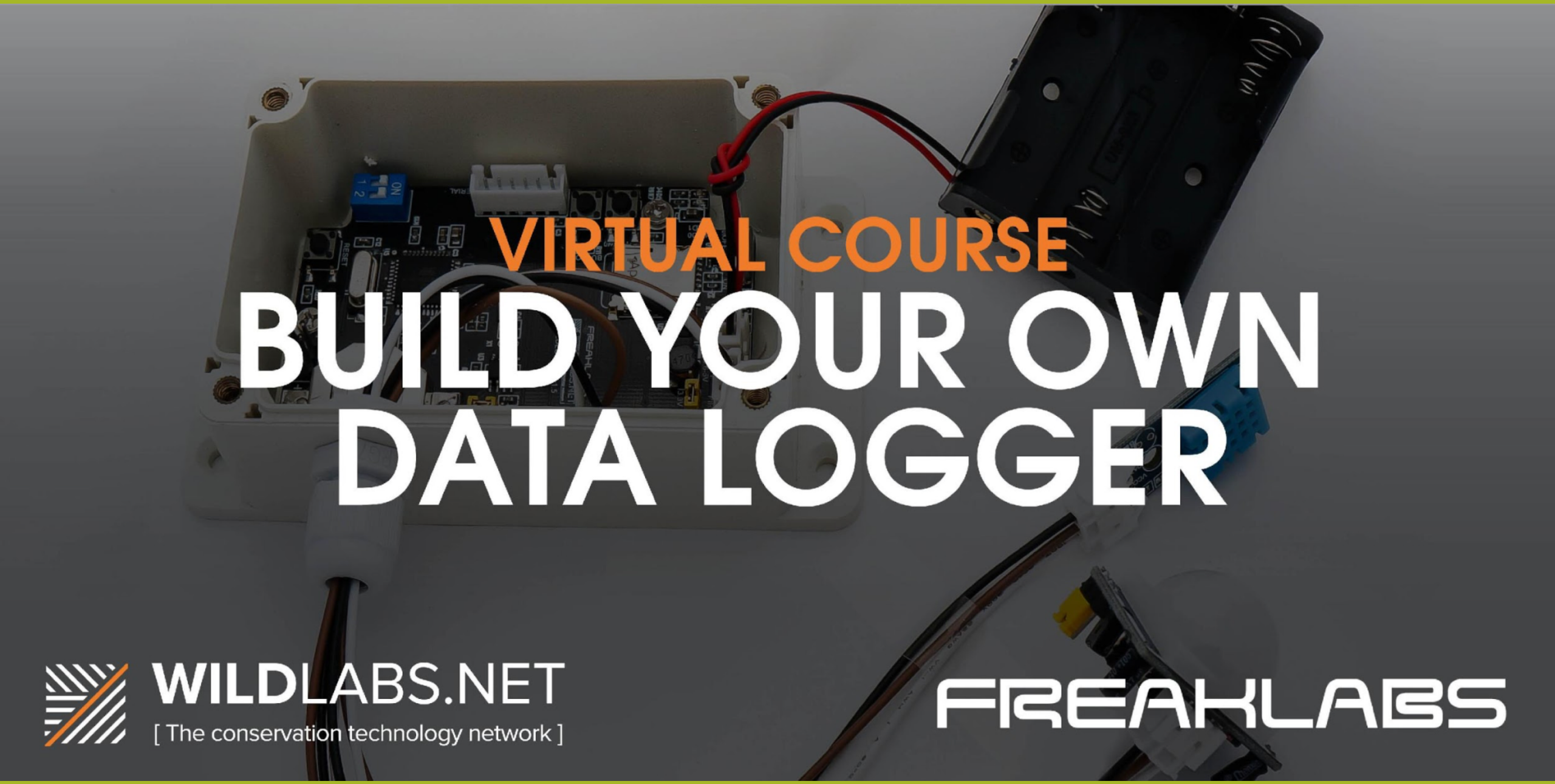
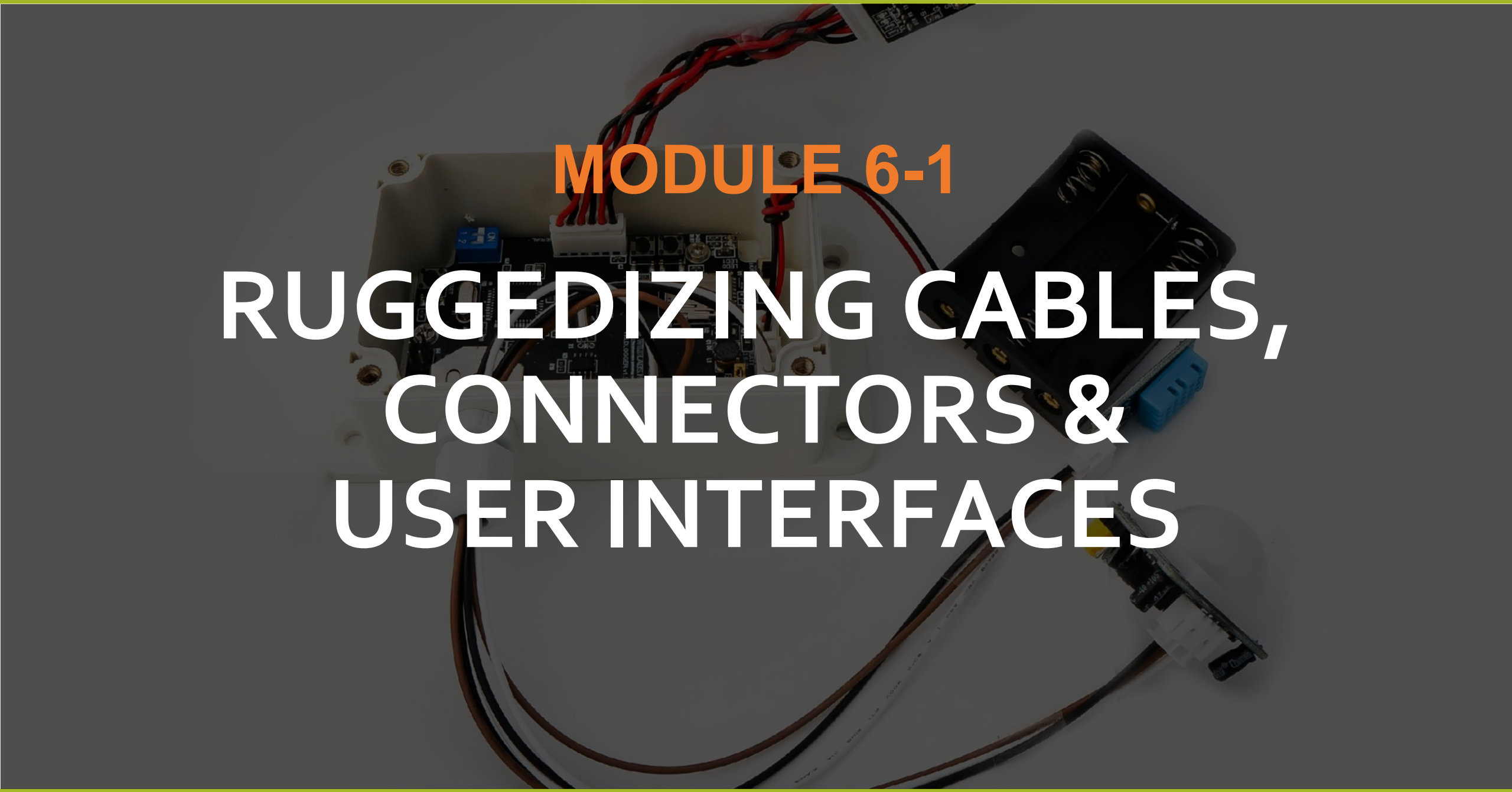

