CEC Friendly Motherboard Program

Now with ENERGY STAR* for Computers v8 option

June 2021

Rev 1.0

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Program for CEC Friendly Motherboards – Overview

Intel has a program of CEC Friendly Motherboards for LOEMs & Board ODM vendors to help with match making opportunities so LOEMs can build systems to meet the CEC Computer Standard Desktop Tier 2 TEC Limits

- Idle Power Target determined based on System Level Power Budgets for Intel® 300, 400, & 500 Series Chipset based designs
  - Motherboard determines CEC Expandability Score therefore Idle Power limits can be assigned to individual boards
- Intel® 300, 400, & 500 Series Chipset based Motherboards are tested by Intel to be included on the list
- The criteria for the CEC Friendly Motherboard program is still based on Idle Power Targets that are determined by System Level Power budgets. System Level Power budgets are designed to represent the majority of system level choices.
  - For the CEC program, OEMs can choose to use a 2.5" HDD or SSD to reduce system power. The purpose of this program is to include boards that will pass requirements with 3.5" HDD and standard power supplies. System level choices will focus on Power Supply support: Multi-Rail PSU (ATX) vs. Single Rail PSU (ATX12VO)
  - For the ENERGY STAR* program: Power Supply, Sleep State, and Storage options will be used to determine the Power Budget for a motherboard

- New for 2021

- List of motherboard that has an Expandability Score > 690 + LAN device with EEE support.

- ENERGY STAR – Computers v8 criteria for motherboards has been added to this program in 2021. The Website will now list which criteria the motherboard meets including what Storage device can be used with this motherboard.

https://compatibleproducts.intel.com/FeaturedLinks/CEC

Choosing other System Components

All system components must be Energy Efficient to meet Energy Regulations

- Memory

  - Testing is done with 16GB memory sticks, as memory amount increases the memory TEC adder from both Energy Regulations should compensate for increase in memory power

  - Many different memory vendors, types, and sizes are available. Power can vary with all of these options

- Discrete Graphics

  - When a discrete Graphics is added to the system each Energy Regulation applies a TEC adder based on the graphics cards Frame Buffer Bandwidth (in GB/sec). Careful selection of a discrete graphics card that does not consume idle power more than what the adder allows is required.

- BIOS

  - BIOS Power Management options are very important to achieve the lowest Idle, Sleep, and Off power states.

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Power Savings Options

- BIOS options that will save power – might be called something different with different vendors, Note: sometimes Auto does not always Enable the feature, choose Enable
  - Intel Speed Step™ = Enabled
  - CPU C-states = Enable
  - Package C State Limit = C10
  - DMI Link ASPM Control = L0sL1
  - ASPM = L0sL1
  - DMI Gen3 ASPM Control = ASPM L0sL1
  - DMI Gen ASPM = ASPM L0sL1
  - L1 Substates = L1.1 & L1.2
  - PEG – ASPM = Auto
  - Aggressive LPM Support = Enabled

- Power Saving Feature in the Operating System interaction with storage, enable HIPM + DIPM

  - Using the Intel RST Driver in AHCI mode will auto enable HIPM + DIPM

  - Or, go into Windows Advanced Power Options, under Hard Disk – AHCI Link Power Management, choose "HIPM+DIPM"

Program for CEC Friendly Motherboards – CEC Tier 2 Details

CEC Tier 2 is coming July 2021

- OEMs can choose to use a 2.5" HDD or SSD to reduce system power. Purpose of this CEC Friendly Motherboard program is to include boards that will pass with 3.5" HDD and industry standards-based power supplies

Pass Criteria for CEC Tier 2

- System Level capabilities + Expandability Score for each specific motherboard model number will determine the CEC Tier 2 DC Power Limit
  - Power supply support: ATX12V (Multi Rail) vs. ATX12VO (12 Volt Only)
  - Modern Standby support: changes the way the system behaves and TEC Calculations to lower measured TEC value
- DC power limits are derived by combining CPU + Board w/8GB SRAM from the Intel Power Budgets to meet CEC Tier 2 (Details next few slides)
- 2 units per model number will be tested. 2 tests per unit with different CPUs will be tested. Results from all 4 tests will be averaged to check if DC power is less than the criteria.

