

# Simulation of Dual Converter Based Power Supply System

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**ABSTRACT:** Clear view of need of dual converter is explained here. Single phase Dual converter for speed control in both the directions is described. The speed control of DC motor is very crucial in applications where precision is required. Dual converters are used for four-quadrant operation of DC drive. In this paper a single phase dual converter based open loop control system for a DC machine Load is presented. The circulating current mode of operation are presented here.

**KEYWORDS:** DC Drive, Dual Converters, Speed control.

## I. INTRODUCTION

The basic structure of dual converter consist of two converters. In which left bridge acts as a forward converter and other (right) acts as reverse converter. The single-phase full converter allows only two-quadrant operations. If this single phase fully-controlled converter is connected back-to-back, then a four-quadrant operation is possible and such type dual converter can be utilized for single phase application. Conventional dual converter is built by employing two full bridge converters one of them is used to allow the current of motor to flow only in one direction while the other is used for reverse direction.

A Dual-Converter is a converter which can handle a load with all four combinations of voltage polarity and current direction. The positive current converter is operated for positive current to load. The negative current converter is operated for negative load current.

There are two modes of dual converter.

- (1) Non-circulating current mode.
- (2) Circulating current mode.

## II. RELATED WORK

Depending on the circuit configuration and performance, dual converters operating in the circulating current mode are classified into three types. In the type-1 dual converter shown in Fig 1, the ac supplies feeding the two converters are isolated using a transformer.  $L_1$  and  $L_2$  form the circulating current limiting inductors (CCLI) [8].

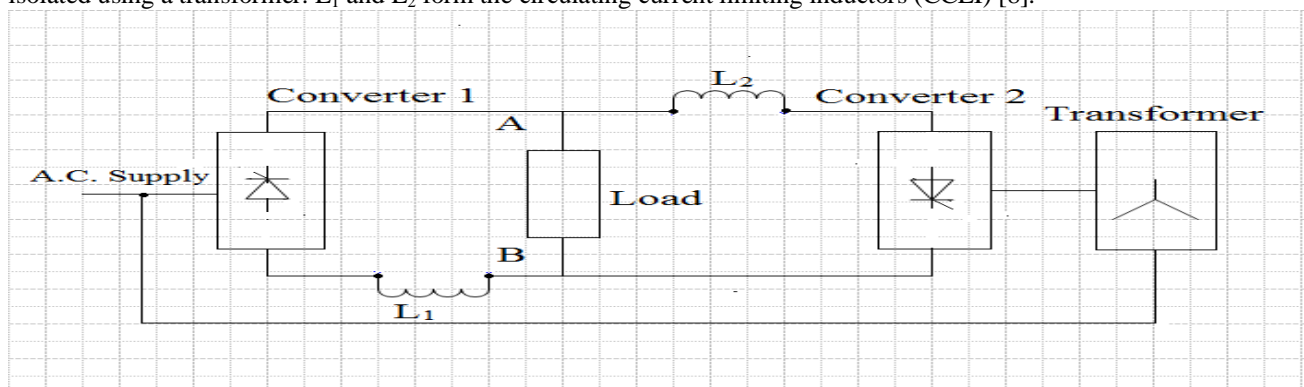


Fig. 1 Schematic diagram of type-1(a) dual converter

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

The type-1 dual-converter configuration of Fig 1 uses two inductors,  $L_1$  and  $L_2$ , to limit the circulating current. It can be seen that it is the total value of the inductances  $L_1$  and  $L_2$  which limits the circulating current.

