



ALL-OPTICAL N-BIT BINARY TO TWO'S COMPLEMENT CONVERTER WITH THE HELP OF SEMICONDUCTOR OPTICAL AMPLIFIER-ASSISTED SAGNAC SWITCH

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Abstract

All-optical n-bit paired to 2's complement converter has been planned with the assistance of Terahertz optical unbalanced demultiplexer (TOAD) switches. The paper depicts all-optical transformation conspire to utilize a bunch of every single optical switch. PC framework ordinarily utilizes 2's complement for paired deduction and intelligent control. By embracing a definite mathematical reproduction the impact of these critical boundaries on the measurements that decide the nature of exchange is completely examined and diverse plan rules are extricated for their legitimate determination to guarantee ideal activity.

Keywords: Terahertz optical asymmetric demultiplexer; semiconductor optical amplifier; 2's complement operation; optical logic.

I. Introduction

Complement when applied to the number framework, is one of the least complex approaches to address positive just as negative numbers. Presently a day parallel number frameworks are utilized in practically all advanced frameworks including signal preparing, systems administration, and PCs. The most usually utilized numbering framework that can store both positive and negative numbers in two's complement number framework. This framework doesn't need that the option and deduction hardware inspect the indications of the operands to decide if to add or take away, making it both less difficult to execute and prepared to effectively deal with exactness number-crunching. The utilization of terahertz optical awry demultiplexer (TOAD) in ultrafast all-optical exchanging has gotten wide revenue over the most recent couple of years in light of its straightforward design and low exchanging energy [VIII]. However, the existing TOAD switch with single CP in the fast all-optical application is restricted on account of uneven exchanging window (SW) profile which brings about high crosstalk that thusly influences the bit error

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(BER) performance. In this paper we propose and portray the all-optical n-cycle parallel to 2's complement converter by utilizing dual-control beats that bring about even exchanging window profile, thus diminishing crosstalk. We have used just the Transmitted port of the gadget and no extra info bar for persistent approaching wave or light sign is needed for this plan. Here just the information signals are adequate to execute the ideal activities.

II. Principle and Operation of Toad Based Switch

Figure 1 shows the proposed TOAD switch with double CP (CP1 and CP2). The information signal contribution to the TOAD circle is part into indistinguishable clockwise (CW) and counter-clockwise (CCW) segments. Without CP(s), the CW and CCW segments proliferating on the up and up will encounter a similar semiconductor optical intensifier (SOA) acquire and phase, recombine at a 2×2 coupler and rise out of the reflected port. Applying the CPs (with a defer TSW) brings about SOA gain immersion, and subsequently changing the increase and stage attributes of CW and CCW parts. These impacts will bring about an SW with a width of TSW, which permits a piece of information sign to be changed to the sent port. In this paper, we have attempted to utilize the yield just from the Transmitted method of the gadget. The yield force can be communicated as [VIII, IX]:

$$\text{Output}(t) = \frac{P_{in}(t)}{4} \cdot \left\{ G_{cw}(t) + G_{ccw}(t) + 2\sqrt{G_{cw}(t) \cdot G_{ccw}(t)} \cdot \cos(\Delta\phi) \right\} \quad (1)$$

where, is the force acquired. The time-subordinate stage contrast between clockwise (CW) and counter-clockwise (CCW) pulses [XI] is

$$\Delta\phi = -\frac{\alpha}{2} \cdot \ln(G_{cw}(t)/G_{ccw}(t)) \quad (2)$$

with α being the line-width enhancement factor.

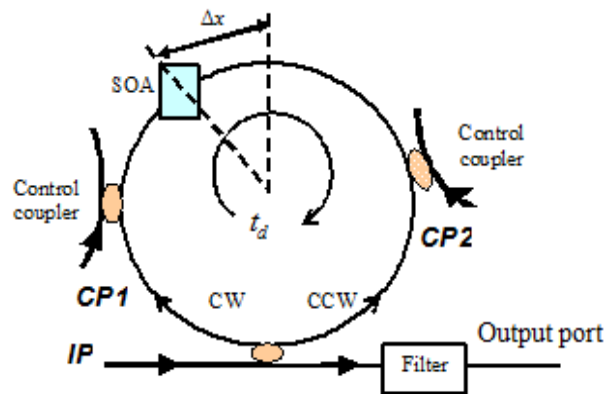


Fig 1. A TOAD based optical switch with double control pulses (CP1 and CP2), where SOA: Semiconductor optical amplifier, CW: Clockwise pulse, CCW: Counterclockwise pulse, t_d : Pulse round trip time, and Δx : Asymmetric distance

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The SOA acquire is: $G(t) = P(\text{LSOA}, t) / P(0, t) = \exp(\Gamma g N(t))$ (3) where Γ is the control factor, g is the increase coefficient, $N(t)$ is the all-out transporter of the SOA of length LSOA. Without a control signal, information signal (approaching sign) enters the fiber circle, goes through the SOA at various occasions as they counter-engender around the circle, and experience a similar unsaturated little enhancer acquire, and recombine at the info coupler for example. At that point, and articulation for. It shows that information is reflected toward the source. At the point when a controlled beat is infused into the circle, it soaks the SOA and changes its record of refraction. The addition of SOA diminishes quickly [IX-III]. Therefore, the two counter-proliferation information sign will encounter a differential increase in immersion profiles for example. In this manner, they recombine at the information coupler, and afterward, no information will exit from the yield i.e., the comparing esteems can be gotten from the condition (1). The energy of the control beat is multiple times more noteworthy than that of the approaching heartbeat [IX]. A channel might be utilized at the yield of TOAD-based change to dismiss the control and pass the approaching heartbeat. The square outline with yield rationale articulation of the switch appears in Fig. 2.

