ENCLOSURES:

CLW/ES/3/SK-1/0054 Alt ‘~~B~~’ C

CLW/ES/3/SK-2/0054 Alt ‘~~B~~’ C

SPECIFICATION FOR DC DC CONVERTER USED FOR 3-PHASE ELECTRIC LOCOMOTIVE OF INDIAN RAILWAYS

Specification No: CLW/ES/3/0054, Alt. ‘~~B~~’ C

ISSUE DATE: 07.03.1999

ISSUED BY:

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CHITTARANJAN LOCOMOTIVE WORKS

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ALTERATION RECORD SHEET

SL NO.	DATE OF AMENDMENT	PAGE NO.	ALTERATION NUMBER	REASON	AUTHORITY
1.	06.03.2003		A	Flammability test included	Sd/
2.	08.02.2022	8,12	B	Existing Drawing in the specification of DC-DC converter at Page 8 which is for reference only. Maximum allowable overall Dimension of DC-DC converter and Dimensional drawing of Panel mounting plate of DC-DC converter is incorporated as Page 12.	Sd/
3.		5	C	1. Impulse voltage withstand test may be performed as per IEC 60255-27 as IEC 60255-4 has been superseded and 500 ohms has been removed. 2. High frequency disturbance test or 1 MHz damped oscillatory wave immunity test/HFD may be performed as per IEC 60255-26 and 200 ohms has been removed. 3. Conducted emission test may be introduced in the specification which may be performed as per IEC 62236-3-2 / IEC 61000-6-4 (CISPR 16-2-1).	

Note: Specification has been digitized and all alterations have been incorporated.

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SPECIFICATION FOR DC-DC CONVERTER

The item should be fulfill our requirement condition as given below:

TECHNICAL SPECIFICATION FOR DC-DC CONVERTER

1. SCOPE :-

This specification is applicable for DC-DC Converter (24 V & 48V) for 3-phase Electric locomotives of Indian Railways.

Two types of DC DC converter namely 110/ 24V and 110/48V are used.

2. SERVICE CONDITION :-

2.1 Climatic and environmental condition: -

- Maximum atmospheric temperatures : +70°C (In Sun) & + 50°C(In Shade)
- Ambient Temperature(operating) : -20°C . . . +70°C
- Ambient Temperature (Storage) : -30°C. . . +80°C
- Normal Humidity : 60%.
- Maximum Humidity : 100% saturation during rainy season.
- Altitude : 160 m.a.s.l.
- Rainfall : Very heavy in certain areas. The equipment should be designed in such away as to withstand it's running at 10 kilometer per hour in flood water level of 102 millimeter above rail level.
- Atmosphere during hot weather : Extremely dusty and desert terrain in certain areas.
- Coastal areas : Locomotive and equipment will be designed to work even in coastal areas in humid and salt laden atmosphere.
- Vibration. :The equipment subsystem and their mounting arrangement will be designed to withstand vibration and shock encountered in service as specified in correspondence unless otherwise prescribed.

3. STANDARD & APPROVAL –

The standard should be as per IEC 60146-3 (1997-01) and other relevant Indian/ International Standardsas and when applicable.

Flammability test as per IS: 11731 (Part 1&2) :1986 or relevant standard for plastic components.

4. Environment Conditions

Mechanical stress impulse Voltages,High frequency disturbance, Temperature, MTBF values

