

**CATEGORY 4 - COMPUTERS**

(See *Supp. No. 1* to part 738).

**Note 1:** Computers, related equipment and “software” performing telecommunications or “local area network” functions must also be evaluated against the performance characteristics of Category 5, Part 1 (Telecommunications).

NS applies to entire entry NS Column 2

MT applies to items in 4A001.a when the parameters in 4A101 are met or exceeded MT Column 1

**Note 2:** Control units that directly interconnect the buses or channels of central processing units, “main storage” or disk controllers are not regarded as telecommunications equipment described in Category 5, Part 1 (Telecommunications).

AT applies to entire entry AT Column 1

NP applies, unless a License Exception is available. See §742.3(b) of the EAR for information on applicable licensing review policies.

**N.B:** For the control status of “software” “specially designed” for packet switching, see ECCN 5D001. (Telecommunications).

**Reporting Requirements**

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, Special Comprehensive Licenses, and Validated End-User authorizations.

**Note 3:** Computers, related equipment and “software” performing cryptographic, cryptanalytic, certifiable multi-level security or certifiable user isolation functions, or that limit electromagnetic compatibility (EMC), must also be evaluated against the performance characteristics in Category 5, Part 2 (“Information Security”).

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

LVS: \$5000 for 4A001.a; N/A for MT.  
GBS: N/A  
CIV: N/A

**A. “END ITEMS,” “EQUIPMENT,” “ACCESSORIES,” “ATTACHMENTS,” “PARTS,” “COMPONENTS,” AND “SYSTEMS”**

**Special Conditions for STA**

**4A001 Electronic computers and related equipment, having any of the following (see List of Items Controlled), and “electronic assemblies” and “specially designed” “components” therefor.**

STA: License Exception STA may not be used to ship any commodity in 4A001.a.2 to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

**License Requirements**

**List of Items Controlled**

*Reason for Control:* NS, MT, AT, NP

*Related Controls:* See also [4A101](#) and [4A994](#). See Category 5-Part 2 for electronic computers and related equipment performing or incorporating “information security” functions as the primary function.

*Control(s)* Country Chart

Equipment designed or rated for transient ionizing radiation is “subject to the ITAR” (see 22 CFR parts 120 through 130).

*Related Definitions:* For the purposes of integrated circuits in 4A001.a.2,  $5 \times 10^3 \text{ Gy(Si)} = 5 \times 10^5 \text{ Rads (Si)}$ ;  $5 \times 10^6 \text{ Gy (Si)/s} = 5 \times 10^8 \text{ Rads (Si)/s}$ .

*Items:*

a. “Specially designed” to have any of the following:

a.1. Rated for operation at an ambient temperature below 228 K (-45°C) or above 358 K (85°C); or

*Note:* 4A001.a.1 does not apply to computers “specially designed” for civil automobile, railway train or “civil aircraft” applications.

a.2. Radiation hardened to exceed any of the following specifications:

a.2.a. A total dose of  $5 \times 10^3 \text{ Gy (Si)}$ ;

a.2.b. A dose rate upset of  $5 \times 10^6 \text{ Gy (Si)/s}$ ; or

a.2.c. Single Event Upset of  $1 \times 10^{-8} \text{ Error/bit/day}$ ;

*Note:* 4A001.a.2 does not apply to computers “specially designed” for “civil aircraft” applications.

b. [RESERVED]

**4A003 “Digital computers”, “electronic assemblies”, and related equipment therefor, as follows (see List of Items Controlled) and “specially designed” “components” therefor. License Requirements**

*Reason for Control:* NS, MT, CC, AT

| <i>Control(s)</i>   | <i>Country Chart (See Supp. No. 1 to part 738)</i> |
|---|--|
| NS applies to 4A003.b and .c  | NS Column 1  |
| NS applies to 4A003.e and .g  | NS Column 2  |
| MT applies to 4A003.e when the parameters in 3A101.a.2.b are met or exceeded                                      | MT Column 1  |
| CC applies to “digital computers” for computerized finger-print equipment   | CC Column 1  |
| AT applies to entire entry (refer to 4A994 for controls on “digital computers” with a APP > 0.0128 but ≤ 8.0 WT). | AT Column 1  |

*Note:* For all destinations, except those countries in Country Group E:1 of Supplement No. 1 to part 740 of the EAR, no license is required (NLR) for computers with an “Adjusted Peak Performance” (“APP”) not exceeding 8.0 Weighted TeraFLOPS (WT) and for “electronic assemblies” described in 4A003.c that are not capable of exceeding an “Adjusted Peak Performance” (“APP”) exceeding 8.0 Weighted TeraFLOPS (WT) in aggregation, except certain transfers as set forth in § 746.3 (Iraq).

