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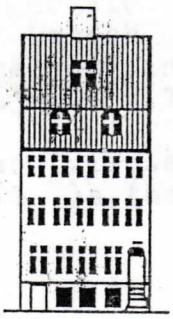

C.S.T. 'THOR' QL add-on, and the new THOR supermicro

The CST QL THor add-on, and the new THOR Supermicro is the result of more than 9 months planning, and technical discussions with officials from the former Sinclair Research Ltd. (SRL). CST approached SRL in order to promote an upgrade for the Sinclair QL (Registered trademark of Sinclair Research Ltd.). This proyect became known as QL Enigma, or internally QL TASH.

Unfortunately, SRL never decided what to do with our proposal, and we decided to carry on, on our own, a few weeks before SRL was bought by Amstrad Consumer Electronics. As a result of the support of Eidersoft, the Danish distributor Dansoft, and hundreds of QL users we are now in the position to offer the ultimate add-on for the SRL's QL : The CST THOR add-on.

The following is a detailed discussion of the specifications of the THOR add-on, as well as the planned THOR 68020 based supermicro.

Hardware: general description:

Intended to offer a coherent upgrade path from Sinclair's 8/16 bit QL to a full 32-bit microcomputer, the C.S.T.'THOR' add-on is a modular expansion system which adds all of the existing C.S.T. peripherals for the QL, an attractive case, a detached IBM standard keyboard, an internal power-pack to either the existing QL main circuit board, or optionally future C.S.T.'s own full 32-bit supermicro board.

Other hardware options include one or two 3.5"discs (either floppy or winchester), a 3 button mouse, and application software in ROM (WIMPS, ICE plus).

Further expansion is properly provided for, with a QL compatible connector for a single peripheral card and an external 4-slot card cage for more complex applications.

The standard **SCSI** (Small Computers Standard Interface) interface permits the addition of other peripheral devices, and is used internally by the C.S.T. 20 MByte winchester disc. Up to 8 devices can be supported by this SCSI interface, subject to the existence of the necessary device drivers thaht must be written to support them.

Typically CD-ROM (compact disc) readers, WORM (Write Once, Read Many times) and Tape Stremers systems is supported by C.S.T. in due course, but the SCSI interface is not restricted to data storage devices alone.

Application software:

The most important aspect is without any doubt the agreement reached between C.S.T., EIDERSOFT, DANSOFT and PSION Ltd. This agreement include the bundling of the new suite of THOR XCHANGE version 3, (PSION integrated programs :QUILL, ABACUS, ARCHIVE, EASEL) with a very user friendly interface: XCHANGE, and a very powerful Task sequencing Language, TSL.

TSL allows the batch operation, and keyboard response smulation of any of the 5 programs of XCHANGE. This facility allows the development of easy and comprehensive demos and tutorials.

Further details are provided in App. 1.

Minimum Hardware Specification of main P.C.B.

Logic design and implementation.

Based on the existing C.S.T. product line, the main P.C.B. of the THOR system uses programmable logic arrays to implement the high-speed hardware needed to satisfy the critical timing of the later 32-bit processor.

This approach allows a considerable degree of performance in hand, to cope with the production variations experienced on the QL main board. By bringing all of the hardware functions together on one board, C.S.T. have been able to reduce the redundancy involved with multiple cards, and to remove the over-engineering needed to ensure that a loose card will always work properly in any QL.

This has produced a cost-effective design, which is also remarkably reliable, when built in production quantities.

512K Dynamic Add-on RAM.

Implemented as 16 256Kx1 CAS before RAS refresh parts with no wait-state operation and fully transparent refresh.

Adds the maximum amount of RAM possible to the standard QL to give a total of 640K bytes.

ROM sockets.

Six 32K ROM sockets (192 Kb) are provided. Two are reserved for C.S.T. + Eidersoft software (device drivers etc) and the remaining four are available for applications software, providing that at least the lowest ROM in the set follows the existing QL method for the linking in of the contents.

