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Application of two inductors with single magnetic core in a two-level current source inverter

Suroso, Hari Prasetijo
Department of Electrical Engineering, Faculty of Engineering, Jenderal Soedirman University, Purbalingga, Indonesia

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ABSTRACT

Current source inverter (CSI) transforms DC current into a predetermined AC current. In practice, the DC current are acquired by connecting inductors with the DC power source. Common-emitter current source inverter (CE-CSI) is an inverter where the emitter terminals of the insulated gate bipolar transistors (IGBTs) or metal oxide semiconductor field effect transistors (MOSFETs) switches are connected at a common voltage. This inverter requires two non-isolated DC current sources as input power. The two level CE-CSI is the simplest circuit of the CE-CSIs. The circuit was able in simplifying inverter circuits compared to the three-level CE-CSI in case of device number, i.e., diodes, IGBTs/MOSFETs, and gate drive circuits. This paper studied the basic characteristics of the two-level CE-CSI when two reactors with a single magnetic core were used. The inverter circuit was examined and evaluated through computer tests, and experimentally. The two-level CE-CSI was able to generate a low distortion of sinusoidal AC load current with total harmonic distortion (THD) value 1.92%. Test data showed that the magnitudes of low order harmonics were less than 0.3% of the fundamental frequency. Moreover, the inverter efficiency can be increased due to reduction of the power losses caused by power switching devices.

Corresponding Author:

Suroso
Department of Electrical Engineering, Faculty of Engineering, Jenderal Soedirman University
Mayjen Sungkono road km. 5, Blater, Purbalingga, Jawa Tengah 53371, Indonesia
Email: suroso.te@unsoed.ac.id

1. INTRODUCTION

The inverter is a power converter processing DC power into controllable AC power of its current and voltage waveforms. Current source inverter (CSI) is a power inverter circuit converting DC current input into a predetermined AC output [1], [2]. A CSI is able to provide a variable AC output current and, simultaneously, varies the voltage depending on the connected load. CSIs require a DC power source that supplies the DC current to the circuits. This is often achieved using inductors employed in the DC current circuit generator together with DC power source, which helps control the desired current magnitude of AC output current. The AC output current can be sinusoidal, square, multilevel wave, or pulse-width modulated (PWM) waveform, depending on the inverter's control design [3]-[5]. Because of its higher power quality, a sinusoidal AC current with small waveform distortion is the most popular operation mode for many applications such as in AC motor drive, uninterruptible power supply (UPS), power compensator, and in renewable energy conversion system [6]-[8].

In an AC motor drive system, a CSI offers features such as faster dynamic response, better quality of AC current, and lower gradient voltage compared with the voltage source inverter (VSI) [9]-[12]. The traditional thyristor based CSI circuits were applied for high power motor drive in industrial processes. Power quality issues such as waveform distortion and harmonics are some concerns of this thyristor converters [13], [14]. High speed switching devices such as insulated gate bipolar transistors (IGBTs) and metal oxide semiconductor field effect transistors (MOSFETs) can be applied to improve the power quality of inverter by reducing output waveform distortion [15], [16]. In the distributed power generation, a grid connected CSI offers advantages such as ability to operate in unity power factor operation, higher power quality of AC current waveform, more immune from power grid disturbance, and possibility operating with boost up voltage feature without step-up power transformer [17]-[20]. Moreover, the lifetime of power inductors applied in CSI topologies is longer, and more durable than electrolytic capacitors utilized in VSIs. The power inductor together with DC power source are needed to create the DC current sources of the CSI circuit [21]-[23].

However, currently there are still some issues that must be addressed to make the CSI inverter type more competitive with its dual, i.e. VSI. One of them is the efficiency problem [24]-[26]. Generally, the CSI operates with lower efficiency compared to voltage source inverter. The dominant reason is because of conduction losses introduced by power inductors and power switches. A low resistance of power inductor using super conductor technically can be an alternative solution to reduce the losses. However, the cost will be more expensive, so it will not be attractive economically. Ultrafast power diodes are traditionally implemented in series connection with IGBTs or MOSFETs to achieve unidirectional current switches contributes conduction losses of inverter circuits [27], [28]. Therefore, other strategies are required to improve the efficiency of CSI.

A common-emitter current source inverter (CE-CSI) is a specific type of current source power inverter that uses a common emitter configuration of its emitter terminal of IGBTs or MOSFETs to generate AC current waveform. This configuration offers features such as simpler gate drive power switches, and more suitable for high speed switching operation [29]. A three-level common-emitter CSI configuration needs four controlled switches in series with four high speed power diodes plus two diodes connected to the two legs of its power switches [30]. The more number of power diodes will cause higher losses in the inverter circuits. As a results lower efficiency operation is unavoidable. Compare to the three-level H-bridge CSI, it also has features related to its common-emitter configuration such as simpler gate drive circuits, and possibility for higher switching speed operation. A potential application of single-phase CE-CSI is for photovoltaic power conversion as discussed in [31].