VIRTUAL COURSE
BUILD YOUR OWN
DATA LOGGER
WILDLABS.NET
[The conservation technology network]
FREAKLABS



MODULE 6-1

RUGGEDIZING CABLES, CONNECTORS & USER INTERFACES

We'll Cover

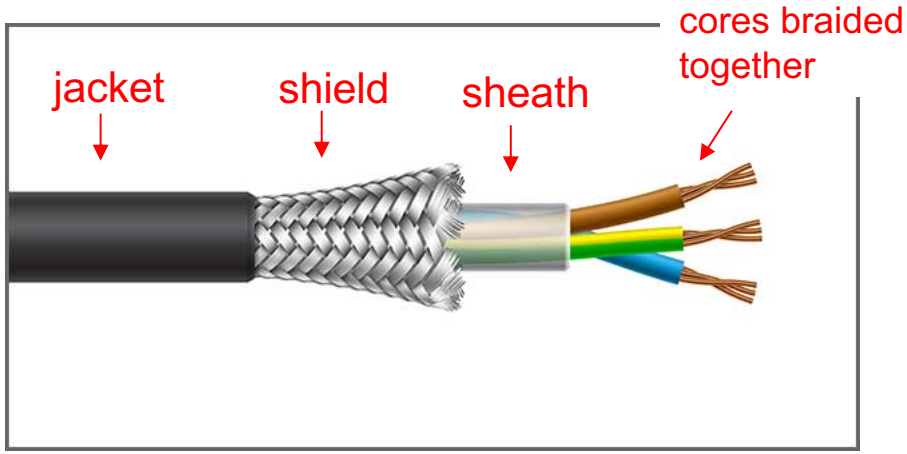
- Selecting the correct wires
  - wire gauge
  - binding
- Connecting peripherals
  - cable harnesses
  - cable glands
  - connectors inside the enclosure
  - connectors outside the enclosure
- Waterproofing user Interfaces
  - pushbuttons
  - LEDs

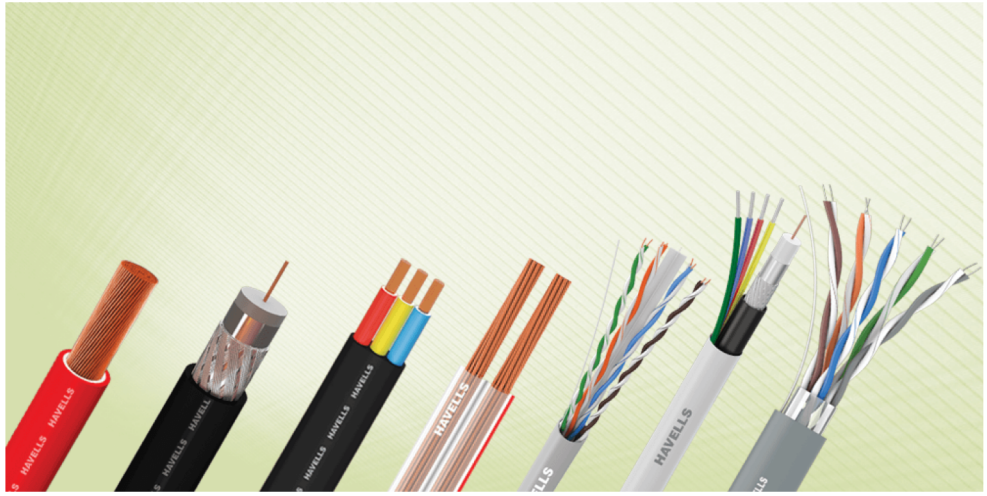
Cables

A collection of cores (wires), usually of the same gauge, bound together and enclosed in a protective sheath.

Different kinds for different applications eg:

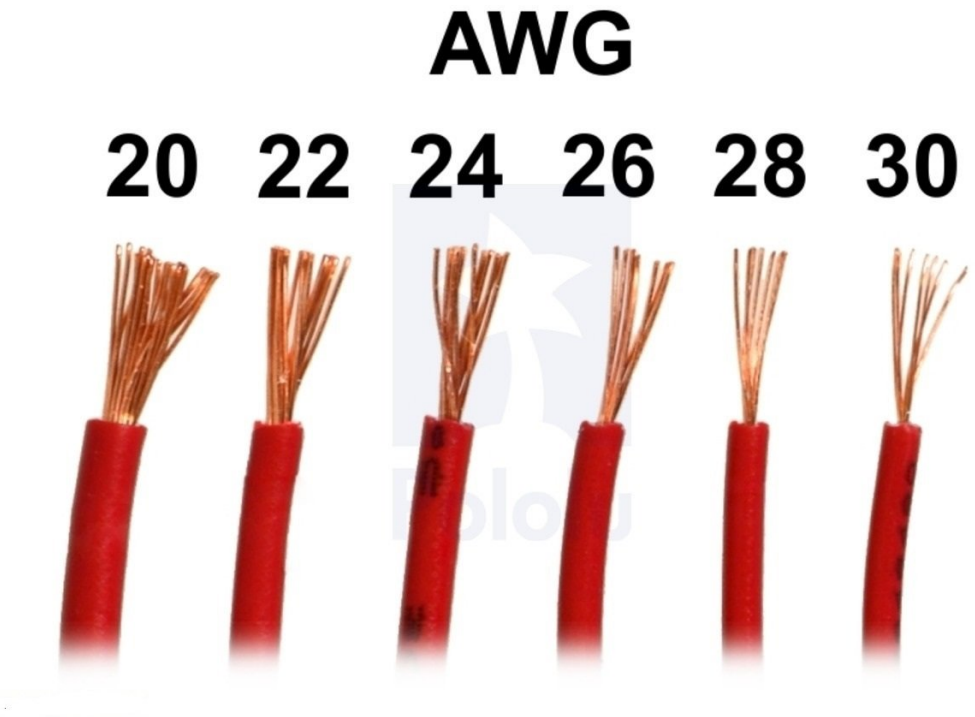
- power
- electrical cables for field devices
  - standard straight cables
  - shielded cables
  - twisted pair cables
  - coaxial cables





Wire Gauges

- wire gauge = measurement of wire's diameter / how thick a wire is
- a wire's diameter determines its current carrying capacity
- often measured in American Wire Gauge (AWG)
- smaller the AWG rating = thicker wire = more current capacity
- eg. AWG 20 = 1.4 Amps, AWG 30 = 0.14 Amps
- If the current passing through the wire is higher than the wire's current carrying capacity, the wire can heat and potentially cause a fire