**Reporting Requirements**

Special Post Shipment Verification reporting and recordkeeping requirements for exports of computers to destinations in Computer Tier 3 may be found in §743.2 of the EAR.

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

LVS: \$5000; N/A for 4A003.b and .c.  
 GBS: Yes, for 4A003.e, and .g and “specially designed” “parts” and

- “components” therefor, exported separately or as part of a system.
- APP: Yes, for computers controlled by 4A003.b, and “electronic assemblies” controlled by 4A003.c, to the exclusion of other technical parameters, with the exception of 4A003.e (equipment performing analog-to-digital conversions exceeding the limits of 3A001.a.5.a). See §740.7 of the EAR.
- CIV: Yes, for 4A003.e, and .g.

### List of Items Controlled

*Related Controls:* See also [4A994](#) and [4A980](#)

*Related Definitions:* N/A  
*Items:*

**Note 1:** 4A003 includes the following:

- ‘Vector processors’ (as defined in Note 7 of the “Technical Note on “Adjusted Peak Performance” (“APP”));
- Array processors;
- Digital signal processors;
- Logic processors;
- Equipment designed for “image enhancement”;
- Equipment designed for “signal processing”.

**Note 2:** The control status of the “digital computers” and related equipment described in 4A003 is determined by the control status of other equipment or systems provided:

a. The “digital computers” or related equipment are essential for the operation of the other equipment or systems;

b. The “digital computers” or related equipment are not a “principal element” of the other equipment or systems; and

**N.B. 1:** The control status of “signal processing” or “image enhancement” equipment “specially designed” for other equipment with functions limited to those required for the other equipment is determined by the control status of the other equipment even if it exceeds the “principal element” criterion.

**N.B. 2:** For the control status of “digital computers” or related equipment for telecommunications equipment, see Category 5, Part 1 (Telecommunications).

c. The “technology” for the “digital computers” and related equipment is determined by 4E.

a. [RESERVED]

b. “Digital computers” having an “Adjusted Peak Performance” (“APP”) exceeding 8.0 weighted TeraFLOPS (WT);

c. “Electronic assemblies” “specially designed” or modified to be capable of enhancing performance by aggregation of processors so that the “APP” of the aggregation exceeds the limit in 4A003.b.;

**Note 1:** 4A003.c applies only to “electronic assemblies” and programmable interconnections not exceeding the limit in 4A003.b. when shipped as unintegrated “electronic assemblies”. It does not apply to “electronic assemblies” inherently limited by nature of their design for use as related equipment controlled by 4A003.e.

**Note 2:** 4A003.c does not control “electronic assemblies” “specially designed” for a product or family of products whose maximum configuration does not exceed the

limit of 4A003.b.

d. [RESERVED]

e. Equipment performing analog-to-digital conversions exceeding the limits in 3A001.a.5;

f. [RESERVED]

g. Equipment “specially designed” for aggregating the performance of “digital computers” by providing external interconnections which allow communications at unidirectional data rates exceeding 2.0 Gbyte/s per link.

*Note:* 4A003.g does not control internal interconnection equipment (e.g., backplanes, buses) passive interconnection equipment, “network access controllers” or “communication channel controllers”.

**4A004 Computers as follows (see List of Items Controlled) and “specially designed” related equipment, “electronic assemblies” and “components” therefor.**

**License Requirements**

*Reason for Control:* NS, AT

*Control(s)* Country Chart  
(See Supp. No. 1 to part 738).

NS applies to entire entry NS Column 2

AT applies to entire entry AT Column 1

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

LVS: \$5000  
GBS: N/A  
CIV: N/A

**List of Items Controlled**

*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

- a. “Systolic array computers”;
- b. “Neural computers”;
- c. “Optical computers”.

**4A101 Analog computers, “digital computers” or digital differential analyzers, other than those controlled by 4A001 designed or modified for use in “missiles”, having any of the following (see List of Items Controlled).**

**License Requirements**

*Reason for Control:* MT, AT

*Control(s)* Country Chart  
(See Supp. No. 1 to part 738).