Keyboard interface.

A serial bidirectional interface is provided to allow the use of a standard IBM PC-AT Keyboard. The keyboard is connected to the machine through an extensible lead to a socket on the rear panel.

A software device driver is provided in ROM to give all of the original QL functions with improved use of the extra keys available on this Keyboard. The foreign character sets and corresponding keyboard configuration is catered for.

Parallel (Centronics) interface.

A 'Centronics compatible' interface is provided on the machine, with a 26 way connector on the rear panel. Device driver software is provided in ROM to duplicate the functions of the C.S.T. Q-PI interface card, which include buffered printer spooling and screen dump utilities.

Mouse Interface.

A standard DB-9 socket is provided on the rear panel of the machine to allow the use of a 3-button TTL Mouse. Device driver software is provided in ROM to allow simulation of the effect of the certain normal keys (at a rate dependant on the range of movement of the Mouse) or to move a specific 'pointer icon' over the screen area. The buttons are user-definable to simulate any normal keyboard entry.

Real-Time Clock.

A battery-backed real time clock is included, with device driver software in ROM to replace all of the existing QL date and time functions. This permits the every-day use of the machine to proceed without interruption by the need to re-set the date every time the machine is started up. In turn this allows the proper date-stamping of files, which simplifies the regular backing up of data by only saving copies of files which have been modified since the system was turned on.

In plain terms this means that the user will be able to take 'incremental backups' of the files as they are modified. This user friendly feature is a must, when using a Winchester based configuration (Everey generation of full backup for a 20 Mb winchester requires at least 28 DS DD 720 Kb floppy discs!).

Floppy Disk Interface.

A standard double-density interface is provided to support floppy-disk drives, using the C.S.T. disk format as on the well known Q-Disk product. One or two internal drives are supported (the interface supports up to 4 drives), and the device driver software in ROM will include all of the existing disc functions and the fast new generation of RAM-DRIVE utility, that does not require preformatting in order to be used.

QL compatible expansion slot.

An expansion slot is provided at the rear of the machine, to allow the use of any existing QL expansion card which fully meets the technical specification of the QL expansion system.

This connector will carry a 5 volt power supply to drive the external card. Only cards which will operate directly on this voltage should be connected.

A maximum of one TTL load can be driven per signal from this port. C.S.T will produce a buffer card which will permit the port to be used with up to four existing expansion cards mounted in a remote housing and independantly powered.

SCSI interface port.

Designed to support the SCSI standard for up to 8 peripheral devices the C.S.T. SCSI port is implemented using programmable logic arrays. Device driver software in ROM will replace that supplied with the floppy only systems, and will contain a number of enhancements more suited to the easy use of the increased amount of data storage available. A hierarchical filing system and data management utilities are some of the enhancements.

The SCSI bus is available at the rear panel via a 34 way connector to simplify the addition of external devices for which device drivers exist. C.S.T. will support several such devices as they become available, and the necessary drivers will be included as standard in the later issues of the floppy / SCSI ROM.

Data transfer rate is dependant on the processor controlling the system, as DMA is not used. The standard QL is limited to approximately 1.5 MBits per second, rather less than the full data rate possible over the SCSI bus, however the buffering of typical SCSI devices allows asynchronous transfers to be used, which stops 'lock-up' of the machine during disc accesses, and gives a much more pleasant effect.

The new THOR 32-bit Supermicro board will be able to run at much higher speed, and can read from a buffered winchester disc at a rate almost equal to the 5 MBits per second data rate of the drive, allowing fully transparent disc operations to be handled as a background task.

Other important software features

The mayor changes and corrections to the standard QDOS (a registered trademark of SRL) as provided by Qjumps Toolkit II and the front edn user interface ICE (Icon Controlled Environment) in an enhanced version are provided.

The Toolkit II EXEC command now performs correctly Supercharge compiled tasks.

