

implementing computer control

340

THE TRW-340 CONTROL COMPUTER SYSTEM



Thompson Ramo Wooldridge Inc.
TRW Computers Company (division)

THE TRW-340 CONT

The TRW-340 is a high performance control computer that combines advanced computer technology with the practical requirements of automatic control. The TRW-340 employs core memory for high speed; for high volume, an auxiliary drum memory is used. As a result, the 340 is a **fast** and **versatile** machine, **flexible** in makeup and **field-expandable**. And like all TRW computers, the 340 is highly **reliable**. In short, TRW-340 provides exceptional computing capability at moderate cost.



FAST Completes typical programs at a rate of over 70,000* operations per second.

VERSATILE Standard features in the TRW-340 include indirect addressing, relative transfer, and operation extension. Relative transfer is a hardware facility that automatically modifies address portions of instructions during drum/core block transfers; with the 340, *any* program can be transferred to and executed from *any* location in core memory. Operation extension is an instruction format that allows up to 320 interpretive instructions or subroutines to be executed without housekeeping, as though they were wired-in commands.

FLEXIBLE The range of core and drum memory sizes and the number of inputs and outputs available mean that the TRW-340 can be tailored to the user's application.

FIELD-EXPANDABLE Core memory: to 65,536 words. Auxiliary drum memory: to 131,072 words. Input-output capacity: can be increased at will by addition of modular plug-in units.

RELIABLE Design is based on reliability proved in the field with successful control computer installations, installations that have logged over 600,000 hours of on-line operation with total equipment uptime better than 99 percent.

* Assumes 50% of 12-microsecond instructions, 35% of 6-microsecond instructions, and 15% of divides, multiplies, and shifts that average 40 microseconds. (The percentage of 6-microsecond instructions will be higher in many programs, since immediate addressing allows a substantial number of operands to be included in instructions, thus eliminating memory access.)

CONTROL COMPUTER SYSTEM

CHARACTERISTICS

GENERALIZED OPERATION LIST

Total of 173 basic operations. (Breakdown shown in parentheses in listings below.) Over 700 variations of basic operations are used.

GENERALIZED OPERATION LIST	Operating Time, Microseconds	
	Direct Address	Immediate Address
Register Transfer (47)	6	—
Load (13)	12	6
Add, Subtract, Decrement Index (8)	12	6
Branch (14)	6	—
Extract, Merge, Exclusive Or (3)	12	6
Store (14)	12	—
Compare (4)	12	—
Program Control, Input, Output (43)	6, 12, 18	—
Multiply (n multiplier bits) (1)	12 + 2n	6 + 2n
Divide (n quotient bits) (1)	18 + 2n	12 + 2n
Shift (n places) (15)	8 + 2n	—
Search (4)	6 + 6/word	—
Compare Tables (4)	6 + 12/word	—
Binary to BCD, BCD to Binary (2)	90 (av) for 7 BCD's	—
Typical Operation Extension Instructions		
Floating Point Load	42	—
Floating Point Store	78	—
Floating Point Add	478	—
Floating Point Subtract	478	—
Floating Point Branch	48	—
Floating Point Multiply	316	—
Floating Point Divide	348	—

SPECIFICATIONS

CORE MEMORY—4,096 to 16,384 words, in blocks of 2,048 words. Additional switchable blocks of 4,096 words to a total of 65,536 words.

DRUM MEMORY—8,192 to 131,072 words, in blocks of 4,096 words.

DATA WORDS—28 bits, including sign (plus one parity bit on all memory operations).

INSTRUCTION FORMAT—Two fields: a 14-bit operation field and a 14-bit operand field.

ADDRESSING—Sequential single-address. Direct, indirect, and immediate (operand) addressing.

NUMBER SYSTEM—2's complement binary.

OPERATION—Arithmetic, control, and core memory circuits: Parallel. Magnetic drum memory circuits: Serial.

CLOCK FREQUENCY—Arithmetic, control, and core memory circuits: 478 kc. Magnetic drum memory circuits: 239 kc.

REGISTERS—Six major arithmetic unit registers. Three index registers. Additional registers are included for communicating with peripheral equipment.

ENVIRONMENTAL CONDITIONS—Designed for operation to 120°F. Power consumption 2000 watts.

CABINETS—Assembled in four (or more, as required for each installation) vertical rack-and-panel cabinets bolted together to form a convenient package. Each cabinet is 84 inches high, 23 inches wide, and 24 inches deep. Rugged industrial construction is used throughout.

SOFTWARE—Features PROCOMP, an integrated software system especially designed for process control programming, and compatible with all other major language formats. PROCOMP includes FORTRAN II, utility package, assembler, compiler, and complete library of subroutines and interpretive routines. PROCOMP also extends machine capabilities to scientific and general-purpose applications.

INPUT/OUTPUT SUBSYSTEMS—The TRW-340 control computer system includes a complete range of peripheral input/output equipment. The system can accommodate over 1000 analog inputs, over 100 analog outputs, and over 3500 digital (contact-closure) inputs and outputs.

PRIORITY INTERRUPT—A priority interrupt subsystem distinguishes automatically between over 100 levels of priority.

The TRW-340 design is based on experience, the unparalleled experience of the company that has designed and installed more control computer systems than anybody else in the field: TRW Computers Company. This experience is your assurance of control system performance and reliability. For further information concerning TRW-340 (and TRW-330) computer systems for specific industrial control problems, call or write any of the TRW offices listed on the back cover of this brochure.

Sales Offices in Principal Cities

TRW Computers Company, 8433 Fallbrook Avenue, CANOGA PARK, CALIFORNIA—telephone 213-346-6000

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