1031. cont'd.

1. f. Rotary input type shaft absolute position encoders having either of the following:
   1. A resolution of better than 1 part in 265,000 (18 bit resolution) of full scale; **or**
   2. An accuracy better than ± 2.5 seconds of arc;
2. General purpose electronic equipment:
   a. Recording equipment, as follows, and specially designed test tape therefor:
      1. Analogue instrumentation magnetic tape recorders, including those permitting the recording of digital signals (e.g. using a high density digital recording (HDDR) module), having any of the following:
         a. A bandwidth exceeding 4 MHz per electronic channel or track;
         b. A bandwidth exceeding 2 MHz per electronic channel or track and having more than 42 tracks; **or**
         c. A time displacement (base) error, measured in accordance with applicable IRIG or EIA documents, of less than ± 0.1 µs;
      2. Digital video magnetic tape recorders having a maximum digital interface transfer rate exceeding 180 Mbit/s, except those specially designed for television recording using a signal format standardized or recommended by the CCIR or the IEC for civil television applications;
      3. Digital instrumentation magnetic tape data recorders employing helical scan techniques or fixed head techniques, having either of the following:
         a. A maximum digital interface transfer rate exceeding 175 Mbit/s; **or**
         b. "Space qualified";

         Note

         1031.2.a.3 does not embargo analogue magnetic tape recorders equipped with HDDR conversion electronics and configured to record only digital data.
      4. Equipment, with a maximum digital interface transfer rate exceeding 175 Mbit/s, designed to convert digital video magnetic tape recorders for use as digital instrumentation data recorders;
      5. Waveform digitisers and transient recorders with both of the following:
         a. Digitising rates equal to or more than 200 million samples per second and a resolution of 10 bits or more; **and**
         b. A continuous throughput of 2 Gbits/s or more;

         Technical Note

         For those instruments with a parallel bus architecture, the continuous throughput rate is the highest word rate multiplied by the number of bits in a word.

         Continuous throughput is the fastest data rate the instrument can output to mass storage without the loss of any information whilst sustaining the sampling rate and analogue-to-digital conversion.
   b. "Frequency synthesiser" "assemblies" having a "frequency switching time" from one selected frequency to another of less than 1 ms;
   c. "Signal analysers", as follows:
      1. Capable of analysing frequencies exceeding 31 GHz;
      2. "Dynamic signal analysers" with a "real-time bandwidth" exceeding 25.6 kHz, except those using only constant percentage bandwidth filters (also known as octave or fractional octave filters);
   d. Frequency synthesised signal generators producing output frequencies, the accuracy and short term and long term stability of which are controlled, derived from or disciplined by the internal master frequency, and having any of the following:
      1. A maximum synthesised frequency exceeding 31 GHz;
      2. A "frequency switching time" from one selected frequency to another of less than 1 ms; **or**
      3. A single sideband (SSB) phase noise better than $-(126 + 20 \log_{10} F - 20 \log_{10} f)$ in dBc/Hz, where F is the off-set from the operating frequency in Hz and f is the operating frequency in MHz;

      Note:

      1031.2.d. does not embargo equipment in which the output frequency is either produced by the addition or subtraction of two or more crystal oscillator frequencies, or by an addition or subtraction followed by a multiplication of the result.
   e. Network analysers with a maximum operating frequency exceeding 31 GHz;

      Note

      1031.2.e. does not embargo "swept frequency network analysers" with a maximum operating frequency not exceeding 40 GHz and which do not contain a data bus for remote control interfacing.
   f. Microwave test receivers with both of the following:
      1. A maximum operating frequency exceeding 31 GHz; **and**
      2. Capable of measuring amplitude and phase simultaneously;
   g. Atomic frequency standards having either of the following:
      1. Long term stability (aging) less (better) than 1×10^{-11}/month; **or**
      2. "Space qualified";

      Note

      1031.2.g.1. does not embargo non-"space qualified" rubidium standards.
   h. Emulators for microcircuits embargoed by 1031.1.a.3.or 1031.1.a.9.

      Note

      1031.2.h. does not embargo emulators designed for a "family" which contains at least one device not embargoed by 1031.1.a.3. or 1031.1.a.9.

1032. Test, Inspection and Production Equipment

Equipment for the manufacture or testing of semiconductor devices or materials, as follows, and specially designed components and accessories therefor:

1. "Stored programme controlled" equipment for epitaxial growth, as follows:
   a. Capable of producing a layer thickness uniform to less than ± 2.5% across a distance of 75 mm or more;
   b. Metal organic chemical vapour deposition (MOCVD) reactors specially designed for compound semiconductor crystal growth by the chemical reaction between materials embargoed by 1033.3 or 1033.4;
   c. Molecular beam epitaxial growth equipment using gas sources;
2. "Stored programme controlled" equipment designed for ion implantation, having any of the following:
   a. An accelerating voltage exceeding 200 keV;
   b. Specially designed and optimized to operate at an accelerating voltage of less than 10 keV;
   c. Direct write capability; **or**
   d. Capable of high energy oxygen implant into a heated semiconductor material "substrate";
3. "Stored programme controlled" anisotropic plasma dry etching equipment, as follows:
   a. With cassette-to-cassette operation and load-locks, and having either of the following:
      1. Magnetic confinement; **or**
      2. Electron cyclotron resonance (ECR);
   b. Specially designed for equipment embargoed by 1032.5. and having either of the following:
      1. Magnetic confinement; **or**
      2. ECR;
4. "Stored programme controlled" plasma enhanced CVD equipment, as follows:
   a. With cassette-to-cassette operation and load-locks, and having either of the following:
      1. Magnetic confinement; **or**
      2. ECR;
   b. Specially designed for equipment embargoed by 1032.5. and having either of the following:
      1. Magnetic confinement; **or**
      2. ECR;
5. "Stored programme controlled" automatic loading multi-chamber central wafer handling systems, having interfaces for wafer input and output, to which more than two pieces of semiconductor processing equipment are to be connected, to form an integrated system in a vacuum environment for sequential multiple wafer processing;

   Note

   1032.5. does not embargo automatic robotic wafer handling systems not designed to operate in a vacuum environment.
6. "Stored programme controlled" lithography equipment, as follows:
   a. Align and expose step and repeat equipment for wafer processing using photo-optical or X-ray methods, having either of the following:
      1. A light source wavelength shorter than 400 nm; **or**