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Basic 4K Report Program Generator Operating Procedures IBM 1401 and 1460

Program 1401-RG-022

This publication, which contains operating procedures for
IBM 1401 and 1460 Basic 4K RPG, should be used with
the SRL publication *Basic 4K Report Program Generator
Specifications for IBM 1401 and 1460* (Form C24-3166).

It contains these main sections: a description of the
Basic 4K RPG deck, the control card, the input deck,
operating instructions for generating as well as for running
an object program, the edit listing, and halts and messages.

For a list of related publications and abstracts, see
the *IBM 1401 and 1460 Bibliography* (Form A24-1495).

Contents

The Basic 4K Report Program Generator (BRPG) for IBM 1401 and 1460, with load-and-go capability, produces programs that write reports of variable format from card input files. Instead of writing a specific program for each report, the user writes a set of specifications and prepares one control card. He supplies these to the BRPG. BRPG then generates the object program.

The user has the option of specifying that BRPG punch the machine-language object program in cards. This option enables him not only to execute the program from core storage, but furthermore to retain the object-program deck for future use.

Together with the generated object program, BRPG also provides the user with an *edit listing*. This is a printed record of the source program and an analysis of the specifications cards. Certain kinds of errors, such as unacceptable entries in the report specifications, produce error messages.

Programs generated by BRPG can produce ouput in any of these forms:

- Printed report.
- Punched cards.
- Printed report and punched cards.

Use this operating-procedures publication with the Systems Reference Library publication *Basic 4K Report Program Generator Specifications for IBM 1401 and 1460* (Form C24-3166).

Machine Requirements

Object programs can be generated and executed on an IBM 1401 Data Processing System equipped with a minimum of:
4,000 positions of core storage.
1 IBM 1402 Card Read-Punch.
1 IBM 1403 Printer.
Object programs can be generated and executed on an IBM 1460 Data Processing System equipped with a minimum of:
8,000 positions of core storage.
1 IBM 1402 Card Read-Punch.
1 IBM 1403 Printer.

Program-Deck Description

The processor is supplied in punched-card form. The card format is the 1401-1311 Autocoder condensed-load format, as follows:

Columns	Contents
1-3	The three-character machine address of the first storage position to be loaded.
4-5	The number of characters to be loaded from the card. Word-separator characters are not counted.
6-72	The instructions and/or the data to be loaded. A word-separator character (0-5-8 punch) precedes every character requiring a word mark in core storage.
73-75	The sequence number of the card within the entire program deck, starting with 001.
76-78	The three-letter BRPG phase identification.
79-80	The two digits that further identify a BRPG phase.

Note: The diagnostic messages in the processor deck are not sequentially numbered. There are two sets of such messages. The first set consists of 33 cards, follows card number 066 (columns 73-75), and is NOTE 22 through NOTE 54 as shown under *Numbered Diagnostic Notes.* The second set consists of 8 cards, follows card number 366 (columns 73-75), and is NOTE 91 through NOTE 98 as shown under *Numbered Diagnostic Notes.* Each set is followed by a card with an asterisk in column 1.

Input Deck for Basic RPG Run

Basic RPG is a load-and-go programming system. Here is a list of the input-deck cards in the required order:
1. Low-core loader.
2. ENT01-phase-cards.
3. Control card.
4. ENT02-phase cards.
5. Source program deck, consisting of:
   a. Asterisk card.
   b. Format-specification cards.
   c. Asterisk card.
   d. Data-specification cards.
   e. Asterisk card.
   f. Calculation-specification cards.
   g. Asterisk card.
   h. Input-specification cards.
   i. Asterisk card.
6. Remainder of BRPG processor deck.
7. Asterisk card.
8. Input-file deck.

Low-Core Loader

Six cards compose the low-core loader. The first two cards are clear-core-storage cards, identified by C1 and C2 punched in columns 79-80. The third card is a bootstrap card, punched BOOTLD01 in columns 73-80. The remaining three cards are punched LOADER02, LOADER03, and LOADER04 in columns 73-80. This self-loading loader clears core storage, sets word marks for the loading instructions, loads the loading instructions, and moves them to the loading-routine area in core storage (positions 82-216).

ENT01-Phase Cards

The first BRPG phase, ENT01, reads the user's control card, analyzes it, checks the core-storage capacity specified in the control card with the capacity required by the BRPG program deck, and prints the heading line for the BRPG edit listing.