MB Exp. Score	Multi-Rail PSU + S3 DC Power Limit	ATX12VO + S3 DC Power Limit	Multi-Rail PSU + S0ix DC Power Limit	ATX12VO + S0ix DC Power Limit
250 < ES ≤ 425	4.2 W [w/16GB]	6.5 W	7.0 W	9.0 W
425 < ES ≤ 690	7.2 W	8.5 W	10.5 W	12.0 W
>690	TEC Exempt, must have EEE			

Motherboard with 2.5G LAN get an additional = 0.5W adder

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Power Budget for Desktop Tier 2 TEC Limits (page 1)

Motherboard Power limit is defined by the Expandability Score + System Level Characteristics

- Tier 2 Base TEC Limit for each category includes basic adders expected for majority of systems
  - Adders include 8GB memory = 5.2 & EEE = 0.9,
    - ATX Multi Rail + S3 was given the 16 GB memory adder to create a more reasonable DC Power limit
  - Difference from Short Idle to Long Idle is based on observed 0.5 watt difference from a variety of measured systems
- <u>Expectations:</u>
  - Low CPU Idle Power
    - CPU must get to C6/C7/C8 for 90% Residency, BIOS & Drivers interaction is important
  - Average power for a 3.5" 1TB HDD
  - Assuming 60% PSU Efficiency at 10 W load
- Board + Memory power includes: PCH, memory, keyboard, mouse, WLAN, Ethernet, Audio Codec, Fan, Other Board devices (Jelly-Bean Logic), and VR Efficiency
- Data is based on average or expected data, not actual tested results.

[1] CPU power is not a promise from Intel for future CPU power,
but a good faith estimate to power budget the whole system

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Program for CEC Friendly Motherboards Details

Program for CEC Friendly Motherboards - Details

Test Configuration – page 1/2

- Hardware to be used with Motherboard during testing
  - 8GB of total memory (2 sticks @ 4GB Each, DDR4-2666/2933/3200, populate one stick per channel, speed is dependent on Platform support) [using minimum memory during testing because as memory is added memory adder will compensate for added power]
  - 3.5" Hard Disk Drive, 1 TB, 7200 RPM
  - PSU with good Low Load Efficiency and meets requirement in Intel's latest PSU DG Rev 1.4 (Doc #336521 - 001)
  - Windows 10 Pro*/Enterprise version

- Measure DC power consumed at all connectors into the motherboard (see equipment diagram for more details)
  - ATX12V - Multi Rail
    - 24 pin Board power connector - all 5 Voltage rails (5V, 3.3V, +12V, 5VSB,-12V) and then combine into total board power
    - 2x2 or 2x4 CPU Power connector
  - ATX12VO – 12 Volt Only designs
    - 10 pin Main Board power connector + optional 6 pin Board power connector
    - 2x2 or 2x4 CPU Power connector
  - If board uses AC Brick power connector (example – Thin Mini-ATX), these will be judged differently (criteria is at the system level TEC)

- If motherboard supports S0ix (Modern Standby) and is requested to test in this mode: make sure to include this request when arranging testing