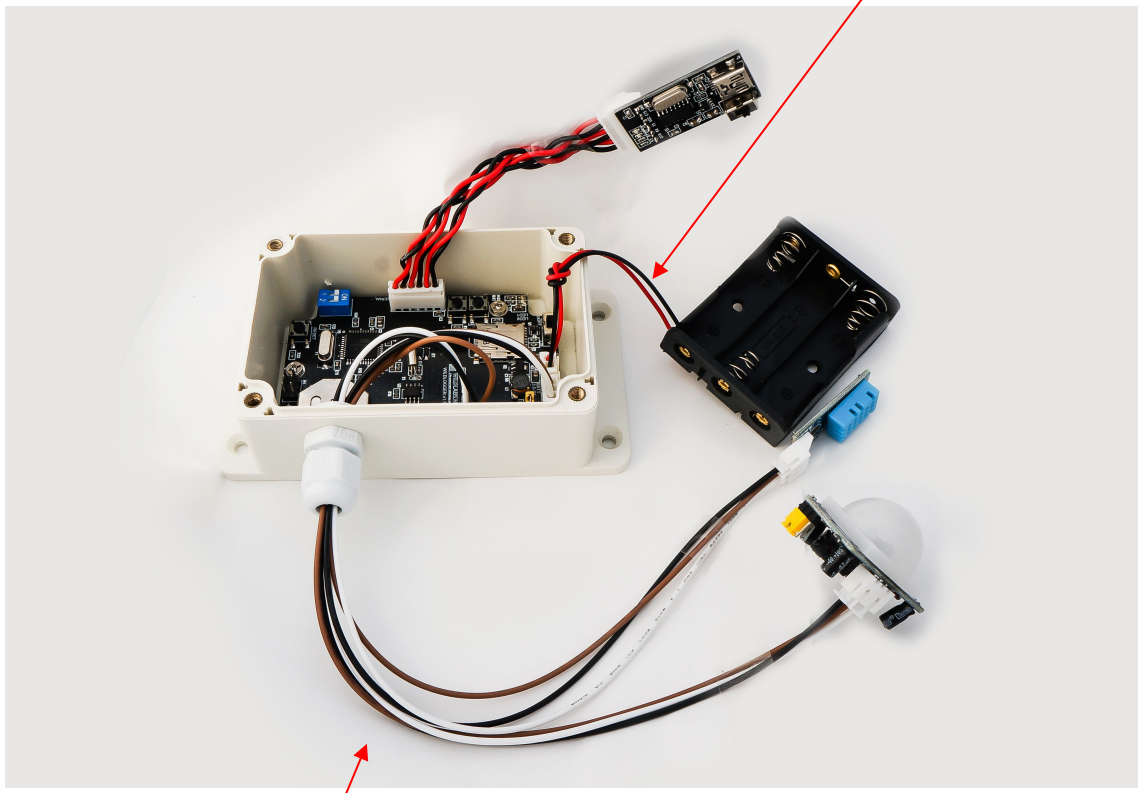
AWG Rating

Wire Size (AWG)	Diameter (MILs)	Area $(CM)^2$	Feet Per Pound Bare	Ohms Per 1000ft 25°C	Current Capacity (Amps)
4	204.3	41738.49	7.918	0.2485	59.626
8	128.5	16512.25	25.24	0.7925	18.696
10	101.9	10383.61	31.82	0.9987	14.834
12	80.8	6528.64	50.61	1.5880	9.327
14	64.1	4108.81	80.39	2.5240	5.870
18	40.3	1624.09	203.5	6.3860	2.320
20	32	1024.00	222.7	10.1280	1.463
22	25.3	640.09	516.3	16.2000	0.914
24	20.1	404.01	817.7	25.6700	0.577
28	12.6	158.76	2081	65.3100	0.227
32	8.0	64.00	5163	162.0000	0.091
40	3.1	9.61	34364	1079.0000	0.014

Wire Gauges on WildLogger

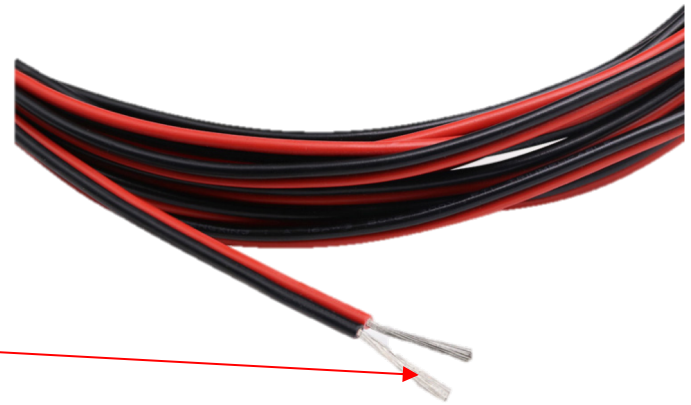
- WildLogger
  - 26 AWG wire on the batteries (400 mA)
  - 28 AWG wire on the sensors (250 mA)
- AWG Rating Current Capacity Ref (rough):
  - 28 AWG ~ 250 mA
  - 26 AWG ~ 400 mA
  - 24 AwG ~ 600 mA
  - 22 AWG ~ 1000 mA

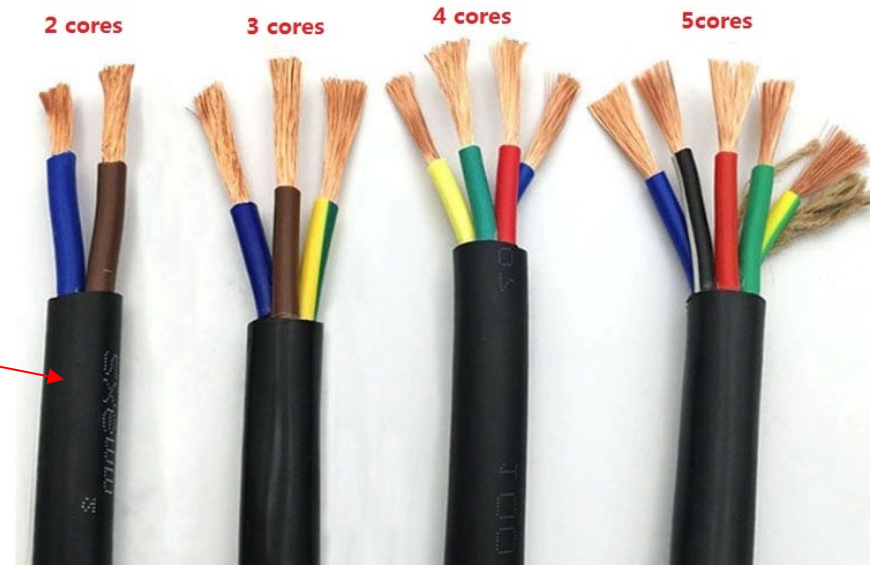
Signal (or control) cables are low current & used to carry electrical signals. Power cables are high current & used for power transmission. These cables are not interchangeable.



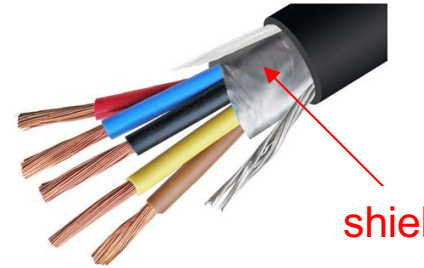
Sheathed Cables

- Discrete (single) PVC insulated wires
  - Usually used internally
- Sheathed cables
  - Multi-core (eg: multi-wire)
    - 2 core
    - 3 cores
    - 4 core
  - Common types
    - RVV – standard sheathed cable
    - RVVP – RVV with conductive shield
  - Usually used with external cable connectors to connect peripherals to a device