This paper presents and discusses a circuit of two-level CE-CSI having simpler and less component number of switching devices. Moreover, the inverter circuits utilize two inductors with single magnetic core as part of DC current source generator circuits. The inverter circuit was tested through computer simulation. Moreover, a laboratory experimental prototype was set-up, and tested to verify the inverter circuits experimentally.

2. PROPOSED INVERTER CIRCUITS

This paper proposed and discussed a different circuit configuration of two-level CE-CSI with a single magnetic core for its inductors. Figure 1 shows the main circuit of the two-level CE-CSI with two ideal DC current sources. The circuits consist of two IGBTs where their emitter terminals are joined. This configuration is called as common-emitter configuration. High-speed discrete diodes in series with IGBTs are required to achieve single-directional current of the IGBT switches. The filter capacitor C_f is used to filter harmonic components of the PWM current (I_{PWM}) generated by the inverter circuit. Two DC current sources are required in this inverter circuit as input power source. These DC currents will be converted into two-level AC current waveform, i.e., level +I and –I.

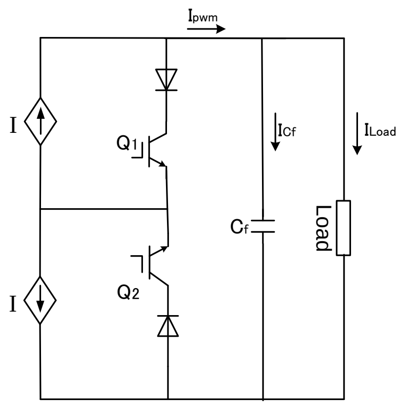


Figure 1. Two-level common-emitter CSI [29]

Table 1 lists the operation states of power switches Q_1 and Q_2 to generate two two-level AC current waveform. The details of current paths for +I and –I current level generation are shown in Figure 2. Figure 2(a) is for +I current, and Figure 2(b) is for –I current generation. Compared to the three-level CE-CSI, this inverter circuit can simplify the number of power devices such as IGBTs, power diodes and gate drive circuits as listed in Table 2. The number of IGBTs and its gate drive circuits were reduced from four devices into two devices only. Moreover, the number of power diodes was reduced significantly from six diodes become two diodes. These will simplify the overall circuit component number of inverter circuits.

Table 1. Operation states of power switches

Power switch		Output current
Q_1	Q_2	
OPEN	CLOSE	+I
CLOSE	OPEN	-I

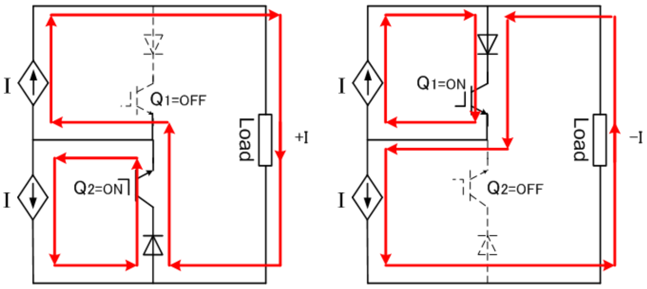


Figure 2. Operation modes of inverter circuits; (a) output current +I and (b) output current -I

Table 2. Comparison of device number between three-level and two-level CE-CSI

Device	Three-level CE-CSI	Two-level CE-CSI
IGBT	4	2
Diode	6	2
Gate drive circuits	4	2

Moreover, Figure 3 presents the proposed two-level CE-CSI equipped with DC current source generation circuit. The DC current generator circuits consist of power switch Q_{ch}, diode D_F, current sensor S, and inductors L_1, L_2. The new unique point of these inverters is that the inductors L_1 and L_2 utilize the same a single magnetic core. The two coils are wound in opposite directions. The power switch Q_{ch} is used to control the current in the inductors L_1 and L_2. The magnitude of each current is half of the total current flowing through current sensor S. The position of dot point in the figure represents the direction of coil wiring of the inductor. Diode D_F functions to keep current paths of inductor current during switching operation of switch Q_{ch}. The DC voltage V_{dc} was connected to the DC current generation circuits as a power source of the inverter circuits. The two inductors with a single core will simplify the inductor design. Moreover, the dc current ripples of inductors will be reduced. The acceptable DC current ripple, inductor losses, and its size were some important criteria in choosing the inductors.

