

- dimensional inspection standards, 6.7 *Table 6-7*
  - Direction bit, 9.3.1, 9.3.4
  - direction of communication flow, 5.4
    - bmRequestType* field, 9.3.1
    - bulk transfers, 5.8.2
    - bus protocol overview, 4.4
    - control transfers, 5.5.2
    - interrupt transfers, 5.7.2
    - isochronous transfers, 5.6.2
  - disabled ports, 11.5, 11.5.1.4, 11.24.2.7.1, 11.24.2.7.2
  - Disabled state, 11.5, 11.5.1.4
  - disabling features, 9.4.1
  - discarding packets, 11.3.2
  - Disconnect\_Detect signal/event, 11.5.2, 11.5 *Table 11-5*
  - Disconnected state
    - connect and disconnect signaling, 7.1.7.3
    - detecting, 7.1, 7.1.4.2, 7.1.20
    - downstream ports, 11.5, 11.5.1.3
    - signaling levels and, 7.1.7.1, 7.1.7.2
  - disconnecting devices. *See* dynamic insertion and removal
  - disconnection envelope detectors, 7.1.7.3, 7.1 *Table 7-1*
  - disconnect timer, 11.5.2
  - distortion, minimizing in SOP, 7.1.7.4.1
  - DLL lock, 7.1
  - documents, applicable standards, 6.7.1
  - down counters in hub timing, 11.2.3.1
  - downstream facing ports and hubs
    - Disconnect state detection, 7.1
    - downstream connectivity defined, 11.1.2.1
    - downstream defined, 2.0 *glossary*
    - downstream facing port state machine, 11.5
    - downstream plugs, 6.2
    - downstream ports defined, 4.8.2.1
    - driver speed and, 7.1.2.3
    - enumeration handling, 11.12.6
    - high-speed driver characteristics and, 7.1.1.3
    - high-speed signaling and, 7.1.7.6.1, 7.1.7.6.2, 11.1.1
    - in hub architecture, 11.1.1
    - hub delay, 7.3.3 *Figure 7-52*
    - hub descriptors, 11.23.2.1
    - hub EOP delay and EOP skew, 7.3.3 *Figure 7-53*
    - input capacitance, 7.1.6.1
    - jitter, 7.3.2 *Table 7-10*
    - multiple Transaction Translators, 11.14.1.3
    - port state descriptions, 11.5.1 to 11.5.1.14
    - reset state machines, C.1
    - signaling delays, 7.1.14.1
    - signaling speeds, 7.1
    - status changes, 11.12.6
    - test mode support, 7.1.20
  - downstream facing ports and hubs (*continued*)
    - transceivers, 7.1, 7.1.7.1, 7.1.7.2
  - downstream facing transceivers, high-speed signaling and, 7, 7.1
  - downstream packets (HSD1), 8.5, 11.15
  - drain wires, 6.5.2, 6.6.1, 6.6.2
  - dribble, defined, 7.1.9.1
  - drift, 5.12.1, 5.12.3
  - driver characteristics
    - full-speed driver characteristics, 7.1.1.1
    - full-speed source electrical characteristics, 7.3.2 *Table 7-9*
    - high-speed driver characteristics, 7.1.1.3
    - high-speed source electrical characteristics, 7.3.2 *Table 7-8*
    - low-speed driver characteristics, 7.1.1.2, 7.1 *Table 7-1*
    - low-speed source electrical characteristics, 7.3.2 *Table 7-10*
    - overview, 7.1.1
  - drivers
    - defined, 2.0 *glossary*
    - role in configuration, 10.3.1
    - in source-to-sink connectivity, 5.12.4.4
  - droop, 7.2.3, 7.2.4.1
  - dual pin-type receptacles, 6.9
  - durability standards, 6.7 *Table 6-7*
  - DWORD, defined, 2.0 *glossary*
  - dynamic insertion and removal, 9.2.1
    - attaching devices, 4.6.1
    - defined, 2.0 *glossary*
    - detecting insertion and removal, 4.9, 9.2.1
    - Hub Repeater responsibilities, 11.1
    - hub support for, 11.1
    - power control, 7.2.3, 7.2.4 to 7.2.4.2
    - power-on and connection events timing, 7.1.7.3
    - removing devices, 4.6.2
    - USB robustness and, 4.5
- E**
- E field (End), 8.4.2.2
  - E2PROM defined, 2.0 *glossary*
  - ease-of-use considerations, 1.1
  - EBEmptied signal/event, 11.7.1.4 *Table 11-10*
  - edges of signals
    - cable delay, 7.1.16
    - data source jitter, 7.1.13.1.1
    - edge transition density, 8.2
    - optional edge rate control capacitors, 7.1.6.1
  - EEPROM, defined, 2.0 *glossary*
  - elasticity buffer, 11.7.1.3
  - Electrical Connector/Socket Test Procedures*, 6.7.1
  - Electrically Erasable Programmable Read Only Memory (EEPROM), 2.0 *glossary*

