



CMC 3/5 KeyProcessing® Systems

## General Information





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## SYSTEM OVERVIEW

CMC 3/5 KeyProcessing<sup>®</sup> Systems provide data processing managers an alternative to the spiraling costs of data preparation in small- to medium-scale installations and remote sites for source data entry.

They provide high volume throughput for distributed data entry applications in which data is entered from electronic keystations onto a magnetic disk under control of a dedicated computer. When data batches have been completely written, processed, and verified, they are transferred on command to the mainframe computing system via data communications or magnetic tape, ready for mainframe processing.

Batches can be prepared at remote CMC 3/5 Systems and sent to a central CMC KeyProcessing System or directly to a mainframe computer via the dial-up switched network or dedicated lines at transmission rates up to 19,200 baud.

CMC 3/5 KeyProcessing Systems reduce the overall cost of data management by:

- Increasing operator productivity.

When a CMC 3/5 System replaces previous methods, users have reported productivity gains averaging between 20 and 50 percent for individual jobs within the installation's mix of applications. These gains are achieved through faster and more accurate keying, operator acceptance, reductions in verification workloads, and automated procedures.

- Reducing demand on the mainframe.

Batches of data are quality controlled by the system at every stage of preparation. When a batch is transferred from disk to tape, it is automatically formatted and labeled for its mainframe application and is in every respect ready for processing.

- Helping management control costs and schedules.

The system's computer monitors all activity taking place anywhere in the system and generates reports that analyze performance by keystation, operator, batch, and shift.

- Optimizing data communications.

TeleBatch<sup>™</sup>, a powerful data communications system, allows users to take full advantage of the CMC 3/5's efficient data preparation methods and then transmit preprocessed data batches to another TeleBatch-equipped system or directly to a mainframe. TeleBatch also permits a CMC 3/5 System to receive data from a mainframe for printing or additional processing. TeleBatch lowers the cost of data communications to only a fraction of what it is when slower card-oriented terminals are used. TeleBatch also increases data management options by permitting remote job entry and control of output printing.

## APPLICATIONS OVERVIEW

CMC 3/5 Systems can be profitably used in any production keying environment—there is literally no limit to the kinds of data that the system can handle efficiently. Some examples of typical job stream characteristics which could be handled by a CMC 3/5:

- Volume of keying is large.
- Throughput time is critical.
- Keying accuracy is critical.
- Records are complex.
- Source documents are either unusually long or very short.
- Not all fields need to be keyed and/or verified.
- Fields within a record are interrelated.
- Records contain a mix of constant and variable data.

Data entry installations in which these characteristics are common abound throughout business, finance, government, and education. The following representative examples, taken from CMC's customer files, show how some CMC customers are using CMC 3/5 KeyProcessing Systems.

In Finance . . . where millions of dollars ride on the speed and accuracy with which stock market transactions are processed . . . and where it is imperative that the complex mix of banking services (such as payroll, general accounting, and check reconciliation) be handled for a large number of customers, under severe time pressures, with near-perfect accuracy.

In Manufacturing . . . where high volumes of sales and parts orders must be processed daily . . . and where complex records must be entered for production scheduling and control, parts listing, and inventory management.

In Education . . . where lengthy, complicated student registration records must be processed in very short time frames.

In Government . . . where millions of individual tax returns must be processed virtually overnight.

In Insurance . . . where very large volumes of claims must be processed accurately . . . and where thousands of accounts are updated and reconciled every day.

In Retailing . . . where customer billings for department stores must be updated and processed within hours after the closing of a billing period.

In Transportation . . . where huge volumes of tickets and air freight billings must be processed around the clock.

In Utilities . . . where interrelated records involving meter readings, billings, and check reconciliations must be continually processed virtually without error.

## **HARDWARE**

The basic CMC 3/5 System includes from one to 16 keystations; a supervisory console housing a small general-purpose computer, magnetic disk unit, and magnetic tape unit; and a freestanding teleprinter. This basic configuration can be expanded to include either an 80-column or a 132-column line printer for high-speed printouts of batch and tape listings and supervisory reports. Wherever the data entry function is distributed over a number of separate locations, a TeleBatch™ data communications system can be added to retain the efficiency and accuracy inherent in keying data at its source, without sacrificing centralized control over quality and procedures. With TeleBatch, a remote CMC 3/5 System can communicate with another KeyProcessing System or with a mainframe computer over the dial-up switched network or a dedicated line.