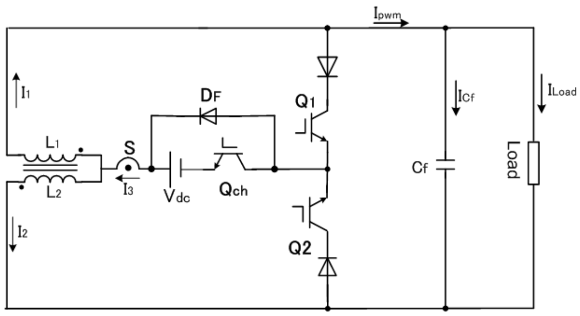


Figure 3. Two-level CE-CSI with DC current generator circuits

To adjust the current flowing through the inductors, a proportional integral (PI) current regulator was applied as shown in Figure 4. The triangular signal will modulate the error between I_{dc} and I_{ref} to generate a control signal of Q_{ch}. Moreover, in order to output a closely sinusoidal AC current, PWM technique was utilized as shown in Figure 4. The PWM method implemented a single triangular signal, and a sinusoidal signal as the modulating signal. The main output frequency of AC current was set by the frequency of the sinusoidal modulating signal. In this test, a 50 Hz sinusoidal signal was applied.

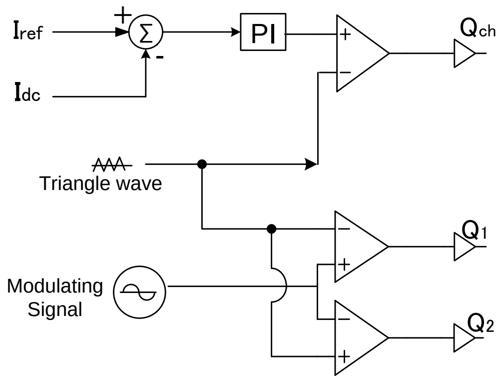


Figure 4. Current control of DC current generator circuits and PWM strategy

3. RESULTS AND DISCUSSION

In order to examine the basic characteristics of the inverter circuit, computer simulation tests were carried out using PSIM software. The circuit parameters were presented in Table 3. The inductor size of L_1 and L_2 was selected to be the same at 4 mH. A filter capacitor 10 µF was connected at the output terminal of the inverter. The triangular frequency used in the current controller and PWM modulation was 22 kHz to attain features of high-frequency switching devices IGBTs or MOSFET in the circuits. The inverter circuit delivered AC power to an inductive power load with resistor 5 Ω and inductor 1 mH.

Table 3. Test parameters

Parameters	Value
Inductor 1	4 mH
Inductor 2	4 mH
Load	R=5 Ω and L=1 mH
Filter C_f	10 µF
Output AC frequency	50 Hz
Triangular frequency	22 kHz
DC input voltage	24 V

Figure 5 shows the simulation test of inverter circuit presenting the load current (I_{Load}) and I_{PWM} waveforms. A sinusoidal I_{Load} and its I_{PWM} before filtering were generated by the inverter circuit. Moreover, an enlarged signal of PWM two-level current waveform was confirmed in Figure 6. The frequency of I_{PWM} was 22 kHz as set by the frequency of carrier signal in the PWM technique. Harmonic analysis result of I_{Load} was depicted in Figure 7. As can be seen in this harmonics profile, the magnitude of low-order harmonics components of 3^{rd}, 5^{th}, 7^{th}, and 11^{th} were 0.07%, 0.2%, 0.07%, and 0.28%, respectively. The low orders of harmonic components were less than 0.3%. Moreover, Figure 8 presents the low harmonics profile of the I_{PWM}.

Figure 9 shows the DC current waveforms of the inductors I_1, I_2, and their total current I_3. A relatively small DC current ripple was achieved by using proposed DC current source generation of the inverter circuits. The inductor current waveforms during load change were depicted in Figure 10. The current controller kept stable DC currents flowing through the inductors. The current pattern flowing in the MOSFET Q_1, Q_2, and Q_{ch} was presented in Figure 11. These current waveforms were not continuous DC currents. They were PWM DC currents formed by the PWM pattern of their gating signals. An efficiency profile of the two-level inverter constructed using power MOSFETs is shown in Figure 12. The maximal efficiency of the two-level common-emitter CSI was 91.68%. The power losses components were presented in Figure 13. The conduction losses of the power diodes were the most dominant power losses in this inverter circuit.

