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SC21-7852-1 S5280-28

IBM 5280 Distributed Data System

DE/RPG Problem Determination Procedures for the Programmer

Program Number 5708-DE1

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Second Edition (June 1981)

This is a major revision of, and obsoletes, SC21-7852-0 and incorporates SN21-8196. Because the changes and additions are extensive, this publication should be reviewed in its entirety.

This edition applies to release 3, version 1, modification 0 of the IBM 5280 System DE/RPG (Program Product 5708-DE1) and to all subsequent versions and modifications. Changes are periodically made to the information herein; these changes will be reported in technical news-letters or in new editions of this publication.

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This publication could contain technical inaccuracies or typographical errors. Use the Reader's Comment Form at the back of this publication to make comments about this publication. If the form has been removed, address your comments to IBM Corporation, Product Information Development, Department 997, Austin, Texas 78758. IBM may use and distribute any of the information you supply in any way it believes appropriate without incurring any obligation whatever. You may, of course, continue to use the information you supply. This manual is intended to help the programmer and the service representative identify and isolate compiler problems or user program problems and to guide them to the appropriate action once the problem is determined.

This manual is divided into three chapters:

Chapter 1. Problem Determination identifies conditions that result in a compiler problem or a user program problem. This section identifies the problem and guides the service representative or programmer to the appropriate action. Also included is a list of information to send to IBM when a problem is reported.

Chapter 2. Debugging DE/RPG Programs describes the functions of the compiler and the organization, content, and logic flow of the object programs that are generated by the compiler. This section is intended mainly for the service representative, although the programmer can also use it to circumvent or investigate compiler problems.

Chapter 3. Debugging Options describes what is available on the system to aid in problem determination. Examples show how to interpret and analyze dumps.

RELATED PUBLICATIONS

- IBM 5280 DE/RPG Reference Manual, SC21-7787
- IBM 5280 Message Manual, GA21-9354
- *IBM 5280 Utilities Reference/Operation Manual,* SC21-7788
- IBM 5280 System Control Programming Reference/Operation Manual, GC21-7824
- IBM 5280 Operator's Guide, GA21-9364
- IBM 5280 Functions Reference Manual, GA21-9353
- IBM 5280 Data Areas and Diagnostic Aids Handbook, SY31-0595
- *IBM 5280 Communications Utilities Reference Manual,* SC34-0247
- IBM 5280-3270 Emulation Reference Manual, SC34-0384

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If you encounter a problem in compiling or executing a DE/RPG program, the information in this section can help you circumvent or solve the problem. If it does not and you decide to call your service representative to investigate the problem, this section can help you gather the information your service representative needs to solve the problem.

This section includes an *Identifying DE/RPG Problems* and a *Reporting DE/RPG Problems* description. The first description helps identify the type of DE/RPG problem that has occurred and what you can do to circumvent it, if possible. The second description provides information about the DE/RPG problem that you should gather before you call for service.

IDENTIFYING DE/RPG PROBLEMS

When a DE/RPG problem occurs, you can use the following series of questions to identify the cause:

Has the user program previously been compiled or run successfully?

NO YES

Consider what has changed. For example, have operating procedures changed, are new files being used, or have programs changed?

Is the current release of the DE/RPG compiler being used? (The release number is printed on the first line of the source listing.)

YES NO

In addition to using the current release of the compiler, make sure the latest utilities licensed program diskette (5708-UT1) that applies to the compiler release, is used during system configuration. Add any PTFs (program temporary fixes) and recompile the program.

Have all IBM-supplied programs on the utilities licensed program diskette (5708-UT1) that apply to the current release of the compiler been used during system configuration?

YES NO Use the current programs and recompile the user program. Have any non-IBM-supplied modifications been made to the compiler or to the utilities licensed program diskette (5708-UT1)?

NO YES

If the compiler has been changed, use the current release and programs, and recompile the program. If the utilities licensed program diskette has been changed, use the current release and programs for system configuration.

Did the DE/RPG compiler terminate abnormally?

NO YES

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Two conditions can occur whenever the compiler terminates abnormally:

One condition displays a system error, number 9999, along with the twocharacter module ID displayed on the status line.

The other condition displays DE/RPG and the two-character module ID.

In either case, record the module ID, address, and partition number displayed and report the condition to the service representative. In addition, record the size of the partition used.

Refer to *Reporting DE/RPG Problems* later in this section for a description of the information that you should gather before calling for service.

Did the DE/RPG compiler get in a loop while compiling a user program? (A loop is a set of instructions that executes repeatedly while a certain condition exists.)

NO YES

Report this condition to the service representative.

Refer to *Reporting DE/RPG Problems* later in this chapter for a description of the information that you should gather before calling for service.

Did the DE/RPG compiler generate any unexpected messages or errors?

NO YES

Review all warning messages and/or errors to ensure that they are not unexpected. Go to the source statement that produced the error and correct it. Recompile the program.

Error code descriptions are in the *DE/RPG Reference Manual*. If you cannot isolate the problem, refer to *Reporting DE/RPG Problems* described in this section, gather the information described there, and call for service.

Note: For service representatives, see *Chapter 3. Debugging Aids, Running the Dump and Trace Programs.*

Did the DE/RPG user program get in a loop during its execution, produce incorrect output, or unexpected messages at execution time? (A loop is a set of instructions that executes repeatedly while a certain condition exists.)

If you cannot solve or circumvent the problem, refer to *Reporting DE/RPG Problems* later in this chapter, gather the information described there, and call for service.

Refer to *Reporting DE/RPG Problems* later in this chapter, gather the information described there, and call for service.

REPORTING DE/RPG PROBLEMS

NO YES

When you identify a DE/RPG problem, refer it to IBM for service.

Gather the following information to help IBM personnel solve the problem.

Compile Time Error

Information to Gather	How to Obtain It
Original source program	SYSCOPY
Source program listing	SYSPRINT or a copy of the listing
Compile-time dump	Absolute dump at the time of failure
PTF log number of all changes made to the compiler and/or to the utilities icensed program diskette (5708-UT1)	SYSPTF-Patch Program (option 5, system history)
Level of the compiler	Source program listing
Level of the utilities licensed pro- gram diskette (5708-UT1)	Adhesive label on the diskette
Engineering change level of the machine	Displayed on the screen during IPL

Execution Time Error

Operation Manual.

Information to Gather	How to Obtain It
Original source program	SYSCOPY
User files required by the DE/RPG program	SYSCOPY
Execution-time dump	Absolute dump taken at the time of failure
DE/RPG object program	SYSCOPY
Description of processing environment	
Printed program output	
PTF log number of all changes made to the compiler and/or to the utilities licensed program diskette (5708-UT1)	SYSPTF-Patch Program (option 5, system history)
Level of the compiler	Source program listing
Level of the utilities licensed pro- gram diskette (5708-UT1)	Adhesive label on the diskette
Engineering change level of the machine	Displayed on the screen during IPL
For further information on the SYSCOF	Y utility, refer to the <i>Utilities Reference</i> /

For further information on the patch program, refer to the System Control Programming Reference/Operation Manual.

The information contained in this chapter requires that the reader have a knowledge of the DE/RPG compiler. This information is intended mainly for the service representative; however, an experienced programmer can also investigate DE/RPG problems with it, before or instead of calling for service. Information about the compiler, the object program organization, and the data areas are described here.