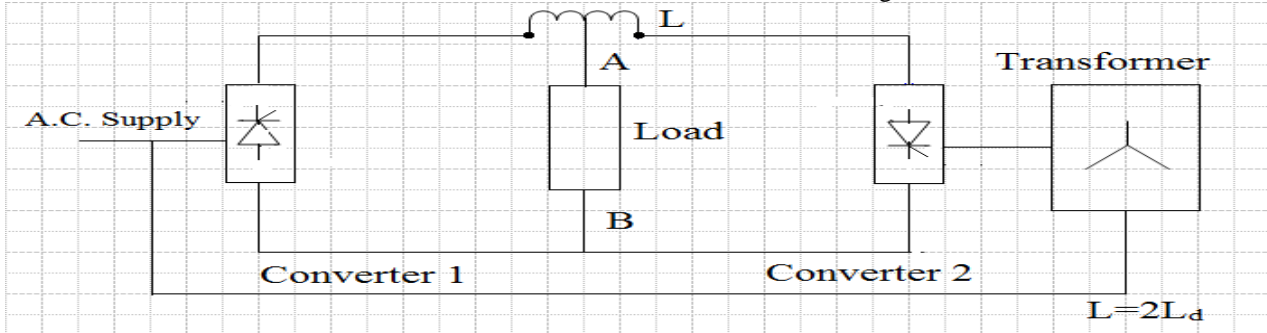


Fig. 2 Schematic diagram of type-1(b) dual converter

Thus, as far as the circulating current is concerned, the position of inductors  $L_1$  and  $L_2$  is not important. Other possible ways of connecting the inductors are shown in Fig 2. The circuit performance remains unchanged in all these cases, provided the total value of the inductance is the same. In Fig. 2, to have the same circulating current, the magnitude of the inductance should be the same as the total value of  $L_1$  and  $L_2$ . Since  $L_1 = L_2$ , the CCLI value should be  $2L$ . This configuration of Fig. 2 is classified as a type-1 case b) dual converter.

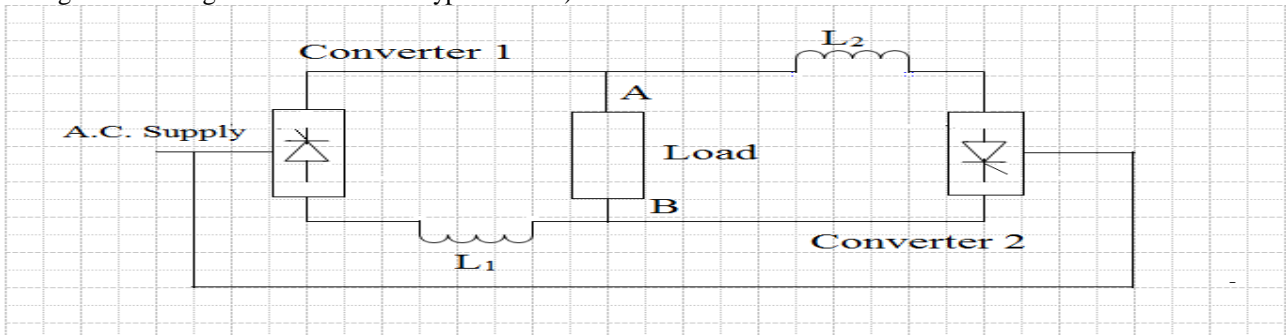


Fig. 3 Schematic diagram of type-2 dual converter

In the type-2 dual converter shown in Fig. 3 and in the type-3 dual converter shown in Fig. 4, the input transformer is eliminated. Type 2 and type 3 are different only in the manner in which the circulating current limiting is achieved. Type-1 dual converters need an input transformer with a size much bigger than the circulating current limiting inductors. The input transformer can be eliminated if two identical isolated single-phase ac supplies are available.