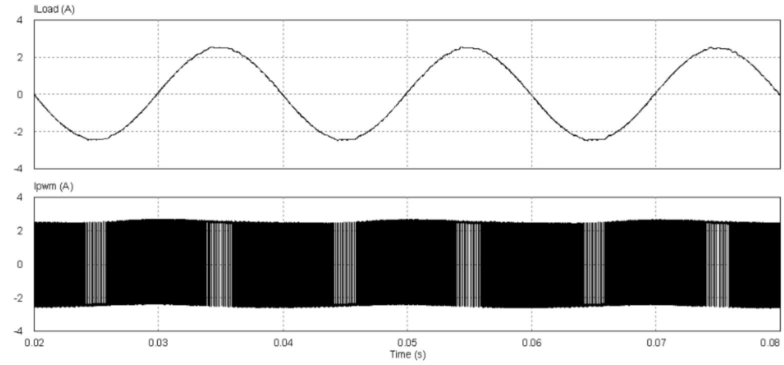


Figure 5. I_{Load} and PWM AC current waveforms

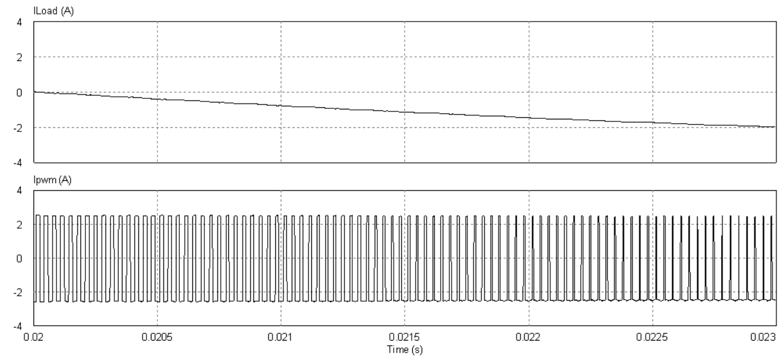


Figure 6. Enlarged waveforms of I_{Load} and I_{PWM}

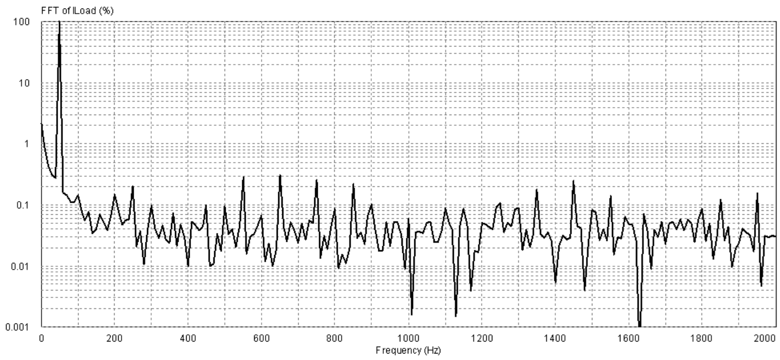


Figure 7. Harmonics spectra of I_{Load}

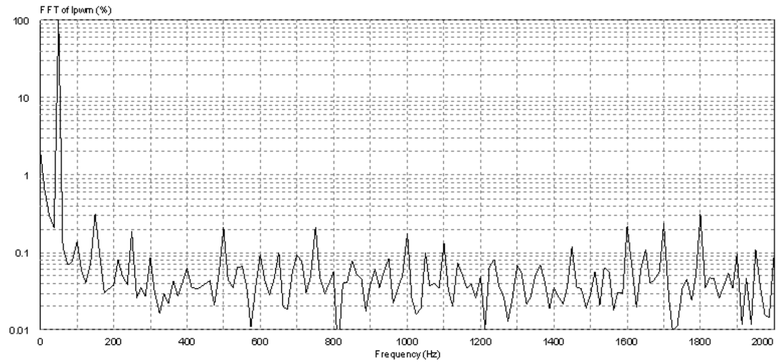


Figure 8. Harmonics spectra of I_{PWM}

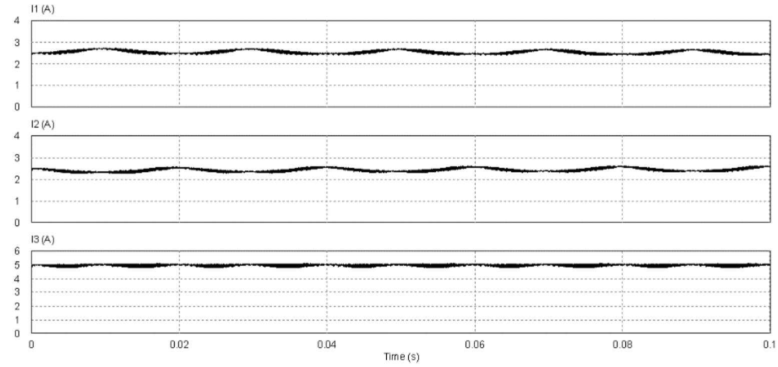


Figure 9. Inductor current 1 (I_1), inductor current 2 (I_2), and total inductor current (I_3)