In addition to these improvements, CST+Eidersoft WIMPS environment is a standard feature. At any moment a press of the SYSTEM REQUEST (BREAK) key will allow the user to perform a series of job control functions, screen dump, etc.

Some other problems, of relevance for the QL users in the continent (MGx type of ROMS) will also be catered for. Some of the mayor improvements are mentioned her:

(MGx ROMS only):

- The serial driver will allow the correct translation of foreign characters (using the TRA 1 option) also when transmitting/receiving with 7 bits.

- The double pixel problem is corrected.

- The names of the months and days of the week are now in the local national language.

C.S.T 32-bit Supermicro board (enhanced QL replacement).

Central processor.

Intended to provide an improvement in performance compared to the normal QL main board, the C.S.T. Supermicro board will be built around the Motorola 68020 R 12 32-bit processor unit running at a 10.66 MHz clock rate. This device is a pin-grid array with non-multiplexed 32-bit address and data busses for the highest speed of operation.

Compared to the standard 68008 device used on the QL board, which operates at 533 nS per 8 bit-read; the 68020 takes 282 nS per 32_bit read, an improvement rate of over 7.5:1.

This comparison is related to operations taking place with no wait-states. Further gains exist however due to the revised mode of Video refresh used by the supermicro board, expressed as the percentage of the overall bus bandwidth used, the QL overhead is 66%, the 68020 board is 19% with enhanced Video modes available, hardware window control, etc.

Maths co_processor.

Maths operations will optionally be supported by the Motorola 68881 R 12 80-bit floating-point co-processor device. Also a pin-grid array component, this device offers full IEEE-802 compatible floating-point mathematics support plus a number of facilities for transcendental functions which are additional to the minimum specified by the IEEE committee.

Calculations can be carried out in Single precision (similar to the QL), Double precision, or Extended precision modes, giving a choice between speed and accuracy.

Maths emulations is carried out in software on systems not fitted with this co-processor, and will be slightly faster than those on the QL despite the increase in precision used. Speed gains of between ten and a hundred times are typically achieved with the co-processor installed, dependant upon the exact calculations being carried out.

System ROM.

A single ROM socket will be provided, allowing the processor to restart at power-on. This will use the processor's 8-bit bus-size mode, but carries a speed penalty of 4:1 compared to the full 32-bit RAM. For this reason the chosen operating system will be loaded from disc into RAM and executed there.

This approach also allows the re-allocation of the system's interrupt vectors into RAM, which will allow them to be dynamically re-configured during the operation of the machine.

Applications software and device-drivers on the main expansion board will be supported, but for similar reasons new versions of the code will operate more quickly from RAM.

System RAM.

A minimum of 1 Megabyte of dynamic memory will be installed, with a further Megabytes being optional. This will be installed as banks of 32 256Kx1 devices due to the full 32-bit width of the data-bus. The memory devices will use the CAS before RAS refresh mode to allow completely transparent operation without the insertion of wait-states.

All on-board RAM memory will be dual-ported with the Video circuitry to reduce the overhead inherent in screen display reads. A full line buffer will also be provided to allow the asynchronous assembly of data from different areas of the main memory for display on the same Video line, when several windows are being displayed at once.

Video display.

It is intended that a superset of the existing QL Video modes will be available, taking better advantage of the possibilities of a standard R-G-B Video monitor. Pixel rate will be increased to allow the display of 512 pixels within the standard line timing of 48 microseconds (a pixel rate of 10.66 MHz) which removes the need for specially adjusted monitors.

Serious applications will require at least the highest of the standard QL resolutions so it is proposed that a new mode with 512x256 pixels in 8 colours will be provided, and possibly also a 512x512 mode using full interlace. (requires a Video monitor with a long persistance tube to stop objectionable flicker).