COMPILER

The following information about the compiler is described here:

- Phases
- Work files
- Error handling
- Module descriptions

Compiler Phases

The compiler consists of the following six major phases necessary to compile a DE/RPG source program into an executable object program:

- 1. Enter
- 2. Diagnostic
- 3. Assign
- 4. Preassemble
- 5. Assemble
- 6. Object

As each module of each phase is brought into the compiler overlay area, the previous module is overlaid. The following chart (Figure 1) shows the sequence of execution and a summary of each phase. Figure 2 shows the layout of the compile-time partition.







Figure 2. Compile-Time Partition Layout

Compiler Communications Area (CCA)

The CCA (compiler communications area) provides an area for information to be stored and passed from module to module during compilation.

The contents of the CCA are:

- Tables that point to each of the shared routines
- Compiler data set information
- Starting addresses of each compression type
- Selected information that pertains to the source program and the object program

Shared Routines

Shared routines are used by several modules of each compiler phase. SYSDERPG loads shared routines, which remain in the compile-time partition during most of the compilation.

Compiler Work Files

The compiler uses two work files. The first work file contains compressions of source statements (the compiler version of the source statements) from the Z-, A-, and C-specifications, and compile-time tables. Compressions are used by the compiler to determine the object code that is needed.

The second work file contains the object code that the compiler generates. During the object phase, the object code is moved from one work file to the other if the work file requires sorting; then the work file is written to the object file.

Compiler Error Handling

The compiler handles source errors during the enter and diagnostic phases.

The enter phase lists the error on the source listing immediately following the source statement that contains the error. Indicators record errors during the enter phase while the compressions are created from the source statements so that the error condition can be stored. Error compressions are updated with error numbers from the indicators that were previously set.

When the diagnostic phase completes, the error in the error compression is sorted and listed along with the severity of the error and the error message text.

Compiler Module Descriptions

The following text is a summary of each phase and the modules within each phase. The module identification name is found in the first 8 bytes of the partition IOB as the module executes its function. The module is overlaid with the next module called. (For a detailed description of the partition IOB, refer to the *Functions Reference Manual*.)

The compiler is stored on a diskette in two files; SYSDERPG and SYSCMPO. SYSCMPO is a partitioned data set and contains all modules described here except SYSDERPG.

Enter Phase

The modules in the enter phase perform initial processing of a DE/RPG source program. During this phase the source program is read and checked for proper syntax. The syntax check is not a complete check, further checks are done in modules of the diagnostic phases.

If a listing is requested, the source program is listed along with error messages for errors detected, and both are printed or written to a diskette data set.

Source statements are reformatted as compressions and written to a compiler work file for other phases to use.

The enter phase modules are listed in the following chart:

Module Identification	Partition IOB Program Name	Function
SYSDERPG	SYSDERPG	 Determines the device the compiler is loaded from. Initializes the compiler work area, shared control routines, IOBs, and buffers. Prompts for data set names, device IDs, and listing information. Opens data sets. Creates error compressions.
RGAC	DERPG AC	 Checks Z-specification source statements for errors. Reads and compresses Z-specification source statements. Writes these compressions to diskette.
RGAG	DERPG AG	 Checks A-specification source statements for errors. Reads and compresses A-specification source statements. Writes these compressions to diskette.
RGAH	DERPG AH	 Checks C-specification source statements for errors. Reads and compresses C-specification source statements. Writes these compressions to diskette.
RGAI	DERPG AI	 Checks compile-time data tables, file translation and alternate collating sequence table source statements for errors. Reads and compresses these source statements. Writes these compressions to diskette.
RGAJ	DERPG AJ	 Processes self-check source records. Reads and compresses these source statements. Writes these compressions to diskette.
RGEA	DERPG EA	 Loads and initializes shared routines for the remainder of the compile.

Diagnostic Phase

These modules process the compressions from the work file and provide further syntax checking for errors not found in the enter phase.

Keywords are prepared for the next phase (assign phase) by reordering and moving their parameters to parameter lists and reformatting the parameters.

The diagnostic phase modules are as follows:

Module Identification	Partition IOB Program Name	Function
RGEC	DERPG EC	 Checks syntax of keywords on the A-specifica- tions.
RGED	DERPG ED	 Checks syntax of keywords on the A-specifica- tions.
RGEF	DERPG EF	 Checks keyword compatibility with the A-speci- fications.
RGEH	DERPG EH	 Checks keyword compatibility and syntax on the A-specifications.
RGEJ	DERPG EJ	 Checks keyword parameter movement, syntax, and reserved word handling on the A-specifica- tions.
RGEO	DERPG EO	- Checks job line keywords on the A-specifications.
RGEP	DERPG EP	 Checks entry and review lines on the Z-specifications.
RGEQ RGER	DERPG EQ DERPG ER	
RGES	DERPG ES	 Checks C-specification fields.
RGFE	DERPG FE	 Checks keyword references on the A-specifica- tions.
RGFG	DERPG FG	 Checks field positions and record lengths on the A-specifications.
RGFM	DERPG FM	 Sorts and prints line numbers and associated error message numbers.
RGFL	DERPG FL	 Sorts and prints error message text.
RGFN	DERPG FN	 Contains the text for error messages used by DERPG FL.
RGFS	DERPG FS	- Checks C-specification references.
RGFX	DERPG FX	 Generates self-check table and checks keyword specifications for self-check specifications.
RGFZ	DERPG FZ	 Checks compile-time tables.

Assign Phase

The modules in the assign phase assign the object program information (such as constants, data fields, and tables) to storage addresses in the object program and assigns IOB numbers to files.

The assign phase modules are listed in the following chart:

Module Identification	Partition IOB Program Name	Function
RGIB	DERPG IB	 Assigns literals to storage addresses.
RGIC RGIE	DERPG IC DERPG IE	 Assigns data areas to storage addresses.
RGIG	DERPG IG	 Assigns literals to storage addresses.
RGII	DERPG II	 Builds literal/prompt and AUXDUP tables, and table dope vectors.
RGIJ RGIK RGIL	DERPG IJ DERPG IK DERPG IL	 Assigns file IOB numbers and accumulates file and record usage information. Builds logical file name block.
RGIM	DERPG IM	 Assigns tables to storage addresses.
RGIO	DERPG IO	 Builds compile-time data tables.
RGIS	DERPG IS	 Assigns block numbers and label numbers.
RGIZ	DERPG IZ	 Checks for undefined names in the source program.

Preassemble and Assemble Phases

Preassemble modules determine the type, length, and location of the object code that is to be created by the assemble phase.

The assemble phase builds the object code that the preassemble phase has determined from the source program, and places that code in the object program.

The preassemble and assemble modules are listed in the following chart:

Module	Partition IOB Program	
Identification	Name	Function
RGMA	DERPG MA	- Builds screen format control strings for all
RGMB	DERPG MB	records defined for the CRT file.
RGMC	DERPG MC	
RGMD	DERPG MD	
RGME	DERPG ME	
RGMF	DERPG MF	

Module Identification	Partition IOB Program Name	Function
RGMG RGMH RGMI	DERPG MG DERPG MH DERPG MI	
RGNA	DERPGNA	 Builds printer and diskette format control strings.
RGNZ	DERPG NZ	 Builds a table of addresses for screen format and diskette/printer format control strings.
RGPA RGPC	DERPG PA DERPG PC	 Determines which subroutines are needed by the object program and includes them.
RGQA RGQB RGQC RGQD RGQE RGQF RGQG	DERPG QA DERPG QB DERPG QC DERPG QD DERPG QE DERPG QF DERPG QG	 Builds the return-to-program exit code from the screen format control string.
RGQR	DERPG QR	 Builds the calculations entry to link the return- to-program exit code to calculations.
RGRA	DERPG RA	 Builds record level I/O control strings.
RGUA RGUB RGVA RG VB RG VC RGVD RGVE	DERPG UA DERPG UB DERPG VA DERPG VB DERPG VC DERPG VD DERPG VE	 Builds calculations code.
RGYA RGYB RGYD RGYF RGYG RGYH RGYI RGYJ	DERPG YA DERPG YB DERPG YD DERPG YF DERPG YG DERPG YH DERPG YI DERPG YJ	 Builds format control table and partition control block. Builds object code to link the following: Data entry driver and Z-specification driver. Job initialization and job termination. IOBs, buffers, file translate tables, and alternate collating sequence tables for diskette, keyboard, printer, and communications data sets.