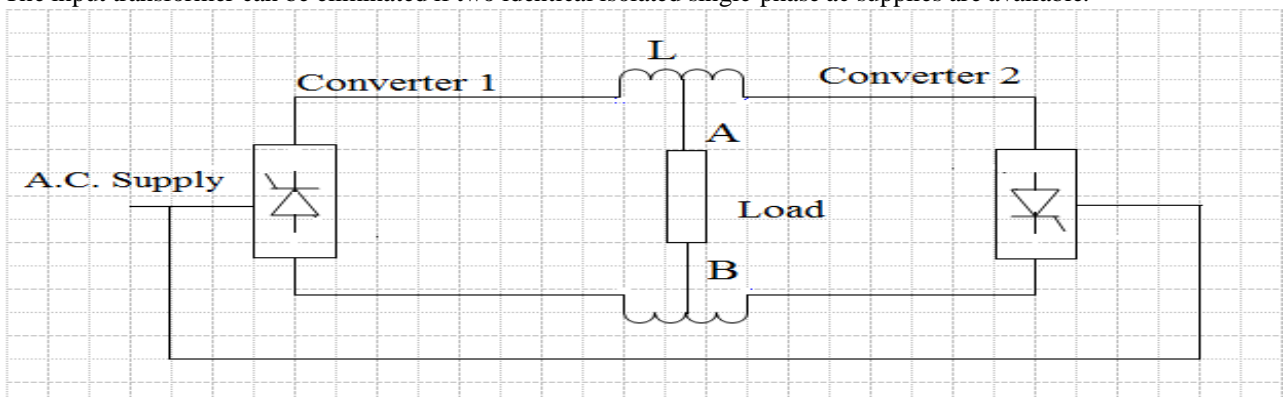


Fig. 4 Schematic diagram of type-3 dual converter

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Vol. 5, Issue 5, May 2016

The overall CCLI size is least in the type-1 case b) configuration and is maximum in the type-2 configuration. Considering the overall component sizes and ratings, the type-3 dual converter is superior to all other configurations. Thus, in general, the type-3 dual converter can be preferred over the other types [8].

Simulation Parameters	Values
Input Voltage	230 V
Smoothing Inductor	500 mH
<b>DC machine Rating</b>	
Power Rating	5 HP
Voltage	230 V
Speed	1750 RPM
Field Voltage	300 V
$R_a$	2.581 $\Omega$
$L_a$	0.028 H
$R_f$	281.3 $\Omega$
$L_f$	156 H

Table 1. Simulation Parameters

Advantages of circulating current mode of Dual converter:

- (1) Over the whole control range, circulating current keeps both converters in virtually continuous conduction, independent of whether the external load current is continuous or discontinuous.
- (2) The reversal of load-current is inherently a natural and smooth procedure due to the natural freedom provided in the power circuit for the load current to flow in either direction at any time.
- (3) Since the converters are in continuous conduction, the time response of the scheme is very fast.
- (4) The current sensing is not required and the normal delay period of 10 to 20 ms as in the case of circulating current free operation is eliminated.
- (5) Linear transfer characteristics are obtained.

Disadvantages of Circulating current mode of Dual converter:

- (1) Since the current limiting reactor is required in this scheme, the size and cost of this reactor may be quite significant at high power levels.
- (2) Since the converters have to handle load as well as circulating currents, the thyristors with high current rating are required for these current.
- (3) The efficiency and power factor are low because of circulating current which increases losses.

### III. SIMULATION MODEL

From parameters which are given in Table we got output voltage, armature current and speed are as shown in Figure 6 to Figure 9.

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Vol. 5, Issue 5, May 2016

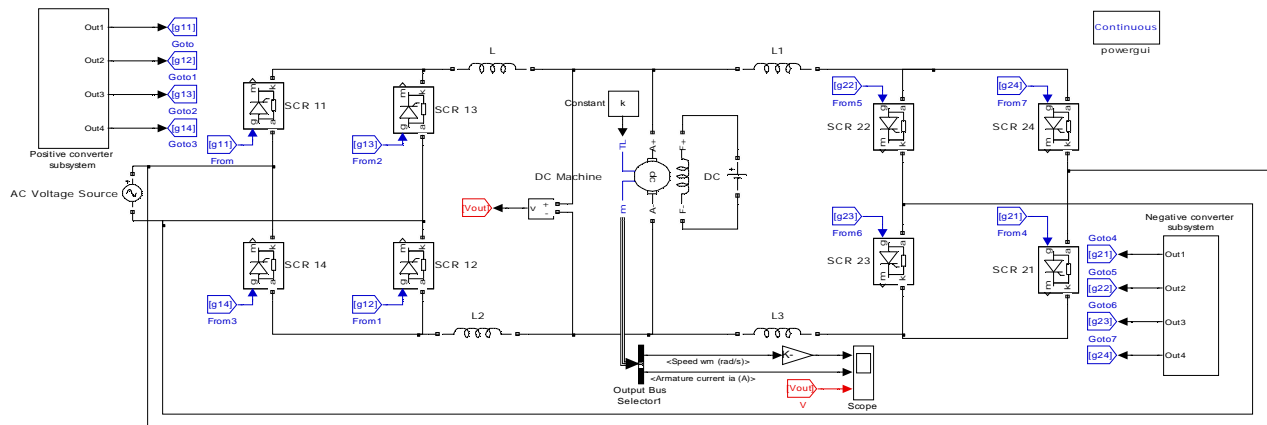


Fig. 5 Simulation of Dual converter with circulating current mode.