Program for CEC Friendly Motherboards – Details

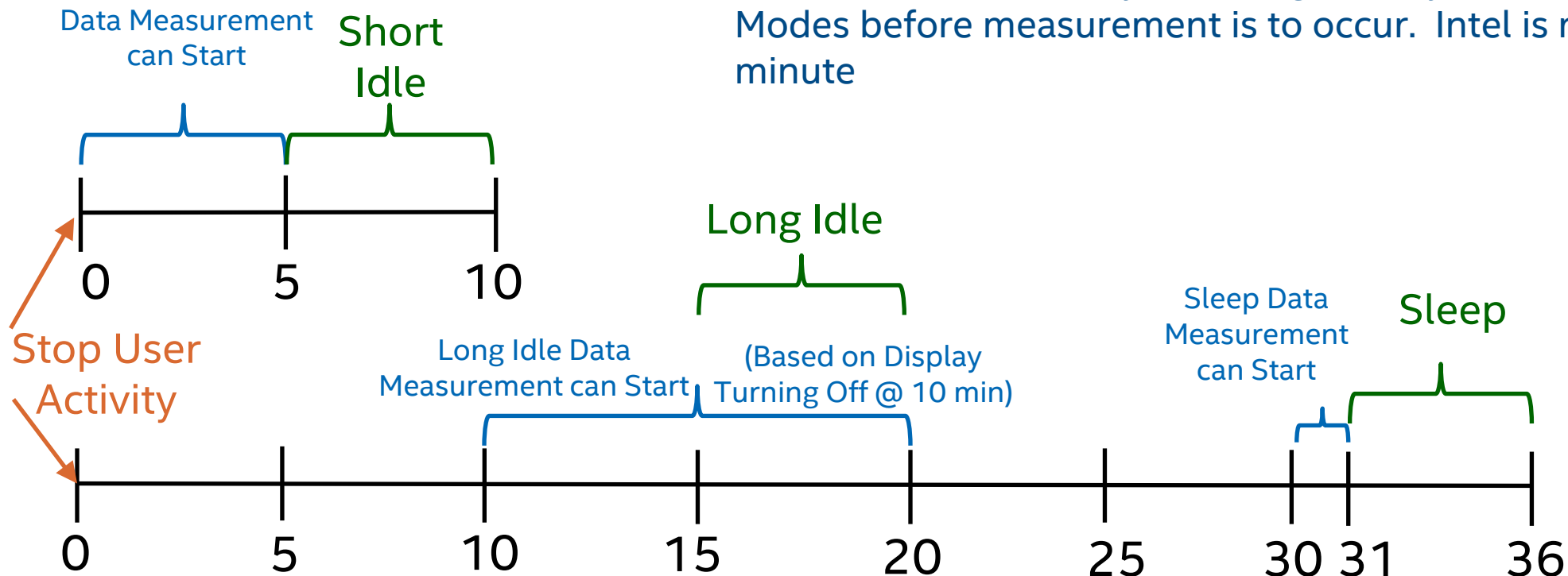## Test Configuration – page 2/2

- Testing Short Idle Mode will be used to determine if motherboard meets the CEC Friendly Motherboard Requirements

  - Short Idle is system in S0 state, Display on, no applications loaded or running, after a fresh re-boot into Windows* OS ;
    - Wait 5 minutes after stopping user interaction, then start data collection for 5 min, 1 reading per second, and average 300 data points.
    - Visual Test Procedure for timings of all test modes are included in the next slide
    - Will Follow CEC Test Procedure by testing system for 36 minutes to measure
      Short Idle (5-10 minutes), Long Idle (15-20 min), and Sleep Mode (31-36 min).
      Windows will automatically put the system to sleep, system must stay in sleep during testing.