Control Card

The Basic 4K Report Program Generator for IBM 1401 and 1460 requires one control card from which to extract certain information. This card must be placed between the cards numbered 018 and 019 in card columns 73 through 75. In it, the user punches information to identify the control card, define the core-storage capacity of the system, and describe the number of print positions on the IBM 1403 Printer. The format and contents of the control card are:

Columns	Contents	Explanation
1-3	CTL	Identifies the control card.
4-5	04	Always 04, because neither the BRPG processor nor a generated object program can use more than 4,000 positions of core storage.
6-8	100 or 132	Specifies the number of print positions of the IBM 1403 Printer attached to the 1401 or 1460.
9-12	1401 or 1460	Specifies the system to be used to generate and execute the object program.

ENT02-Phase Cards

This phase of the BRPG program reads the user's source-program cards (the specifications cards). It diagnoses the specifications, processes them, prints them on the edit listing, and places them in core storage for further use by other BRPG phases.

Source-Program Deck

This deck consists of five asterisk cards and the specifications cards. The user punches the specifications cards from the specifications sheets he has written. The

proper card order is ascending sequence by page and line number (columns 76-80) with two exceptions: the *format* specification cards are *first* and the *input* specification cards are *last*. The source-program deck must be placed between cards numbered 063 and 064 in card columns 73 through 75.

Asterisk Cards

These cards contain only an asterisk (11-4-8 punch) in column 1. As indicated in the preceding list of cards for the input deck, one asterisk card precedes each group of specifications, and another follows the last specification. In the case of an application that requires no calculation specifications, *two* asterisk cards must follow the data specifications. In the preceding list, note that an asterisk card precedes the input-file deck.

Format Specification Cards

Punch these cards from the Format Specifications Sheet (Form X24-6593). Punch one card for each line written on the sheet.

Data Specification Cards

In a manner similar to that of the format cards, prepare the data specification cards from the Data Specifications Sheet (Form X24-6591).

Calculation Specification Cards

Punch these cards from the Calculation Specifications Sheet (Form X24-6592).

Input Specification Cards

Punch these cards from the Input Specifications Sheet (Form X24-6590).

Remainder of Processor Deck

This is all of the BRPG processor deck except for the first two phases (ENT01 and ENT02).

Input-File Deck

This deck contains the cards of the input file. The object program, when executed, will process the data from the input file to produce the output that the user specified.

Operating Instructions for Generating an Object Program

System Preparation

1. Insert the desired forms in the IBM 1403 Printer. Install an appropriately punched carriage tape (punched in channels 1 and 12). Ready the printer.

2. Place the input deck in the 1402 read feed. The composition of this deck is given under *Input Deck for Basic RPG Run*. Ready the 1402.
3. Turn on the check-stop switch and the I/O check-stop switch.

Loading and Executing Basic RPG

With the IBM 1401 or 1460 system prepared for operation, the user can load and execute the Basic Report Program Generator program. Press the program-load key on the 1402. Loading and execution of the BRPG program are automatic. The generating run of BRPG proceeds without interruption until completed, with a few exceptions. (The exceptions are given under *Halts and Messages*.) BRPG thus performs its analysis of *all* the user's report specifications as well as his control card. Unacceptable entries in these cards are noted on the edit listing, but they do not halt the BRPG program. When it has finished generating the object program, BRPG halts so the user can examine the edit listing. He can then decide whether to proceed with program execution. If he proceeds, the I/O check-stop switch must be turned off.

Output of Basic RPG Run

On the IBM 1403, BRPG prints an edit listing. (For a description, see *Edit Listing*.) It also generates the object program in machine language. The object program is in core storage, ready to be either executed or both punched into cards and executed.

Operating Instructions for Running an Object Program

Load-and-Go Operation

System Preparation

Having determined that the generated object program in core storage is correct for this application, proceed as follows:
1. If the object program is to print a report, insert the proper report forms in the printer and install a correspondingly punched carriage tape.
2. Perform one of these steps:
   a. If the object program is to be executed, press console start key.
   b. If the object program is to be punched in cards (in load-card format, for future use) and executed, press the console start-reset key and then the start key.

Object-Program Deck

If the user chooses the punched-object-program-deck option, as indicated in the preceding step 2b, BRPG punches the object program in condensed machine-language form. This is the format and contents of the object program cards:

Columns	Contents
1-3	The three-character machine address of the first storage position to be loaded.
4-5	The number of characters to be loaded from the card. Word-separator characters are not counted.
6-71	The instructions and/or data to be loaded. A word-separator character (0-5-8 punch) precedes every character requiring a word mark in core storage.
72-75	Sequence number of the card within the entire program deck, starting with 001.
76-80	Blank.

A six-card low-core loader as described under *Input Deck for Basic RPG Run* must be used to load the object deck for future runs of the object program.