*Electrical Performance Properties of Insulation and Jacket for Telecommunication Wire and Cable*, 6.7.1

electrical specifications, 6.1, 7  
 applicable documents, 6.7.1  
 bus timing/electrical characteristics, 7.3.2  
 cables, 6.3, 6.4 to 6.4.4, 6.6 to 6.6.5  
 connectors, 6.2, 6.5 to 6.5.4.3  
 overview, 4.2.1, 6  
 PCB reference drawings, 6.9  
 physical layer specifications, 7.3 to 7.3.3  
 power distribution, 7.2 to 7.2.1.5, 7.2.3, 7.2.4 to 7.2.4.2  
 signaling, 7.1 to 7.1.20  
 standards for, 6.7, 7.3.1  
 timing waveforms, 7.3.3  
 USB grounding, 6.8  
 embedded hubs, 4.8.2.2, 5.2.3  
 EMI, USB grounding and, 6.8  
 enabled ports  
   connectivity and, 11.1.2.1  
   downstream ports, 11.5, 11.5.1.6  
   getting port status, 11.24.2.7.1  
   PORT\_ENABLE bit, 11.24.2.7.1.2  
   port status change bits, 11.24.2.7.2  
 Enabled state, 11.5, 11.5.1.6  
 Enable Transmit state, 11.7.1.4.3  
 encoding data, 7.1.8, 11.18.4  
 "end" encoding, 11.18.4  
 End field (E), 8.4.2.2  
 End-of-Frame (EOF). *See* EOFs  
 End of High-speed Packet (HSEOP), 7.1.7.2, 7.1.7.4.2  
 End-of-Packet (EOP). *See* EOPs  
 End-of-Packet bus state, 7.1.7.1, 7.1.7.2, 7.1.7.4.1, 7.1.7.4.2  
 end-of-packet delimiter. *See* EOPs  
 ENDP field, 8.3.2.2, 8.3.5.1, 8.4.1  
 endpoint addresses, 2.0 *glossary*, 5.3.1, 9.6.6  
 ENDPOINT descriptor, 9.4 *Table 9-5*  
 endpoint descriptors, 9.4.3, 9.6.1, 9.6.5, 9.6.6  
 endpoint direction, defined, 2.0 *glossary*  
 endpoint field (ENDP), 8.3.2.2, 8.3.5.1, 8.4.1  
 ENDPOINT\_HALT, 9.4 *Table 9-6*  
 endpoint numbers, 2.0 *glossary*, 5.3.1  
 endpoints  
   addresses, 9.6.6  
   characteristics, 5.3.1  
   description in descriptors, 9.4.3, 9.6.1, 9.6.5, 9.6.6  
   in device class definitions, 9.7.2  
   direction of flow, 5.3.1  
   endpoint address field, 8.3.2.2  
   endpoint aliasing, 8.3.2  
   endpoint zero requirements, 4.8.1, 5.3.1.1, 5.3.1.2, 5.3.2

endpoints (*continued*)