Test Method		Standard	Test Conditions		Status
Ca	Damp Heat Steady State	DIN 40046 part 5 IEC 60068-2-3	Temperature: Relative Humidity: Time:	40±2°C $93^{-3/+2}$ % 56 Days	Not Operating
Ea	Shock (Half Sinusoidal)	DIN 40046 part 7 IEC 60068-2-27	Acceleration Amplitude: Bump duration: Number of Bumps:	100 g_n =981 m/s² 6 ms 9 (3 each axis)	Operating
Eb	Continuous shock (Half Sinusoidal)	DIN 40046 part 26 IEC 60068-2-29	Acceleration Amplitude: Bump duration: Number of Bumps:	40 g_n =392 m/s² 6 ms 6000 (2000 each axis)	Operating
Fc	Vibration (Sinusoidal)	DIN 40046 part 8 IEC 60068-2-6	Frequency (1 Okt/min): Max. Vibration Amplitude: Acceleration Amplitude: Test Duration:	10…..2000Hz 0.35mm (10…60Hz) 5 g =49 m/s²(60…2000Hz) 7.5 h (2.5 h each axis)	Operating
Impulse Voltage Withstand Test		~~IEC 60255-4 Appendix E~~ IEC 60255-27	Class III: 5 KV (1.2/50 µs;~~500 Ω~~)		Not Operating
High – Frequency Disturbance Test		~~IEC 60255-4 Appendix E~~ IEC 60255-26 IEC 61000-4-18 (basic standard) IEC 60255-22-1 (test procedure & acceptance criteria)	Class II: Long 2.5 KV Trans: 1.0KV (~~200 Ω~~)		Operating
Surge Test		IEC 801-5	Class I: 0.5 KV (1.2 kV/50 µs; 2 Ω)		Operating
Emission test		IEC 62236 / IEC 61000-6-4 (basic standard & test setup as per CISPR 16-2-1)			

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Temperature			Standard-7		Option-9		Unit
Characteristics		Conditions	Min	Max	Min	Max	
Ta	Ambient temperature	U_{imin}……..U_{imax}	-25	+71	-40	+71	˚C
Tc	Case temperature	I_o =0….. I_{onom}	-25	+95	-40	+95	
Ts	Storage temperature	(Not Operational)	-55	+100	-55	+100	

MTBF	Ground Benign	Ground Fixed		Ground Mobile
MTBF according to MIL-HDBK-217F	Tc=40℃	Tc=40℃	Tc=70℃	Tc=50℃
	624’000 h	207’000 h	96’000 h	46’000 h

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5. DATA: INPUT VOLTAGE RANGE

General Conditions: T_A= + 25°C (unless Tc is specified)