Object Phase

The object phase assembles the object code into an executable object module.

The object phase modules are listed in the following chart:

Module	Partition IOB Program	
Identification	Name	Function
RGYZ	DERPG YZ	 Prints object program map and initializes parti- tion IOB areas.
RGZC	DERPG ZC	 Writes a load module to a data set.

OBJECT PROGRAM ORGANIZATION

The first part of the partition area contains fixed addresses relative to the start of the partition. The addresses are hex 0000 for the partition IOB, hex 0040 for the logical I/O table, hex 0080 for the keyboard display IOB, and hex 0100 for indicators and registers.

For a description of the partition IOB, logical I/O table, keyboard/display IOB, indicators, and registers, see the *Functions Reference Manual* or the *Data Areas and Diagnostic Aids Handbook*.

Indicators and registers that are assigned for DE/RPG programs are described in the following charts.

Indicator Assignments

Indicator

	•
10	File allocate at open time is not allowed
11-199	DE/RPG user indicators
1108	Keyboard external status disabled
1110	Foreground/background
1151	Enter (add) mode
1152	Attention/system request
1153	Open allocate
1192-1207	Test bits loaded into BR12 (all 16 indicators used this way)

Indicators for Modes

1208	Enter mode

- Update mode
- I210 Verify mode
- I211 Rerun mode
- I212 Prompt mode
- I213 Print or copy process mode

Meaning when On

- I214 Print key
- I215 Copy mode
- I216 Search mode
- I217 Search relative record
- I218 Search content
- I219 Search content forward
- 1220 Auto run, search content first pass mask, and updated statistics
- I221 Search parameter error
- I222 Record insert mode
- I223 Cancel key pressed

Indicators for Transaction Data Set

1224	Beginning of extent
1225	Beginning of extent plus 1
1226	First pass record backspace
1227	First pass record advance
1228	End of data
1229	End of data plus 1
1230	End of extent

Indicators for I/O Functions in the Data Entry Driver

1231	Clear next buffer
1232	Read next record
1233	Read previous record
1234	Write previous record
1235	Write record to extend file

Copy Data Set Indicators

1236	Beginning of extent
1237	Beginning of extent plus 1
1238	First pass record backspace
1239	First pass record advance
1240	End of data
1241	End of data plus 1

Miscellaneous Indicators

1242	Enter was canceled by the common area
1243	Transaction file = 0; copy file = 1
1244	Page forward
1245	Next format
1246	Select format
1247	Record correct
1248	Record changed in record correct
1249	Record marked
1250	Erase function key invoked
1251	I/O complete
1252	External status pending
1253	End of data in verify mode
1254	Last record written (in copy mode); last record verified (in verify mode)

Register Assignments

Register	Meaning
BR10	Field changed indicator
BR11	Field changed indicator
BR12	Used to test bits by indicators I192-I207
BR18	Partition subroutine stack
BR32	Register save area
BR37	Partition control block address
BR38	Key accept address area
BR39	Number of inputs and enter commands address
BR40	Transaction file IOB address
BR41	Print file IOB address
BR42	Copy file IOB address
BR43	Keyboard/display IOB address
BR44	Current read file IOB address
BR45	Address of IOB passed to the open routine
BR46	Previous record buffer address
BR47	Current record buffer address
BR48	Next record buffer address
BR49	Mask output area address
BR 50	Search mask area address
BR51	Format control table address
BR52	Current format pointer in format table
BR53	Status line buffer address
BR54	Job statistics counter address
BR55	Current screen format control string format number
BR56	Logical record length
BR57	Previous record number (first half)
BR58	Previous record number (second half)
BR59	Current record number (first half)
BR60	Current record number (second half)
BR61	Next record number (first half)
BR62	Next record number (second half)
BR63	Current read file IOB number
BR 64	Number of records to insert
BR73	Format repeat count
BR74	Deleted records count
BR75	Next format ID
BR76	Displacement in the return-to-program exit table for the next exit
BR77	Parameter address from the I/O driver to the I/O management subroutines
BR78	Constant value 4 for return function
BR79	Current named field address

The following list shows how the object program is organized and the sequence in which it is generated. Following this list is a description of each item. (Because the user program determines which items are included in the object program, some of the items listed may not be generated.)

- 1. Literals and prompts constants
- 2. Named fields
- 3. Logical file name block
- 4. User data tables
- 5. Literal/prompt and dup/store tables
- 6. Table directories
- 7. Screen format control strings and table
- 8. Printer and diskette edit format control strings and table
- 9. Subroutines
- 10. Return-to-program exit code
- 11. Keyboard record level code
- 12. Printer and diskette record level code
- 13. Calculations code
- 14. Return-to-program exit code table
- 15. Format control table
- 16. Z-specification driver routine
- 17. Termination code
- 18. Initialization code
- 19. File translation and alternate collating sequence tables
- 20. Logical buffers
- 21. IOBs
- 22. Physical buffers

Literals/Prompts

The addresses of all literal and prompt constants are shown on the source listing.

Named Fields

The addresses of all named fields are shown on the source listing.

Logical File Name Block

The description of the logical file name block is listed in this chapter under *Data Areas.*

User Data Table

This table contains the data for the users tables.

Literal/Prompt and Dup/Store Tables

The address of the storage duplication table is at hex displacement 36 in the keyboard/display IOB. The index into the table is in the screen format control string. This table contains the address of fields that were named on the A-specification with keywords AUXDUP or AUXST. Access to this table is via the screen format control string.

The address of this table is at hex displacement 0D in the keyboard/display IOB. This address points to the literal/prompt table, which points to the actual literal/ prompt. The address of each literal/prompt is also shown on the source listing.

Table Directory

The address of the table directory is in the partition IOB at hex displacement 18. The main microprocessor uses this address to access tables. The contents of the table are:

Hex	Length in	
Displ	Bytes (Hex)	Description
0	2	Starting address of the table
2	2	Address of the last table entry
4	1	Length minus 1 of the table entry
5	1	Length of the bypass (see Note)
6	2	Number of table entries

Note: Bypass is used for alternate tables where the length is between the last byte of a search argument and the first byte of the next search argument.

Screen Format Control String Table

A screen format control string is built for each CRT record defined on the A-specification. These control strings provide the operations to the keyboard/display microprocessor to perform.

The address of the screen format control string table is in the keyboard/display IOB at hex displacement 79. This address points to the first byte of the screen format control string.

The keyboard/display microprocessor uses the keyboard format number in the Enter instruction as an index into the table.

Printer and Diskette Edit Format Control Strings and Table

Edit format control strings are generated for printer, diskette, and communications files referred to on the C-specification. The address of the format control string table is in the partition IOB at hex displacement 24.

Subroutines

Subroutines control I/O operations specified on the C-specification. Basically the I/O driver and I/O management routines control and perform I/O operations.

The I/O driver provides the link from the object code to the I/O management routines, which in turn provide the device microprocessors with the necessary information to move data to and from buffers in the object program.