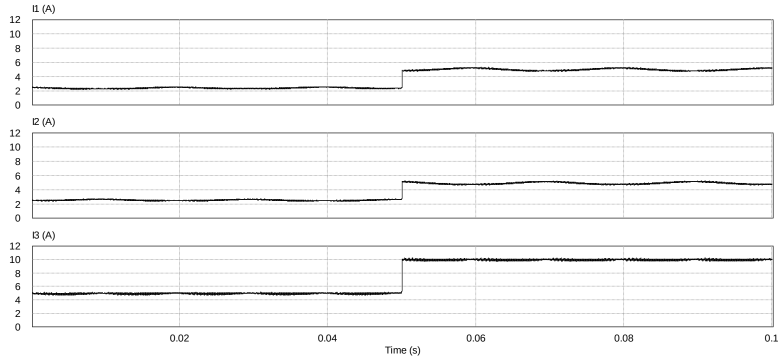


Figure 10. Inductor current L_1 (I_1), inductor current L_2 (I_2), and total inductor current (I_3) during load change

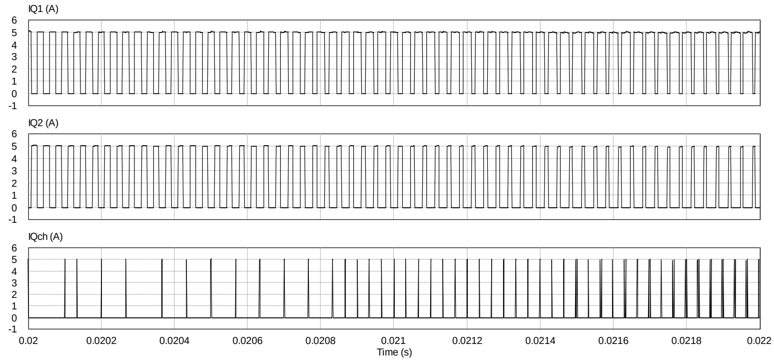
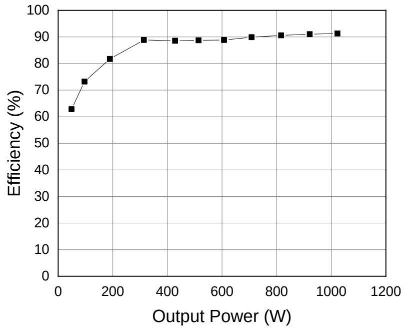


Figure 11. Current flowing through power switch Q_1, Q_2, and Q_{ch}



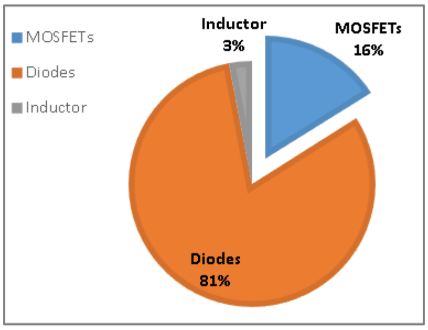
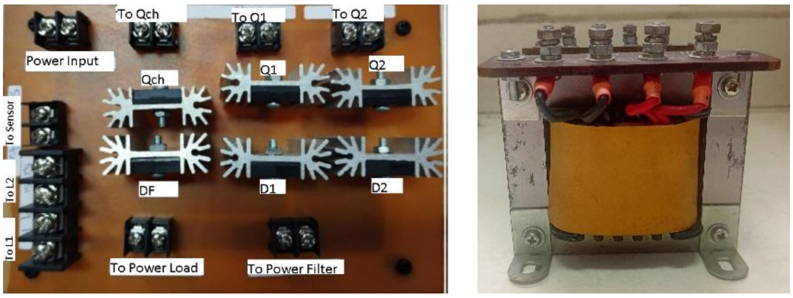


Figure 12. Efficiency profile of two-level CE-CSI

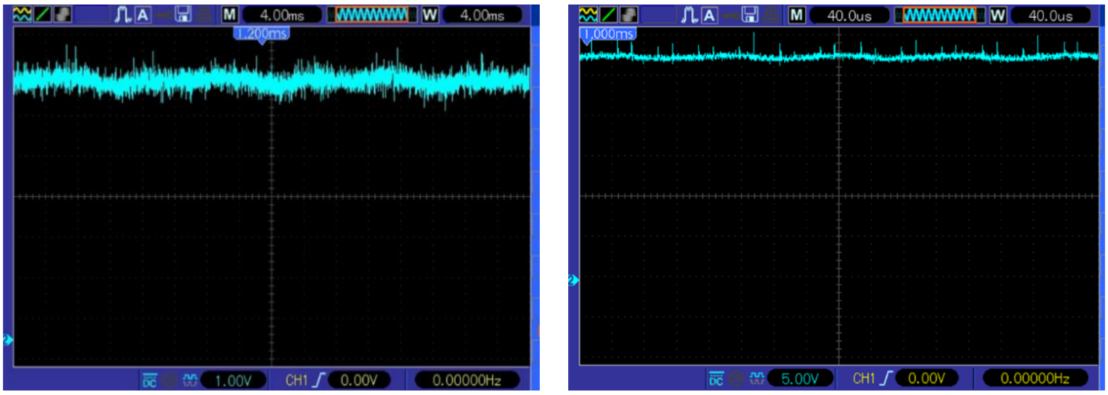
Figure 13. Power loss analysis of inverter components