## **KEYSTATIONS**

Because source data can be entered, updated, processed, and verified — under computer control — through the same multipurpose keystations, data preparation is faster and fewer input stations are required.

CMC 3/5 Systems support up to 16 CMC 103 video or CMC 105 panel display keystations. Or the user can intermix video and panel display keystations in the same system.

CMC 103 and 105 keystations are compact, desktop units with identical electronic keyboards but different types of display panels. The CMC 103 has a 9-inch CRT that can display a complete 112-character data record plus 16 characters of mode and status information. These video displays guide an operator through various data entry functions and permit the visual verification of keyed data.

The CMC 105 keystation has a display panel with indicators that light to show an operator in simple English the current mode and status of the keystation, including error conditions. The displays also show the last character keyed and the number of the column of field in which the next character will be entered.

Because the keyboards of both types of keystations are arranged in the standard keypunch style, operators can transfer from a keypunch device to a CMC 103 or 105 with only a few hours of training.

Keystations are almost noiseless. Operators hear only a quiet, adjustable click, which has been built into the system to help them maintain a steady keying cadence. A two-key rollover feature reduces errors and speeds up keying by allowing an operator to strike a key before the previous one has been released.

## **SUPERVISORY CONSOLE**

All data preparation is controlled from a supervisory console that provides an ample work surface. A supervisory control panel mounts on top of the console, which houses the system computer, magnetic disk unit, and magnetic tape unit in addition to various electronic control circuits.

### **Control Panel**

Pushbuttons on the supervisory control panel enable the supervisor to start and stop the system, load program tapes, and initiate call-up of a variety of status reports for listing on the teleprinter or optional line printer. Indicators on the control panel signal the status and mode of the system.

### **Computer**

A high-speed digital computer that performs more than 500,000 operations per second controls the CMC 3/5 System. The unit, mounted in the supervisory console, comes equipped with an expandable core memory and a CMC-developed software system.

The computer operates in a partitioned environment. Input data is processed in real time in the foreground partition. Lower priority tasks, such as the listing of reports on the teleprinter or line printer and the transfer of records from disk to tape, are performed in the background partition.

### **Magnetic Disk Unit**

A magnetic disk unit in the lower drawer of the supervisory console stores the system programs, files, and libraries, and serves as temporary storage for batch data.

As keyed data is received from the computer, the system allocates storage area automatically and dynamically, track by track, on an as-needed basis. This data is recorded on both surfaces of an IBM 2315-type removable disk cartridge. User data storage capacities range from 6000 to 200,000 112-character records.

A separate format library capacity can include up to 480 main/alternate (single) formats. In addition, multiple format groups, each with up to eight format levels, can be defined. An indicator on the supervisory control panel signals when 75 percent of the available capacity has been filled. A system interlock automatically inhibits further keying, without loss of data, when storage consumption exceeds 99.9 percent.



## **Magnetic Tape Units**

Completed batches of data are transferred from the disk to a magnetic tape unit in the upper section of the supervisory console. The tape unit can also be used to read input files to disk for subsequent updating. The CMC 3/5 system accommodates any one of five models of tape unit so that users have a choice of tracks, densities, speeds, and reel sizes. These include 7-track units with densities of 556/800 bpi and 9-track units with densities of 800 and 1600 bpi.

## **DUPLEX CONTROL UNIT**

CMC 3/5 Systems normally function independently of one another, each supervisory console servicing its own complement of one to 16 keystations. In a two-system installation, however, an optional switching arrangement permits keystations from one system to be cross-connected to the supervisory console of the second system. To implement this arrangement, a CMC Duplex Control Unit is added. Connections are made by quick-disconnect cables and can be changed without the assistance of CMC personnel.

The duplexing capability ensures that operation continues uninterrupted during scheduled periods of routine preventive maintenance or at any time special service is required for one of the consoles.

