**Structured Macros for the IBM® High Level Assembler**

This set of structured programming macros was created to make it as simple and straightforward as possible to implement complex logic in an IBM Mainframe Assembly Language program. The macros can be processed using the IBM® High Level Assembler.

Similar to other structured programming macros, this set processes logic phrases, connected by "AND" or "OR" conjunctions. Each logic requirement of the user must be invoked by coding the "IF" macro with its operands. Each logical expression must be enclosed within parentheses, and will consist of the operation code of an instruction that sets the system condition code, such as a TM instruction, or an LTR, an AP, or a CLC. etc. Any machine language instruction that sets the condition code may be used. For an instruction that requires two operands, the operation code must be followed by the first operand, the second operand, and the extended mnemonic condition code required for the execution of the instructions comprising the body of the "IF" group. For any instruction used, the first positional sub-parameter must be the op-code and the last must be the extended mnemonic condition code. Between these two values should be coded one operand for each parameter required by the instruction. All of the values required must be enclosed within a pair of parentheses:

IF (TM,ERRSW,X'08',Z)

...

ENDIF

This construct will test the fourth bit of the variable ERRSW, and perform the body of the IF-GROUP if the value of that bit is ZERO.

If more than one condition is to be tested, then each phrase except the last in the list must be followed by an AND or an OR:

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IF (TM,ERRSW,X'08',Z),AND,(CLC,TEST,=C'PASS',E),OR, C

(LTR,R15,R15,Z)

...

ENDIF

Since the evaluation of "AND" in a logical expression would take precedence over "OR", you may need to override that precedence to force the "OR" conjunction(s) to take precedence over the "AND". You would enclose the two or more phrases joined by an "OR" with an additional pair of parentheses.

When the additional pair of parentheses is detected, the "IF" macro goes into recursive mode and calls itself, passing a list of the sub-parameters from the operand of the macro to the recursive copy. This recursive copy will then process the passed parameters in exactly the same way as the previous recursive level processed the its set of parameters. If an additional instance of extra parentheses is detected, then the macro will enter an additional level of recursion, ad infinitum.

Here are a few examples of the code created by the use of the IF macro. These examples are from a test program written to verify that the use of the IF macro will produce the correct result based on the operands provided to it. The output of the program confirms that the IF has created the correct logic. This program was processed by the IBM® High Level Assembler. These examples also show the use of the ELSE and the ENDIF macros.

In the following example the body of the IF-GROUP will execute if the first phrase is true AND if at least one of the other two phrases is true (note the extra pair of parentheses surrounding the second and third conditional phrases):

1924 \*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*

1925 \* \*

1926 \* IF (A) AND ((B) OR (C)) \*

1927 \* \*

1928 \*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*

1929 \*

000D86 92C1 D0D1 03229 1930 MVI VARBL1,C'A' SET TO PASS

000D8A 92C2 D0D2 0322A 1931 MVI VARBL2,C'B' SET TO PASS

000D8E 92C3 D0D3 0322B 1932 MVI VARBL3,C'C' SET TO PASS

000D92 D204 D069 9144 031C1 03144 1933 MVC PREDOUT,=C'TRUE '

000D98 D207 D04D AEF0 031A5 02EF0 1934 MVC TESTNBR,=C'TEST080A'

1935 \*

1936 TEST080A IF (CLI,VARBL1,C'A',E),AND, C

((CLI,VARBL2,C'B',E),OR,(CLI,VARBL3,C'C',E))

000D9E 95C1 D0D1 03229 1938+TEST080A CLI VARBL1,C'A' 01-IF

000DA2 A774 000F 00DC0 1941+ JNE $MDF134 01-IF

000DA6 95C2 D0D2 0322A 1946+ CLI VARBL2,C'B' 02-IF2

000DAA A784 0006 00DB6 1949+ JE $MDT135 02-IF2

000DAE 95C3 D0D3 0322B 1951+ CLI VARBL3,C'C' 02-IF2

000DB2 A774 0007 00DC0 1957+ JNE $MDF134 01-IF

000DB6 1958+$MDT135 DC 0H'0' 01-IF

000DB6 D204 D080 9144 031D8 03144 1959 MVC ACTOUT,=C'TRUE '

1960 ELSE

000DBC A7F4 0005 00DC6 1962+ J $FINI136 01-ELSE

000DC0 1963+$MDF134 DC 0H'0' 01-ELSE

000DC0 D204 D080 9149 031D8 03149 1964 MVC ACTOUT,=C'FALSE'

1965 ENDIF

000DC6 1967+$FINI136 DC 0H'0' 01-ENDIF

Output: TEST080A PREDICTED OUTCOME: TRUE ; ACTUAL OUTCOME: TRUE

In this example, the body of the IF group will execute if both the first and the second conditional phrases are true, or if both the third and fourth phrases are true:

2410 \*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*

2411 \* \*

2412 \* IF (A) AND (B) OR (C) AND (D) \*

2413 \* \*

2414 \*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*

001782 92E9 D0D1 03229 3331 MVI VARBL1,C'Z' SET TO FAIL

001786 41F0 0004 00004 3332 LA R15,4 SET TO FAIL

00178A 9201 D0D3 0322B 3333 MVI VARBL3,X'01' SET TO FAIL

00178E F230 D048 9150 031A0 03150 3334 PACK PACK1,=Z'2' SET TO FAIL

001794 D204 D069 9149 031C1 03149 3335 MVC PREDOUT,=C'FALSE'

00179A D207 D04D AFA8 031A5 02FA8 3336 MVC TESTNBR,=C'TEST090P'

3337 \*

3338 TEST090P IF (CLI,VARBL1,C'A',E),AND,(LTR,R15,R15,Z),OR, C

(TM,VARBL3,X'01',Z),AND,(SP,PACK1,=P'1',Z)

0017A0 95C1 D0D1 03229 3340+TEST090P CLI VARBL1,C'A' 01-IF

0017A4 A774 0005 017AE 3343+ JNE $MDF241 01-IF

0017A8 12FF 3345+ LTR R15,R15 01-IF

0017AA A784 000B 017C0 3348+ JZ $MDT242 01-IF

0017AE 9101 D0D3 0322B 3350+$MDF241 TM VARBL3,X'01' 01-IF

0017B2 A774 000C 017CA 3353+ JNZ $MDF243 01-IF

0017B6 FB30 D048 914F 031A0 0314F 3355+ SP PACK1,=P'1' 01-IF

0017BC A774 0007 017CA 3359+ JNZ $MDF243 01-IF

0017C0 3360+$MDT242 DC 0H'0' 01-IF

0017C0 D204 D080 9144 031D8 03144 3361 MVC ACTOUT,=C'TRUE '

3362 ELSE

0017C6 A7F4 0005 017D0 3364+ J $FINI244 01-ELSE

0017CA 3365+$MDF243 DC 0H'0' 01-ELSE

0017CA D204 D080 9149 031D8 03149 3366 MVC ACTOUT,=C'FALSE'

3367 ENDIF

0017D0 3369+$FINI244 DC 0H'0' 01-ENDIF

3370 IF (CLC,PREDOUT,ACTOUT,NE)

0017D0 D504 D069 D080 031C1 031D8 3372+ CLC PREDOUT,ACTOUT 01-IF

0017D6 A784 0005 017E0 3376+ JE $NEXT245 01-IF

0017DA D209 D086 9130 031DE 03130 3377 MVC ERROR,=C'<=== ERROR'

3378 ENDIF

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Active Usings: IFTEST,R12,R11,R10,R9 $$WA$$,R13

0 Loc Object Code Addr1 Addr2 Stmt Source Statement HLASM R6.0 2021/03/04 03.02

00017E0 3380+$NEXT245 DC 0H'0' 01-ENDIF

Output: TEST090P PREDICTED OUTCOME: FALSE; ACTUAL OUTCOME: FALSE

Here the body of the IF group will execute if the first phrase is true, at least one of the next two phrases is true, and the final phrase is true (note the extra pair of parentheses surrounding the second and third phrases);

3391 \*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*

3392 \* \*

3393 \* IF (A) AND ((B) OR (C)) AND (D) \*

3394 \* \*

3395 \*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*

3396 \*

0017F6 92C1 D0D1 03229 3397 MVI VARBL1,C'A' SET TO PASS

0017FA 41F0 0000 00000 3398 LA R15,0 SET TO PASS

0017FE 9200 D0D3 0322B 3399 MVI VARBL3,X'00' SET TO PASS

001802 F230 D048 914E 031A0 0314E 3400 PACK PACK1,=Z'1' SET TO PASS

001808 D204 D069 9144 031C1 03144 3401 MVC PREDOUT,=C'TRUE '

00180E D207 D04D AFB0 031A5 02FB0 3402 MVC TESTNBR,=C'TEST100A'

3403 \*

3404 TEST100A IF (CLI,VARBL1,C'A',E),AND, C

((LTR,R15,R15,Z),OR,(TM,VARBL3,X'01',Z)),AND, C

(SP,PACK1,=P'1',Z)