The object program requests an I/O operation via a CALL instruction, which is followed by the 8-byte control block. The I/O driver calculates the IOB address using the logical I/O table, and uses the logical file name block to get the address of the I/O management routine.

The I/O management routine uses the I/O control code to determine the function to be performed by the device microprocessor. The I/O function is passed to the device microprocessor in an instruction via the device IOB.

The device microprocessor moves data to or from logical buffers and to or from physical buffers depending on the I/O operation.

The source listing contains the address of each included subroutine.

The following text lists all the possible subroutines used in a DE/RPG program and a brief description of each.

RG01 Keyboard External Status Processor

The keyboard external status subroutine processes external status conditions from the keyboard for the object program.

RG03 Keyboard/CRT I/O Management

The keyboard/CRT I/O management subroutine provides the interface to the keyboard/display device from calculations and from formats which specify the WRITE(*NO) keyword.

RG04 Magnetic Stripe Reader I/O Management

The magnetic stripe reader I/O management processes open, close, and read operations for the magnetic stripe reader.

RG20 Printer External Status Processor

The printer external status processor displays and retries error conditions for the printer, when appropriate, and calls the diskette external status subroutine for diskette errors when the printer output has been redirected to diskette. Other printer I/O errors are posted in the appropriate logical file block.

RG22 Printer I/O Management

The printer I/O management subroutine performs printer data set operations such as open, close, write a record, and control space and skip.

RG30 Diskette External Status

The diskette external status routine provides diskette error recovery during run time for files controlled by calculations.

RG31 Diskette External Status Processor

This diskette external status routine transfers control to the common area to process diskette external status conditions for data entry files (transaction files and copy files).

RG32 Diskette I/O Management

The diskette I/O management subroutine processes requests to diskette data sets, such as open and close. It updates, writes, reads, chains, and deletes records, as well as sets record limits.

RG33 Diskette I/O Management

The diskette I/O management provides diskette I/O operations for data sets that are keyed and indexed.

RG34 Diskette I/O Management

The diskette I/O management provides diskette I/O operations for multivolume data sets.

RG35 Diskette I/O Management

The diskette I/O management provides diskette I/O operations for data sets that are keyed, indexed, and multivolume.

RG36 Diskette I/O Management

The diskette I/O management provides diskette I/O operations for the transaction file.

RG40 Communications External Status Processor

The communications external status routine processes external status codes for SNA and BSC.

RG42 Communications Management

The communications I/O management subroutine performs communications data set operations such as open, close, write a record, read a record, and FEOD (force end of data).

RG47 IBM 3270 Emulation Communications Management

The IBM 3270 Emulation communications management subroutine performs communications data set operations such as open, close, write a record, and read a record.

RG50 and RG51 I/O Driver

The I/O driver provides the interface from the object code to the I/O management routines. RG50 is provided when no calculation controlled files are used in the program. RG51 is provided when a control string is passed in the parameter block.

RG80 Verify Error Display

The verify error display subroutine provides the interface to the common area to display error codes while in verify mode.

RG81 Error Display

The error display subroutine displays error codes (with or without help text) and marks the current data field and current record when the automark function is active.

RG82 Packed/Binary Data Conversion

The packed/binary data conversion subroutine performs data conversion for packed and/or binary fields.

RG83 Alternate Collating Sequence

The alternate collating sequence subroutine compares two alphameric characters for the collating sequence by using either the ASCII translate table or a user defined table.

RG84 Calculations Extended Precision Arithmetic

The calculations extended precision arithmetic subroutine processes all extended arithmetic for add, subtract, multiply, and divide operations.

RG85 Resolve Table Element Address

The resolve table element address subroutine computes the address of table elements by using the table directory and index numbers.

RG86 Physical Buffer Allocation

The physical buffer allocation subroutine provides buffer space for devices that require buffers.

RG99 File Close

The file close subroutine handles job termination by closing all DE/RPG files and calling CFA.

Return-to-Program Exit Code

This code handles extended edits for keyboard/display operations that cannot be handled by the screen format control strings. All named fields require exit code and the following keywords require exit code:

- ADD
- AUXST
- CHECK (BY BV Gxx Mxx)
- COMP
- ERROR
- EXSR
- INSERT

- LOOK
- RANGE
- RANGET
- RESET
- SETOF
- SETON
- SEQ
- SUB
- SUBST
- TADD
- TSUB
- XCHK

The return-to-program exit table address is in the partition control block. The partition control block address is in BR37.

Record Level Code

Keyboard

This code provides the interface between calculations code and keyboard operations. This code sets up the return-to-program exit code, initializes cursor positions, and clears the display line.

Printer/Diskette Record Level Code

This code provides the read and write operations specified on the A-specification. This code performs functions such as forms control (printer), record identification, interface to access methods on diskette, and formatting data.

Calculations Object Code

This code performs the operations that are specified on the C-specifications.

Format Control Table

The description of the format control table is in this chapter under Data Areas.

Z-Specification Driver

The Z-specification driver is generated from the Z-specification compressions. It interfaces with either the data entry driver in the common area when the transaction file is specified or the keyboard/CRT I/O management subroutine when a WRITE(*NO) is specified.

The Z-specification driver includes the format control table. The Z-specification driver passes a pointer to the format control table entry for the current format to the data entry driver. The Z-specification driver also clears the screen, sets the cursor, and controls format chaining.

The object code generated by the Z-specification driver controls the repeat count, format sequence, write function of the TFILE, production statistics, and calls the data entry driver or keyboard/CRT I/O management subroutine.

The address of the Z-specification driver is on the source listing. The contents of the format control table is in this chapter under *Data Areas.*

Termination Code

A DE/RPG program is terminated when the End of Job key is pressed or the EOJ keyword is encountered. Termination code, then performs the following functions:

- Closes files
- Update station statistics
- Goes to end of job
- Write job statistics
- Chains to the next job (EOJ keyword only)

These functions are primarily handled in the common area.

Initialization Code

Initialization code prepares the object program for execution. The main microprocessor starts executing initialization code when the load prompt response is executed. The address of the code is in the partition IOB at hex displacement 10 and 11 (instruction address). The first executable instruction is also on the listing. Initialization code performs the following functions:

- Checks indicator 0 for an active request to dump or trace indicator
- Checks for the data entry driver routine in the common function area
- Initializes the stack pointer
- Attaches the keyboard and clears the screen if TFILE is present
- Initializes user fields
- Reads data tables
- Opens all files (except the copy file, print file, and communications file) pertaining to transaction files (calls I/O driver)
- Prompts for mode selections
- Initializes the station statistics
- Gets the system date from the system control block
- Calls Z-specification driver
- Allocates storage buffers for:
 - register save area
 - logical buffers for non-data-entry files
 - job statistics
 - status line
 - search mask areas

File Translation and Alternate Collating Sequence Tables

The file IOB contains the file translation table number that points to the table directory. The table directory contains the address of the file translation table.

The address of the alternate collating sequence table is in the partition control block.

Logical Buffers

Three logical buffers for records; previous, current, and next are provided for data entry. These buffers must have the same length with minimum size dependent on logical record length.

Two subroutines located in the common area, record advance and record backspace, exchange addresses to these buffers for record advance and record backspace operations.

The new addresses of the previous and current buffers is placed in the keyboard/ display IOB.

Physical Buffers

Physical buffers are used for all files except the communications files and magnetic stripe reader files.

Double buffers are needed for transaction files and keyed files with WRITE specified. Separate buffers are needed for copy files and print files if copy and print IOBs are included.

I/O Driver

The I/O driver provides the interface from object code to I/O management routines for the required I/O operations. An 8-byte parameter list is input to the I/O driver for processing the I/O control strings.