Loading an Object-Program Deck

System Preparation
1. Depending on the object-program output specified, ready the proper units (printer and/or the card read-punch).
2. Place these cards in the read feed of the 1402:
   a. Low-core loader.
   b. Object program.
   c. Input data file.
   Ready the 1402.
3. Turn on sense switch A. Turn the check-stop switch on, and the I/O check-stop switch off. Press the check-reset and the start-reset keys.
4. To begin loading and executing the object program, press the 1402 program-load key.

Edit Listing

This is a listing printed on the IBM 1403 Printer. It contains a printed record of the user's RPG specifications cards, together with references to diagnostic notes when applicable. A diagnostic note calls the user's attention either to an error in a report specification or to an unusual calculation specification. An unusual calculation specification may not be an error. Because it is unusual, however, it deserves attention to ensure that its use is intentional.

For certain errors that the user might make, BRPG not only notes them but also makes assumptions. This

permits the user to proceed if the assumed information is correct for his application. For example, if the user did not specify the output medium (column 5 or 6 of the format specifications), BRPG detects this error. It prints the format specification exactly punched, and on the next line it prints the card number of the format specification and the reference, NOTE 26. After it lists all the specifications, BRPG prints in numerical order all of the diagnostic notes that apply. In this group the message appears NOTE 26 NO OUTPUT MEDIUM SPECIFIED IN COL 5 OR 6 OF THIS L FORMAT ENTRY. PRINTED OUTPUT IS ASSUMED.

Besides the analysis of the specifications just mentioned, BRPG also includes in the edit listing other items of information that are valuable documentation for the source program. These items are mentioned in the following discussion of the contents of the edit listing.

Specifications

The first line of this listing contains the title (1401 or 1460 BRPG EDIT LISTING). If the user specifies in his CTL control card a core-storage capacity different from the actual capacity of the generating 1401 or 1460 system, BRPG prints on the second line the message MACHINE SIZE XXK. XX is the actual core-storage capacity of the generating 1401 or 1460 system, in thousands of positions. The third line indicates the printer size by the message PRINTER POSITIONS 100 (or 132). The fourth line indicates the 1401 core-storage capacity by the message STORAGE POSITIONS 4000 (or 8000, or 12000, or 16000).

The next two lines contain headings for five columns: CD NO, PAGE, LINE, CARD IMAGE, and DIAGNOSTIC. These five columns pertain to the analysis of the specifications cards. The *card number* column identifies the specification card in the order it appears in the deck. The *page* and the *line* columns print as punched in the specifications cards. The *card image* column contains the contents of the first 75 columns of the specifications cards. The *diagnostic* column contains NOTE xxx in those cases when BRPG detects an error. This refers to a specific diagnostic message in the list of all the errors BRPG detects up until the time the list is printed.

Diagnostic Notes

A section of the edit listing containing one or more lines for every referenced note is printed next. This listing of the numbered diagnostic notes is printed in numeric sequence. It indicates not only the errors BRPG has detected up to this point, but in most cases it also indicates the action taken by the BRPG processor (such as the assumptions made or that the specification is bypassed).

Resulting Conditions

Next, BRPG prints a list of the resulting conditions. To the right of each two-character condition, there appears a three-character core address that BRPG assigned to the condition and the five-digit equivalent address. The first ten conditions are always listed, because BRPG automatically defines them. The list includes these conditions: F1-F6, LC, 1P, condition 00, OF, and any resulting condition the user has defined in his input, data, and calculation specifications. (A resulting condition that is used but not defined does not appear in this list.)

Literals and Constants

The next portion of the edit listing is a list of all literals and constants used in the source program. The listing contains these columns of information: the BRPG-assigned core-storage address (both three-character and five-digit), length, decimal length, type (whether alphameric or numeric), the literal or the constant, and, if applicable, a diagnostic comment indicating an error.

Wordxx

Next, BRPG prints a list of all WORDxx constants or edit control words defined by W-entries in the format specifications. This list is like the previous one, except for an additional column on the left in which WORDxx is printed.

Defined Field Names

In the next list appears every field that the user defined as a field name in his specifications. This list contains these columns: field name as defined by the user, BRPG-assigned core-storage address, field length, decimal length, type (whether alphameric or numeric), and, if applicable, a diagnostic comment indicating an error.

Control Fields

BRPG lists all six control fields (field 1 through field 6). For each control field that the user defined on his input specifications, BRPG gives the length and the BRPG-assigned core-storage address. For each field not defined, it prints the notation NOT DEFINED.

Undefined Labels

Undefined labels (field names) are listed next. If BRPG detects a field used in a calculation or a format specification that is not defined in a specification, it prints a line that shows the name of the undefined field and the kind of specification in which it appears.