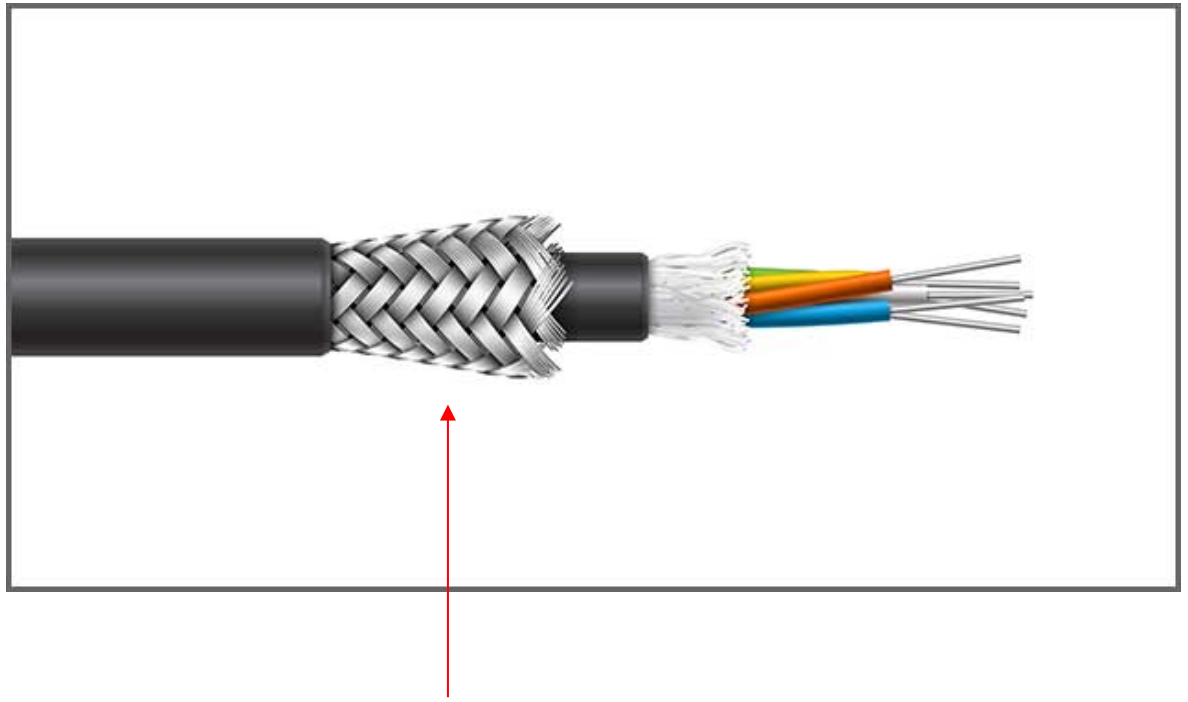
sheath



Shielded Cables

Shielded cables

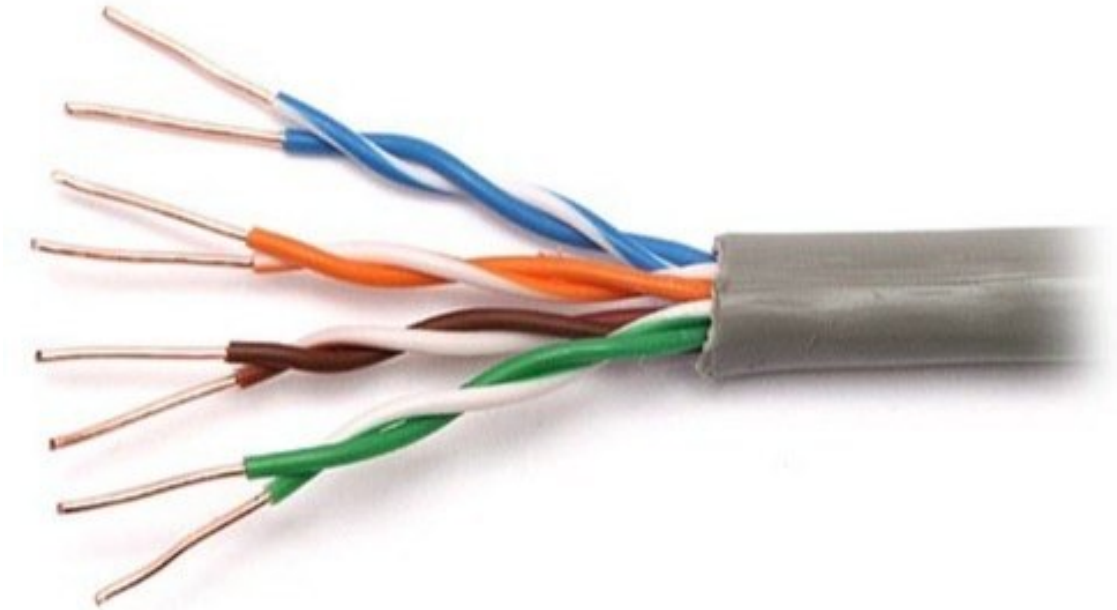
- have an additional conductive jacket called a shield
- shield is grounded to the device it's connected to
- protects sensitive cables from picking up noise signals
- eg used in high end microphones



Twisted Pairs Cables

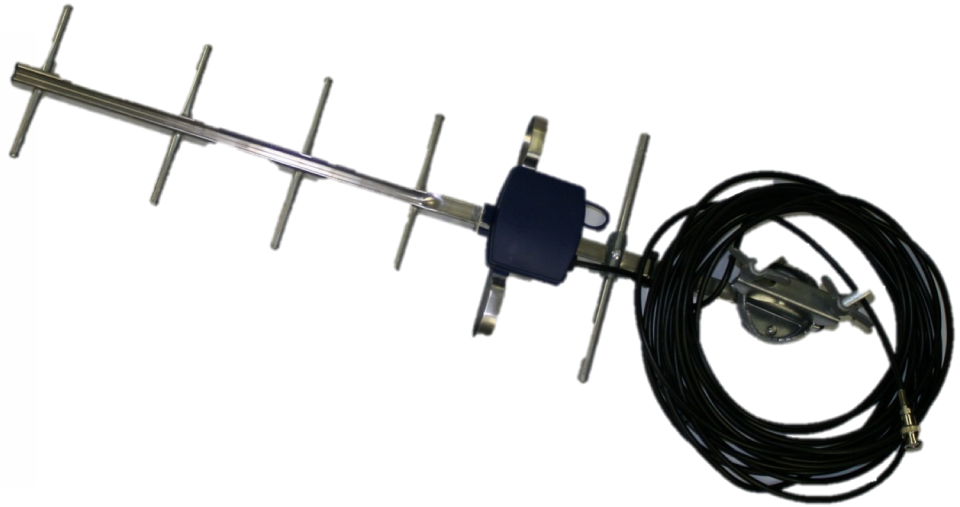
Twisted Pairs

- suppresses noise by twisting wires differentially so noise from wires cancel each other out
- prevents wires from causing signal interference to other devices
- carries fast signals
- used in high speed Ethernet cables



Coaxial Cables

- Coaxial
  - used for antennas
  - single wire with shield
  - cable resistance must match resistance of wireless system it's being used with
  - resistance is usually 50 ohms

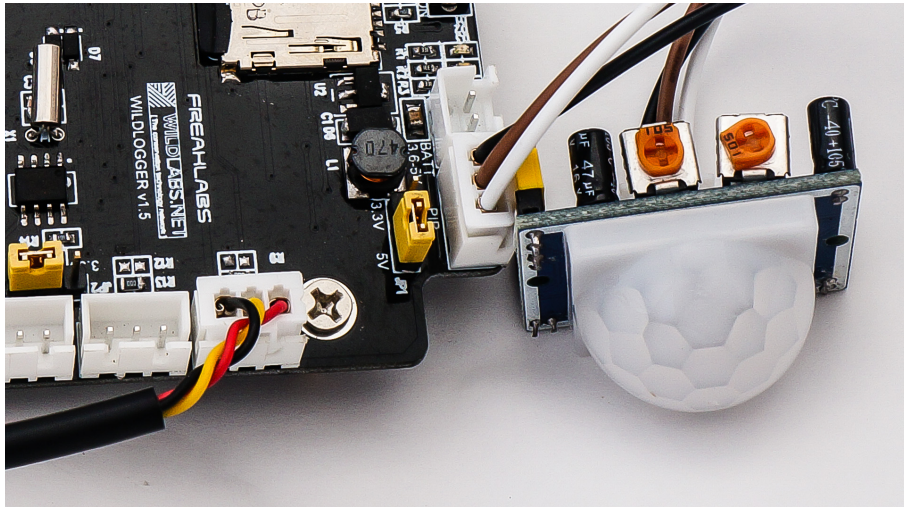


Cable Harnesses

- Easily connect and disconnect a group of cables (eg discrete cables)