Speed, output voltage, armature current is shown in figure 6. As shown in figure both voltage and armature current are positive i.e. Mode 1. Mode 1 is forward motoring mode.

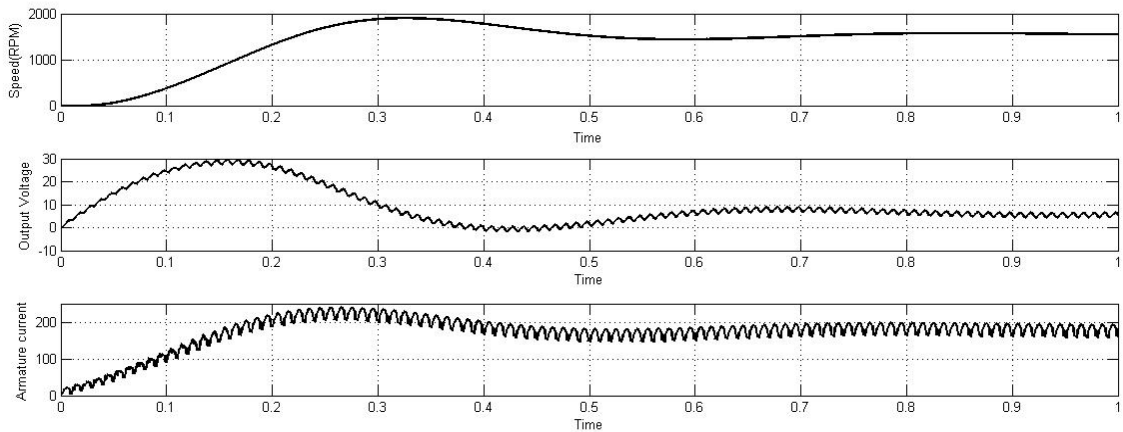


Fig. 6 Mode 1 Forward motoring.

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(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

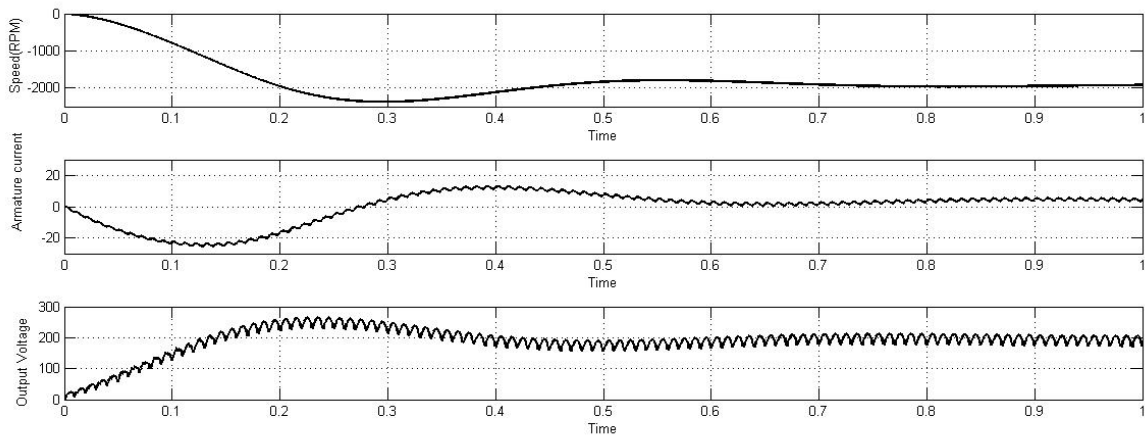


Fig. 7 Mode 2 forward generating mode

Speed, output voltage, armature current is shown in figure 7. Mode 2 is forward generating mode. As shown in figure 8 both voltage and speed waveform is negative. Mode 3 is reverse motoring mode.