## **TELEPRINTER**

A standard Model 33 teleprinter serves as the principal communications link between the supervisor and the system. Instructions entered through the teleprinter control the transfer of data from disk to tape, establish new record formats or modify existing ones, and clear batch data from the disk. The supervisor can also call up a variety of status reports for listing on the teleprinter. These reports provide a permanent record of work in progress, work accomplished, operator production rates, and system status.

## **LINE PRINTER**

A high-speed line printer added to the basic system boosts overall system efficiency by making supervisory reports run up to 30 times faster than they run on the teleprinter. The CMC 3/5 can drive either a CMC 761 80-column printer or CMC 762 or 791 132-column printers. All are freestanding printers that can run concurrent with keying operations without affecting keystation responsiveness. Rated speeds are 356 lines per minute for the CMC 761 printer, 300 lines per minute for the CMC 791 printer, and 600 lines per minute for the CMC 792 printer.

## **DATA COMMUNICATIONS**

### **TeleBatch™ Data Communications System**

The TeleBatch hardware and software system adds the on-line remote processing capabilities of IBM 2780, 3780 or 3741 type terminals to the off-line data entry capabilities of CMC 3/5 systems. TeleBatch supports remote batch transfer, remote job entry, and remote output printing.

With the basic TeleBatch System, data can be communicated over the dial-up switched network or dedicated lines at rates from 1800 to 4800 baud. An optional hi-performance feature boosts the permissible transfer rate to 19,200 baud.

A TeleBatch System consists of a CMC 515 Bi-Synchronous Communications Controller (BSCC) – with dual 400-byte buffers – which mounts in the CMC 3/5 supervisory console, plus a complete software system. The user must furnish modems for all communications line interfaces as well as hardware and software for any telecommunications functions performed by the mainframe computer.

Under control of the BSCC the TeleBatch System prepares and transmits batches of data from a local CMC 3/5 system's disk or tape to another KeyProcessing system or to a mainframe computer. Similarly, it permits a local system to receive data files to be printed in hard-copy form or to be recorded on magnetic tape and rerecorded, in batch form, on the CMC 3/5 magnetic disk.

All communication is in EBCDIC code and observes IBM's Binary Synchronous Communication protocol. With TeleBatch, all CMC 3/5 Systems on-line with a mainframe computer emulate IBM 2780 Data Transmission Terminals.

IBM 3780-compatible compression capability and other optional enhancement features are available to increase system throughput, provide remote job entry capability, and add new types of network control.

## **SYSTEM FUNCTIONS**

Data is entered in accordance with a computer-controlled format into the CMC 3/5 System at keystations, processed in the computer, and stored temporarily on the magnetic disk. Automatic data editing occurs either at the time of original entry (foreground editing) or when a batch is closed (background data validation), depending on user requirements. As data is being rekeyed in the verify mode, the record originally keyed in the write mode is retrieved from the disk. The two versions of the record are compared keystroke by keystroke, and any differences are reconciled by the verify operator. The verified data is then returned to its original location on the disk. Batches of completed and verified work can be transferred at any time from the disk to the output tape.

Closed batches can be transmitted to a central KeyProcessing System or a mainframe computer via the TeleBatch System.

## FORMATTING

The CMC 3/5 record format is a master plan for controlling all operations performed on a data batch, from original keying until it is transferred to tape.

The format defines each field—by length and type of content—and it structures multilevel format groups. It also specifies fields to be automatically skipped, duplicated, or filled with left zeros. In addition, it specifies the type of editing to be performed—by field, record, or batch. If the format specifies that a certain field or record must be verified, then batches containing those formats cannot be accidentally transferred to tape without being verified.

The supervisor creates formats and enters them into the format library via a keystation or the teleprinter. Operators call up formats for new batches of work by simply keying in the format identification numbers. This action (program select) retrieves the formats from the disk file and stores them in the appropriate buffers in the computer's core memory.

Formats can also be entered by reading in a magnetic tape. In addition, a utility program copies the contents of the library onto a format tape, which affords a convenient method of entering complete sets of formats that were prepared on another CMC System.

The CMC 3/5 comes equipped with library storage for 100 record formats. Each format can contain up to 32 fields in a main format or 16 fields each in a main and alternate format. Each field, in turn, can contain up to 64 characters, except batch total or auto-balance fields, which can contain up to 14 characters. Optional features can bring the total to 480 single (main or alternate) formats.

