PROGRAM

PDP-7 Gray Code Conversion

COMPUTER SYSTEM

PDP-7 with special IOT instructions that permit the input of an encoded number in Gray binary.

DESCRIPTION

The Gray code is a specific n bit counting sequence of 2^n counts having the characteristics of being nonweighted, monostrophic (binary codes in which only one bit changes from count to count) and reflected (represents a numbering system of a radix r, and by complementing a given bit, which is the same bit for all counts and is usually the most significant bit, will yield the r-1's complement of the original count) and represents a specific ordered numbering system of 2^n counts.
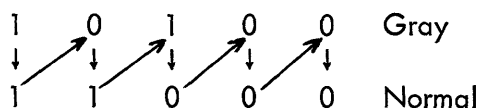
METHOD

Adjacent bits in the Gray word are compared. When they are equal, the corresponding normal bit is set to 0. When they are different, the corresponding normal bit is set to 1.

EXAMPLE

Gray binary input = 10100

Compute normal binary by comparing bits

```
1    0    1    0    0    Gray

1    1    0    0    0    Normal
```

SPECIFICATIONS

Timing

1. Size-oriented subroutine:
        21 μsec + 12.25 x N μsec + 8.75 μsec
        average time = 210 μsec for 18-bit Gray code word

2. Speed-oriented subroutine:
        7 μsec + 7 x N μsec + 3.5K μsec
        average time = 101.5 μsec for 18-bit Gray code word

        where N is the number of Gray bits = 1
        where K is the number of Gray bits = 0

Storage Requirements

1. Size-oriented subroutine
        14 locations

2. Speed-oriented subroutine
        3 + 31 locations

   where I is the number of bits in the Gray code word

USAGE

        The size-oriented routine is entered with the Gray code to be converted in the AC. The routine returns with the converted number (in normal binary) in the AC.

                        LAC   A
                        JMS   GRYBIN

where A is the Gray code to be converted.

        The speed-oriented routine is open coding, to be used when the number of Gray code bits to be converted is known.
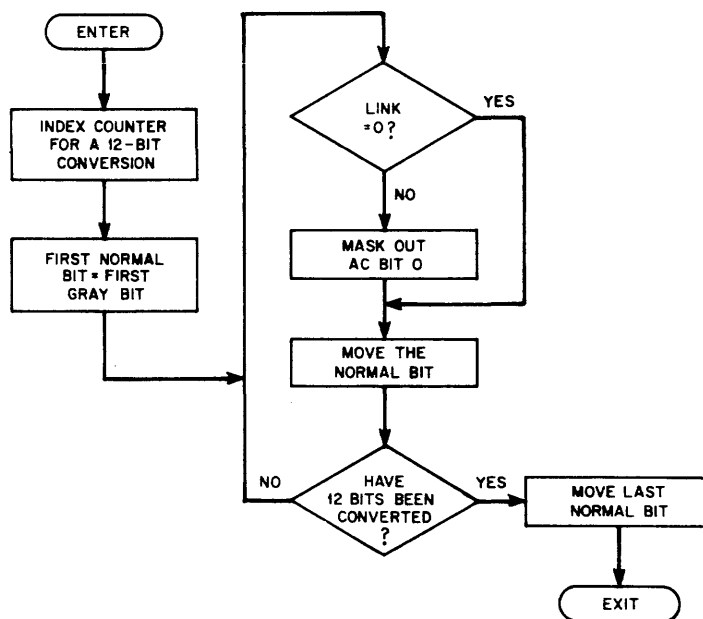
Size-Oriented Conversion Routine Flow Chart

LISTING

Size-Oriented Routine

/GRAY CODE TO NORMAL BINARY - SIZE ORIENTED

```
GRYBIN,         0
                DAC TEMP
                LAC (-11
                DAC COUNT        /INITIALIZE COUNTER FOR 12-BIT CONVERSION
                LAC TEMP
                CLL RAL          /FIRST NORMAL BIT - FIRST GRAY BIT
                SPL
                XOR (400000
                RAL              /MOVE NORMAL BIT
                ISZ COUNT        /HAVE 12 BITS BEEN CONVERTED
                JMP .-4          /NO - CONTINUE; LOOP
                RAL              /MOVE LAST NORMAL BIT
                JMP I GRYBIN     /RETURN
```

STORAGE MAP

TEMP	(Gray number to be converted) C(TEMP)
COUNT	Contains indexable constant for 12-bit conversion

SPEED-ORIENTED IN-LINE CODING

```
                ---              /MAIN PROGRAM
                CLL RAL
                SPL
                XOR (400000
                RAL
                SPL
                XDR (400000
                RAL
                 .               /REPEAT UNTIL I BITS HAVE
                 .               /BEEN CONVERTED
                 .
                RAL
                ---              /MAIN PROGRAM
```

DEFINITION OF TERMS

AC	Accumulator
C(AC)	Contents of AC
C(A) C(B)	Contents of B are replaced by the contents of A
IOT	Input-output transfer commands

PDP
7
LIBRARY

COMPARISON OF NUMBER SYSTEMS

Binary

Gray	Normal	Decimal
1	1	1
11	10	2
10	11	3
110	100	4
111	101	5
101	110	6
100	111	7
1100	1000	8
1101	1001	9
1111	1010	10
1110	1011	11
1010	1100	12
1011	1101	13
1001	1110	14
1000	1111	15
11000	10000	16