001814 95C1 D0D1 03229 3406+TEST100A CLI VARBL1,C'A' 01-IF

001818 A774 0013 0183E 3409+ JNE $MDF246 01-IF

00181C 12FF 3414+ LTR R15,R15 02-IF2

00181E A784 0006 0182A 3417+ JZ $MDT247 02-IF2

001822 9101 D0D3 0322B 3419+ TM VARBL3,X'01' 02-IF2

001826 A774 000C 0183E 3424+ JNZ $MDF246 01-IF

00182A FB30 D048 914F 031A0 0314F 3426+$MDT247 SP PACK1,=P'1' 01-IF

001830 A774 0007 0183E 3430+ JNZ $MDF246 01-IF

001834 D204 D080 9144 031D8 03144 3431 MVC ACTOUT,=C'TRUE '

3432 ELSE

00183A A7F4 0005 01844 3434+ J $FINI248 01-ELSE

00183E 3435+$MDF246 DC 0H'0' 01-ELSE

00183E D204 D080 9149 031D8 03149 3436 MVC ACTOUT,=C'FALSE'

3437 ENDIF

Output: TEST100A PREDICTED OUTCOME: TRUE ; ACTUAL OUTCOME: TRUE

In the following example, the body of the IF group will be executed if the first conditional term is TRUE, or if both of the next two terms are true, or if the final term is true:

4436 \*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*

4437 \* \*

4438 \* IF (A) OR (B) AND (C) OR (D) \*

4439 \* \*

4440 \*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*

4441 \*

002432 92E9 D0D1 03229 5113 MVI VARBL1,C'Z' SET TO FAIL

002436 41F0 0004 00004 5114 LA R15,4 SET TO FAIL

00243A 9200 D0D3 0322B 5115 MVI VARBL3,X'00' SET TO PASS

00243E F230 D048 9150 031A0 03150 5116 PACK PACK1,=Z'2' SET TO FAIL

002444 D204 D069 9149 031C1 03149 5117 MVC PREDOUT,=C'FALSE'

00244A D207 D04D 9088 031A5 03088 5118 MVC TESTNBR,=C'TEST110L'

5119 \*

5120 TEST110L IF (CLI,VARBL1,C'A',E),OR,(LTR,R15,R15,Z),AND, C

(TM,VARBL3,X'01',Z),OR,(SP,PACK1,=P'1',Z)

002450 95C1 D0D1 03229 5122+TEST110L CLI VARBL1,C'A' 01-IF

002454 A784 000E 02470 5125+ JE $MDT365 01-IF

002458 12FF 5127+ LTR R15,R15 01-IF

00245A A774 0006 02466 5130+ JNZ $MDF366 01-IF

00245E 9101 D0D3 0322B 5132+ TM VARBL3,X'01' 01-IF

002462 A784 0007 02470 5135+ JZ $MDT365 01-IF

002466 FB30 D048 914F 031A0 0314F 5137+$MDF366 SP PACK1,=P'1' 01-IF

00246C A774 0007 0247A 5141+ JNZ $NEXT367 01-IF

002470 5142+$MDT365 DC 0H'0' 01-IF

002470 D204 D080 9144 031D8 03144 5143 MVC ACTOUT,=C'TRUE '

5144 ELSE

002476 A7F4 0005 02480 5146+ J $FINI368 01-ELSE

00247A 5147+$NEXT367 DC 0H'0' 01-ELSE

00247A D204 D080 9149 031D8 03149 5148 MVC ACTOUT,=C'FALSE'

5149 ENDIF

002480 5151+$FINI368 DC 0H'0' 01-ENDIF

Output: TEST110L PREDICTED OUTCOME: FALSE; ACTUAL OUTCOME: FALSE

In this example, the body of the IF group will be executed if at least one of the first two terms is true AND at least one of the last two terms is true (note the extra pair of parentheses surrounding the first and second phrases and the third and fourth);

5417 \*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*

5418 \* \*

5419 \* IF ((A) OR (B)) AND ((C) OR (D)) \*

5420 \* \*

5421 \*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*

5422 \*

002A8A 92E9 D0D1 03229 6062 MVI VARBL1,C'Z' SET TO FAIL

002A8E 41F0 0000 00000 6063 LA R15,0 SET TO PASS

002A92 9200 D0D3 0322B 6064 MVI VARBL3,X'00' SET TO PASS

002A96 F230 D048 9150 031A0 03150 6065 PACK PACK1,=Z'2' SET TO FAIL

002A9C D204 D069 9144 031C1 03144 6066 MVC PREDOUT,=C'TRUE '

002AA2 D207 D04D 90F8 031A5 030F8 6067 MVC TESTNBR,=C'TEST120J'

6068 \*

6069 TEST120J IF ((CLI,VARBL1,C'A',E),OR,(LTR,R15,R15,Z)),AND, C

((TM,VARBL3,X'01',Z),OR,(SP,PACK1,=P'1',Z))