explicit feedback endpoints, 9.6.5, 9.6.6  
 getting endpoint status, 9.4.5  
 high-bandwidth endpoints, 2.0 *glossary*, 5.7.4  
 high-speed signaling attributes, 9.6.6  
 Hub Controller endpoint organization, 11.12.1  
 in interfaces, 9.2.3, 9.6.3, 9.6.5  
 logical devices as collections of endpoints, 5.3  
 message pipes and, 5.3.2.2  
 non-endpoint zero requirements, 5.3.1.2  
 number matching, 9.6.6  
 overview, 5.3.1  
 pipes and, 4.4, 5.3.2  
 programmable data rates, 2.0 *glossary*  
 reflected endpoint status, 10.5.2.2  
 role in data transfers, 4.7  
 samples, 2.0 *glossary*  
 specifying in *wIndex* field, 9.3.4  
 state machines, 8.5  
 stream pipes and, 5.3.2.1  
 synchronization frame, 9.4.11  
 Transfer Types, Synchronization Types, and Usage Types, 9.6.6  
 endpoint synchronization type, 5.12.4, 5.12.4.1  
 Endpoint Type field (ET), 8.4.2.2  
 endpoint type field (ET), 8.4.2.2  
 endpoint zero  
   Default Control Pipe and, 5.3.2  
   in device characteristics, 4.8.1  
   non-endpoint zero requirements, 5.3.1.2  
   requirements, 5.3.1.1  
 end-to-end signal delay, 7.1.19 to 7.1.19.2  
 end users, 2.0 *glossary*, 3.3  
 entering test mode, 7.1.20  
 entry points into state machines, 8.5  
 enumeration. *See* bus enumeration  
 envelope detectors, 2.0 *glossary*, 7.1, 7.1.4.2, 7.1.7.3, 7.1 *Table 7-1*  
 environmental characteristics for cables, 6.6.4  
 environmental compliance standards, 6.7  
 EOF1 or EOF2 signal/event  
   frame and microframe timers, 11.2.3.2, 11.2.5 to 11.2.5.2  
   host behavior at end-of-frame, 11.3  
   in Hub Repeater state machine, 11.7.2.3 *Table 11-11*  
   in transmitter state machine, 11.6.4 *Table 11-9*