The address of the I/O driver is on the source listing.

DATA AREAS

This section describes the data areas and control blocks used by the DE/RPG program and how they can be located in the object program.

Register Save Area

The register save area is a 128-byte area that is used by the common area.

The address of the register save area is in BR32.

Partition Control Block

The partition control block provides the link from a partition to the common area. The address of the partition control block is in BR37. The contents of the partition control block are described in the following chart:

Hex Displ	Length in Bytes (Hex)	Descriptions
0	2	Record length of the logical buffers for data entry
2	2	Record mark position (no mark = hex FFFF)
4	2	Verify record mark position (no mark = hex FFFF)
6	1	File exchange type: Hex 00 = basic 01 = H 02 = I
7	6	Record count for allocating files
0D	2	Display attributes

Hex	Length in	Description
Dispi	Bytes (Hex)	Descriptions
OF	1	Flags: Bit 0-1 = bypass production statistics 0 = prompt for writing production statistics 1-1 = auto mark 2-1 = clear screen 3-1 = write deleted record 4-1 = write record 5-1 = write record and hypers ENTR (data
10	1	entry) 6-1 = no prompt for file open 7-1 = print file specified in the program
10	•	or Az maga (act to nex ou)
11	1	Flags: Bit 0-1 = calculations mode 1-1 = EXFMT is active 2-1 = magnetic stripe reader has data available 3-1 = EXFMT detected a function key 4-1 = SUBST determined 5-1 = first SEQ error detected 6-1 = not used 7-1 = keyboard external status enabled
12	1	 Flags: Bit 0-1 = processing a format that specified WRITE(*NO) 1-1 = Enter instruction issued for the EXFMT operation has been canceled by the common area for ATTN, SYS REQ, or dump file open processing. 2-1 = Initialized deleted record insert count 3-1 = Force review mode tests for this record 4-1 = Error code returned with data 5-1 = End of Job and file closing has begun 6-1 = Abnormal End of Job 7-1 = Field modified
13	2	Number of records between deleted record insertions for transaction file (WRITE (*NO) = hex 0000)
15	2	Address of the record read by the I/O driver
17	2	Lowest address for buffer allocation
19	2	Lowest address available for buffer allocation
1B	2	Forward return to program address

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Hex Displ	Length in Bytes (Hex)	Descriptions
1D	2	Backward return to program address
1F	1	I/O error indicator for EXFMT operations
20	2	Error code for a function key detected during an EXFMT operation
22	2	Absolute storage address of the alternate collating sequence table
24	2	Address of the EXFMT buffer

Logical Record Buffers

Three equal length logical buffers are required by a DE/RPG program for data entry. The minimum length of each buffer is determined by the logical record length. There are no alignment requirements nor need the buffers be adjacent.

The address of each logical buffer for the keyboard is in:

Previous: BR46

Current: BR47

Next: BR48

The address of logical buffers for other files are in the device IOB.

Physical Buffers

All files need physical buffers except the communications file and the magnetic stripe reader file. A double buffer is required for the transaction file and a keyed file with a WRITE specified. Separate buffers are required for the copy file and the print file.

The address of the physical buffer is in the device IOB.

Input Mask Buffer

The input mask buffer is a 78-byte area to store input masks for search content and search sequential content.

The address of the input mask buffer is in BR50.

Output Mask Buffer

The output mask buffer is an 80-byte area that follows the input mask buffer. This area stores the search mask that is passed to microcode for search content and search sequential content.

The complete input and output mask buffer area is also used to allocate data sets and write production statistics.

The last 11 bytes of the output mask buffer area is current record buffer when user inputs are accepted.

The address of this area is in BR49.

Format Control Table

The format control table contains one 10-byte entry for each format defined by a DE/RPG program. This table controls the sequence between formats on an entry format; the record IDs and format selection on a review format.

Format 0 is always the first entry in the table. The address of the format control table is in BR51. The address of the format currently being displayed is in BR52.

The contents of the format control table are described in the following chart:

Hex Displ	Length in Bytes (Hex)	Description	
0	1	 Bit 0-1 = Last entry in this table 1-1 = WRITE(*NO) specified on Z-specification statement for this format (used by Z-specification driver) 2-1 = Calculations reference (BEGSR specified on C-specification) 3 = Not used 4-7 = Repeat count for the current format 	
1	2	Format ID	
3	1	Keyboard format number	
4	2	Displacement into the return-to-program table, or the calculations entry point address	
6	2	Address of format test code	
8	1	Starting line number on the display	
9	1	Clear line count on the display (hex FF for WRITE (*NO))	

Status Line Buffer Area

The status line buffer area contains the 21 bytes (bytes 20 through 40) of the status line data. The address of this area is in BR53.

The contents of the status line buffer area is described in the following chart:

Hex Displ	Length in Bytes (Hex)	Description
0	1	Display control
1	5	Record number
6	1	Display control
7	1	Auto dup/skip indicator
8	1	Display control
9	1	Auto record advance indicator
А	1	Display control
В	2	Format ID
D	1	Display control
E	3	Mode of operation
11	1	Display control
12	1	Verify mark
13	1	Display control

Note: All display control bytes are initialized to hex 20.

Job Statistics Counter Area

The job statistics area is a 54-byte reserved area for job counters that are updated at mode select time, record advance time, and end-of-job time by the common area.

The address of the job statistics area is in BR54.

I/O Driver Parameter Block

The I/O driver parameter block follows a CALL instruction to the I/O driver routine.

Hex Displ	Length in Bytes (Hex)	Description
0	2	Address of the I/O control string
2	1	I/O control code
3	1	IOB number
4	1	Not used, set to hex 00
5	1	Not-found indicator
6	1	I/O error indicator
7	1	End-of-file indicator

I/O Control Codes

Code	Hex	Description
Close	01	Close data set
Open	02	Open data set
Exfmt	03	Execute format
Update	04	Update current record
Write	05	Write next record
Read-P	06	Read previous record
Read	07	Read next record
Chain-R	08	Chain to relative record
Chain-K	09	Chain to keyed record
Delete	0A	Delete current record
Delete-R	OB	Delete relative record
Delete-K	0C	Delete keyed record

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Code	Hex	Description
Setll-R	0D	Set lower limit of relative control
SetII-K	0E	Set lower limit of keyed record
Wrtno	10	WRITE(*NO) to CRT
Feod	11	Force end of data

I/O Control String Commands

Each record control string begins with a begin-record command and ends with an end-record command. Each file group of control strings is preceded by a begin-file command, followed by an end-file command.

Command Code	Hex	I/O Operation Description
Noop	01	Continue with next command
Begin-file	02	Begin a file operation
End-file	03	End a file operation
Begin-record	04xxxx	Begin a record operation (numeric field table address) refer to the numeric field table
End-record	05	End a record operation
Execute	06	Execute a transfer
Recid	07xxxxxx	Record identifier and position
Screen	08xxxxx	Screen formats control string number (index into screen format table and index into return- to-program start exit number table)
Format	09xx	Format number (index into format table)
Space	0Axx	Space the number of line
Skip	0B×x	Skip to line number
Seton	0C×x	Set indicator on
Setof	0Dxx	Set indicator off

Numeric Field Table

There is one numeric field table for each record in the following format:

Hex Displ	Length in Bytes (Hex)	Description
0	1	Length minus 1 of the field, or hex FF if end of table
1	2	Address of the numeric field

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The logical file name block is the interface to the I/O management routine from the I/O driver routine. This block contains one entry for each file defined in the source program. The address of the block is in the data set name address field of the device IOB at hex displacement 14.