Advantages

- easier, quicker to assemble & disassemble devices
- ensures correct polarity. Can't insert (connect) wires backwards
- locks in place. Cable can't be pulled out, or fall out of place

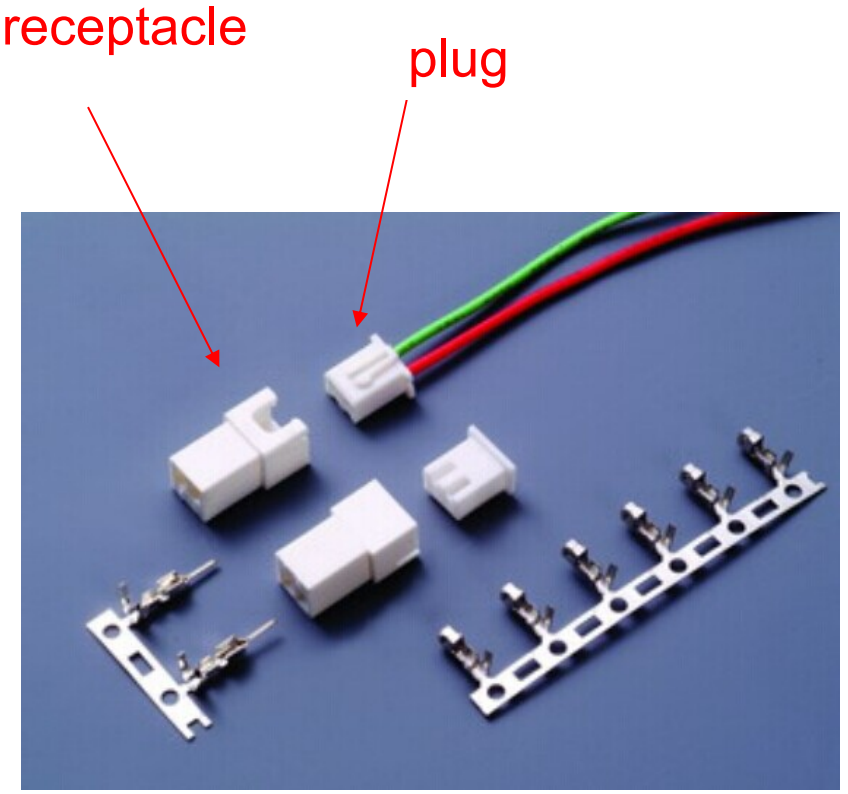


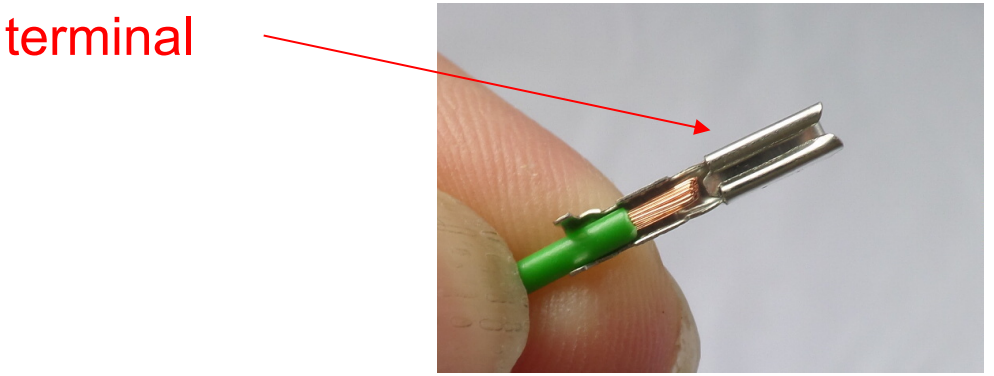
Cable Harnesses

In a cable harness, the plug (usually wire end) and receptacle (usually board end) join to make electrical contact

The plug and receptacle are made up of:

- wire (plug only)
- Terminal (electrical contact)
- Housing





Cable Harnesses

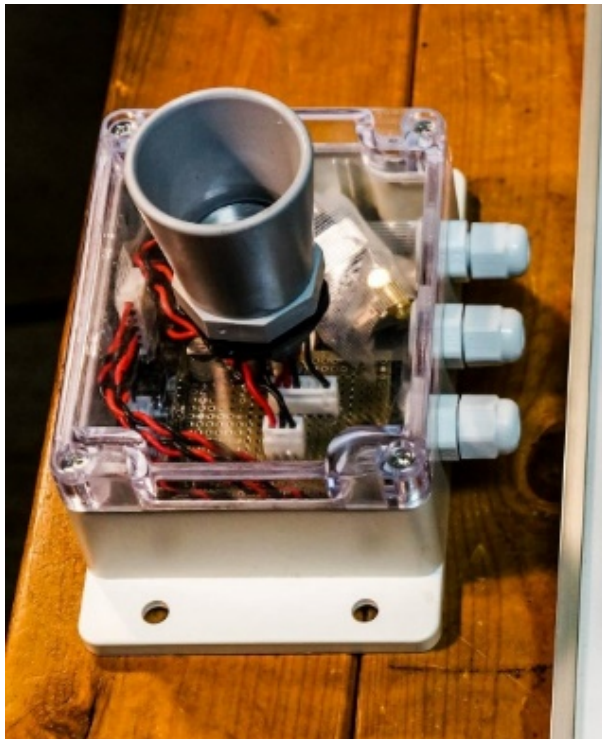
Types of cable harness connectors:

- board to cable
  - connects sensors, speakers, battery packs directly to board
  - JST XH – 2.54mm (0.100") pitch or spacing between electrical contacts
  - JST PH – 2.0 mm pitch
- cable to cable
  - connects one cable to another
  - usually to connect peripheral without opening the enclosure or extend a cable
  - JST SM 2.54mm (0.100") pitch