- EOFs
  - advancing, 11.2.3.2
  - defined, 2.0 *glossary*
  - in frame and microframe timer synchronization, 11.2.3.2
  - host behavior at end-of-frame, 11.3 to 11.3.3
  - Host Controller frame and microframe generation, 10.2.3
  - in transaction completion prediction, 11.3.3
- EOI signal/event
  - defined, 11.7.1.4 *Table 11-10*
  - in downstream port state machine, 11.5 *Table 11-5*
  - in internal port state machine, 11.4
  - in receiver state machine, 11.6.3 *Table 11-8*
  - in transmitter state machine, 11.6.4
- EOP bus state, 7.1.7.1, 7.1.7.2, 7.1.7.4.1, 7.1.7.4.2
- EOPs
  - defined, 2.0 *glossary*
  - differential-to-EOP transition skew and EOP width, 7.3.3 *Figure 7-50*
  - EOP delimiter, 8.3
  - EOP dribble defined, 11.7.1.1
  - EOP width, 7.1.13.2 to 7.1.13.2.2, 7.3.3 *Figure 7-50*
  - error detection through bus turn-around timing, 8.7.2
  - extra bits and, 7.1.9, 7.1.9.1
  - false EOPs, 2.0 *glossary*, 8.7.3, 11.15
  - handshake packets and, 8.4.5
  - high-speed signaling and, 7.1
  - hub EOP delay and EOP skew, 7.3.3 *Figure 7-53*
  - hub/repeater electrical characteristics, 7.3.2 *Table 7-11*
  - hub signaling at EOF1, 11.3.1
  - intervals between IN token and EOP, 11.3.3
  - propagation delays, 7.1.14.1
- EOR signal/event, 11.6.3 *Table 11-8*
- equations
  - buffering for rate matching, 5.12.8
  - buffer sizes in functions and software, 5.11.4
  - bus transaction times, 5.11.3
- ERR handshake
  - interrupt transactions, 11.20.4
  - isochronous transactions, 11.21.1, 11.21.4
  - Transaction Translator response generation, 11.18.5
- error detection and handling. *See also* corrupted transfers and requests
  - "3 strikes and you're out" mechanism, 11.17.1
  - babble and loss of activity recovery, 8.7.4
  - bit stuff violations, 8.7.1
  - bulk transfers and, 5.8.5, 8.5.2
  - error detection and handling. (*Continued*)
    - bus turn-around timing, 8.7.2
    - busy (ready/x) state, 11.17.5
    - control transfers and, 5.5.5, 8.5.3.1
    - corrupted ACK handshake, 8.5.3.3, 8.6.4
    - corrupted SOF packets in isochronous transfers, 5.12.6
    - CRCs, 8.3.5, 8.7.1, 11.15, 11.20.3, 11.20.4, 11.21.3, 11.21.4
    - data corrupted or not accepted, 8.6.3
    - error count tally, 10.2.6, 11.17.1
    - error handling for transfers, 5.4
    - error handling on last data transaction, 8.5.3.3
    - false EOPs, 2.0 *glossary*, 8.7.3
    - HC\_Data\_or\_error state machine, 11.20.2
    - high bandwidth transactions, 5.9.2
    - Host Controller role in, 10.2.6
    - Hub Repeater responsibilities, 11.1
    - hub role in, 11.1.2.3
    - interrupt transfers and, 5.7.5
    - isochronous transfers and, 5.6.4, 5.6.5, 5.12.7
    - notation for error cases, 11.15
    - overview, 8.7
    - packet error categories, 8.7.1
    - periodic transactions, 11.18.4
    - PID check bits, 8.7.1
    - Port Error conditions, 11.8.1
    - port indicators, 11.5.3 to 11.5.3.1
    - Request Errors, 9.2.7
    - sample size and, 5.12.8
    - short packets and error conditions, 5.3.2
    - split transaction sequencing, 11.21.3
    - status values for, 11.15
    - synchronous data connectivity, 5.12.4.4.2
    - timeouts, 8.7.2, 11.17.1
    - Transaction Translator error handling, 11.22
    - USB role in, 10.5.4.4
    - USB robustness and, 4.5.1, 4.5.2
- ERR PID, 8.3.1 *Table 8-1*, 8.4.5
- ESD, USB grounding and, 6.8
- ET field (Endpoint Type), 8.4.2.2
- event notifications, USB and, 10.5.4.3
- example declarations in state machines, B.1, B.2, B.3
- exception handling. *See* error detection and handling
- Exception Window, 7.1.6.2
- exiting test mode, 7.1.20
- exit points from state machines, 8.5
- explicit feedback endpoints, 9.6.5, 9.6.6
- extended descriptor definitions, 9.7.1
- extensibility of USB architecture, 4.10
- extension cable assemblies, 6.4.4
- externally-powered hubs, 7.2.1. *See also* self-powered hubs
- extraction force standards, 6.7 *Table 6-7*

eye pattern templates  
 defined, 2.0 *glossary*  
 error rates and jitter tolerance, 7.1.14.2, 7.1.15.2  
 high-speed receiver characteristics and, 7.1.4.2  
 overview, 7.1.2.2  
 transmit eye patterns, 7.1, 7.1.2