MT applies to entire entry MT Column 1

AT applies to entire entry AT Column 1

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

LVS: N/A  
GBS: N/A  
CIV: N/A

**List of Items Controlled**

*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

- a. Rated for continuous operation at

temperatures from below 228 K (-45° C) to above 328 K (+55°C); or

GBS: N/A  
CIV: N/A

b. Designed as ruggedized or ‘radiation hardened’.

**List of Items Controlled**

*Note: ‘Radiation hardened’ means that the “part,” “component” or equipment is designed or rated to withstand radiation levels which meet or exceed a total irradiation dose of 5 X 10<sup>5</sup> rads (Si).*

*Related Controls: N/A  
Related Definitions: N/A  
Items:*

The list of items controlled is contained in the ECCN heading.

*Note: 4A980 does not control equipment limited to one finger and designed for user authentication or access control.*

**4A102 “Hybrid computers” “specially designed” for modelling, simulation or design integration of “missiles” or their subsystems. (These items are “subject to the ITAR” See 22 CFR parts 120 through 130.)**

**4A994 Computers, “electronic assemblies”, and related equipment not controlled by 4A001 or 4A003, and “specially designed” “parts” and “components” therefor.**

**4A611 Computers, and “parts,” “components,” “accessories,” and “attachments” “specially designed” therefor, “specially designed” for a military application that are not enumerated in any USML category are controlled by ECCN 3A611.**

**License Requirements**

*Reason for Control: AT*

**4A980 Computers for fingerprint equipment, n.e.s.**

*Control(s) Country Chart  
(See Supp. No. 1 to part 738).*

AT applies to entire entry AT Column 1

**License Requirements**

*Reason for Control: CC, AT*

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

*Control(s) Country Chart  
(See Supp. No. 1 to part 738).*

LVS: N/A  
GBS: N/A  
CIV: N/A

CC applies to entire entry CC Column 1

**List of Items Controlled**

AT applies to entire entry AT Column 1

*Related Controls: N/A  
Related Definitions: N/A  
Items:*

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

LVS: N/A

*Note 1: The control status of the “digital computers” and related equipment described*

*in 4A994 is determined by the control status of other equipment or systems provided:*

*a. The “digital computers” or related equipment are essential for the operation of the other equipment or systems;*

*b. The “digital computers” or related equipment are not a “principal element” of the other equipment or systems; and*

*N.B. 1: The control status of “signal processing” or “image enhancement” equipment “specially designed” for other equipment with functions limited to those required for the other equipment is determined by the control status of the other equipment even if it exceeds the “principal element” criterion.*

*N.B. 2: For the control status of “digital computers” or related equipment for telecommunications equipment, see Category 5, Part 1 (Telecommunications).*

*c. The “technology” for the “digital computers” and related equipment is determined by 4E.*

a. Electronic computers and related equipment, and “electronic assemblies” and “specially designed” “parts” and “components” therefor, rated for operation at an ambient temperature above 343 K (70°C);

b. “Digital computers”, including equipment of “signal processing” or image enhancement”, having an “Adjusted Peak Performance” (“APP”) equal to or greater than 0.0128 Weighted TeraFLOPS (WT);

c. “Electronic assemblies” that are “specially designed” or modified to enhance performance by aggregation of processors, as follows:

c.1. Designed to be capable of aggregation in configurations of 16 or more processors;

c.2. [RESERVED];

*Note 1: 4A994.c applies only to “electronic assemblies” and programmable interconnections with a “APP” not exceeding the limits in 4A994.b, when shipped as unintegrated “electronic assemblies”. It does not apply to “electronic assemblies” inherently limited by nature of their design for use as related equipment controlled by 4A994.k.*

*Note 2: 4A994.c does not control any “electronic assembly” “specially designed” for a product or family of products whose maximum configuration does not exceed the limits of 4A994.b.*

d. [RESERVED];

e. [RESERVED];

f. Equipment for “signal processing” or “image enhancement” having an “Adjusted Peak Performance” (“APP”) equal to or greater than 0.0128 Weighted TeraFLOPS WT;

g. [RESERVED];

h. [RESERVED];

i. Equipment containing “terminal interface equipment” exceeding the limits in 5A991;

j. Equipment “specially designed” to provide external interconnection of “digital computers” or associated equipment that allows communications at data rates exceeding 80 Mbyte/s.

