the event of \overline{MCLR}/V_{PP} pin breakdown, due to Electrostatic Discharge (ESD) or Electrical Overstress (EOS).



Actual circuit used in Core Module
R=100kOhm

(docs suggest: R=500..10k)

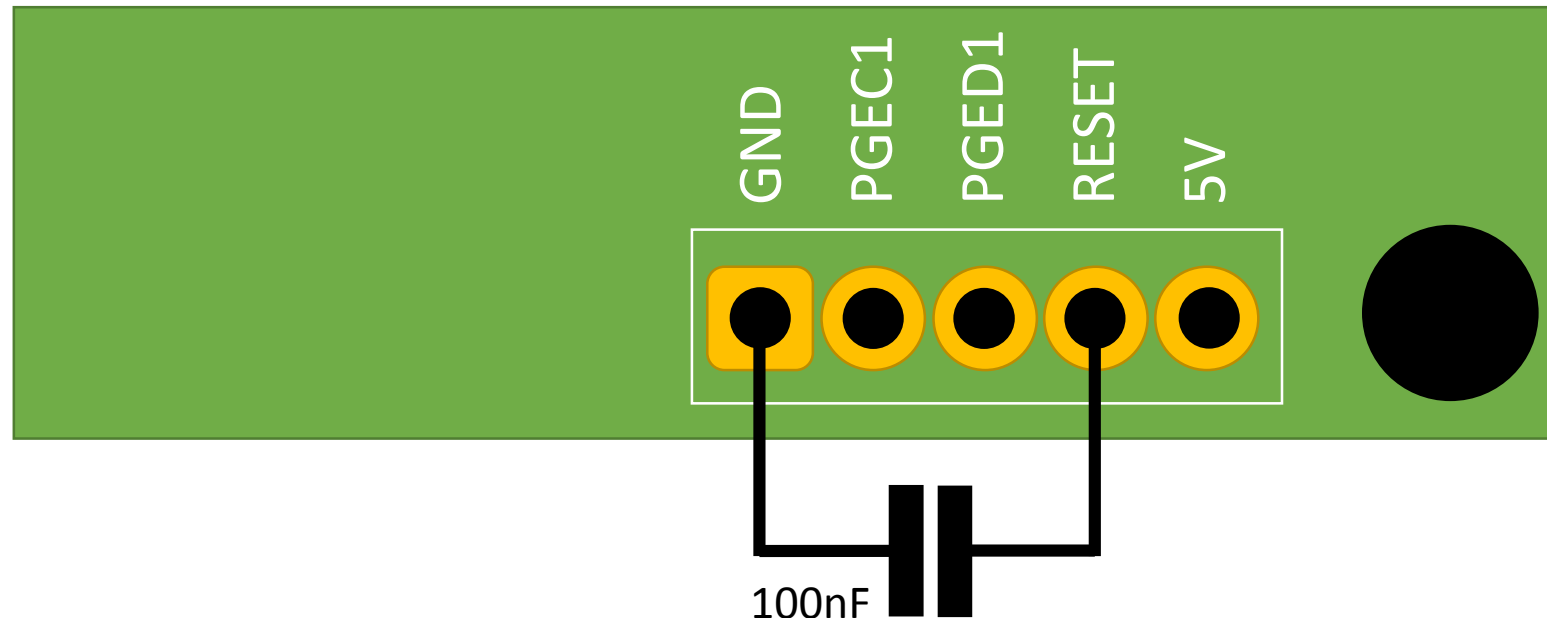
<http://ww1.microchip.com/downloads/en/DeviceDoc/39728a.pdf>

<http://ww1.microchip.com/downloads/en/DeviceDoc/reset.pdf>

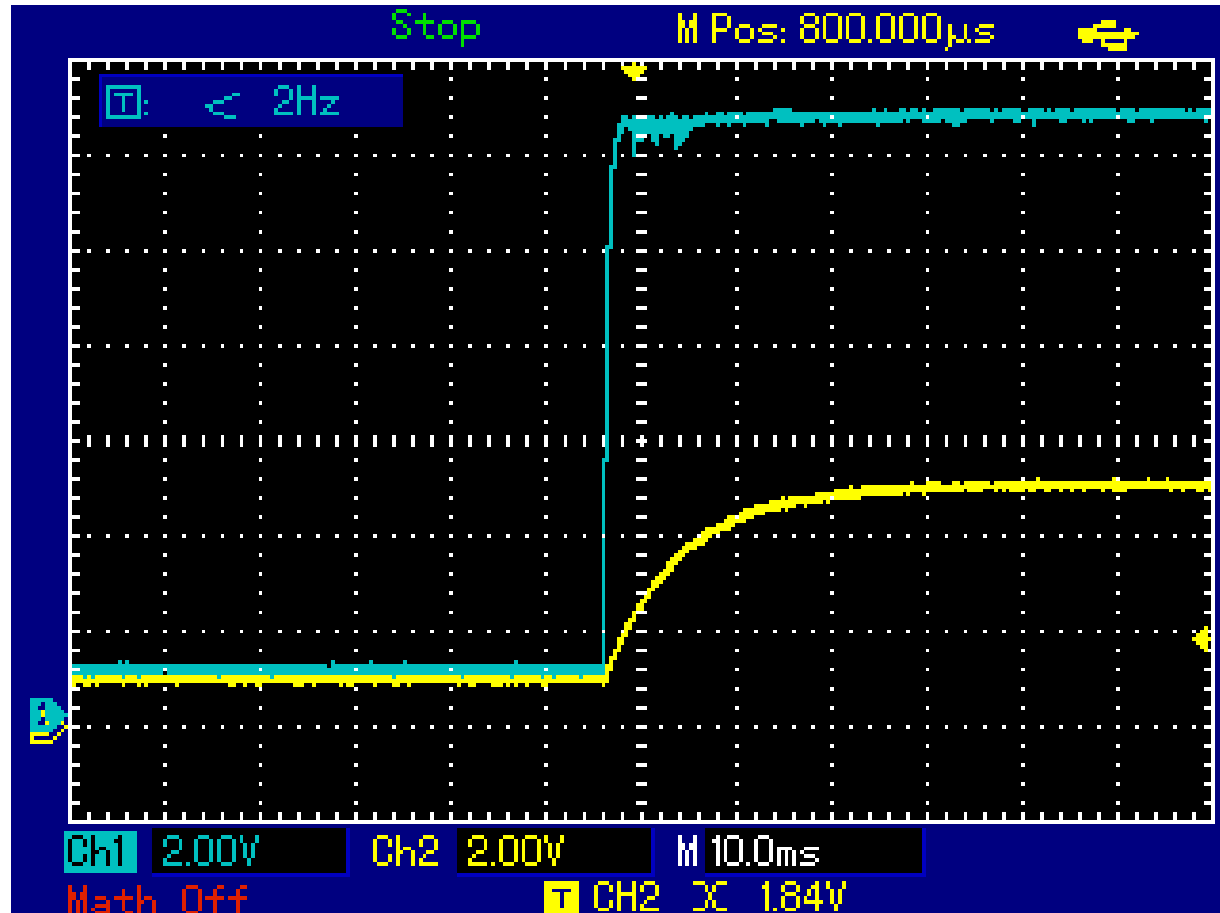
<http://ww1.microchip.com/downloads/en/DeviceDoc/39927c.pdf>

Program/Debug connector

- Located on Code module PCB
- Add 100nF Capacitor to delay rise of reset signal
- Note: may also prevent possible CM reset due to static



12V and RESET voltage measurement on PIC



Delay in reset line ~ 30msec

Switch on-detection problems solved
for the patched modules