## F

failed data transactions, 8.6.3  
 false EOPs, 2.0 *glossary*, 8.7.3, 11.15  
 fault detection. *See* error detection and handling  
 features  
   hub class feature selectors, 11.24.2  
   SetFeature() request, 9.4.9  
   setting hub features, 11.24.2.12  
   standard feature selectors, 9.4 *Table 9-6*  
 feedback endpoints, 9.6.6  
 feedback for isochronous transfers, 5.12.4.2, 5.12.4.3, 9.6.5  
 ferrite beads, 7.1.6.2  
 fields. *See names of specific fields*  
 flammability  
   cables, 6.6.4  
   Series "A" and Series "B" plugs, 6.5.4.1  
   Series "A" and Series "B" receptacles, 6.5.3.1  
   standards, 6.7 *Table 6-7*  
 flexibility of USB devices, 3.3  
 flow control mechanisms  
   in bus protocol overview, 4.4  
   handshake packets and, 8.4.5  
   non-periodic transactions, 11.14.2.2  
   USB robustness and, 4.5  
 flow sequences  
   non-periodic transactions, 11.17 to 11.17.5  
   periodic transactions, 11.18 to 11.18.8, 11.20 to 11.20.4, 11.21.1  
   split transaction notation for, 11.15  
 flyback voltage, 7.2.4.2  
 format of USB device requests, 9.3  
 formulas  
   buffering for rate matching, 5.12.8  
   buffer sizes in functions and software, 5.11.4  
   bus transaction times, 5.11.3  
 frame and microframe intervals  
   full-speed source electrical characteristics, 7.3.2 *Table 7-9*  
   high-speed source electrical characteristics, 7.3.2 *Table 7-8*  
   low-speed source electrical characteristics, 7.3.2 *Table 7-10*  
   repeatability, 7.1.12

frame and microframe numbers  
   buffering for rate matching, 5.12.8  
   frame and microframe number field, 8.4.3  
   frame number field, 8.3.3  
   frame numbers, 8.3.3  
   generating frames and microframes, 10.2.3  
   illustrated, 8.4.3.1  
   SOF tracking, 5.12.6  
 frame and microframe timers  
   frame wander, 11.2.5.2  
   hub frame timer, 11.2 to 11.2.5.2  
   timing skew, 11.2.5.1 to 11.2.5.2  
   TT loss of synchronization, 11.22.1  
 frame clocks, 5.12.3, 5.12.4.1.2, 11.18.3  
 frame pattern, defined, 2.0 *glossary*  
 frames and microframes. *See also* frame and microframe timers  
   allocating bandwidth, 4.7.5, 5.11.1 to 5.11.1.5, 10.3.2  
   available time in frames and microframes, 5.5.4, 5.6, 5.6.4, 5.7.4, 5.8.4, 5.11.5  
   babble and loss of activity recovery, 8.7.4  
   bandwidth reclamation, 5.11.5  
   best case full-speed budgets, 11.18.1, 11.18.4  
   bit time zero, 11.3  
   clock tracking and microframe SOFs, 5.12.4.1.2  
   control transfer reserved portions, 5.5.4  
   data prebuffering and, 5.12.5  
   defined, 2.0 *glossary*, 5.3.3  
   error handling in transfers, 5.12.7  
   frame and microframe intervals, 7.1.12, 7.3.2 *Table 7-8*, 7.3.2 *Table 7-9*, 7.3.2 *Table 7-10*  
   frame and microframe numbers (*See* frame and microframe numbers)  
   frame and microframe timer ranges, 11.2.1 to 11.2.2  
   frame wander, defined, 11.2.5.2  
   generation role of Host Controller, 10.2.3  
   generation role of Transaction Translator, 11.18.3  
   host behavior at end-of-frame, 11.3  
   interrupt transfer limitations, 5.7.4  
   isochronous transactions, 5.6.3, 5.6.4, 5.12.4.2, 8.5.5  
   jitter, 11.2.4  
   maximum allowable transactions, 5.4.1, 11.18.6.3  
   microframe numbers, 8.4.3.1



frames and microframes (*Continued*)

