

3. Canonical SOP, POS

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CANONICAL SOP & POS

$$F = ABC + \bar{A}\bar{B}C + \bar{A}B\bar{C} + \bar{A}\bar{B}\bar{C}$$

Find the SOP for this canonical SOP form.

$$F = ABC + \bar{A}\bar{B}(C + \bar{C}) + \bar{A}B\bar{C}$$

$$= ABC + \bar{A}\bar{B} + \bar{A}B\bar{C} \quad] \rightarrow \text{SOP form: cannot be called canonical}$$

Find the POS for this canonical expression:

$$(A + B + C)(\bar{A} + \bar{B} + C)(\bar{A} + B + \bar{C})$$

POS = canonical expression for this case

Find the POS for this canonical POS expression:

$$\frac{(x+y+z)(x+y+\bar{z})(x+\bar{y}+\bar{z})(x+\bar{y}+z)}{(x+y)(x+\bar{y}+\bar{z})(x+y+z)} \rightarrow \text{POS form}$$

Find the minterms for the given expression [Hint: Convert into canonical SOP form]

$$F = A + BC \quad \{ \text{SOP}$$

$$F = A(B + \bar{B})(C + \bar{C}) + BC(A + \bar{A})$$

$$= (AB + A\bar{B})(C + \bar{C}) + ABC + \bar{A}BC$$

$$= ABC + A\bar{B}\bar{C} + A\bar{B}C + A\bar{B}\bar{C} + ABC + \bar{A}BC$$

$$= ABC + \underset{111}{\bar{A}BC} + \underset{011}{A\bar{B}\bar{C}} + \underset{110}{A\bar{B}C} + \underset{101}{A\bar{B}\bar{C}} \quad \{ \text{Canonical SOP}$$

$$F = m_7 + m_3 + m_6 + m_5 + m_4$$

$$F = \sum(m_3, m_4, m_5, m_6, m_7)$$

$$\underline{\underline{F = \sum m(3, 4, 5, 6, 7)}}$$

Find the POS and canonical POS for:

Find the POS and canonical POS form:

$$F = \sum m(3, 4, 5, 6, 7)$$

$$F = \sum m(3, 4, 5, 6, 7) \rightarrow \text{where output is } 1; \text{ SOP}$$

$$\begin{array}{l} \\ \\ F = \prod M(0, 1, 2) \end{array} \rightarrow \text{where output is } 0; \text{ POS}$$

indicates product

Minterms

	A	B	C	F	
0	0	0	0	0	$A + B + C$
1	0	0	1	0	$A + B + \bar{C}$
2	0	1	0	0	$A + \bar{B} + C$

$$\text{Canonical POS} = (\underline{A+B+C})(\underline{A+\bar{B}+C})(A+\bar{B}+\bar{C})$$

$$\begin{aligned} \text{POS} &= (A+B)(A+\bar{B}+C) \\ &\quad (\cancel{(A+C)}) (A+\bar{B}+\bar{C}) \end{aligned}$$

Write the minterms and maxterms for the following:

A	B	C	F	Minterms	Maxterms
0	0	0	0		$(A+B+C) \rightarrow M_0$
0	0	1	1	$\bar{A}\bar{B}C \rightarrow m_1$	
0	1	0	0		$(A+\bar{B}+C) \rightarrow M_2$
0	1	1	0		$(A+\bar{B}+\bar{C}) \rightarrow M_3$
1	0	0	1	$A\bar{B}\bar{C} \rightarrow m_4$	
1	0	1	0		$(\bar{A}+B+\bar{C}) \rightarrow M_5$
1	1	0	0		$(\bar{A}+\bar{B}+C) \rightarrow M_6$
1	1	1	1	m_7	

$$\begin{array}{cccc} 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 \end{array} \quad ABC \rightarrow m7 \quad (\bar{A} + \bar{B} + C) \rightarrow M_6$$

Canonical SOP:

$$F_1 = \bar{A}\bar{B}C + A\bar{B}\bar{C} + ABC$$

SOP is the same

Canonical POS

$$\begin{aligned} & (\underline{A+B+C})(\underline{A+\bar{B}+C})(A+\bar{B}+\bar{C})(\bar{A}+B+\bar{C})(\bar{A}+\bar{B}+C) \\ & (A+C)(A+\bar{B}+\bar{C})(\bar{A}+B+\bar{C})(\bar{A}+\bar{B}+C) \end{aligned}$$

Canonical SOP:

$$F_2 = \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$$

$$= \bar{A}BC + A\bar{B}C + AB$$

Canonical POS:

$$\begin{aligned} F_2 &= (A+B+C)(A+B+\bar{C})(A+\bar{B}+C)(\bar{A}+B+C) \\ &= (A+B)(A+\bar{B}+C)(\bar{A}+B+C) \end{aligned}$$

Find the minterms and maxterms for the output to be 1 if input is a palindrome for 3 input.

	A	B	C	F	Minterms	Maxterms
①	0	0	0	1	$\bar{A}\bar{B}\bar{C}$	
②	0	0	1	0		$A+B+\bar{C}$
③	0	1	0	1	$\bar{A}B\bar{C}$	
④	0	1	1	0		$A+\bar{B}+\bar{C}$
⑤	1	0	0	0		$\bar{A}+B+C$
⑥	1	0	1	1	$A\bar{B}C$	

⑥ | | 0 0

$\bar{A} + \bar{B} + C$

⑦ | | | | ABC

Canonical SOP:

$$\begin{aligned} F &= \bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + A\bar{B}C + ABC \\ &= \bar{A}\bar{C} + A\bar{B}C + ABC = \bar{A}\bar{C} + AC = \sum m(0, 2, 5, 7) \end{aligned}$$

Canonical POS:

$$\begin{aligned} F &= (\bar{A} + B + \bar{C})(A + \bar{B} + \bar{C})(\bar{A} + B + C)(\bar{A} + \bar{B} + C) \\ &= (\bar{A} + \bar{C})(\bar{A} + C) = \prod M(1, 3, 4, 6) \end{aligned}$$