UPAMD™/P1823™ Potential Goals Updated 7/10/10

Reflector input Update/Bob Davis

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UPAMD™ Goals

- General Goals
- Connector Goals
  - Connector Options
- Communications Goals
  - Communications Options
- Power Goals
  - Power Options

UPAMD™ General Goals

- Life expectancy of 10 years, hopefully more
- Same connector for All device and adapter connections
- Power range >10W – 130W delivered power to device and is brand, model, and year agnostic
- First adapter must work with last device and last adapter with first device. Standard Compatibility.
    - Adapter<->Mobile Device communications required for higher power safety.
    - Continuous communications growth to support growth of UPAMD capability.
- Must support regular non-battery and battery powered devices
    - Basic power delivery mechanism
    - Make independent of rapidly changing technology
    - Multiple battery technologies currently used – no common adapter or battery voltage
    - Consider isolation to meet medical power needs
- Standard designed to support Certification testing of adapter and device
- Consider future mobile device design options
    - Smaller profiles, headed for 10mm to 5mm? Different shape devices, non-edge usage
- No DANGEROUS power without communications.
- Device may be a source or sink of power
    - To supply power other devices beyond the USB power range of <10W.
    - Able to share power for mission critical or business critical applications
- Connector must not mate with any current designs – product Safety issue – no confusion
- Apply KISS principle – Keep It Simple Stupid within the other goals.
- Environmentally friendly to eventual disposal

UPAMD™ Connector Goals

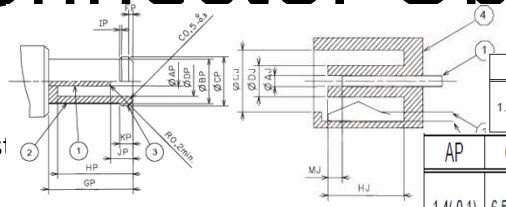
- Capable of >10W to 130W No conflict with USB based 5V power delivery systems
  - Contacts rated for currents to 9A?. Voltage Rated SELV?.
- Not compatible with any existing connector design
  - Equipment safety - Prevent damage – new starting point
- Easy disconnect AND cable retention capability in same common connector design
  - Easy disconnect to prevent tripping in office/home environment – health and safety issue
  - Strong retention capability for rugged high acceleration environments - car/boat/airplane/mission-critical
- Floating electrical connection, electrically isolated – Safety
  - No shock hazard under any conditions - meet medical isolation requirements
- Very high connect – disconnect life cycle capability – Many year usage
- Support lower profile devices
  - 10mm or less? iPad=13.4mm (to start with) 5mm or less goal
  - other shapes and possibly flat surface connect
- Watertight or Water resistant
  - To keep coffee, tea, rain, adult beverages, out of the connection.
  - Seal on cable side of connection for easy replacement of cable or seal.
- Positive and Negative connection with communication AC coupled
  - Assume redundant contacts for reliability and current sharing?
- Aesthetically pleasing
- Retention mechanism - Magnetic or Mechanical
  - Magnetic possibly good choice, Apple Patent 7,311,526 Needs IEEE SA Patent policy LOA.
  - Several clip possibilities exist. New Ideas clearly welcome
- Blind mate friendly - it possible
  - think of mating adapters and device alignment by feel in the dark
  - Easy docking station or charging station operation

UPAMD™ Connector Goals (Continued)

- Separate Power Cable capability
  - Same connector on each end – adapter and device
  - Buy cable to meet length need
  - Reduce adapter cost – consumer buys UPAMD cable(s) to meet needs
  - Possible quick interface to join two cables
  - One adapter could support multiple cables/devices
    - Cut down total number of adapters for desk top use. Each socket on adapter independent.
- Support device to device power charging or power sharing
  - Support for mission-critical and business-critical applications
  - Borrow power needed to watch the end of the movie
  - Software only modification to protocol
  - Power sourcing optional for device
- User replaceable power cable
  - Most damage is to connectors and cables, replace as needed
  - Change cable to adjust length needs
  - Carry/borrow backup cable

UPAMD™ Connector Options

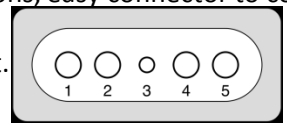
- Barrel Connector – TC100 proposal
  - Advantages
    - Exists, History, IEC 61076-2-102 spec, cost
  - Disadvantages
    - Big, No sources found, Safety trip hazard, connector damage history



AJ	CJ	HJ	DJ	MJ
1.45(+0.1)	7.0(+0.15)	8.0(-0.2)	4(-0.2)	1.5(+1.5,-1.0)

AP	CP	FP	KP	JP	HP	GP	BP	DP	IP
1.4(-0.1)	6.5(+0.1)	0.5(-0.3)	1.5(+-0.1)	2.5(+-0.1)	8.5	9.5(+-0.3)	6.0(+0.1)	4.3(+0.2)	0.25(+-0.1)

- Spring Loaded Contact Style – Cable side
  - Advantages
    - Small Footprint, flat device contact surface, good usage models, low cost to device, possible Flush mount on device, aesthetically pleasing, contact life >1,000,000 operations, easy connector to connector adapter for extension cable.
    - Can be symmetrical on cable and device/adapter
    - 42mil dia pin = 2Amp cont. 50mil dia pin = 9Amp cont.
  - Disadvantages
    - Latching/retention mechanism, required to overcome spring pressure 300-500+ grams



Device has flat contact – cable "Pogo" style spring-loaded pin
Pin 1 and 5 Negative connection
Pin 2 and 4 Positive connection
Pin 3 charge control – shorter pin = last make
Communication AC coupled to positive and negative wires

- Edge Connector
  - Advantage
    - Direct extension of pc board, low cost edge connector
  - Disadvantages
    - Direct access to pcb, moisture seal, contact life
- Multi-pin Connector
  - Advantages
    - Separate power from control on different wires
  - Disadvantages
    - Cost, single orientation, connector life cycle count
- Magnetic Induction coupling
  - Advantages
    - No contact coupling, no penetration of casing, cleanest design.
  - Disadvantages
    - Size of coil, position for good coupling. Field effect on surrounding parts at 130W, power transfer efficiency, modulation for communications. Interference with other radio traffic from device.