Logical File Name Block

Hex Displ	Length in Bytes (Hex)	Description				
0	1A	File name (data set name)				
1A	4	Device code				
1E	E	Owner ID or COMM3270*				
2C	2	I/O routine address				
2E	2	Logical buffer address				
30	2	Error code				
32	1	Flags: Hex 80 = I/O error 40 = end of file 20 = record not found 10 = Internal error flag used by I/O management routines 0C = transaction or copy file 08 = transaction file 04 = copy file 02 = random access 01 = physical buffer has been allocated				
*The follow	ving applies only t	o COMM3270 files:				
Hex Displ	Length in Bytes (Hex)	Description				
1E	В	3270 printer control block				
29	1	3270 internal to user EBCDIC translation table high address				
2A	1	3270 user EBCDIC to internal translation table high address				

2B 1 3270 last AID byte sent to host

Hex Displ	Length in Bytes (Hex)	Description
33	1	Hex 80 = continued volume 40 = first volume 20 = read previous record in progress 10 = retry with next volume 08 = current record not valid 04 = record not found 02 = volume end of extent 01 = active volume
34	1	 Flags: Hex 80 = current active volume when reading or updating 40 = index file positioned at end-of-data 20 = last volume of an offline multi-volume file (volume number = 99) 10 = user error indicator specified 0F = index file job number
35	1	Count of the volumes or the length of the LOGON parameter
36	2	Either the end of page indicator, LOGON address, or key table entry address

Partition Subroutine Stack

This stack is a system table with a maximum of 128 two-byte entries. Whenever a subroutine CALL instruction is executed, the address of the next sequential instruction is assumed to be the return address, and is stored in the stack. The address of the stack is in BR18.

EXAMPLE PROGRAM SOURCE LISTING

The source listing in the following figure (Figure 3) is from an example program in the *DE/RPG User's Guide*. A dump of this program is shown in Figure 4.

×

	DE	EZRPG COMP	ILER VON	123				
	* <	Couves fil	e PROC	34.55				
	× ¥(biect fil	e. OBJa	54				
00001	Z**	 	*******	*******	******	****	******	×
00002	Z×							
00003	Z××	******	********	*******	********	********	******	¥
00004	ZJ,	COMBINA	,			N - 27	TETTE (BICCUSE)	
00005	<u>Z ></u>	C1FIND	i.E.			X2	WRIFE(*NU)	
00006	X >	C2 LUGE LH	11			X1 DELIZOE (OD)	WRITE(BILL)	
00007	e A	F F	UE I	(5		DEVICECCE	D D2E217(9 80)	
00008	64 A	P.	: F.1ND		0000000	1010200000	311 134 T H ²¹ P1 1	
00009	н ^		KH LM THEFT	C;'	10002001	CO2 LONEY	RUNDER EVenzeneetty	
00010	н ^	c	TOCETH	?	1002017	UNEURODIO	EASECOUDET7	
00012	е А				0001001	CHSTOMER	NAMEL	
00013	A				0002001	'ADDRESS'	EVEN HES	
00014	Ĥ		CUSTN	30	1001017	INSERT (CU.	SNA)	
00015	Á		ADRES	30	1002017	INSERT (AD	DR)	
00016	A		ITEMN	6	01003001	PMTCENTER	ITEM NUMBER)	
00017	A		PRICE	6	21004001	PMT (ENTER	COST)	
00018	A	F	BILLMST	75		DEVICE(DI	SK D1)	
00019	A	6	BILL					
00020	A		ITEMN					
00021	A		PRICE					
00022	A		CUSIN					
00023	- А - А	c	22700000000000000000000000000000000000	2.55		DEUTCEODT	CK 04.)	
00024	н А	r F	2 1 008/95	0.7		<i>V</i> L. V I C/L. V I/ I	1247 1247	
00026	н А		CUSNA	30				
00027	A		ADDR	30				
00028	A	h	NUMBER	5				
00029	С		GOGET	BEGSR				
00030	C		NUMBER	CHAINLOO	KSE		0102	
00031	C			ENDSR				
00032								
00033								
00034								
00035								
	* ADDR	CONSTANT						
	* 02F0	CUSTOME	R NUMBER !					
	* 02FF	CUSTOME	R NAME'					
	* 030C	'ADDRESS	1					
	* 0313	'ENTER I	TEM NUMBER	•				
	* 0324	'ENTER CO	0ST'					
	¥							
	* ADDR	NAME						
	* 032E	NUMBER						
	* 0333	COSIN						
	× 0301 ¥ 034⊑	TTEMN						
	* 0375	PRICE						
	* 037B	CUSNA						
	* 0399	ADDR						
	*							
	*LINE	ERROR						
	*000i2	1068						
	*00014	1068						
	¥							
	*002 er	rors appe	ared in th	iis progra	m			

Figure 3 (Part 1 of 2). Source Listing

```
DE/RPG COMPILER VOM23
     ×
     *ERROR MESSAGE TEXT
DE W*1068 CRT field is in the prompt line
     ×
     ¥
              OBJECT PROGRAM MAP
     *ROUTINE ENTRY POINTS
     *EP
*0670
                 RTN DESCRIPTION
                 RG99 - End of job processor
     *06C4
                 RG80 - Verify mode error display
                RG80 - Physical buffer allocation
RG01 - Keyboard external status routine
RG03 - KB/CRT I/O management routine
     *0784
     *0850
     *0A7C
                RG30 - Diskette external status routine
RG33 - Diskette I/O management routine
RG51 - I/O driver - full function
     *0BE8
     *0D54
     *17B4
     ×
     *iDD4
                 Z-spec driver entry point
     *1F6C
                Program entry point
     * 9,472 Is the program length.
```

Figure 3 (Part 2 of 2). Source Listing

Data	Areas in the Dump Example	How to Find Data Areas in the Dump Example		
1	Partition IOB pointers	System control block hex 00000		
2	Diskette IOB pointers	System control block hex 00040		
3	Printer IOB	System control block hex 00080		
4	Partition IOB	Relative address hex 0000		
5	Logical I/O table	Relative address hex 0040		
6	Keyboard/display IOB	Relative address hex 0080		
7	Indicators (10–1255)	Relative address hex 0100		
8	Binary registers (BR0–BR127)	Relative address hex 0100		
9	Decimal registers (R0–R30)	Relative address hex 0100		
10	Literals/prompts	Literals/prompts table and the source listing		
11	Named fields	Source listing		
12	Logical file name block for the TFILE IOB	TFILE IOB hex displacement 14		
13	Logical file name block for the CUSMAST IOB	CUSMAST IOB hex displacement 14		
14	Keyed index file table	Table directory		
15	Literals/prompts table	Keyboard/display IOB hex displacement 0D		
16	Dup/store table	Keyboard/display IOB hex displacement 36		
17	Table directory	Partition IOB hex displacement 18		
18	Logical buffer next	BR48		
19	Logical buffer previous	BR46		
20	Logical buffer current	BR47		
21	EXFMT buffer (a work area used when EXFMT and WRITE(*NO) are specified)	Partition control block hex displacement 24		
22	Dup/store area (used for INSERT)	Dup/store table		
23	Screen format control string (keyboard)	Screen format control string table		
24	Edit format control string (diskette)	Edit format control string table		
25	Screen format control string table	Keyboard/display IOB hex displacement 79		