It is not proposed to support the QL's TV output, as the system is unlikely to be used with low resolution text, and the limits imposed on bandwidth within a Television (5 MHz) will not permit the adequate display of higher resolution modes. The pitch of the phosphor matrix on a domestic television tube (0.43 mm typically) cannot resolve 512 pixels per line on less than a 22 inch (diagonal) tube, but this theoretical performance is unlikely to be realised on a domestic television due to convergence errors.

If you are in doubt, please remember that the Teletext format gives a good indication of the maximum practical definition on a T.V. set, being 320 pixels by 256.

Video monitor (R-G-B-Sync inputs TTL levels).

The minimum adequate resolution on a typical 14" shadow-mask monitor tube trequires a phosphor triad pitch of no more than 0.31mm and a video signal bandwidth of at least 15 MHz. (the medium resolution Microvitec is a good example). With the maximum convergence errors at the screen corners no more than 1 mm.

Hardware Windowing.

Hardware will be provided to allow each window to be drawn from a different part of the main memory. This will allow a window to be re-sized or removed with fully automatic re-instatement of whatever it previously obscured on the display. This is intended to reduce the overhead involved in re-drawing the screen when windows are changed.

Serial ports / Networking.

With the increase in single-user computing power available with the C.S.T. Supermicro board, it is anticipated that a number of applications will arise where diskless workstations will be required, operating with a central storage system. To implement this properly requires an intelligent network interface card on each machine in the cluster, and a full multi-user operating system to handle the interchange of data between machines on demand.

Provision will be made on the supermicro board for the later installation of such a communications card. Network data transfers will be handled by synchronous ring hardware, using dual twisted pairs of conductors between nodes. Clock and data information will be transmitted simultaneously, to reduce propagation errors.

Male and Female connectors will be provided for the incoming and outgoing data lines, allowing a node to be removed or added at any time. Each machine will require it's own identification number on the ring, and this will be switch selectable on the interface. Data will be passed round the ring in 'packets', variable in size to improve the efficiency of the system, including information about the sender and the adressee, type and amaount of data, and a checksum.

Packets will be automatically re-transmitted by each node until they circulate round the ring to reach the addressee, they can then be acknowledged to the sender as soon as the checksum has been verified. A gross data transfer rate of 250 KBits per Second is intended, allowing practical transfers of just under 30 KBytes per second with verification. (Faster than a floppy disc transfer). Maximum cable lengths of 100 metres will be supported between nodes, with longer distances being split in multiples of this length, with low-cost repeaters inserted between cable-lengths.

The serial ports of the QL will also be replaced by this card which carries two programmable RS-232 interfaces using standard DB-25 connectors. Full modem control will be provided on this interface, allowing any standard external hardware to be used.

Baud rates from 50 to 19200 will be available, with word length and parity selectable to suit the external equipment.

Other QL fuctions replaced by the Supermicro board.

System clocks will be generated by the supermicro board, with an increase in the speed compared to the standard QL. The CPU clock (CPUCLCK) will now be 10.66 MHz instead of 7.5 MHz, and 'E' will be at 1.34 MHz instead of 750 KHz. Any peripheral card using 6800 type devices on the 'E' clock will probably run correctly if the devices used are the 'A' or 'B' grade. Many devices of the lowest grade available will operate satisfactorily despite theoretically being 34% over-speed.

Peripheral cards built to the Sinclair specification for QL accessories should not use SYSCLK for any critical part of their operation, however many simple designs do not include their own clocks, and may not therefore operate correctly.

The real-time clock function of the QL has already been taken out of use by the installation of the battery-backed unit on the main

The existing beeper will be retained on models based on the QL, but there are presently no plans to duplicate it on the full 32-bit system, as a proper programmable sound generator can be (optionally)implemented on the Supermicro board.

Mechanical changes:

Due to the enhancements to the hardware inherent in the C.S.T. Supermicro board, it is necessary for the rear panel of the basic THOR model to be replaced when the upgrade is installed.

This allows the re-allocation of panel space for the range of new connectors.

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