- Test Results will be provided to the Board Vendor in an Excel* based test report and include results from Long Idle, Sleep, and Off mode measurements.
  - Any motherboard listed on the website passed the published limit
  - If there are any specific BIOS options needed to meet low Idle Power values, please specify. If they are different than default, they will be listed on website
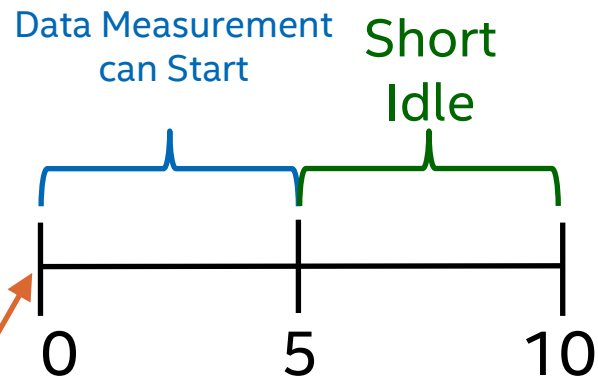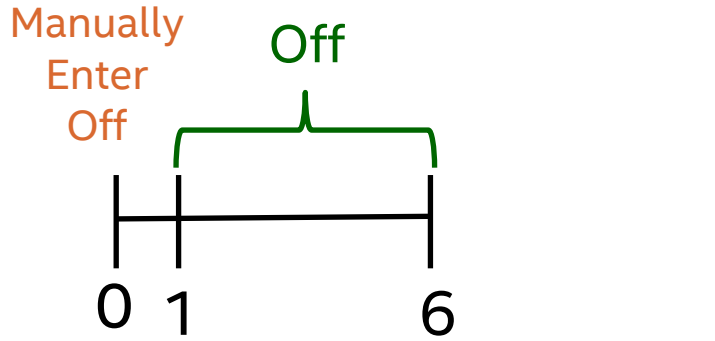
Computers with S3 - Test Procedure for CEC
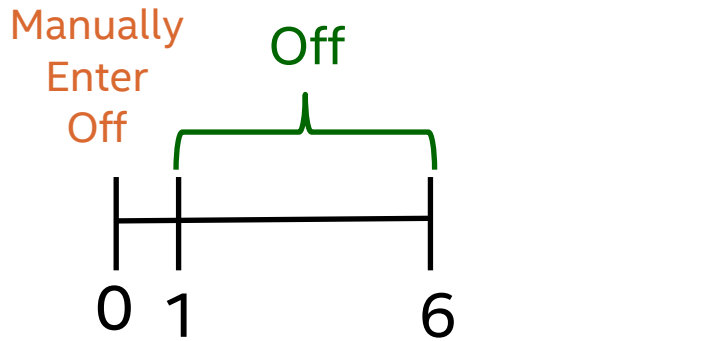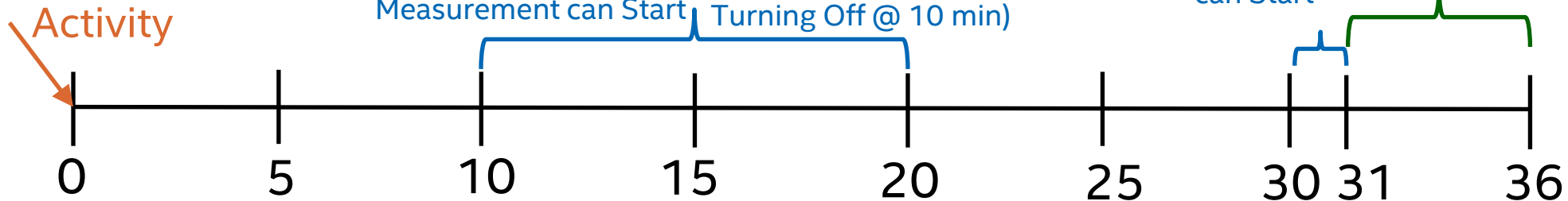
Manually Enter Off

Off

0   1   6

Notes:
- All Measurements must be 5 minutes long (300 Seconds)
  - Green Bars show when Intel Recommends Testing Measurement is to happen
- At least 1 data point must be collected every Second
- Long Idle and Sleep Mode must be measured together
- IEC 62623 does not say how long after system enters Sleep or Off Modes before measurement is to occur. Intel is recommending 1 minute

Data Measurement can Start

Short Idle

0   5   10

Stop User Activity

Long Idle

Long Idle Data Measurement can Start

(Based on Display Turning Off @ 10 min)

Sleep Data Measurement can Start

Sleep

0   5   10   15   20   25   30 31   36

Computers with ASM - Test Procedure for CEC

Manually Enter Off

Off

0 1 6

Data Measurement can Start

Short Idle

0 5 10

Stop User Activity

Long Idle/ASM

Long Idle Data Measurement can Start

(Based on Display Turning Off @ 10 min)