*Note: 4A994.j does not control internal interconnection equipment (e.g., backplanes, buses) passive interconnection equipment, “network access controllers” or “communication channel controllers”.*

k. “Hybrid computers” and “electronic assemblies” and “specially designed” “parts”

and “components” therefor containing analog-to-digital converters having all of the following characteristics:

k.1. 32 channels or more; and

k.2. A resolution of 14 bit (plus sign bit) or more with a conversion rate of 200,000 conversions/s or more.

controlled by 4A003 for CC reasons

AT applies to entire entry AT Column 1

NP applies, unless a License Exception is available. See §742.3(b) of the EAR for information on applicable licensing review policies.

**B. TEST, INSPECTION AND “PRODUCTION EQUIPMENT”**

[RESERVED]

**C. “MATERIALS”**

[RESERVED]

**D. “SOFTWARE”**

*Note: The control status of “software” for equipment described in other Categories is dealt with in the appropriate Category.*

**Reporting Requirements**

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, Special Comprehensive Licenses, and Validated End-User authorizations.

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

CIV: N/A

TSR: Yes, except for “software” for the “development” or “production” of commodities with an “Adjusted Peak Performance” (“APP”) exceeding 1.0 WT.

APP: Yes to specific countries (see §740.7 of the EAR for eligibility criteria)

**4D001 “Software” as follows (see List of Items Controlled).**

**License Requirements**

*Reason for Control:* NS, CC, AT, NP

|                   |   |
|-------------------|---|
| <i>Control(s)</i> | <i>Country Chart (See Supp. No. 1 to part 738).</i> |
|-------------------|---|

|                            |             |
|----------------------------|-------------|
| NS applies to entire entry | NS Column 1 |
|----------------------------|-------------|

|  |             |
|--|-------------|
| CC applies to “software” for computerized finger-print equipment | CC Column 1 |
|--|-------------|

**Special Conditions for STA**

STA: License Exception STA may not be used to ship or transmit “software” “specially designed” for the “development” or “production” of equipment specified by ECCN 4A001.a.2 or for the “development” or “production” of “digital computers” having an ‘Adjusted Peak Performance’ (‘APP’) exceeding 1.0 Weighted TeraFLOPS (WT) to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

**List of Items Controlled**

*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

a. “Software” “specially designed” or modified for the “development” or “production”, of equipment or “software” controlled by 4A001, 4A003, 4A004, or 4D (except 4D980, 4D993 or 4D994).

b. “Software”, other than that controlled by 4D001.a, “specially designed” or modified for the “development” or “production” of equipment as follows:

b.1. “Digital computers” having an “Adjusted Peak Performance” (“APP”) exceeding 0.60 Weighted TeraFLOPS (WT);

b.2. “Electronic assemblies” “specially designed” or modified for enhancing performance by aggregation of processors so that the “APP” of the aggregation exceeds the limit in 4D001.b.1.

**4D002 “Software” “specially designed” or modified to support “technology” controlled by 4E (except 4E980, 4E992, and 4E993).**

**License Requirements**

*Reason for Control:* NS, AT, NP

*Control(s)* *Country Chart*  
 (See *Supp. No. 1 to part 738*).

NS applies to entire entry NS Column 1

AT applies to entire entry AT Column 1

NP applies, unless a License Exception is available. See §742.3(b) of the EAR for information on applicable licensing review policies.

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

CIV: N/A  
 TSR: Yes, except N/A for “software” specifically designed or modified to support “technology” for computers requiring a license.

**List of Items Controlled**

*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

The list of items controlled is contained in the ECCN heading.

**4D980 “Software” “specially designed” for the “development,” “production” or “use” of commodities controlled by 4A980.**

**License Requirements**

*Reason for Control:* CC, AT

*Control(s)* *Country Chart*  
 (See *Supp. No. 1 to part 738*).

CC applies to entire entry CC Column 1

AT applies to entire entry AT Column 1

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

CIV: N/A  
 TSR: N/A

**List of Items Controlled**

*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*



The list of items controlled is contained in the ECCN heading.

**4D993 “Program” proof and validation “software”, “software” allowing the automatic generation of “source codes”, and operating system “software” that are “specially designed” for real time processing equipment (see List of Items Controlled).**

**License Requirements**

*Reason for Control:* AT

|                   |   |
|-------------------|---|
| <i>Control(s)</i> | <i>Country Chart<br/>(See Supp. No. 1 to part 738).</i> |
|-------------------|---|

|                            |             |
|----------------------------|-------------|
| AT applies to entire entry | AT Column 1 |
|----------------------------|-------------|

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

CIV: N/A  
TSR: N/A

**List of Items Controlled**

*Related Controls:* N/A

*Related Definitions:* “Global interrupt latency time” is the time taken by the computer system to recognize an interrupt due to the event, service the interrupt and perform a context switch to an alternate memory-resident task waiting on the interrupt.