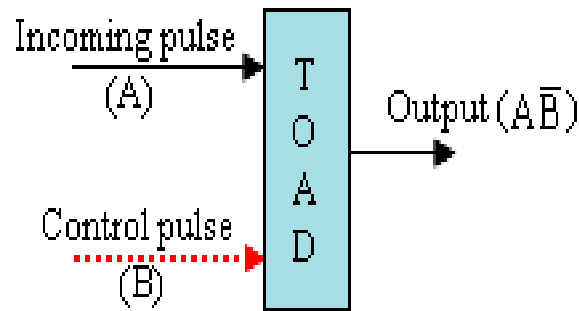


Fig 2. Schematic diagram of TOAD based switch

III. All-optical conversion from binary to Two's complement

Table 1 is a posting of the 4-cycle BCD code for the parallel numbers 0 to 15. Decimal numbers appear in the table for reference. To plan paired to Twos-Complement converter circuit Karnaugh map has been drawn as demonstrated in Fig. 3 from Table 1. Here, each piece of the 4-cycle double code is marked as beginning from MSB (most significant bit) to LSB (least significant bit), and each piece of the Twos-Complement is named as beginning from MSB to LSB.

Table 1: Truth table for binary to 2's Complement

Decimal	Binary code				2's Complement			
	A ₃	A ₂	A ₁	A ₀	D ₃	D ₂	D ₁	D ₀
0	0	0	0	0	0	0	0	0
1	0	0	0	1	1	1	1	1
2	0	0	1	0	1	1	1	0
3	0	0	1	1	1	1	0	1
4	0	1	0	0	1	1	0	0
5	0	1	0	1	1	0	1	1
6	0	1	1	0	0	1	0	0
7	0	1	1	1	1	1	0	1
8	1	0	0	0	0	1	0	0
9	1	0	0	1	1	0	1	1
10	1	0	1	0	0	1	1	0
11	1	0	1	1	1	0	1	1
12	1	1	0	0	0	0	1	0
13	1	1	0	1	1	0	0	1
14	1	1	1	0	0	0	1	0
15	1	1	1	1	1	0	0	1

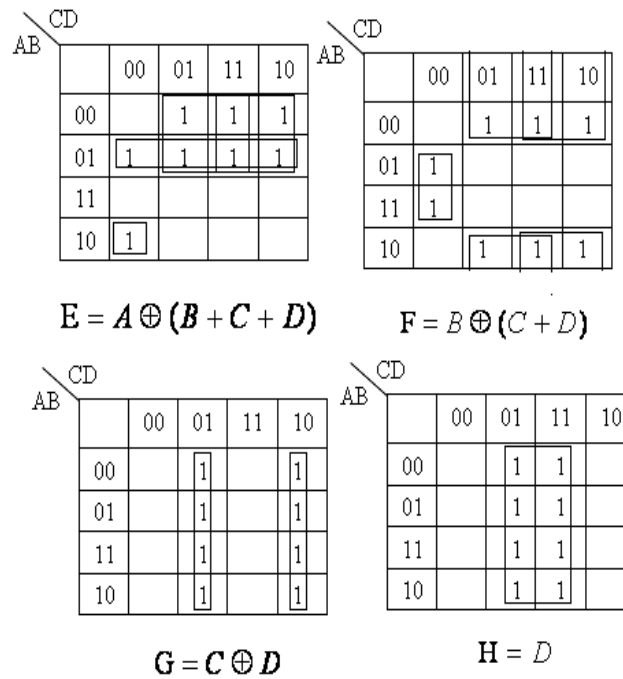


Fig 3. Karnaugh map for binary to 2's complement

From the above Karnaugh map (Fig. 3), the Boolean equations are obtained as the product of sums form for each output as in equation 3.