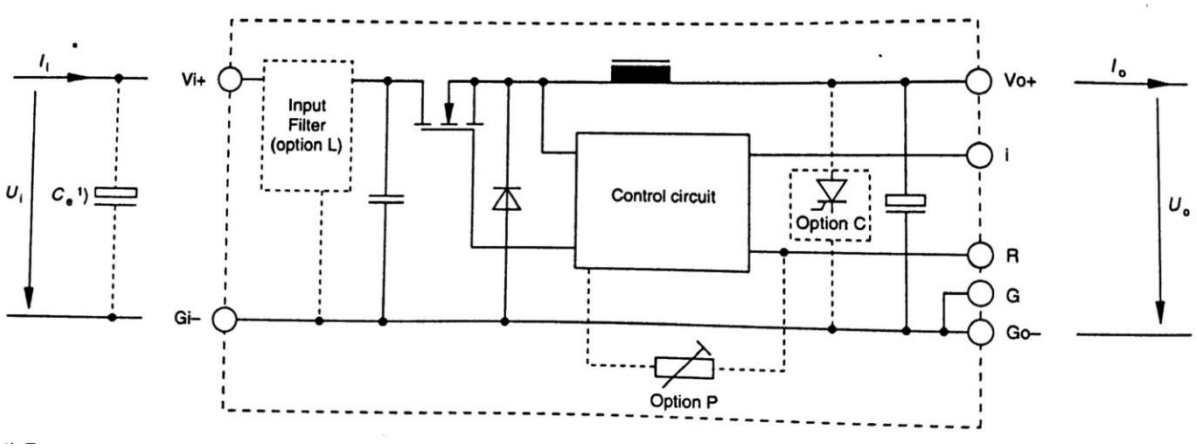
Characteristics		Conditions	110/24V			110/48V			Unit
Output			Min	typ	Max	Min	typ	Max	
U_0nom	Output voltage	U_{1nom} $I_{0\ max}$	23.85	24.00	24.14	47.70	48.00	48.29	V
$I_{0\ max}$	Output current (S)	$U_{1\ min}$ $U_{1\ max}$		4.0			4.0		A
I_{dl}	Output current limitation response (s)	T_{cmin}…$T_{c\ max}$	4.0		5.2	4.0		5.2	
U_0	Output ripple voltage	U_{1nom} $I_{0\ max}$ BW=20 MHZ		75	200		150	300	MVpp
ΔU_{0u}	Static control deviation versus input voltage U_1	$U_{1\ min}$… $U_{1\ max}$ $I_{0\ max}$		70	150		150	300	mV
ΔU_{01}	Static control deviation versus output current I_0	U_{1nom} I_0= 0… $I_{0\ max}$		70	120		150	250	
U_{dd}	Dynamic control deviation	U_{1nom}		+120			+150		
I_0	Load transient recovery time	$I_{0\ max}$ 0.3. $I_{0\ max}$		30			100		µs
U_0	Temperature coefficient $\Delta U_0/\Delta T_c$ ($T_{c\ max}$… $T_{c\ max}$)	$U_{1\ min}$… $U_{1\ max}$ I_0 = 0…. $I_{0\ max}$		±5 ±0.02			±10 ±0.02		MV/K K
Input									
U_1	Input voltage	I_0 = 0…. $I_{0\ max}$ T_{cmin}…T_{cmax}	31		144	58		144	VDC
ΔU_{10}	Min. diff voltage (U_1- U_0^2)			7			10		V
U_{10}	Under voltage look-out			19			40		
I_{10}	No load input current I_0=0	$U_{1\ min}$… $U_{1\ max}$			35			45	mA
I_1	Peak value of Inrush current	U_{1nom}		150			150		A
I_{12}	Rise Time			5			5		µs
I_{11}	Tail half value time			40			40		
I_{1m}	Peak value of Inrush current	U_{1nom} With option L		180			180		A
I_{12}	Rise Time			15			15		µs
I_{11}	Tail half value time			100			100		
$U_{1\ RFI}$	Input RR level, VDE 0871	$I_{0\ max}$ $U_{1\ min.}$ $U_{1\ max}$			B			B	CB (µv)
Efficiency									
	Efficiency	U_{1nom} $I_{0\ max}$		94			96		%

The Tenderer’s scope of supply includes:

i) 110/ 24V DC-DC converter – 2 Nos./loco

ii) 110/ 48V DC-DC converter – 2 Nos./loco

6. BLOCK DIAGRAM :-



1) External Input circuitry required in rectifier mode and for DC operation only, if the sum of the length of the two input lines without option I, is greater than approx 5 m.

NOTE: - Option ‘C’ is not applicable for 48 V O/P.

7. DESCRIPTION OF OPTIONS :

Option L Input filter

Option L is recommended to reduce superimposed interference voltages, and to prevent oscillations, if input lines exceed approx. 5m in total length. The fundamental wave (approx. 120 kHz) of the reduced interference voltage between Vi +and Gi – has, with an input line inductance of 5 µH a maximum magnitude of 60mVrms

The input impedance ofthe switching regulator at 120 kHz is about 17 Ohm. The insertion of a capacitance of for example 1 µF (plastic foil capacitor), between Vi + and Gi - can achieve a further reduction to approx. 4 mVmax. The harmonics are small in comparison with the fundamental wave. See also data : RFI.

L, the maximum permissible additionally superimposed ripple u_1 ofthe input voltage (rectifier mode) ata specified input frequency f_1 has the following values:

For modules with input up to 40 V:

U_1 max = 12 Vpp at 100 Hz or Vpp * 1200 Hz/f_1

For modules with input up to 80 V:

U_1 max = 22Vpp at 100 Hz or Vpp * 2200 Hz/f,.