Data	Areas in the Dump Example	How to Find Data Areas in the Dump Example		
26	Edit format control string table	Partition IOB hex displacement 24		
27	RG99 End-of-job processor subroutine	Source listing		
28	RG80 Verify mode error display subroutine	Source listing		
29	RG86 Physical buffer allocation subroutine	Source listing		
30	RG01 Keyboard external status subroutine	Source listing		
31	RG03 KB/CRT I/O management subroutine	Source listing		
32	RG30 Diskette external status subroutine	Source listing		
33	RG33 Diskette I/O management subroutine	Source listing		
34	RG51 I/O driver—full function subroutine	Source listing		
35	Return to program exit code	Return to program exit code table		
36	Return to program exit code table	Partition control block (BR37) hex displacement 1B		
37	Z-specification driver format control table	BR51		
38	Partition control block	BR37		
39	Z-specification driver	Source listing		
40	Review tests	Z-specification driver format control table hex dis- placement 06 into each 10 byte table entry		
41	Initialization code (program entry point)	Source listing		
42	Status line buffer	BR53		
43	Logical buffer for CUSMAST	CUSMAST IOB hex displacement 0C		
44	Register save area	BR32		
45	Input mask buffer	BR50		
46	Output mask buffer	BR49		
47	Job statistics counter area	BR54		
48	TFILE IOB	BR40 and logical I/O table		
49	CUSMAST IOB	Logical I/O table		
50	Physical buffer 1 for TFILE	TFILE IOB hex displacement 18		

Data Areas in the Dump Example	How to Find Data Areas in the Dump Example			
51 Physical buffer 2 for TFILE	TFILE IOB hex displacement 20			
52 Physical buffer for CUSMAST	CUSMAST IOB hex displacement 18			
53 Partition subroutine stack	BR 18			
54 Main microprocessor work area	Last 256 bytes of the partition			

00000.00814	300.00808300.0040C300.0040FF00.	
000201.0040	F39 0040FF00.0040FF00.0040FF00.	
00040.1.0000	P39.000300000000000000000000000000000000	
	500.00000000.0000000000000000000000000	
0000010000		
000A000000		
00000.00000	000.0001FF00.002E0000.00000000.	
000E0.100000	000.0000000.00003088.00003000	00202000.20000000.2008A400.3UF03D0E*
0.000 0000 F		TANDA INFLICTION CONTRACTOR AND AND ADDR.
04300 0000	U3D6D4U2 U9D5U140 3FU08000 004.	34300 4E540080 80250115 04950203 0F014058 4*CUMBINA .(+
04320 0020	48680300 066E0000 00000000 0000	00000 00438200 43008440 00000000 00002000 * 1,
04340 0040	00400080 44032240 44832209 0000	00000 0000000 0000000 0000000 0000000 5 *CCC.
04360 0060	00000000 00000000 00000000 0000	00000 0000000 0000000 0000000 0000000 *********
04380 0080	40100000 11614E54 CF05FE04 8704	48705 08508000 00000000 00000000 0000271D 6 */+g.g&
043A0 00A0	02010200 00006824 057EF4B0 057H	E057E 0004F4B4 40F00493 21300010 00248020 *
04300 0000	00410004 84000000 00000200 0005	50000 FCC0FD70 FE500000 F4000C50 8120FCFF *d
043E0 00E0 [F0000002 F4FEF200 00040000 F45(00005_00010004_00000000_40066800_00002000}*04-24&4&
04400 0100	80000000 00000000 00000000 0200	00000 0000002 80000000 80208000 210E0000 7 *
04420 0120	00430000 3E82057E F4B01004 2280	00000 00004000 0000000 0000000 00000000
04440 0140	204E0004 00020000 00001DAA 216	72161 22000000 00000080 22002280 04E80533 * .+//
04460 0160	049D2iiC 20CE1D8C 1D961FF8 2160	C0001 004B0000 00010000 00020000 00030001
04480 0180	00000000 00010000 00172160 0014	40014 00020001 00001D96 00001C0A 0004032E [***********************************
044A0 01A0	057E004B 00FF0001 02010080 053	304E8 00000000 0000000 0000000 00000000 *.=
04400 0100	00000000 0000000 00000000 000	00000 0000000 0000000 0000000 00000000
044E0 01E0	00800000 0000000 00000000 000	00000 FOFOFOFO FOFOFOFO FOFOFOFOFOFO FOFO U : *
04500 0200	FOFOFOFO FOFOFOFO FOFOFOFO FOF	0F0F1 F0F0F0F0 F0F0F0F0 F0F0F0F0F0F0F0F0
04520 0220	00000000 0000000 00000000 000	00000 F0F0F0F0 F0F0F0F0 F0F0F0F0F0 *
04540 0240	FOFOFOFO FOFOFOFO FOFOFOFO FOF	05150 00000000 0000000 0000000 0000000 *000000
04560 0260	00000000 0000000 00000000 000	000000 0000000 0000000 0000000 0000000 *
04580 0280	00000000 0000000 0000000 000	000000 F0F0F0F0 F0F0F0F0 F0F0F1F0 F0F0F0F2 *
04560 0260	40404040 40404040 4040404040 404	
04500 0200	00000000 0000000 0000000 000	
04560 0260	00000000 0000000 00000000 000	00000 C3E4E2E3 DAD4C5D9 40D5E4D4 C2C5D9C3 CA*
04400 0300	EAE2E3DA DACSD940 D5C1D4C5 C1C	ACADS CSEPERCE DEFICED ACCREACE DAADDEA HISTOMEE NAMEADDEESSENTER ITE
04620 0320	D4020509 050505710 05010100 010 D4020509 05050305 09400306 E2E	TEGED FORDERS FARTER DATED A CIDED TO MERENTER COSTODOOCCUSTOMER
04640 0340	<u> 1404040 40404040 40404040 404</u>	
04640 0740	E3404040 40404040 40404040 404	(-)
04660 0360	DACED940 COCEESC4 A0404040 404	(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
04600 0300	- DACODIAC COCOCOCI ACACACAC 404 - CIDADECA ACCESCE ACACACACAC 404	
04660 0360	LODODOL4 40LIEOLO 40404040 404	
04800 0300	40404040 40404040 40404040 404	
U46EU U3EU	40404000 0000000 0000000 000	000L2 C9D3D3D4 E2E34040 40404040 40404040 12 *BILLM31
04700 0400	40404040 40404040 40F4F4F0 F04	
04720 0420	<u>000A0000 00000</u> C3 E4E2D4C1 E2E	34040 40404040 40404040 40404040 40404040 13 * CUSMAS I
04740 0440	<u>40F4F4F0 F0404040 40404040 404</u>	
04760 0460	FOFOF0F1 000001F0 F0F0F0F2 000	-002F0 F0F0F3 00000300 0000000 0000000 #00010000200003
04780 0480	00000000 00000000 0002F002 FF0	<u>30003 13032405 UMQ45F00 03040300 05</u> 404040 18 *********************************
-047A0-04A0	40404040 40404040 <u>10404040</u> 404	,04040 4040404 0 404040 40404040 40404040 *
	LINES 047CO SAME AS ABOVE 15	
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Debugging DE/RPG Programs 41