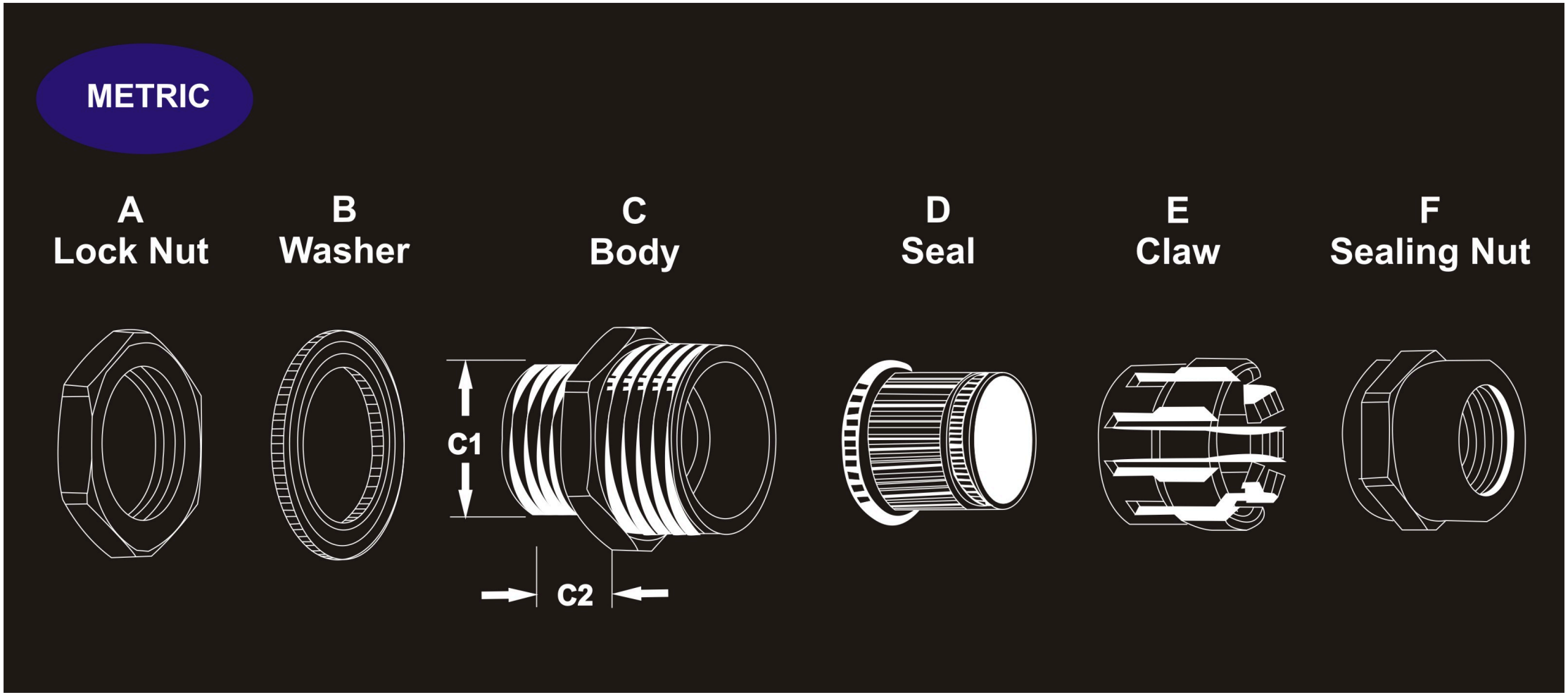
Cable Glands

Cable glands allow cables out of the enclosure through a watertight seal

- Rated IP68
- Cable gland size needs to be as close to cable size as possible
- Need to correctly fit cable glands when assembling



Cable Glands Breakdown



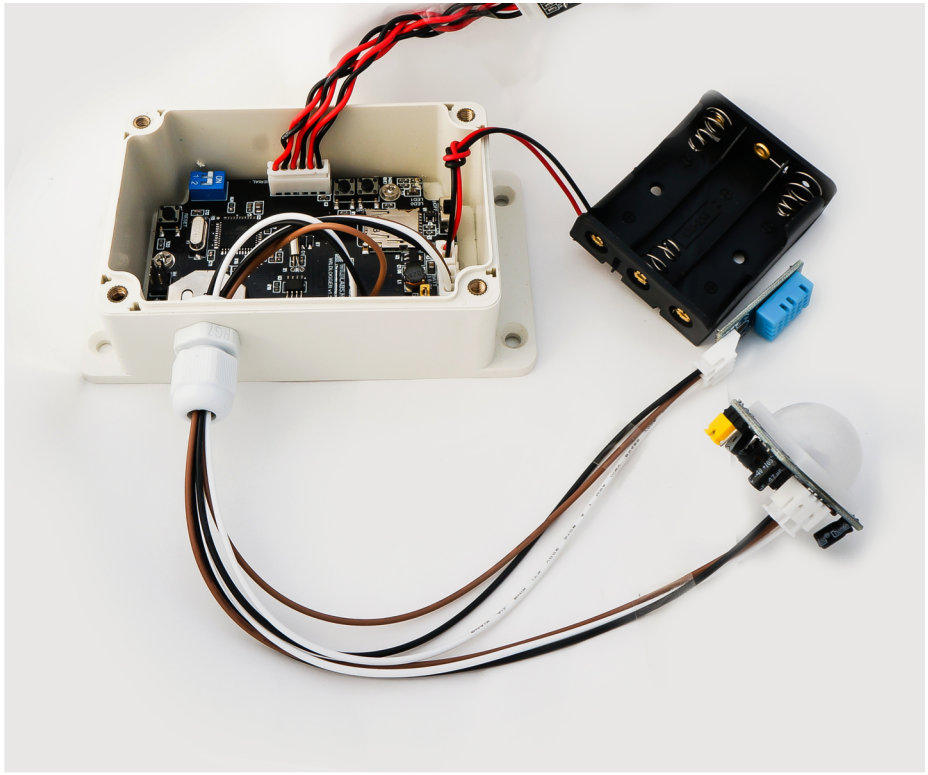
Cable Glands

Advantages

- affordable
- easy way to maintain enclosure ingress protection when device has cables

Disadvantages

- semi permanent
- not easy to remove the cable from the cable gland (have to disassemble cable harness)

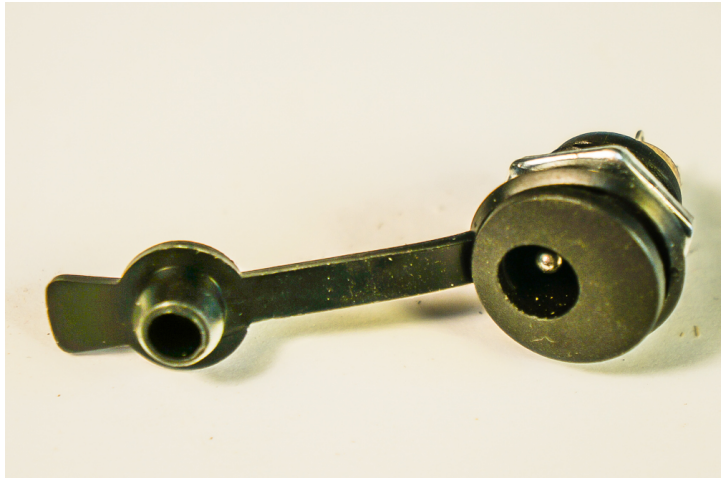


External Cable Connectors

- Can easily attach and detach peripherals without opening up enclosure
- More $$ than cable glands