The multiple format group feature gives an operator up to eight record format levels for use within a single batch. Each format level can contain up to 32 fields. Operators can key-select formats within a group at random or use a linking feature that cycles through the group automatically.

An optional reformatting feature allows an operator to key data as it is presented in the source document—from left to right and top to bottom, for example. If this format differs from that required by the user's mainframe processing program, the system's reformatting feature rearranges the fields at the time of batch output. Reformatting results in faster and more accurate data entry.

## **DATA ENTRY**

Data characters entered from the keyboard, when the keystation is in the write mode, are compared with the appropriate record format in the computer memory. If the entry is valid, the computer stores it in a data buffer dedicated to the keystation of origin.

Automatically maintained internal files keep track of the status and location of every batch of work entered into the system. Data entered without legal format or batch identifiers is automatically rejected, and the Illegal and Keyboard Inhibit indicators notify an operator.

During normal data entry, various format functions – such as field duplicating and skipping – are performed automatically at electronic speeds without breaking an operator's keying cadence.

By using various control keys on the keyboard, an operator can read previously written data without destroying it. The operator can also change data by simply backspacing over a character, a field, or an entire record and then keying the new data.

## **DATA VERIFICATION AND BACKGROUND DATA VALIDATION**

One of the main advantages of a CMC 3/5 KeyProcessing System is its ability to drastically reduce the time required to find and correct errors. While the methods used come under the general heading of "data verification", they are aimed at preventing operators from making errors as well as helping them correct errors after they have been made. The following methods are available.

### **Verification by Rekeying**

To verify data, an operator other than the write operator simply rekeys previously keyed records, either immediately after a record has been entered or after the entire batch has been completed. Operators at two different keystations can enter and verify the same batch concurrently. (The write operator must stay at least one record ahead of the verify operator.) An interlock prevents the write operator from interfering with the record being verified.

A complete record is retrieved from the disk as written and stored in the computer for comparison with data keyed during verification. If an error occurs, the keystation miscompare indicator lights, an audible alarm sounds, the keyboard locks, and the display indicates which character was keyed to cause the miscompare. An operator must either correct the verify record or, in effect, rewrite the original record. A verify operator need correct only the erroneous data, not the entire record.

## **Auto-Balance**

The auto-balance capability permits numeric data to be verified without being rekeyed. One or two auto-balance fields, with up to 14 positions each, can be specified in the record format. Control totals are entered at the beginning of the batch for each field to be balanced. The computer then decrements totals for these fields as each record is keyed. At the end of batch keying, the program tests the two totals for a zero balance. If the result is zero, verifying is unnecessary. If not, a message at the keystation notifies the operator and a message on the teleprinter notifies the supervisor of the discrepancy. Disk-to-tape transfer is automatically inhibited until the batch is corrected.

## **Check Digit Control**

The check digit control feature is a means of validating numeric data when it is entered so that it need not be rekeyed for verification. This program permits check digit control by the standard 7, 9, 10, or 11 modulus checks. In addition, many specialized application-dependent check digit schemes are available. An example is the CUSIP check digit for stock certificates. If the two check digits—one keyed and the other computed—are identical, the operator continues keying. Any difference between the digits indicates an error that the operator must correct before proceeding.

## **Other Data Validation Tests**

Using a validation format, the supervisor defines tests to be performed on the data after a batch is closed but before it is transferred to tape. Records are retrieved automatically from disk during data validation and processed according to the test sequence. Results of the tests are printed out by the teleprinter or line printer. Flags are inserted in records found to be in error to allow easy retrieval and correction by the verify operator.

Tests that can be performed under the data validation feature include crossfooting, balancing, totaling, field qualification, and value and range checking.

- Crossfooting

This check verifies that a specific arithmetic operation performed on predetermined fields in a record balances to zero. Crossfooting can also be applied to fields accumulated across a group of related records. If the result of a crossfoot operation is nonzero, a flag is set to indicate an error.

- Balancing

This operation verifies that the sum of detail items in a batch equals a predetermined control total. Balancing can also be applied to a group of records within a batch; each group is checked against its own control total. Balancing can be specified for up to 16 numeric fields.