A laboratory prototype of two-level CE-CSI was made and tested in the laboratory. The power MOSFET switches and diodes were realized by IRFP460 and STTH6012W, respectively. The ACS 712 current sensor was implemented to sense the current of DC current generator circuits. Figure 14 shows an experimental circuits of the proposed inverter. The laboratory prototype of the power inverter circuits and its power inductor are shown in Figures 14(a) and (b), respectively. The MOSFETs driver circuits was constructed by optocoupler TLP250S and DCP020515 as its power supplies. The DC input currents of inverter circuits are shown in Figure 15. Figures 15(a) and (b) show the measured DC current flowing through inductor (I_1) and current flowing thru current sensor (I_3), respectively. The current waveforms were measured by using CP06 AC/DC current probe. Stable and low ripple DC currents were attained experimentally. The I_{Load} waveform is presented in Figure 16. It was a sinusoidal current with low distortion. The two-level CSI circuit was experimentally confirmed work well generating a sinusoidal I_{Load} waveform.



(a) (b)

Figure 14. Experimental circuits; (a) power inverter circuits and (b) power inductors



(a) (b)

Figure 15. DC input current; (a) current of inductor L_1 and (b) current flowing through sensor

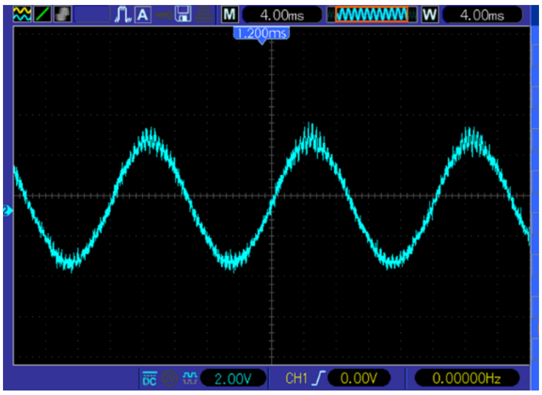


Figure 16. I_{Load} waveform

4. CONCLUSION

A two-level CE-CSI with single magnetic core inductors was presented and discussed in this paper. The inverter circuit was able in simplifying inverter circuits compared to the three-level CE-CSI in case of device number, i.e., power diodes, MOSFETs, and gate drive circuits. The number of IGBTs/MOSFETs and its gate drive circuits were reduced from four devices into two devices only. Moreover, the number of power diodes was reduced significantly from six diodes become two diodes. The two-level CE-CSI is able in delivering a low distortion of sinusoidal AC output current. The low orders of harmonics components of I_{Load} were less than 0.3%. Moreover, the maximum efficiency of the two-level common-emitter CSI in this research was achieved at 91.68% with diodes as the major devices of power losses. It is the main challenge in implementing this inverter. The two-level CE-CSI was verified its basic operation using computer simulation and experimental test in laboratory. Development of the two-level inverter circuits such as for photovoltaics power conversion will be the next research topic.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Suroso	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hari Prasetijo					✓		✓			✓		✓		

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

REFERENCES

[1] Suroso, A. N. Aziz, and T. Noguchi, "Five-level PWM Inverter with a Single DC Power Source for DC-AC Power Conversion," *International Journal of Power Electronics and Drive Systems (IJPEDS)*, vol. 8, no. 3, pp. 1230-1237, 2017, doi: 10.11591/ijpeds.v8.i3.pp1212-1219.

[2] R. Bai *et al.*, "PWM-Current Source Converter Based on IGCT-in-Series for DC Buck and Constant-Current Application: Topology, Design, and Experiment," *IEEE Transactions on Industrial Electronics*, vol. 70, no. 5, pp. 4865–4874, 2023, doi: 10.1109/TIE.2022.3186385.

[3] N. I. L. Santos, M. A. Vitorino, and M. B. D. R. Correa, "Novel Multilevel Current Source Converter with Asymmetric Configuration: Analysis, Comparison, Modulation, and FPGA Implementation," *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 12, no. 3, pp. 2481–2499, 2024, doi: 10.1109/JESTPE.2024.3384947.

[4] J. Xia, X. Guo, C. Wang, X. Xiong, C. Zhao, and C. Guo, "Cooperative Control Strategy of Fundamental Frequency Modulation-Based Current Source Converters for Offshore Wind Farms," *IEEE Transactions on Power Delivery*, vol. 37, no. 6, pp. 4805–4815, 2022, doi: 10.1109/TPWRD.2022.3160074.