Additional Calculation Diagnostics

BRPG performs two separate tests for calculation specifications. The results of the first test are printed in the first part of the edit listing, as described previously. The results of the second error test are printed here. This list includes only the calculation specifications that contain errors revealed by the second test. Each line is printed in this form:

CARD NUMBER xxx   NOTE xx.

The card number printed here refers to the sequence number of the specification (it appears in the leftmost column of the calculation-specification list). The reference to a numbered note indicates the specification error. After all these lines are listed, the numbered diagnostic notes (messages) that are applicable are printed in sequential order.

BRPG-Routine Addresses

BRPG halts before printing this last portion of the edit listing. The purpose of the halt is to permit the user to determine whether his object program is correct. If it is, BRPG prints this last section after the user presses the start key.

Each line in this section indicates both the three-character core-storage address and the five-digit equivalent address of a BRPG routine. There are nine lines, each one giving the address of one of the following routines:

B, F, and K entries
Heading and detail lines
Total lines
Overflow lines
Data entries
Detail calculations
Total calculations
Alpha input entries
Numeric input entries.

This is the form of each line:

STARTING ADDRESS OF (name of routine) IS nnnnn mmm.

The three m's represent the three-character core-storage address, and the five n's represent the equivalent five-digit address.

Numbered Diagnostic Notes

Here is a list in numeric order of the numbered diagnostic notes in the BRPG program. Headings indicate the kind of specification card to which the notes apply.

Format Specifications

NOTE 22   NO L, B, F, K, OR W IN COL 1 OF FORMAT SPEC CARD. CARD BYPASSED.

OR   THIS CARD IS NOT A W FORMAT ENTRY AND A W ENTRY HAS BEEN PREVIOUSLY PROCESSED. THIS CARD IS BYPASSED.

OR   COL 2 OF THIS L FORMAT ENTRY IS NOT A T, D, OR H. AND THIS IS NOT A CONTINUE ENTRY. THIS CARD IS BYPASSED.

NOTE 23   DISK OUTPUT IS ASKED FOR BY THIS ENTRY. PRINTER OUTPUT IS ASSUMED.

NOTE 24   NO PRINT POSITION SPECIFIED IN COL 35-37 OF THIS B, F, OR K FORMAT ENTRY. PROCESSING CONTINUES USING POSITON 122.

NOTE 25   THIS L FORMAT ENTRY SHOULD HAVE A LINE OUTPUT CONDITION IN COL 20-28. PROCESSING CONTINUES WITH CONDITION 00.

NOTE 26   NO OUTPUT MEDIUM SPECIFIED IN COL 5 OR 6 OF THIS L FORMAT ENTRY. PRINTED OUTPUT IS ASSUMED.

Data Specifications

NOTE 32   COL 1 OF A DATA SPEC ENTRY DOES NOT CONTAIN A D. CARD IS BYPASSED.

NOTE 33   NO FIELD LENGTH GIVEN IN COL 8-10. LENGTH OF 009 IS ASSUMED.

NOTE 34   COL 32 OF DATA SPEC DOES NOT HAVE VALID OP. MOVE OP IS ASSUMED.

NOTE 35   ORDER OF DATA SPECS NOT CORRECT. EITHER AN ALPHA SOURCE CARD FOLLOWS A NUMERIC, OR A NUMERIC CARD OF LOWER LEVEL THAN THE PRECEDING CARD HAS BEEN ENCOUNTERED.

NOTE 36   NO FIELD END POSITION IS SPECIFIED IN COL 26-28 OF THIS DATA SPEC. PROCESSING CONTINUES ASSUMING POSITION 009.

NOTE 37   COL 13, 16, OR 19 OF THIS DATA SPEC DOES NOT CONTAIN A VALID STATUS CHARACTER. PROCESSING CONTINUES ASSUMING A P.

Calculation Specifications

NOTE 42   COL 1 OF CALC SPEC DOES NOT CONTAIN AN A. CARD BYPASSED.

NOTE 43   NO FIELD LENGTH GIVEN IN COL 8-10 IN THIS CALC CARD. LENGTH 009 IS ASSUMED.

NOTE 44   COL 29 OF CALC SPEC IS NOT A PLUS, −, ×, /, OR C. FACTOR 1 IS IGNORED.

NOTE 45   COL 46 OF CALC SPEC IS NOT A D OR T. OR A D IS ENCOUNTERED AFTER A T HAS BEEN PROCESSED. COL 46 OF PREVIOUS CARD IS ASSUMED.

NOTE 46   COL 36 OF CALC SPEC IS NOT A VALID OP CODE. A MOVE OP IS USED.