Modules with input up to 144 V are specially designed for battery driven applications

Option P Potentiometer

Option P excludes R function. The output voltage U_o can be adjusted with a screwdriver in the range from 0.92... 1.08 of the nominal output voltage U_o nom.

However, the minimum differential voltage $\triangle U_{10}$ min between input and output voltages as specified in chapter 5, must be maintained.

Option C Thyristor Crowbar

This option is recommended to protect the load against power supply malfunction, but it is not designed to sink external current.

A fixed value monitoring circuit checks the output voltage Uo. When the trigger voltage U_{oc} is exceeded, the thyristor crowbar triggers and disables the output. It may be deactivated by removal of the input voltage. In case of a switching transistor defect, an internal fuse prevent excess current.

Note: As a central overvoltage protection device, the crowbar is usually connected to the external source via distributed inductance of the lines. For this reason, the overvoltage at the load can temporarily exceed the trigger voltage U_{oc}. Depending on the application, further decentralized overvoltage protection elements may have to be used additionally.

Characteristics		Conditions	24V		48V		Unit
			Min	Max	Min	Max	
U_{oc}	Trigger voltage	U_1min……U_1 max I_0 = 0…I_{0nom}	27	31	55	61	V
I_1	Delay Time	Tcmin…Tcmax		1.5		1.5	µs

8) OUTPUT PROTECTIONS

Each output is protected against overvoltages which could occur due to a failure of control circuit. A voltage suppressor diode, turning in worst case into short circuit condition, provides protection. The suppressor diode would not be designed to withstand externally applied over voltages.

9) STANDARD FEATURES

- **I Inhibit**

Note: With open I. output in enabled (Uo. . .00)

The inhibit input allows the switching regulators to be disabled via a control signal. In systems with several units, this feature can be used, for example, to control the activation sequence of the regulators by a logic signal (TTL, C-MOS. etc.).

With an inhibited output, the switching regulator has a typical input current I_1 of 8 to 15 mA.

An output voltage overshoot will not occur, when the units are switched on or off.