- **Totaling**

The totaling feature generates totals and subtotals of selected fields in a group of records and prints them on the teleprinter. The group of records can be a portion of a batch, an entire batch, or a range of batches. This allows batches to be checked visually for accuracy and also generates control totals for subsequent processing operations.

- **Field Qualification**

This test ensures that designated data fields meet certain criteria such as all numeric, all nonnumeric, all space, nonspace, all special symbols, no special symbols, or any combination of these criteria. It also ensures that duplicated data has been correctly copied from record to record.

- **Value and Range Checking**

Value checks ensure that certain fields contain values specifically defined as valid for those fields. Range tests determine that values, as entered, fall within minimum and maximum limits established for those fields. Range and value checks are entered and stored in the system in a "range batch" that is listed, modified, and cancelled the same as a data batch.

### **Foreground Editing (PL/E) and Operator Prompting**

Increased throughput can be achieved by utilizing CMC's powerful foreground editing capability, PL/E (Program Language/Edit). The user applies PL/E by writing simple program statements in language similar to that of the CMC background Data Validation feature. The user can specify anything from a single test or prompt to a sequence of tests, arithmetic operations, logical operations, a retry count and a prompt. The edit table can consist of many short statements or a smaller number of larger statements.

Foreground editing programs are entirely core-resident. The system provides accuracy assurance with no time-consuming disk references to compromise operator productivity. Highlights of PL/E include:

- Range, value, and character testing
- Real-time arithmetic operations: add, subtract, multiply, and test for zero
- Must-enter, must-complete, and right boundary checking
- Logical operations for conditional testing within records, and across record boundaries
- Operator prompting messages for display on CMC 103 keystations
- Expanded capabilities for verification, field update, and treatment of program-detected errors

All features are accessible to any number of operators simultaneously, working on any mix of jobs.

## **Programming Language/Edit (PL/E)**

The user applies PL/E to foreground editing requirements by writing simple program statements in a language similar to that of the CMC Data Validation feature. The user can specify up to 255 edit statements in an edit table. A statement can specify anything from a single test or prompt to a sequence of tests, arithmetic operations, logical operations, a retry count and a prompt. The edit table can consist of many short statements or a smaller number of larger statements. Continuation records are permitted when edit statements are keyed into the edit table. The compiled edit table occupies a workspace in memory of approximately 3055 characters.

## **BATCH TRANSFER**

Because batch transfer is a background program, keystation operations can continue while the supervisor transfers data from disk to tape. Interlocks in the operating system prevent unverified data from being inadvertently written to the output tape.

If several operators have worked on the same job, thereby creating several batches on the disk, these individual batches can be merged and transferred as one file. The supervisor can also selectively transfer batches to create tape files for specific jobs.

The system provides a comprehensive set of conversion tables, which translate the keystation keytop symbols into standard magnetic tape codes used by every major computer mainframe manufacturer. The codes are software controlled and are translated automatically at the time of batch transfer. The supervisor selects the appropriate conversion table simply typing in a code identification letter at the teleprinter.

## **TAPE ENTRY**

This optional feature allows input data recorded on magnetic tape to be transferred to disk in batches organized the same way as batches entered through the keystation. The CMC 3/5 accepts computer-compatible tapes prepared either on CMC Key Processing Systems or on data processing systems. Once on disk, the batches can be manipulated in the same manner as batches entered through the keystations.

## **BATCH APPEND**

The batch append feature permits a keystation operator to close a batch being written or verified, go to other work of higher priority, and later reopen the batch immediately following the last record keyed.

## **SEARCH AND INSERT**

The CMC 3/5's search capability helps a verify operator quickly locate error records detected by mainframe edit runs and still on disk. The operator initiates the search by keying as much of the target record as is required to uniquely identify it. Successive records are then automatically retrieved from the disk until the target record is found. The operator can then key-verify the record, change its contents by rewriting, delete the record from the batch, or insert a new record between two existing records.

## **QUICKSTARTS**

The Quickstart procedure on the CMC 3/5 provides the supervisor with the capability to prestore responses to procedures and reports used in day to day operations. The system will allow the supervisor to combine several procedures into one quickstart or to interrupt and enter variable procedure entries and return back to the quickstart.