002AA8 95C1 D0D1 03229 6074+TEST120J CLI VARBL1,C'A' 02-IF2

002AAC A784 0005 02AB6 6077+ JE $MDT435 02-IF2

002AB0 12FF 6079+ LTR R15,R15 02-IF2

002AB2 A774 0010 02AD2 6084+ JNZ $MDF436 01-IF

002AB6 9101 D0D3 0322B 6089+$MDT435 TM VARBL3,X'01' 02-IF2

002ABA A784 0007 02AC8 6092+ JZ $MDT437 02-IF2

002ABE FB30 D048 914F 031A0 0314F 6094+ SP PACK1,=P'1' 02-IF2

002AC4 A774 0007 02AD2 6100+ JNZ $MDF436 01-IF

002AC8 6101+$MDT437 DC 0H'0' 01-IF

002AC8 D204 D080 9144 031D8 03144 6102 MVC ACTOUT,=C'TRUE '

6103 ELSE

002ACE A7F4 0005 02AD8 6105+ J $FINI438 01-ELSE

002AD2 6106+$MDF436 DC 0H'0' 01-ELSE

002AD2 D204 D080 9149 031D8 03149 6107 MVC ACTOUT,=C'FALSE'

6108 ENDIF

002AD8 6110+$FINI438 DC 0H'0' 01-ENDIF

Output: TEST120J PREDICTED OUTCOME: TRUE ; ACTUAL OUTCOME: TRUE

This example demonstrates the requirement for an additional level of recursion (2 total). The body of the IF group will be executed if A and B are true, or A and C and D are true, or A and C and E are true:

6531 \*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\* 21090007

6532 \* \* 21100007

6533 \* TWO LEVELS OF RECURSION ARE REQUIRED: \* 21110007

6534 \* \* 21120007

6535 \* IF (A) AND ((B) OR (C) AND ((D) OR (E))) \* 21130007

6536 \* \* 21140007

6537 \*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\*=\* 21150007

6538 \* 21160007

003368 92C1 D542 042CA 7488 MVI VARBL1,C'A' SET TO PASS 23700007

00336C 41F0 0000 00000 7489 LA R15,0 SET TO PASS 23710007

003370 9201 D544 042CC 7490 MVI VARBL3,X'01' SET TO FAIL 23720007

003374 F230 D4B9 D4B8 04241 04240 7491 PACK PACK1,=Z'2' SET TO FAIL 23730007

00337A 9210 D546 042CE 7492 MVI TSWITCH,X'10' SET TO PASS 23740007

00337E D204 D4DA D4AC 04262 04234 7493 MVC PREDOUT,=C'TRUE ' 23750011

003384 D207 D4BE D3F8 04246 04180 7494 MVC TESTNBR,=C'TEST130M' 23760007

7495 \* 23770007

7496 TEST130M IF (CLI,VARBL1,C'A',E),AND, C23780007

((LTR,R15,R15,Z),OR,(TM,VARBL3,X'01',Z),AND, C23790007

((SP,PACK1,=P'1',Z),OR,(CLI,TSWITCH,X'10',E))) 23800009

00338A 95C1 D542 042CA 7498+TEST130M CLI VARBL1,C'A' 01-IF

00338E A774 0017 033BC 7501+ JNE $MDF540 01-IF

003392 12FF 7506+ LTR R15,R15 02-IF2

003394 A784 000F 033B2 7509+ JZ $MDT541 02-IF2

003398 9101 D544 042CC 7511+ TM VARBL3,X'01' 02-IF2

00339C A774 0010 033BC 7514+ JNZ $MDF542 02-IF2

0033A0 FB30 D4B9 D4B7 04241 0423F 7519+ SP PACK1,=P'1' 03-IF2

0033A6 A784 0006 033B2 7522+ JZ $MDT543 03-IF2

0033AA 9510 D546 042CE 7524+ CLI TSWITCH,X'10' 03-IF2

0033AE A774 0007 033BC 7532+ JNE $MDF540 01-IF

0033B2 7533+$MDT541 DC 0H'0' 01-IF

0033B2 D204 D4F1 D4AC 04279 04234 7534 MVC ACTOUT,=C'TRUE ' 23810007

7535 ELSE 23820007

0033B8 A7F4 0005 033C2 7537+ J $FINI544 01-ELSE

0033BC 7538+$MDF540 DC 0H'0' 01-ELSE

0033BC D204 D4F1 D4B1 04279 04239 7539 MVC ACTOUT,=C'FALSE' 23830007

7540 ENDIF 23840007

0033C2 7542+$FINI544 DC 0H'0' 01-ENDIF

033BC 7543+$MDF542 EQU $MDF540 01-ENDIF

033B2 7544+$MDT543 EQU $MDT541 01-ENDIF

Output: TEST130M PREDICTED OUTCOME: TRUE ; ACTUAL OUTCOME: TRUE