UPAMD™ Communication Goals

- Use existing standards if possible.
  - CAN bus, RS422/RS485, USB, others?
- Differential signal communications
  - AC coupled on positive and negative power leads
  - Robust system – EMI, EMC, ESD
- Other communications schema?
- Possible symmetrical operation
  - Allow device to source other devices
  - Allow power sharing to keep critical devices working in emergencies -- adaptive UPS
  - Software controlled
- No communications = how much power?
  - Device startup for regular non-battery powered devices
    - Provide nominal 12-14V at <0.5A until communications established
  - Device startup for low battery
    - Must assume device protects itself at low end of battery to retain restart capability.
    - Restarting safety circuits is very battery and safety circuit specific. Battery failures require new battery/external charge
  - No shock hazard, power source protects self
- Communications messages needed (starting thoughts -- extend for symmetrical operation)
    - "Any adapter present?" (probably connector pin)
    - "Who are you?": To adapter or other device/source
    - "I am ___and my capability is ___ max available power is ___ watt/hours": to device/load
    - "Supply power XX Volts YY mA max": to adapter/source
    - " Ready" or "not capable" : to device/load
    - " Start power": to adapter/source
    - "Status?": to adapter/source
    - "Status is ____" : to device/load
    - "STOP power supply": to adapter/source

UPAMD™ Communications Options

- Signaling
  - Extra wires with transformer/capacitive coupling for isolation – Ethernet /LVDS style
  - Differential signals AC coupled to positive and negative power leads
- Protocols
  - CAN Bus
    - Advantages
      - Known protocol, very flexible, designed for control structures
      - Most small embedded controllers have it built-in
      - High growth potential
      - Used in industrial and vehicular control systems – Noise issues well addressed
    - Disadvantages
      - Less well known
  - UART – RS422/RS485
    - Advantages
      - Low cost. Easy implementation, can support needed communications.
    - Disadvantages
      - Needs UART from host
      - Protocol development needed.
  - USB
    - Advantages
      - Ubiquitous, well known, many ports available.
    - Disadvantages
      - USB certification for modified protocols
      - Requires cooperation with USB-IF committee
      - Operation over differential power lines needs to be verified.
  - Ethernet – Ethernet over-power-line method (P1901)
    - Advantages
      - Proven to work, also can connect for other communications
    - Disadvantages
      - Needs additional Ethernet port
      - Most expensive.
  - I2C/SMB; SPI; 1-Wire – probably difficult to implement and noise sensitive
  - X-10 – not designed for DC – other pulse derived communications possible.

UPAMD™ Power Goals

- One connector meets all power needs
- Power Range >10W – 130W
- New Connector – Not inter-mateable with existing connectors – Safety issue for equipment and people
- Positive rail and Negative rail
- Floating connection, not grounded at adapter
  - Isolation (leakage) sufficient for medical applications?
- Device to Device to share power if needed
  - Possibly support powering one device from another
    - Higher power version of USB power option with smart control
    - Power sharing in mission and business critical situations.
- Smart interconnect.
  - Higher power enabled through communications between devices
- Regular non-battery and dead battery devices need starting power?
  - Supply 12-14V at <0.5A without communications for startup
  - Higher power requires communications and software control

UPAMD™ Power Options

- 10 year Life Expectancy
  - Think ahead – All devices will immediately transform input power into internally needed voltages based on technology used.
  - Consider both as a fixed power source and as battery charging source - basically power transfer
- Adjustable power Source
  - Adapter/source sets output voltage based on communications with device/load and its capabilities
  - Adapter/source sets maximum current limit based on communications with device/load and its capabilities
  - Good match for each user
  - May need starting voltage such as 12-14V @ <0.5A for starting
  - Specify range from 12V to 45V. Power limited by connector current capacity.
    - Use of 9A rated 0.050 spring loaded contacts with 2 per rail provides good margin to 130W above 15V.
    - Possible options 12-14V, 20V, 24V, 36V, 42V, 48V. Power precision +/- 10%?
    - Possible current limits: 1A, 3A, 5A, 10A. Or at specified mA rating 0-10000.
- Semi-regulated bulk power
  - Bulk power ie 24V +/- 10-15% (6+A) or 45V +/- 10-15% (3A) @ 130W
    - Power delivery vehicle with point of use regulation
    - Regulator efficiency works
    - Lower Cost
    - Smaller wire size needed
    - Longer power cable allowed.
    - Higher voltage more efficient transfer.
    - Higher voltage smaller contacts.
- Well regulated Fixed voltage
  - Tight regulation +/- 5% DC @ fixed voltage
    - consider cable losses and feedback loop – more expensive
    - Battery chemistry driven voltage
    - No common voltage used.
      - 12V, 13.75V, 15V, 18.5, 19V, 19.5V, 24V now with some up to 48V SELV limited
      - Battery chemistry – NiCad, NiMH, Li-ion, Li-PO other exotics. New technology will probably be different
      - All devices seem to have internal regulators.
    - Battery voltages – laptops
      - 11.1 ,10.8, 14.8, 9.6, 14.4, 12, ……

Backup Slides