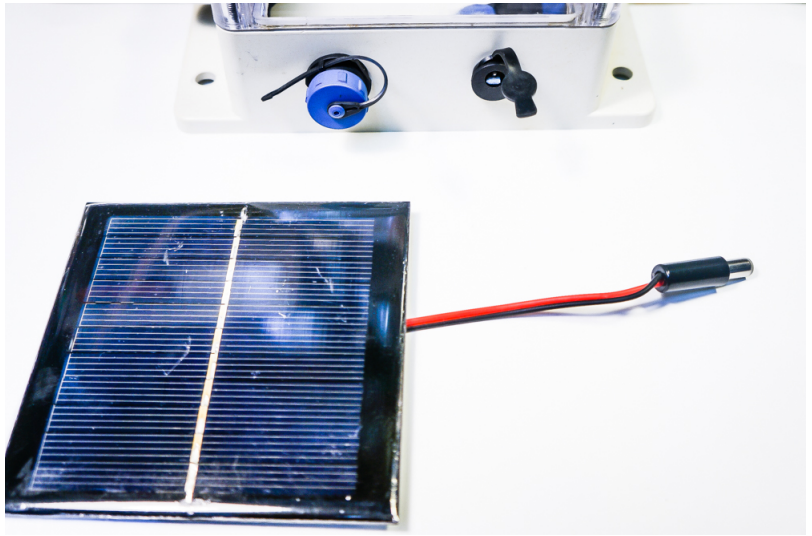
Types of external connectors

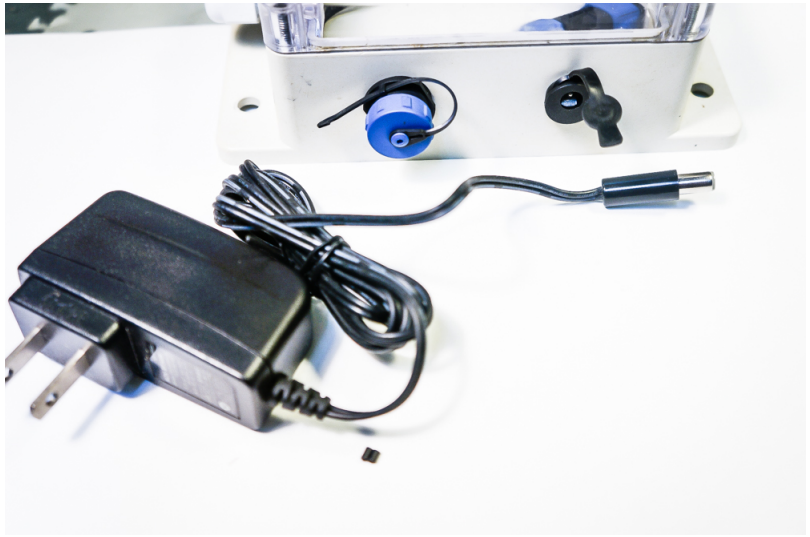
- Barrel Jack connectors
- Aviation connectors
- SP series connectors
- M connectors

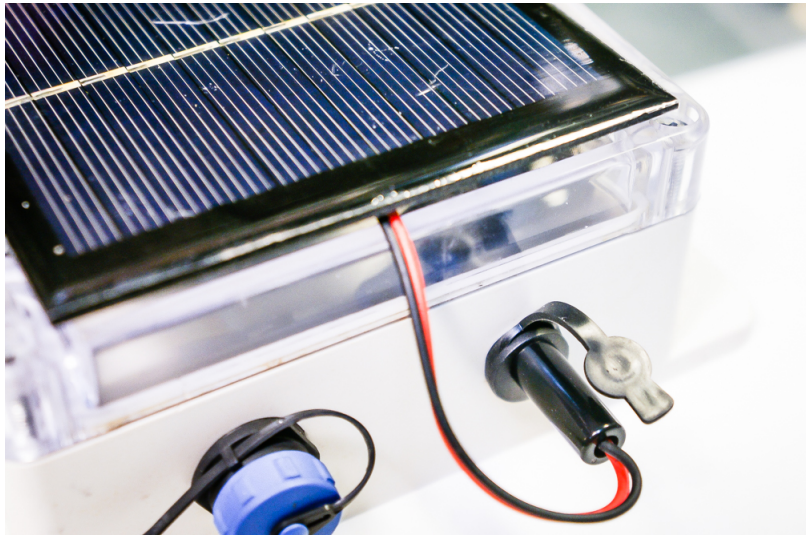


Panel Mount Barrel Jack Connectors

- commonly used for power inputs
- off-the-shelf will fit standard 2.1mm barrel jack plug (typical size found on AC adapters)
- 2 wires: power and ground
- typically handle up to 5A current
- good for solar or external battery input
- has cover to plug receptacle but **NOT waterproof**
  - seal gaps if exposed in the field
  - can use electrical tape, silicone sealant, rubber cement

