Karnaugh Map with Dont Care Conditions

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Contents

***Abstract*—This manual explains Karnaugh maps (K-map) using don't care conditions.**

1 Don't Care Conditions

1. Don't Care Conditions: 4 binary digits are used in the incrementing decoder [1]. However, only the numbers from 0-9 are used as input/output in the decoder and we *don't care* about the numbers from 10-15. This phenomenon can be addressed by revising the truth table in [1] to obtain Table 1.
2. The revised K-map for A is available in Fig. 2. Show that
$$A = W' \tag{1}$$
3. The revised K-map for B is available in Fig. 3. Show that
$$B = WX'Z' + W'X \tag{2}$$
4. The revised K-map for C is available in Fig. 4. Show that
$$C = X'Y + W'Y + WXY' \tag{3}$$

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Z	Y	X	W	D	C	B	A
0	0	0	0	0	0	0	1
0	0	0	1	0	0	1	0
0	0	1	0	0	0	1	1
0	0	1	1	0	1	0	0
0	1	0	0	0	1	0	1
0	1	0	1	0	1	1	0
0	1	1	0	0	1	1	1
0	1	1	1	1	0	0	0
1	0	0	0	1	0	0	1
1	0	0	1	0	0	0	0
1	0	1	0	-	-	-	-
1	0	1	1	-	-	-	-
1	1	0	0	-	-	-	-
1	1	0	1	-	-	-	-
1	1	1	0	-	-	-	-
1	1	1	1	-	-	-	-

TABLE 1

5. The revised K-map for D is available in Fig. 5. Show that
$$D = W'Z + WXY \tag{4}$$
6. Verify the incrementing decoder with don't care conditions using the arduino.
7. Display Decoder: Use K-maps to obtain the minimized expressions for a, b, c, d, e, f, g in terms of A, B, C, D with don't care conditions.
Solution:
With Don't Care:
from Fig. 7
$$a = CB'A' + D'C'B'A \tag{5}$$

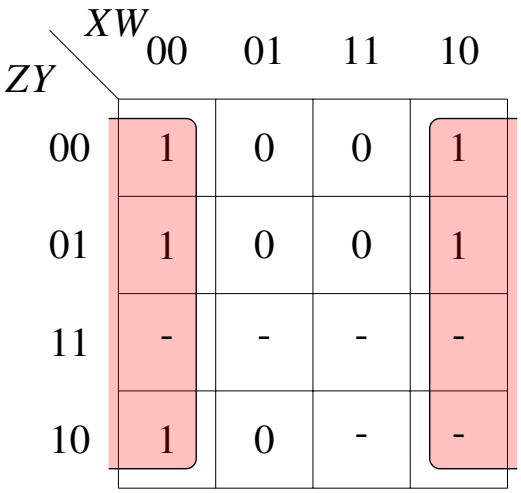

Fig. 2: K-map for A with don't cares.

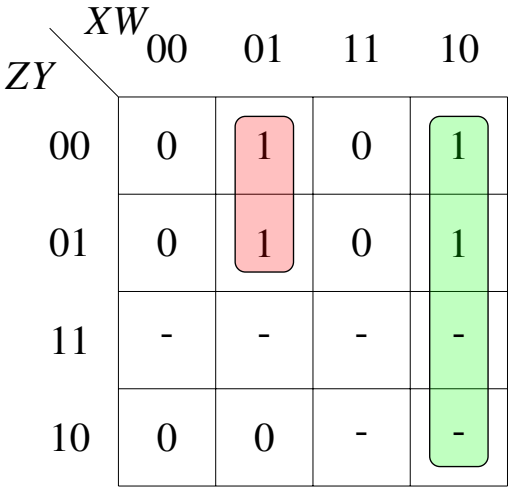

Fig. 3: K-map for B with don't cares.

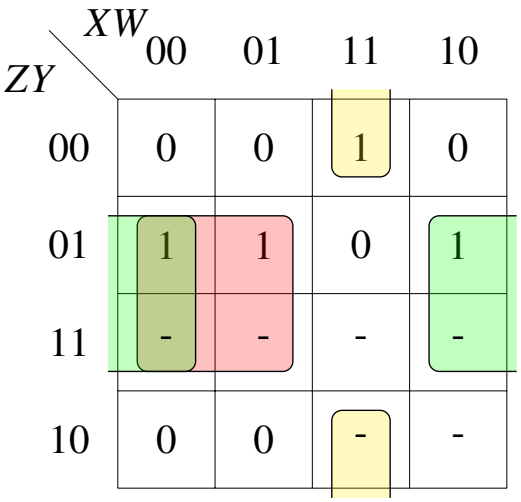

Fig. 4: K-map for C with don't cares.