*Items:*

- a. “Program” proof and validation “software” using mathematical and analytical techniques and designed or modified for “programs” having more than 500,000 “source code” instructions;
- b. “Software” allowing the automatic generation

of “source codes” from data acquired on line from external sensors described in the Commerce Control List; *or*

- c. Operating system “software” “specially designed” for “real time processing” equipment that guarantees a “global interrupt latency time” of less than 20 microseconds.

**4D994 “Software” other than that controlled in 4D001 “specially designed” or modified for the “development”, “production”, or “use” of equipment controlled by 4A101, 4A994.**

**License Requirements**

*Reason for Control:* AT

|                   |   |
|-------------------|---|
| <i>Control(s)</i> | <i>Country Chart<br/>(See Supp. No. 1 to part 738).</i> |
|-------------------|---|

|                            |             |
|----------------------------|-------------|
| AT applies to entire entry | AT Column 1 |
|----------------------------|-------------|

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

CIV: N/A  
TSR: N/A

**List of Items Controlled**

*Related Controls:* N/A

*Related Definitions:* N/A

*Items:*

The list of items controlled is contained in the ECCN heading.

**E. “TECHNOLOGY”**

**4E001 “Technology” as follows (see List of Items Controlled).**

**License Requirements**

*Reason for Control:* NS, MT, CC, AT, NP

|  |   |
|--|---|
| <i>Control(s)</i>  | <i>Country Chart<br/>(See Supp. No.<br/>1 to part 738).</i> |
| NS applies to entire entry   | NS Column 1   |
| MT applies to “technology” for items controlled by 4A001.a and 4A101 for MT reasons  | MT Column 1   |
| CC applies to “technology” for computerized fingerprint equipment controlled by 4A003 for CC reasons                                   | CC Column 1   |
| AT applies to entire entry   | AT Column 1   |
| NP applies, unless a License Exception is available. See §742.3(b) of the EAR for information on applicable licensing review policies. |   |

**Reporting Requirements**

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, Special Comprehensive Licenses, and Validated End-User authorizations.

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

|      |   |
|------|---|
| CIV: | N/A   |
| TSR: | Yes, except for “technology” for the “development” or “production” of commodities with an “Adjusted Peak Performance” (“APP”) exceeding 1.0 WT. |
| APP: | Yes to specific countries (see §740.7 of the EAR for eligibility criteria).   |

**Special Conditions for STA**

STA: License Exception STA may not be used to ship or transmit “technology” according to the General Technology Note for the “development” or “production” of any of the following equipment or “software”: a. Equipment specified by ECCN 4A001.a.2; b. “Digital computers” having an ‘Adjusted Peak Performance’ (‘APP’) exceeding 1.0 Weighted TeraFLOPS (WT); or c. “software” specified in the License Exception STA paragraph found in the License Exception section of ECCN 4D001 to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

**List of Items Controlled**

*Related Controls:* N/A

*Related Definitions:* N/A

*Items:*

a. “Technology” according to the General Technology Note, for the “development”, “production”, or “use” of equipment or “software” controlled by 4A (except 4A980 or 4A994) or 4D (except 4D980, 4D993, 4D994).

b. “Technology”, other than that controlled by 4E001.a, “specially designed” or modified for the “development” or “production” of equipment as follows:

b.1. “Digital computers” having an “Adjusted Peak Performance” (“APP”) exceeding 0.60 Weighted TeraFLOPS (WT);

b.2. “Electronic assemblies” “specially designed” or modified for enhancing performance by aggregation of processors so that the “APP” of the aggregation exceeds the limit in 4E001.b.1.

**4E980 “Technology” for the “development,” “production” or “use” of commodities controlled by 4A980.**

**License Requirements**

*Reason for Control:* CC, AT

*Control(s)*                      *Country Chart*  
(See *Supp. No.*  
*1 to part 738*).

CC applies to entire entry      CC Column 1

AT applies to entire entry      AT Column 1

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

CIV: N/A  
TSR: N/A

**List of Items Controlled**

*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

The list of items controlled is contained in the ECCN heading.