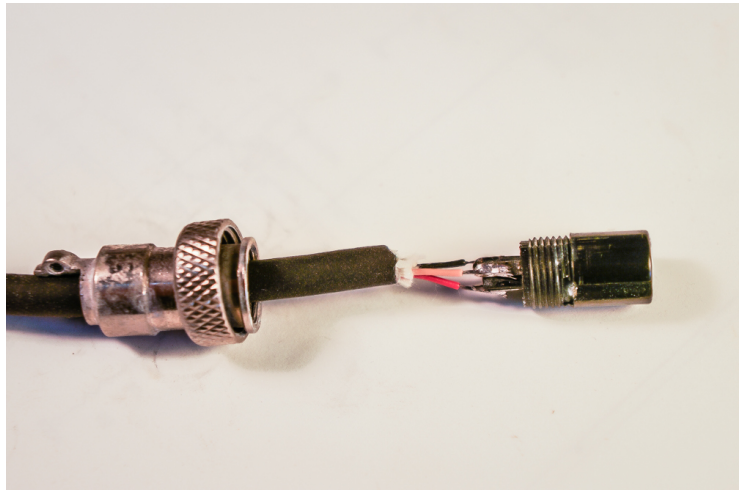


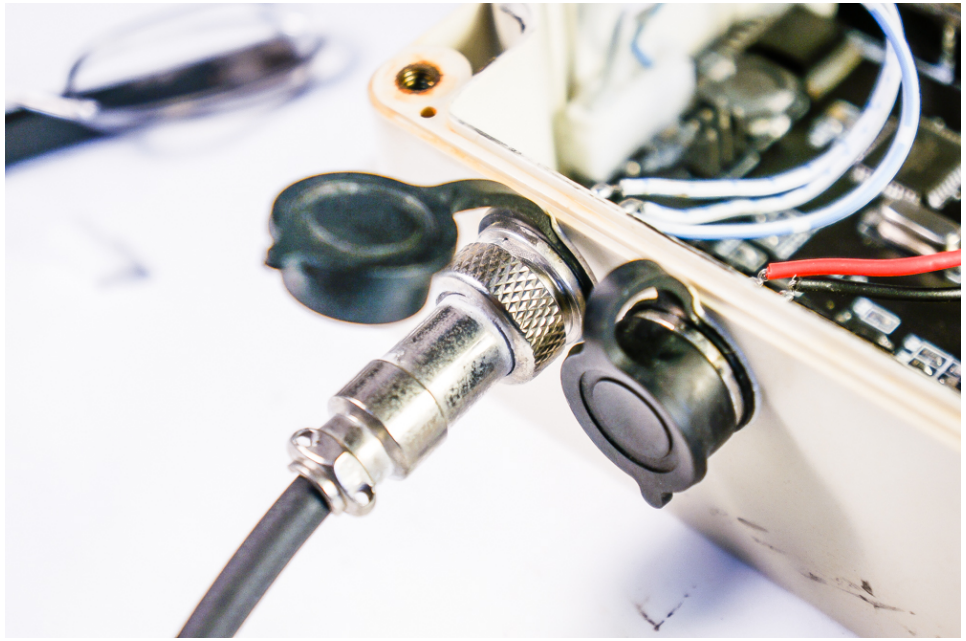


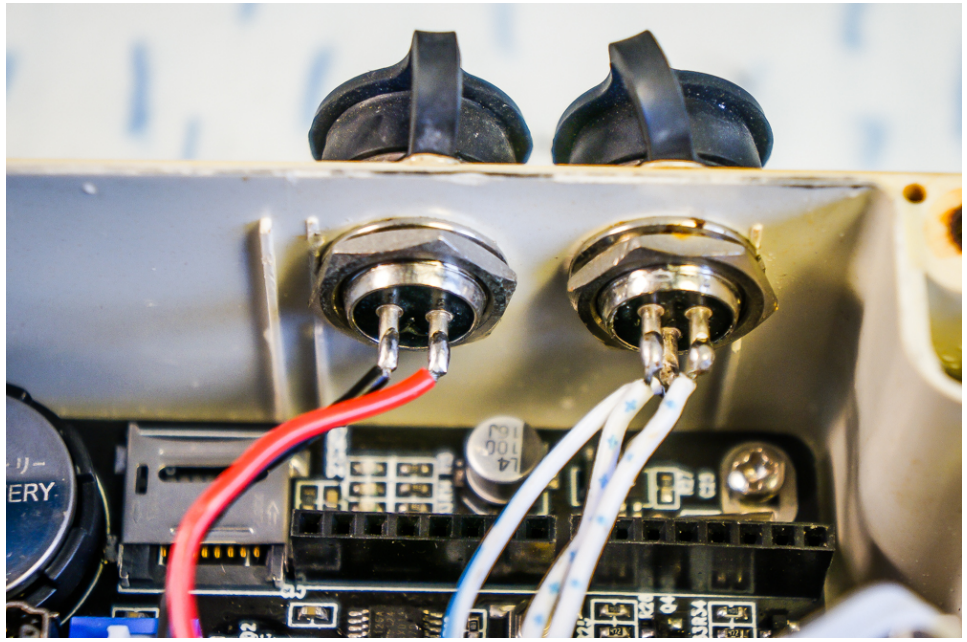


Aviation GX Connectors

- threaded connectors
- screw-on, screw-off
- good to prevent cables being pulled out
- low cost
- connector receptacles can be covered however **NOT waterproof**
  - need to seal gaps if exposed in the field
  - can use electrical tape, heat shrink tubing

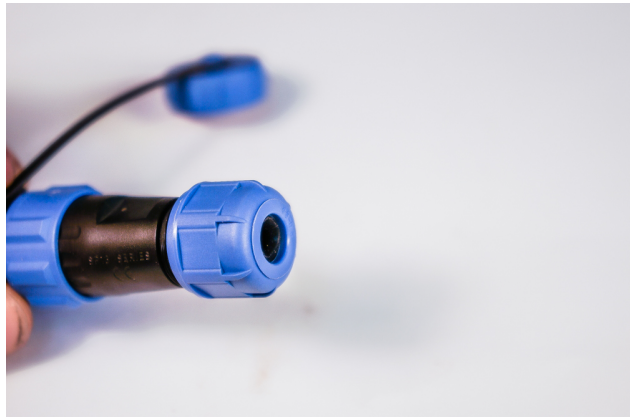






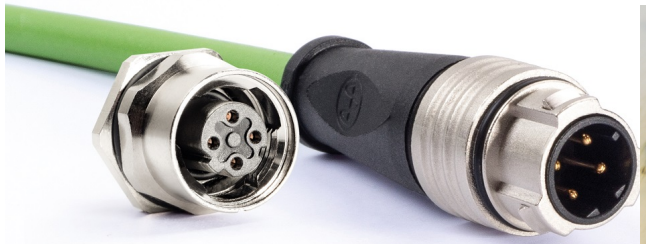
SP Connectors

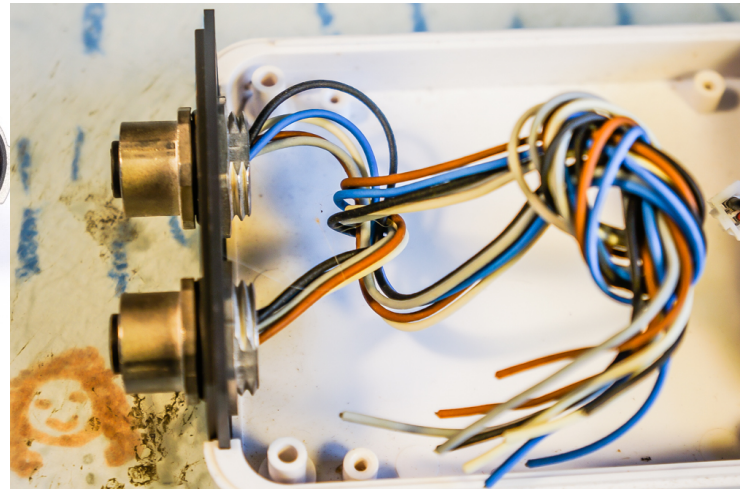
- rugged, heavy duty
- rated IP68 (waterproof, dust proof)
- different sizes: SP11, SP13, SP17, SP21
  - number = diameter of mounting hole
  - larger diameter = more pins
- covered receptacles
- screw on/off with waterproof gasket
- compression seal, gasketed cable interface
- good protection against animals yanking cables out of device



M Connectors

- originally designed for factories
- metallic housing
- different sizes: M8, M12, M16
    - size of mounting hole (mm)
    - size relates to how thick cable can be
- threaded connectors
- IP65 waterproof, dust proof, $$
- good protection for extreme environments
- ok to be dropped, knocked
- good protection against cables being pulled out





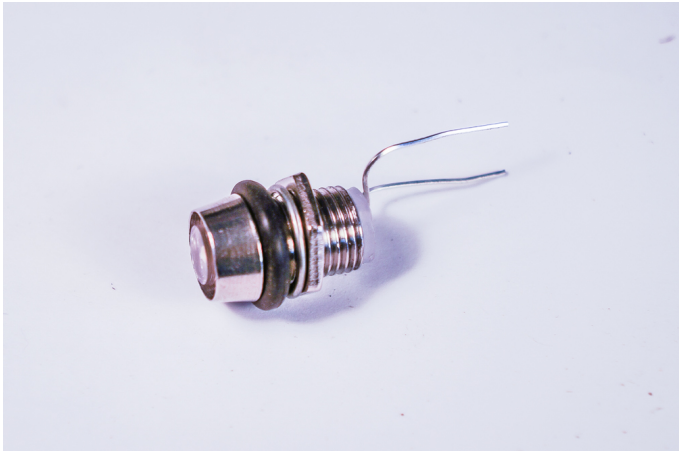
User Interfaces – Waterproof Buttons

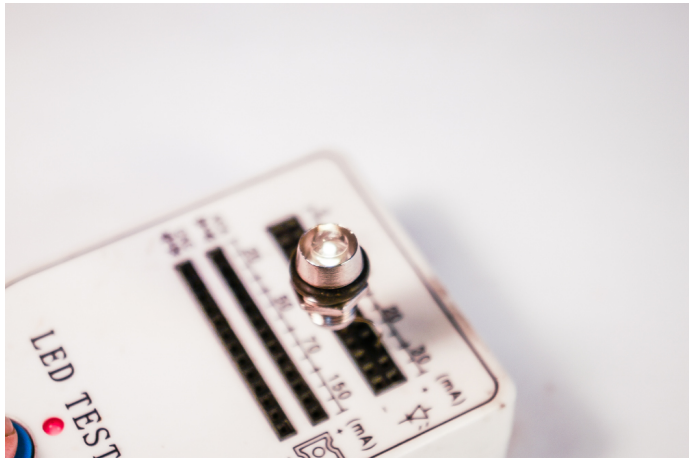
- Has gaskets on mounting screw and inside button
- Useful if buttons (ie. test or reset buttons) are outside the enclosure and need to be protect

User Interface – Waterproof LED Sockets

For external LED indicators

- LED sits inside a socket
- two socket sizes
  - For 3mm LEDs
  - For 5mm LEDs
- gasket on mounting screw threads however **NOT fully waterproof**
  - need to seal area around LED
  - Can use rubber cement, or any liquid sealant





COMING UP

Module 6-2:
Assembling the WildLogger