Sleep Data Measurement can Start

ASM

0 5 10 15 20 25 30 31 36

Notes:
- Alternative Sleep Mode (ASM) Examples are Modern Standby and Chrome OS
  - ASM does not replace Long Idle Mode
  - Modern Standby needs SW DRIPS state to be entered by 20 minutes after user inactivity to get power benefit of this state for CEC
    - Long Idle & ASM Measurement should be the same value
- All Measurements must be 5 minutes long (300 Seconds)
  - Green Bars show when Intel Recommends Testing Measurement is to happen
- At least 1 data point must be collected every Second
- Long Idle and Sleep Mode must be measured together
- IEC 62623 does not say how long after system enters Sleep or Off Modes before measurement is to occur. Intel is recommending 1 minute

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- ENERGY STAR is a system-level energy specification, defined by the US Environmental Protection Agency, that relies on all system components, such as processor, chipset, power supply, etc. For more information, visit http://www.energystar.gov/.

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Program for CEC Friendly Motherboards - Disclaimer

- Intel has developed Power Budgets for Desktop Computers based on the Expandability Score to come up with the program for CEC Friendly Motherboards
  - The purpose of the program for CEC Friendly Motherboards is to help promote and educate LOEMs with energy efficient motherboard selections that when used in a computer system along with other energy efficient components is more likely to comply with the CEC computers TEC Limits.
  - Motherboards are one of the main power consuming components in a computer, and the CEC Computer Category system is based on the Expandability Score of the computer, which is almost completely derived from the motherboard expansion interfaces and inter-connects. Therefore, the motherboard attributes become the basis for the category allocation for the computer configuration and the TEC limits that scale with the expandability score which is a function of motherboard expandability attributes.
  - Participants of the program for CEC Friendly Motherboards will have their motherboards tested in accordance with Intel-drafted testing document. (available upon request.) The test will only focus on motherboard power consumption values measured in DC Watts. The tested values will be compared with Intel developed power budgets. If the motherboard meets the DC Power values, it would be listed as a CEC Friendly Motherboard as part of the Intel program. Inclusion of a motherboard on the approved list itself does not guarantee that the computer configuration the motherboard is part of, will ultimately comply with the CEC Computers standard.
  - Conversely, a given computer configuration could still meet the CEC program requirements, even if the motherboard is not part of the Intel program or does not meet the Intel-developed power budget, if the system manufacturer has made the proper tradeoffs for other components selection. Examples include a lower power storage device like an SSD or a more low load efficient power supply.
  - There are other components in the system that may not meet the appropriate power budget for the computer configuration to comply with the CEC standard. Every component in the computer is important to meet system level TEC Targets.
  - The program for CEC Friendly Motherboards is currently focused on CEC's Tier 1criteria. CEC criteria will change on July 1, 2021 when Tier 2 criteria goes into effect. This program has been updated to define the DC Power Limit criteria for CEC Tier 2 which is based on System Characteristics plus motherboard Expandability Score

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Program for CEC Friendly Motherboards - Disclaimer

- CEC Computer Standard requires a Typical Energy Consumption (TEC) based limit for all computers sold into the State of California with a manufacturing date on or after January 1, 2019. Desktop Computers with an Expandability Score between 250 and 690 will have lower TEC limits described as CEC Tier 2 in this document.

  - This TEC limit is for Complete Systems, and there are no specific guidelines for individual components in the computer from the CEC Computer Program.

- Additional background and limitations:

  - This program is not endorsed by the California Energy Commission.

  - This program is only available and validated for Intel® 300, 400, & 500 Series chipset based motherboards

  - No pre-release, non-production quality motherboards may be delivered to Intel as part of the program for CEC Friendly Motherboards.

  - To sell computers into the state of CA, even when a motherboard from the CEC Friendly Motherboard list is used in a computer, the system integrator is responsible for conducting the computer compliance test at the system level, and register the compliant system with the CEC program. http://www.energy.ca.gov/appliances/

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