**4E992 “Technology” other than that controlled in 4E001 for the “development,” “production,” or “use” of equipment controlled by 4A994, or “software” controlled by 4D993 or 4D994.**

**License Requirements**

*Reason for Control:* AT

*Control(s)*                      *Country Chart*  
(See *Supp. No.*  
*1 to part 738*).

AT applies to entire entry      AT Column 1

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

CIV: N/A  
TSR: N/A

**List of Items Controlled**

*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

The list of items controlled is contained in the ECCN heading.

**4E993 “Technology” for the “development” or “production” of equipment designed for “multi-data-stream processing.”**

**License Requirements**

*Reason for Control:* AT

*Control(s)*                      *Country Chart*  
(See *Supp. No.*  
*1 to part 738*).

AT applies to entire entry      AT Column 1

**List Based License Exceptions** (See Part 740 for a description of all license exceptions)

CIV: N/A  
TSR: N/A

**List of Items Controlled**

*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

The list of items controlled is contained in the ECCN heading.

**EAR99** Items subject to the EAR that are *not* elsewhere specified in this CCL Category or in any other category in the CCL are designated by the number **EAR99**.

**TECHNICAL NOTE ON “ADJUSTED PEAK PERFORMANCE” (“APP”)**

“APP” is an adjusted peak rate at which “digital computers” perform 64-bit or larger floating point additions and multiplications.

**Abbreviations used in this Technical Note**

|                      |   |
|----------------------|---|
| <i>n</i>             | number of processors in the “digital computer”                          |
| <i>I</i>             | processor number ( <i>i</i> ,..., <i>n</i> )                            |
| <i>t<sub>i</sub></i> | processor cycle time ( <i>t<sub>i</sub></i> = 1/ <i>F<sub>i</sub></i> ) |
| <i>F<sub>i</sub></i> | processor frequency   |
| <i>R<sub>i</sub></i> | peak floating point calculating rate                                    |
| <i>W<sub>i</sub></i> | architecture adjustment factor  |

“APP” is expressed in Weighted TeraFLOPS (WT), in units of 10<sup>12</sup> adjusted floating point operations per second.

**Outline of “APP” calculation method**

1. For each processor *i*, determine the peak number of 64-bit or larger floating-point operations, *FPO<sub>i</sub>*, performed per cycle for each processor in the “digital computer”.

**Note:** In determining *FPO*, include only 64-bit or larger floating point additions and/or multiplications. All floating point operations must be expressed in operations per processor cycle; operations requiring multiple cycles may be expressed in fractional results per cycle. For processors not capable of performing calculations on floating-point operands of 64-bits or more the effective calculating rate *R* is zero.

2. Calculate the floating point rate *R* for each processor

$$R_i = FPO_i/t_i$$

3. Calculate “APP” as

$$“APP” = W_1 \times R_1 + W_2 \times R_2 + \dots + W_n \times R_n$$

4. For ‘vector processors’, *W<sub>i</sub>* = 0.9. For non-‘vector processors’, *W<sub>i</sub>* = 0.3.

**Note 1:** For processors that perform compound operations in a cycle, such as an addition and multiplication, each operation is counted.

**Note 2:** For a pipelined processor the effective calculating rate *R* is the faster of the pipelined rate, once the pipeline is full, or the non-pipelined rate.

**Note 3:** The calculating rate *R* of each contributing processor is to be calculated at its maximum value theoretically possible before the “APP” of the combination is derived. Simultaneous operations are assumed to exist when the computer manufacturer claims concurrent, parallel, or simultaneous operation or execution in a manual or brochure for the computer.

**Note 4:** Do not include processors that are limited to input/output and peripheral functions (e.g., disk drive, communication and video display) when calculating “APP”.

**Note 5:** “APP” values are not to be calculated for processor combinations(inter)connected by “Local Area Networks”, Wide Area Networks, I/O shared connections/devices, I/O controllers and any communication interconnection implemented by “software”.

**Note 6:** “APP” values must be calculated for:

(1) Processor combinations containing processors “specially designed” to enhance performance by aggregation, operating

*simultaneously and sharing memory; or*

*(2) Multiple memory/processor combinations operating simultaneously utilizing “specially designed” hardware.*

**Technical Note:** *Aggregate all processors and accelerators operating simultaneously and located on the same die.*

**Note 7:** *A ‘vector processor’ is defined as a processor with built-in instructions that perform multiple calculations on floating-point vectors (one-dimensional arrays of 64-bit or larger numbers) simultaneously, having at least 2 vector functional units and at least 8 vector registers of at least 64 elements each.*