[5] R. Bai *et al.*, "Step-Current-Approximation Modulation of Multilevel-CSC With Near-Power-Frequency Switching for High-Current Variable-Voltage Application," *IEEE Transactions on Power Electronics*, vol. 38, no. 9, pp. 11069–11079, 2023, doi: 10.1109/TPEL.2023.3287922.

[6] F. Faraji and H. Cha, "Five-Level Switching-Cell Current Source Inverter Immune to Open-Circuit Fault Issue," *IEEE Transactions on Industrial Electronics*, vol. 72, no. 2, pp. 1402–1411, 2025, doi: 10.1109/TIE.2024.3419238.

[7] K. Gnanasambandam, A. K. Rathore, A. Edpuganti, D. Srinivasan, and J. Rodriguez, "Current-Fed Multilevel Converters: An Overview of Circuit Topologies, Modulation Techniques, and Applications," *IEEE Transactions on Power Electronics*, vol. 32, no. 5, pp. 3382–3401, 2017, doi: 10.1109/TPEL.2016.2585576.

[8] F. Alskran and M. G. Simoes, "Multilevel current source converter-based STATCOM suitable for medium-voltage applications," *IEEE Transactions on Power Delivery*, vol. 36, no. 2, pp. 1222–1232, 2021, doi: 10.1109/TPWRD.2020.3004419.

[9] G. Migliazza *et al.*, "DC Current Control for a Single-Stage Current Source Inverter in Motor Drive Application," *IEEE Transactions on Power Electronics*, vol. 36, no. 3, pp. 3367–3376, 2021, doi: 10.1109/TPEL.2020.3013301.

[10] V. Madonna, G. Migliazza, P. Giangrande, E. Lorenzani, G. Buticchi, and M. Galea, "The Rebirth of the Current Source Inverter: Advantages for Aerospace Motor Design," *IEEE Industrial Electronics Magazine*, vol. 13, no. 4, pp. 65–76, 2019, doi: 10.1109/MIE.2019.2936319.

[11] N. Aarzoo and G. Poddar, "Sensorless Control of Wound Field Synchronous Machine Drive Using Current Source-Based Modular Multilevel Converter," *IEEE Transactions on Industrial Electronics*, vol. 70, no. 11, pp. 10946–10956, 2023, doi: 10.1109/TIE.2022.3231303.

[12] N. Aarzoo and G. Poddar, "Input Current Source-Based Modular Multilevel Converter for Wound Field Synchronous Machine Drive With Improved Low-Speed Operation," *IEEE Journal of Emerging and Selected Topics in Industrial Electronics*, vol. 4, no. 1, pp. 419–429, 2022, doi: 10.1109/jestie.2022.3214152.

[13] S. C. Richu and P. P. Rajeevan, "A load commutated multilevel current source inverter fed open-end winding induction motor drive with regeneration capability," *IEEE Transactions on Power Electronics*, vol. 35, no. 1, pp. 816–825, 2020, doi: 10.1109/TPEL.2019.2916224.

[14] R. Cheng, Y. He, C. Lei, Y. Wang, and J. Liu, "Research on Realizing Space Vector Equivalent Modulation Output by Dual Carrier Modulation of Current Source Inverter," *IEEE Transactions on Power Electronics*, vol. 36, no. 7, pp. 8494–8505, 2021, doi: 10.1109/TPEL.2020.3046492.

[15] X. Yang, Z. Zhao, C. Wang, J. Xu, K. Liu, and J. Qiu, "Analysis and Parameter Design of SiC-Based Current Source Inverter (CSI)," *World Electric Vehicle Journal*, vol. 13, no. 10, 2022, doi: 10.3390/wevj13100187.

[16] T. T. Nguyen and H. Cha, "Five-Level Current Source Inverter with Inductor Cell Using Switching-Cell Structure," *IEEE Transactions on Industrial Electronics*, vol. 69, no. 7, pp. 6859–6869, 2022, doi: 10.1109/TIE.2021.3101008.

[17] L. Xing, Q. Wei, and Y. Li, "A Practical Current Source Inverter-Based High-Power Medium-Voltage PV System," *IEEE Transactions on Power Electronics*, vol. 38, no. 2, pp. 2617–2625, 2023, doi: 10.1109/TPEL.2022.3211409.

[18] E. Lorenzani, F. Immovilli, G. Migliazza, M. Frigieri, C. Bianchini, and M. Davoli, "CSI7: A Modified Three-Phase Current-Source Inverter for Modular Photovoltaic Applications," *IEEE Transactions on Industrial Electronics*, vol. 64, no. 7, pp. 5449–5459, Jul. 2017, doi: 10.1109/TIE.2017.2674595.

[19] N. Danapour, E. Akbari, and M. Tarafdar-Hagh, "A Review on the Power Circuit Topologies of Current Source Inverters in Photovoltaic Applications," *Iranian Journal of Electrical and Electronic Engineering*, vol. 18, no. 3, 2022, doi: 10.22068/IJEEE.18.3.2404.