Input Specifications

NOTE 52   COL 1 OF INPUT SPEC IS NOT A C OR S. CARD IS BYPASSED.

NOTE 53   THIS INPUT SPEC SHOULD HAVE A RESULTING CONDITION IN COL 42-43.

NOTE 54   AN ALPHA INPUT SPEC CARD FOLLOWS A NUMERIC INPUT SPEC CARD, OR A NUMERIC INPUT SPEC CARD IS OUT OF NUMERIC SEQUENCE.

Calculation Specifications

NOTE 91   COMPARE OP WITH NO RESULTING CONDITION SPECIFIED.

NOTE 92   NUMERIC TO ALPHANUMERIC COMPARE SPECIFIED. NUMERIC COMPARE PERFORMED.

NOTE 93   NUMERIC TO ALPHANUMERIC ARITHMETIC OP SPECIFIED. OP WILL BE PERFORMED.

NOTE 94   INVALID STATUS CHARACTER. VALID CODES ARE B, Z, N, P, OR BLANK.

NOTE 95   RESULTANT FIELD LENGTH NOT OF MAGNITUDE TO ALWAYS CONTAIN TRUE ANSWER.

NOTE 96   COMPARE OP WITH FACTOR 1 NOT SPECIFIED.

NOTE 97   MULTIPLY OR DIVIDE OP WITH FACTOR 1 NOT SPECIFIED.

NOTE 98   INVALID STATUS CHARACTER. VALID CODES FOR COMPARE OP ARE H, L, E, OR U.

Halts and Messages

Figure 1 shows the BRPG-programmed halts that can occur during the time of a BRPG-generating run. Included are the contents of the B-address register, a message if there is one, the reason for the halt, and the recommended procedure.

Similarly, Figure 2 shows the programmed halts that can occur when running an object program that BRPG generated.

A-REGISTER	B-ADDRESS REGISTER	I-ADDRESS REGISTER	MESSAGE	REASON	PROCEDURE
0			PROG. TOO BIG	This means that the amount of core storage required exceeds the available core capacity of the generating 1401-1460 system.	Terminate the run at this point.
1				Card-read error occurred while reading the control card.	Remove the cards from the 1402 hopper and run the cards out of the machine. The first of the three cards is the one that caused the error. Correct the card in error and place it and the cards that followed back in the hopper. Press 1402 Start.
2				Card-read error occurred while reading the source program.	Same as for halt 1bb.
3				Card-read error while reading the diagnostic messages.	Same as for halt 1bb.
7				This halt permits the user to determine whether his object program is correct. He does this by examining the edit listing.	If the edit listing reveals errors, correct them if necessary and perform the BRPG generating run again. Otherwise, press console Start to proceed.
8			ONLY FORMAT SOURCE CARDS.	This source-program deck is incomplete. It consists of only formal specification cards.	Remove the cards from the reader-punch, make up a complete source-program deck, and prepare again for the BRPG generating run.
9			WRONG MACHINE FOR THIS PROCESSOR	The 4K BRPG processor is being used on a 1401 or 1460 with 8000, 12000, or 16000 positions of core storage and the control card does not specify 4000 positions of core storage.	Press the start button to continue. The BRPG Processor has assumed 4000 positions of core storage.
		1293		Card punch error occurred while punching the object deck.	Remove the last card in the punch stacker. Press Start on the IBM 1402 Card Read-Punch.
	888			This halt permits the user to exercise the object-program-deck option. Set the I/O check stop switch off.	If the user wants BRPG to punch the object program in cards as well as to execute it, he presses console Start Reset and Start. If he wants BRPG to only execute the object program, he presses console Start.
		1150		End of Compilation	If the punch option was selected, punching is now completed. The program may be executed by pressing Start. If the load and go option was selected, place the asterisk and data cards in the reader and press Start.

Figure 1. BRPG Processor Halts

I-ADDRESS REGISTER	B-ADDRESS REGISTER	REASON	PROCEDURE
372		End-of-Job.	
	372	Cards of the input file are out of the sequence specified in the object program.	Run cards out of the machine. Correct the card sequence and place the cards back in the hopper. Press 1402 Start.
	398 (with adv. prog. spec. feat.) or 30bb (without adv. prog. spec. feat.)	Card-read error occurred while reading input-file card.	Remove cards from reader hopper and run cards out of the machine. The first of the three cards run out is the error card. Correct the error card, place it and the cards that followed it back in the hopper, and press the reader start key.
1201		Card-punch error occurred while punching card output.	Remove and discard the last card punched; run out and discard the cards in the punch feed and press start.

Figure 2. Object-Program Halts

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