- microframe pipelines
  - buffer space, 11.19
  - clearing and aborting transactions, 11.18.6
  - defined, 11.18.2
  - periodic split transactions, 11.14.2.1, 11.18
  - resetting, 11.24.2.9
  - transaction tracking, 11.18.7
- multiple transactions, 5.6.4, 5.7.4, 5.9, 5.9.2, 9.6.6
- organization of transactions within, 5.11.2
- overview, 8.4.3.1
- samples per frame in isochronous transfers, 5.12.4.2
- SOF packets, 8.4.3
- SOF tracking, 5.12.6
- split transactions and, 5.10
- synch frame requests, 9.4.11
- timers, 11.2 to 11.2.5.2
- timer synchronization, 11.2.3 to 11.2.3.3, 11.22.1
- toggle sequencing, 8.5.5
- zeroth microframe, 9.4.11, 11.14.2.3
- freeing pending start-splits, 11.18.6.2
- frequency-locked clocks, 5.12.3
- Fs. *See* SRC
- Fsus state, 11.4, 11.4.3
- full-duplex, defined, 2.0 *glossary*
- full-speed buffers, 7.1.2.1
- full-speed cables. *See* high-/full-speed cables
- full-speed driver characteristics, 7.1.1.1, 7.1 *Table 7-1*
- full-speed functions and hubs
  - bulk transfers and, 5.8.4
  - cable and resistor connections, 7.1.5.1
  - connect detection, 7.1.7.3
  - control transfers and, 5.5.3, 5.5.4, 5.5.4 *Table 5-2*
  - data-rate tolerance, 7.1.11
  - defined, 2.0 *glossary*
  - detachable cables and, 6.4.1
  - full-speed port transceiver, 7.1.7.1
  - full-speed source electrical characteristics, 7.3.2 *Table 7-9*
  - full- vs. low-speed port behavior, 11.8.4
  - getting port status, 11.24.2.7.1
  - hub/repeater electrical characteristics, 7.3.2 *Table 7-11*
  - hub support for, 11.1
  - input capacitance, 7.1.6.1
  - interrupt transfers and, 5.7.3, 5.7.4 *Table 5-7*
  - isochronous transfers and, 5.6.4
  - maximum data payload, 8.4.4
  - optional endpoints, 5.3.1.2
  - in physical bus topology, 5.2.3
  - reset states and, C.2.2

full-speed functions and hubs (*Continued*)

- sampling rates, 5.12.4.2
- signal termination, 7.1.5.1
- SOF PID and, 8.4.3
- speed detection and, 11.8.2
- Transmit state and, 11.5.1.7
- full-speed signaling
  - babble and loss of activity recovery, 8.7.4
  - best case full-speed budgets, 11.18.1, 11.18.4
  - bus transactions and, 4.4
  - calculating transaction times, 5.11.3
  - data rates, 4.2.1
  - data signaling overview, 7.1.7.4.1
  - data source jitter, 7.1.13.1.1
  - defined, 2.0 *glossary*
  - differential receivers, 7.1 *Table 7-1*
  - downstream and upstream facing ports, 7.1
  - driver characteristics, 7.1.1
  - driver requirements, 7.1.2.3
  - endpoint zero requirements, 5.3.1.1
  - EOF timing points, 11.2.5.2
  - EOP width, 7.1.13.2.1
  - errors, 8.6.4
  - frame timer ranges, 11.2.2
  - full-speed loads, 7.1.2.1
  - high-speed devices operating at full-speed, 5.3.1.1
  - host behavior at end-of-frame, 11.3 to 11.3.3
  - hub class descriptors and, 11.23.1
  - intervals between IN token and EOP, 11.3.3
  - isochronous transaction limits, 5.6.3
  - J and K states, 7.1.7.1
  - jitter budget table, 7.1.15.1
  - propagation delays, 7.1.14.1
  - receiver characteristics, 7.1.4.1
  - reset signaling, 7.1.7.5
  - sampling rates, 5.12.4.2
  - scheduling, 11.14.2.3
  - speed detection, 9.1.1.3
  - Transaction Translator and, 4.8.2.1, 11.18.3, 11.18.5
- Full Suspend (Fsus) state, 11.4, 11.4.3
- function address field (ADDR), 8.3.2.1, 8.4.2.2
- functional stall, 8.4.5, 8.5.3.4
- Function layer
  - detailed communication flow, 5.3
  - illustrated, 5.1
  - interlayer communications model, 10.1.1

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.