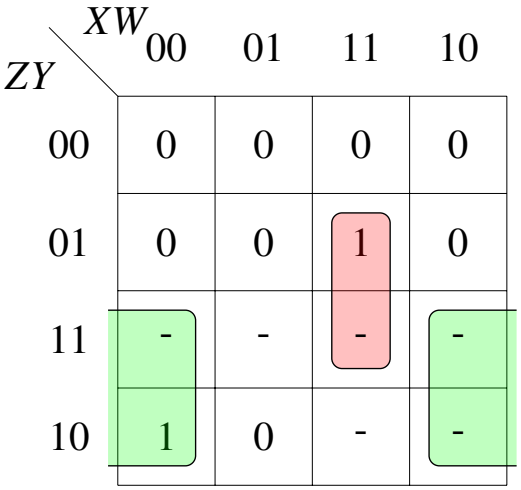

Fig. 5: K-map for D with don't cares.

from Fig. 7

$$b = CB'A + CBA' \tag{6}$$

from Fig. 7

$$c = C'BA' \tag{7}$$

from Fig. 7

$$d = CB'A' + CBA + C'B'A \tag{8}$$

from Fig. 7

$$e = A + CB' \tag{9}$$

from Fig. 7

$$f = BA + D'C'A + C'B \tag{10}$$

from Fig. 7

$$g = D'C'B' + CBA \tag{11}$$

8. Verify the display decoder with don't care conditions using arduino.

DC \ BA	00	01	11	10
00	0	1	0	0
01	1	0	0	0
11	-	-	-	-
10	0	0	-	-

Fig. 7: K-map for a with don't cares.

DC \ BA	00	01	11	10
00	0	0	0	0
01	0	1	0	1
11	-	-	-	-
10	0	0	-	-

Fig. 7: K-map for b with don't cares.

References

[1] G V V Sharma, *Karnaugh Map*. [Online]. Available: https://github.com/gadepall/arduino/raw/master/ide/kmap/gvv_kmap.pdf

DC \ BA	00	01	11	10
00	0	0	0	1
01	0	0	0	0
11	-	-	-	-
10	0	0	-	-

Fig. 7: K-map for c with don't cares.

DC \ BA	00	01	11	10
00	0	1	0	0
01	1	0	1	0
11	-	-	-	-
10	0	1	-	-

Fig. 7: K-map for d with don't cares.

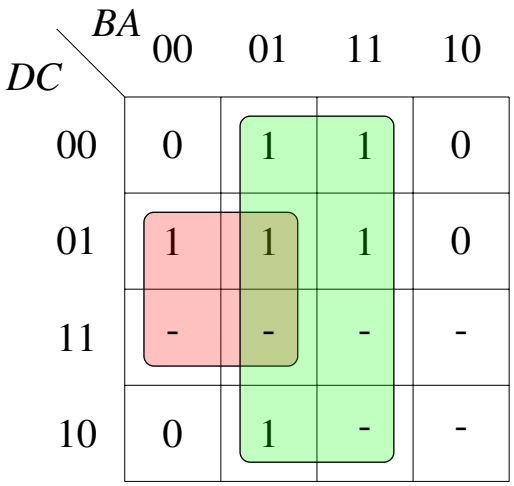

Fig. 7: K-map for e with don't cares.

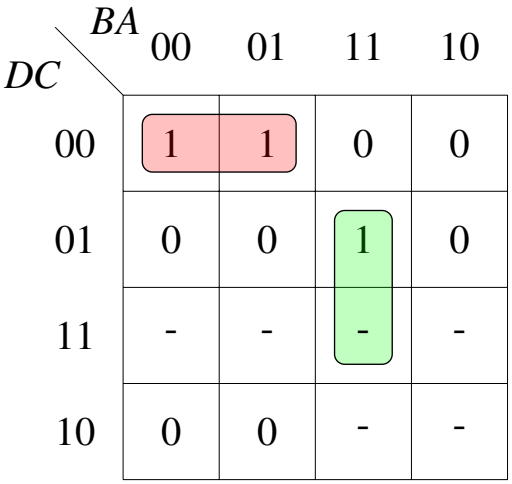

Fig. 7: K-map for g with don't cares.

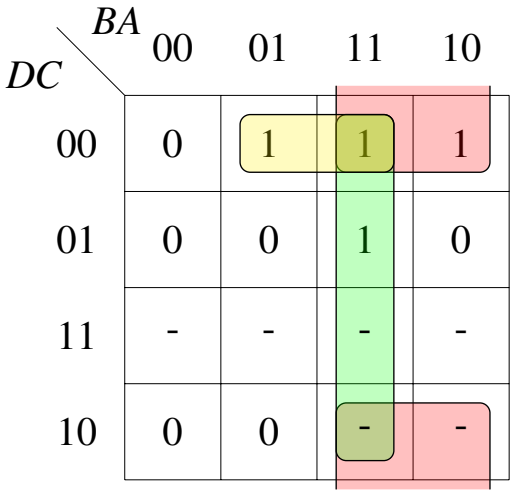

Fig. 7: K-map for f with don't cares.