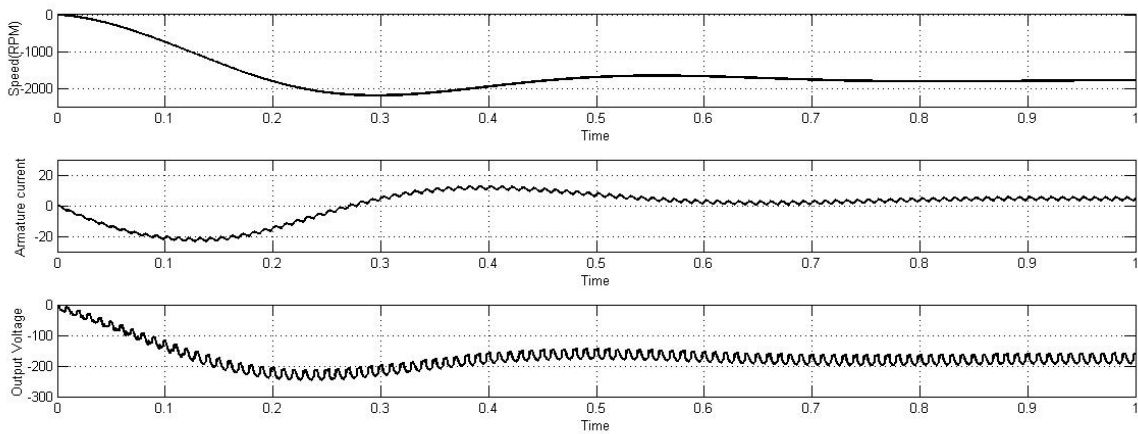


Fig. 8 Mode 3 Reverse motoring mode

Speed, output voltage, armature current is shown in figure 9. As shown in figure 9 voltage is negative but speed is positive i.e. Mode 4. Mode 4 is reverse generating mode.

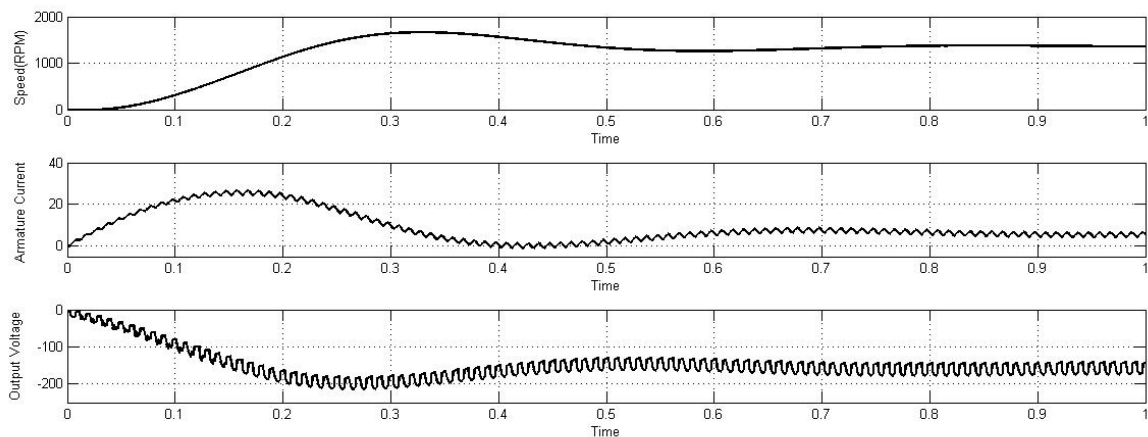


Fig. 9 Mode 4 Reverse generating mode.

#### IV. CONCLUSION

This paper discussed the detailed study of DC machine speed control using dual converter in both the direction (forward and reverse) and in both the mode of operation (generating and motoring). Dual converters are used for four-quadrant operation of DC drive. In circulating mode of operation there is no need of dead time. So the speed reversal is very quick and smooth. The results of circulating current mode of operation in open loop control is shown in MATLAB simulation.

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