[20] X. Guo, Y. Yang, and X. Zhang, "Advanced Control of Grid-Connected Current Source Converter under Unbalanced Grid Voltage Conditions," *IEEE Transactions on Industrial Electronics*, vol. 65, no. 12, pp. 9225–9233, 2018, doi: 10.1109/TIE.2018.2835367.

[21] F. Marignetti, R. L. Di Stefano, G. Rubino, and R. Giacomobono, "Current Source Inverter (CSI) Power Converters in Photovoltaic Systems: A Comprehensive Review of Performance, Control, and Integration," *Energies*, vol. 16, no. 21, 2023, doi: 10.3390/en16217319.

[22] X. Guo, Y. Bai, and B. Wang, "A Programmable Single-Phase Multilevel Current Source Inverter," *IEEE Access*, vol. 7, pp. 102417–102426, 2019, doi: 10.1109/ACCESS.2019.2931741.

[23] Suroso, H. Siswantoro, and T. Noguchi, "Ripple reduction of DC current sources in three-level CE-CSI circuits using single core inductors," *Journal of Physics: Conference Series*, vol. 1367, no. 1, 2019, doi: 10.1088/1742-6596/1367/1/012057.

[24] D. T. Do, H. Cha, and F. Akbar, "Switching-Cell Four-Leg Current Source Inverter," *IEEE Transactions on Industrial Electronics*, vol. 68, no. 11, pp. 10349–10359, 2021, doi: 10.1109/TIE.2020.3036229.

[25] D. T. Do and H. Cha, "High-Reliability and Reduced Switch Count Single-Phase Dual-Output Current Source Inverter Using Switching-Cell Structure," *IEEE Transactions on Power Electronics*, vol. 36, no. 6, pp. 6513–6524, 2021, doi: 10.1109/tpel.2020.3040167.

[26] D. Hong, J. Kim, and H. Cha, "Overlap-Time Elimination for Current Source Inverters Using Output Voltage Sensing," *IEEE Transactions on Power Electronics*, vol. 39, no. 5, pp. 5034–5039, 2024, doi: 10.1109/TPEL.2024.3368562.

[27] X. Guo, N. Wang, J. Zhang, B. Wang, and M. K. Nguyen, "A Novel Transformerless Current Source Inverter for Leakage Current Reduction," *IEEE Access*, vol. 7, pp. 50681–50690, 2019, doi: 10.1109/ACCESS.2019.2908287.

[28] F. Faraji and H. Cha, "Single-Rating Multilevel Current Source Inverter with Fault Tolerance," *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 12, no. 5, pp. 4538–4549, 2024, doi: 10.1109/JESTPE.2024.3432888.

[29] Suroso and T. Noguchi, "Common-emitter topology of multilevel current-source pulse width modulation inverter with chopper-based DC current sources," *IET Power Electronics*, vol. 4, no. 7, pp. 759–766, 2011, doi: 10.1049/iet-pel.2010.0008.

[30] Suroso, D. T. Nugroho, and Winasis, "Three-level common-emitter current-source power inverter with simplified DC current-source generation," *Journal of Engineering Science and Technology*, vol. 13, no. 12, pp. 4027–4038, 2018.

[31] Suroso and T. Noguchi, "Three-level common emitter-current source inverter equipped with MPPT system for photovoltaic power converter," *Bulletin of Electrical Engineering and Informatics (BEEI)*, vol. 14, no. 2, pp. 893–901, 2025, doi: 10.11591/eei.v14i2.7628.

BIOGRAPHIES OF AUTHORS

Suroso received the B.Eng. degree in electrical engineering from Gadjah Mada University, Indonesia in 2001, and the M.Eng. degree in electrical and electronics engineering from Nagaoka University of Technology, Japan, in 2008. He was a research student at Electrical Engineering Department, Tokyo University, Japan, from 2005 to 2006. He earned the Ph.D. degree in Energy and Environment Engineering Department, Nagaoka University of Technology, Japan in 2011. He was a visiting researcher at Electrical and Electronics Engineering Department, Shizuoka University, Japan, from 2009 to 2011. Currently, he is a professor at Department of Electrical Engineering, Jenderal Soedirman University, Purbalingga, Jawa Tengah, Indonesia. His research interest includes static power converters, and its application in renewable energy conversion and electric vehicles. He can be contacted at email: suroso.te@unsoed.ac.id.

Hari Prasetijo is Associate Professor at Electrical Engineering Department, Jenderal Soedirman University, Indonesia. He received the B.Sc. degree from Electrical Engineering Department, University of Indonesia, and a M.Sc. degree from Institut Teknologi Bandung. His research areas are distribution power systems and permanent magnet generators. He can be contacted at email: hari.prasetijo@unsoed.ac.id.