## **SUPERVISORY AIDS**

To help ensure tight control over all data entry operations, the CMC 3/5 KeyProcessing System blends human skills and machine capabilities. And through continuing interactions with the system, the supervisor performs important administrative and operational tasks more effectively.

As an administrator, the supervisor manages, assists, motivates, and guides keystation operators. In addition, the supervisor identifies possible system malfunctions and initiates automatic recovery procedures to prevent any loss of data or reports.

The supervisor turns the system on and off; loads, removes, and labels the tape reels; and initiates the preparation of machine-printed reports. The supervisor need not continuously monitor the system; an audible alarm sounds if supervisory attention is needed.

Certain reports and procedures help the supervisor maintain minute-by-minute control over all system operations. Other reports contain statistical analyses that can be used to evaluate operator and system performance, optimize procedures, and plan future improvements.

## **CONTROL REPORTS AND PROCEDURES**

Through controls at the supervisory console, and through person/machine dialogue conducted via the teleprinter, the supervisor initiates actions and requests information about work in progress. The following reports can be printed on either the teleprinter or line printer.



### **Batch Status Report**

Shows the status of batches in the system: open for write or verify, closed after write or verify, or transferred to tape. For example, the supervisor can ask the system which batches are:

- Written and verified
- Written but not verified
- Only partially verified
- Out of balance.

### **System Status Report**

Shows the operations currently in progress at each keystation: write, read, verify, program entry, or program select. It identifies the batch in process at each keystation. It also shows the amount of disk storage currently available for data.

### **Batch Transfer**

Transfers completed batches from disk storage to tape. The supervisor uses the teleprinter keyboard to specify tape code format, density, blocking, and other parameters that organize the data as required for mainframe programs. The teleprinter or line printer then produces a detailed log of all batches transferred to tape. The log is a permanent audit trail of batch output activity.

### **Event Log**

Produced on the teleprinter or the line printer, the Event Log indicates that a keystation operator has opened a batch, closed a batch, or entered a new record format. For each event the log shows the keystation number, batch number, record format number, and status code indicating the action taken. On systems equipped with the auto-balance feature, the log also lists the amount and the sign of any out-of-balance condition remaining when the batch is closed.

The Event Log can be printed in real time as events occur at the keystations. A storage area on the disk holds messages about events that occurred while the teleprinter was busy with other higher priority reports. When event-logging is resumed, the supervisor can request printout of any messages in the queue.

### **Batch Release**

Releases batches that have been transferred to tape, so the data storage can be reused. A log of all batches released can be produced on the teleprinter or line printer.

### **Save and Reload**

Allows all or portions of the contents of the system's disk to be "saved" on tape. This precautionary procedure requires only minutes to execute. It prevents the permanent loss of information accidentally erased from the disk. Data and directories can be reloaded on the disk from the "save" tape.

### **Record Format List, Store on Tape, and Enter from Tape**

These three utility routines allow the supervisor to:

- Print details of any record format stored in the disk library.
- Store all formats on magnetic tape for safekeeping.
- Read in a complete set of formats from a prerecorded magnetic tape.

All operations are noted in the log produced on the teleprinter or line printer.

### **Batch Format Alter**

Permits the supervisor to modify the record format of a batch already written on the disk. The supervisor can change the format of any field from verify to nonverify, or vice versa.

### **Program Load**

Enters a new system program from a CMC-supplied magnetic tape.

## **PERFORMANCE MEASUREMENT AND ACCOUNTING REPORTS**

Performance measurement and accounting reports—unique to computer-controlled data entry systems—are generated as byproducts of internal system functions. The reports can be used for:

- Evaluating operator proficiency and training requirements.
- Measuring overall system performance in terms of people, procedures, and equipment.
- Preparing highly accurate cost estimates.
- Generating accurate job cost details, especially important for "service" installations where job-by-job cost accounting is required.
- Analyzing actual vs. standard job costs.
- Forecasting workloads.

The CMC 3/5 System generates performance reports upon the supervisor's command at batch transfer time or at the end of a shift. More detailed reports, covering longer time periods, can be run on the mainframe computer; these are based on statistics developed by the system and are furnished on computer--ready magnetic tapes.



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