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 ★ ★ (* * * * * * * * * * * * * * * * *	■ * * * * * * * * * * * * * * * * * * *		1. "我不是你有什么?""我不知道我们,你不知道你不知道,你们就是你们的你,你不能能能。" "我不知道,我们不是你?""我不是你,你们就不能说,你们的你?""你不能说我	来来说来。""你说,"""""""""说道""你,不是。"不说"来了来来,""""""""""""""""""""""""""""""""""	**************************************		**************************************	★ Y T T Y Y T = T Y Y T Y T Y T Y T Y T Y	****)**()*****************************	「●・・・・人・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・	×	黑水,是一水水是的水,是是是一块水水,也是一水水。" "这个人,也是一个人,也是一个人,就是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一		★ * · A · * * A … * * A ☆ * * m 〔 * m in h * · * * · · * * * * n in k	"黑王,于D·李,始后"王王王"。"""""王王"的时代,说书上"登船王来"""""""""""""""""""""""""""""""""""""""		** **X********************************	「「「「」」「」」「「」」」」」」」」」」」」」」」」」」」」」」」」」」			意。 ▲ "案 " * * * * * [E * 始A * E · * E · 明A * E 的。* E 明 [案]	★* 「「明*」」 ● 「「「「「「「「」」」 ● 「「」」 ● 「」 ● 「」 ● 「」			「「「」」「「」」」」」」」」」」」」」」」」」」」」」」」」」」」」」」	「「、、、、、、、、、、、、、、、、、、、、、、、、、、、、、、、、、、、		(唐书曰:"王书的。我有人自己,""()"。"()"。"王子,"有"有人","王子","王子","王子","王子","王子","王子","王子","王子		第二、「「」、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」	新来(キャキキャイキャキャイ・ションションパーの約日の11111111111111111111111111111111111	第一位、1月11日、11日、11日、11日、11日、11日、11日、11日、11日、1	37 # states and the second states and the states and the second st	38 ₩a X2 000200	30 #************************************	* - * * * * * * * * * * * * * * * * * *		「第三日(1~2~日~日~日~日~日~日~日~~~~~~~~~~~~~~~~~~~~~			"我们,你们,你们,你,你的你?"你们,你们,你们,你不能。" "你们的,你们,你们们不是你们,你们们,你们们,你不能不是你。""你,你们们,你们们,你		and the state of	ku */uu/jakukuaauokauoka ku *reXittureeu.eesu.estekt.*	
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Figure 4 (Part 4 of 6). Example Program Dump

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Figure 4 (Part 5 of 6). Example Program Dump

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Figure 4 (Part 6 of 6). Example Program Dump

COMPILER DEBUG FUNCTIONS

Debug functions are available as an aid for debugging complex DE/RPG problems. These functions of the compiler should be used by service representatives only, normally under the guidance and direction of field support personnel. This description is for reference purposes only.

Debug functions are used during compilation to halt on the load of a module and to dump main storage, compressions, and object text.

A debug function requires an additional 1 K byte in the partition. Ten functions can be specified for each compilation.

Invoking the Compiler Debug Functions

Functions are invoked by responding to prompts for a compilation.

- 1. When the list options prompt is displayed, select option 7 instead of options 1, 2, 3, or 4.
- 2. Press the Error Reset key when error code 9400 is displayed. (This redisplays the list options.)
- 3. Select one of the list options; then select the device for the output.

The following lines are displayed:

BLANK TO END OR MODULE ID DEBUG CONTROL SPECIFICATIONS BEGIN BEFORE MODULE LOWER LIMITUPPER LIMIT FUNCTION CODECOMPRESSION CODE	(
DEBUG CONTROL SPECIFICATIONS REGIN REFORE MODULE	T_{11} Alls T_{12} mains and Manager T_{12}			
DEBUG CONTROL SPECIFICATIONS BEGIN BEFORE MODULE LOWER LIMITUPPER LIMIT FUNCTION CODECOMPRESSION CODE	BLANN TO END OF MODULE ID			
BEGIN BEFORE MODULEUPPER LIMIT LOWER LIMITUPPER LIMIT FUNCTION CODECOMPRESSION CODE	DEBUG CONTROL SPECIFICA	TIONS		
LOWER LIMITUPPER LIMIT FUNCTION CODECOMPRESSION CODE	BEGIN BEFORE MODULE		END BEFORE MODULE	
FUNCTION CODE	LOWER LIMIT		UPPER LIMIT	
	FUNCTION CODE		COMPRESSION CODE	
	1			
	-			

.

Specify the functions you want performed by entering information into the fields. Lower and upper limits define the controls on these functions.

Three prompts are displayed on line 2 as you specify the required information. The first prompt (BLANK TO END or MODULE ID) means that *no entry* ends the debug function; or *enter* the module ID to continue. The module ID must be 'EO' or greater.

The next prompt lists the dump function codes and meanings.

The last prompt lists the compression codes and meanings.

Some fields of the function code have different meanings depending on the function to be performed. The function descriptions that follow contain only the entries that are valid for that function.

Function Code H = HALT

- Begin before module The compiler halts when the request to load this module is made.
- End before module The compiler will continue to halt for all module load requests up to and including this module.

Function Code D = Dump Main Storage

- Begin before module The first dump is taken before the module is loaded.
- End before module The last dump is taken before this module is loaded.
- Lower limit The lower limit hex address of main storage. (Defaults to 0.)
- Upper limit The upper limit hex address of main storage. (Defaults to 0.)

Function Code C = Dump Compressions

- Begin before module The first dump is taken before the module is loaded.
- End before module The last dump is taken before this module is loaded.
- Lower limit The source statement number (in decimal) of the first compression to be dumped. If a value of 0000 is entered, all compressions of the specified type are dumped.
- Upper limit The source statement number (in decimal) of the last compression to be dumped.

- Compression code The character that identifies the type of compression to dump:
 - 0 = Z-compressions
 - 1 = A-compressions
 - 2 = C-compressions
 - 3 = Table compressions
 - 4 = Error compressions
 - 5 = Debug compressions
 - 6 = Module compressions

Function Code T = Dump Text

- Begin before module Start dumping text at this module.
- End before module -- Stop dumping text before this module has loaded.

RUNNING THE DUMP AND TRACE PROGRAMS

When unexpected results occur while executing a user program, use the dump or the trace function to isolate the problem. When the trace function is to be used, you must first use the Patch program in order to reserve IOB space to execute dump/ trace. Reserve IOB space by modifying location hex 100 to 80. By doing this, indicator 0 is set on. Otherwise, if indicator 0 is off, the IOB space is used for other purposes.

For a description of how to use the Patch program, refer to the *System Control Programming Reference/Operation Manual*. For a description of how to use the dump and trace functions, refer to the *Functions Reference Manual* or the *Data Areas and Diagnostic Aids Handbook*.

ASCII: American National Standard Code for Information Interchange.

BR: Binary register.

BSC: Binary synchronous communications.

CCA: Compiler communications area.

compiler communications area (CCA): A portion of main storage where information is saved for use by other modules during compilation of a program. Each module can access the information in the CCA and can also pass the information on to the succeeding phase(s).

compressions: The compiler version of source statements contained on a work file that determines the object code required.

CRT: Cathode-ray tube.

DE/RPG: Data Entry with RPG subroutines.

displ: Displacement.

dup: Duplicate.

external status: A condition encountered by an I/O device whenever that device cannot resolve, for example, an error condition or a certain object code instruction. The unresolved condition is brought to the attention of the main microprocessor for it to resolve.

hex: Hexadecimal.

I: Indicator.

ID: Identification.

I/O: Input/output.

IOB: Input/output control block.

IPL: Initial program load.

K: Storage capacity of 1024 bytes.

KB: Keyboard.

microprocessor: A processing unit that is microprogramcontrolled and performs internal machine operations.

overlay area: A technique of repeatedly using the same portion of main storage for all compiler phases during the compilation of a program. As each phase of the compiler is brought into the overlay area, the previous phase is overlaid.

PTF: Program temporary fix.

relative addressing: A means of addressing instructions and data areas by designating their location in relation to the location counter or to some symbol.

return-to-program exit code: Object program code that processes advanced edit functions such as self-check digit, range check, and arithmetic checks between fields for keyboard/display operations.

SNA: Systems network architecture.

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