$$D_3 = (A_3 \oplus (A_0 + A_1 + A_2)) \quad (4a)$$

$$D_2 = (A_2 \oplus (A_0 + A_1)) \quad (4b)$$

$$D_1 = A_1 \oplus A_0 \quad (4c)$$

$$D_0 = A_0 \quad (4d)$$

From the output, it can be generalized that it is applicable for ‘n’ number of bits and the equation becomes,

$$D_{n-1} = A_{n-1} \oplus (A_0 + A_1 + A_2 + \dots + A_{n-2})$$

For example, if the number of bits is 3 then putting the value of n=1,2,3 the equation becomes,

$$D_0 = A_0$$

$$D_1 = A_1 \oplus A_0$$

$$D_2 = A_2 \oplus (A_0 + A_1)$$

Schematic of the all-optical circuit for binary to 2’s complement conversion scheme is shown in Fig. 4 which is based on equation (4). Here we used TOAD-based Double control switches, namely S_1 to S_{n-1} to design binary to 2’s complement converter. Here we consider that for all these switches S_1 to S_{n-1} , the incoming pulses are present. Let $A_0A_1A_2\dots A_{n-1}$ is the n-bit binary information. Control signals applied at $A_0A_1A_2\dots A_n$ can be considered as binary inputs. The output (D_0) is directly taken from the input A_0 so the output (D_0) receives the same value as input A_0 , i.e, $D_0 = A_0$. Light from the A_0 and A_1 are act as control pulse one (CP1) and control pulse two (CP2) for switch S_1 . According to the switching principle, it will produce the output $A_1 \oplus A_0$. So D_1 is $A_1 \oplus A_0$. The light from A_0 and A_1 are combined to act as a CP1 and the light from A_2 is acts as a CP2 for switch S_2 . The output will be $A_2 \oplus (A_0 + A_1)$ and it is denoted as D_2 . Again, the light from A_0 , A_1 , and A_2 are combined to form a combined signal which will act as a CP1 and the light from A_3 is acts as a CP2 for switch S_3 . According to the switching principle, it will produce the result $A_3 \oplus (A_0 + A_1 + A_2)$ which is the value of output D_3 . In a similar way if we can generate the output from the switch S_{n-1} . The incoming pulse is A_{n-1} acts as a CP1 and $A_0 + A_1 + A_2 + \dots + A_{n-1}$ acts as a CP2. So it will produce the output D_{n-1} which will be equal to $D_{n-1} = A_{n-1} \oplus (A_0 + A_1 + A_2 + \dots + A_{n-2})$.

in Table 1. In this way, any n bit binary input can be converted into corresponding 2's complement code.

IV. Simulated results

Mathematical reenactment is done to affirm the activity of this proposed circuit. The estimations of the boundaries utilized in this reenactment are taken from the writing review [8-10] as follows: Dual control beat Powe (CP1=CP2)=0.5W per CP, unsaturated intensifier gain of the SOA (G_{ss}) = 30 dB, acquire recuperation season of the SOA (τ_e) = 50 ps, immersion energy of the SOA (E_{sat}) = 1000 fJ, the unusualness of the circle (T_{asym}) = 15 ps, line-width upgrade factor (\square) = 6, FWHM of the control beat (σ) = 3.6 ps, bit period (T_c) = 50 ps, and a control beat energy (E_{cp}) = 100 fJ. The mimicked information and yield waveforms are given in Fig. ?. In this, underneath reenactment, we are thinking about 0.02mW as the edge esteem. At the point when the force is beneath 0.02mW, it is considered as a '0' state and the estimation of the force above 0.02mW is treated as '1' state.

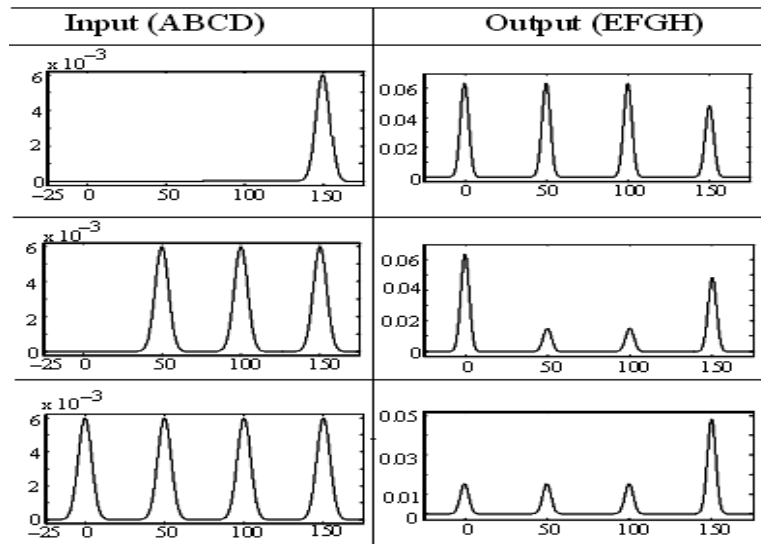


Fig 5. Simulated input and output waveforms, where power (mW) is along the y-axis whereas time is along the x-axis in ps.

V. Conclusion

In this paper, we have detailed paired to 2's complement converter utilizing TOAD-based switches. Here in this proposed conspire, the huge preferred position is that the proposed change over circuit can perform transformation activities, which are all-optical. PCs are put away number in 2's complement structure. Two's supplements are utilized for twofold deduction activity just as legitimate control.

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Conflict of Interest:

The authors declare that no conflict of interest to report the present study.

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