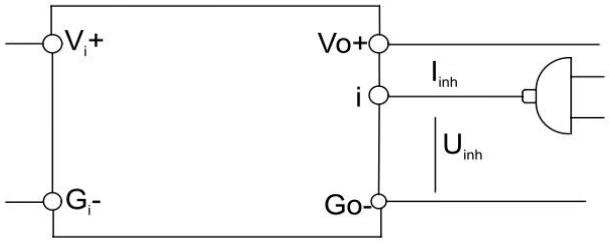


Fig 2
Definition of I_{inh} and U_{inh}

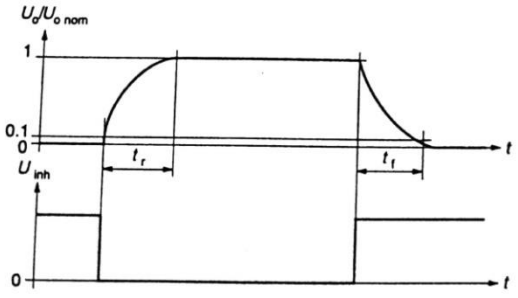


Fig. 3
Output response as a function of inhibit signal

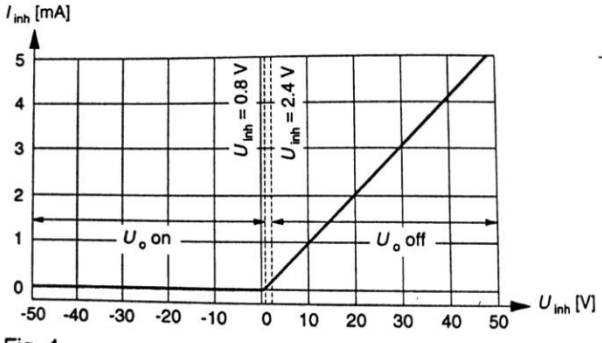
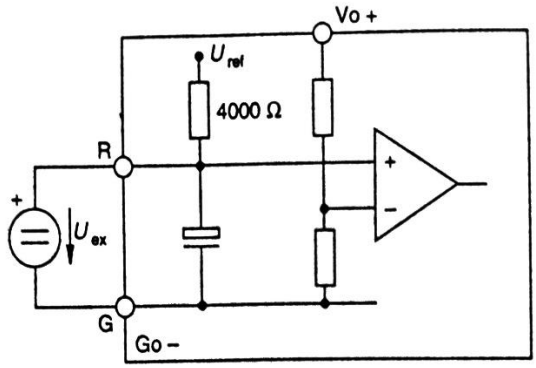
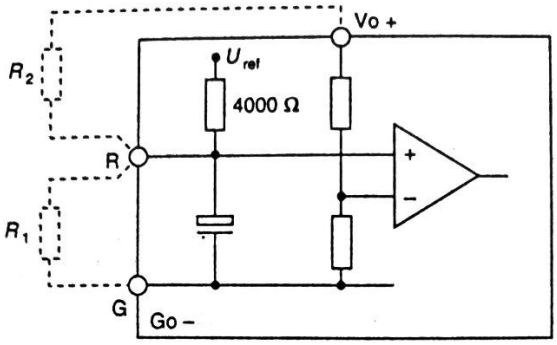


Fig. 4
Inhibit current I_{inh} versus inhibit voltage U_{inh}





Voltage adjustment with Uex [V] between R and G (Go-):

a) $U_o = U_{ex} * \frac{U\ o\ nom}{U\ ref}$ (U_{ref}= 2.5 V ± 2%)

Voltage adjustment with external resistor R_1 or R_2 [Ω]

b) U_o= 0……100 % U_{onom} , using R_1 between R and G (G_o);

$$U_o = U_{onom} * \frac{R1}{R1+4000} \quad R_1 = \frac{4000 * Uo}{Uo\ nom - Uo}$$

c) $U_o = U_{o\ nom}$ ……U_{omax} using R_3 between R and V_o

$U_{omax} = U_{o\ nom}$ + 8 %

$$U_o = U_{ref} * \frac{R2}{K*(R2+4000)-4000} \quad K = \frac{Uref}{Uo\ nom}$$

$$R_3 = 4000 * \frac{Uo*(1-K)}{K*\ Uo - Uref}, \quad (U_{ref} = 2.5\ V \pm 2\%)$$

All formulae give approximate values only-

Data :

Characteristics			Conditions	min	typ	Max	Unit
U_{min}	Inhibit input voltage to keep regulator voltage	U_0 = on	U_{1min}…. U_{1max}	-50		+ 0.8	VDC
		U_0 = off	T_{cmin}… T_{cmax}	+ 2.4		+ 50	
I_1	Switch-on time after inhibit command [1]		$U_1 = U_{1nom}$		5		ms
I_1	Switch-off time after inhibit command[1]		$R_L = U_{0nom}$ I_{0nom}		10		
$I_{1\ off}$	Input current when inhibited		$I_0 = 0$ I $U_1 = U_{1nom}$		10		mA

[1]) Family dependent; shorter with lower input voltage and longer with higher input voltage.

R External Output Voltage Adjustment

Note : With open R input. $U_0 = U_{0nom}$

(For superseded PSR types, $U_0 = 1.08 \bullet U_{0nom}$)

R-input and option P cannot be supported simultaneously.

The output voltage Uo can either be adjusted with $U_0 = 1.08 * U_{0nom}$.

Manufacturers Reference :

M/s. MELCHER AG,

Ackerstrasse 56, CH- 8610 Vster

Tel : (01) 944 81 11, Fax : 01 940 9858.

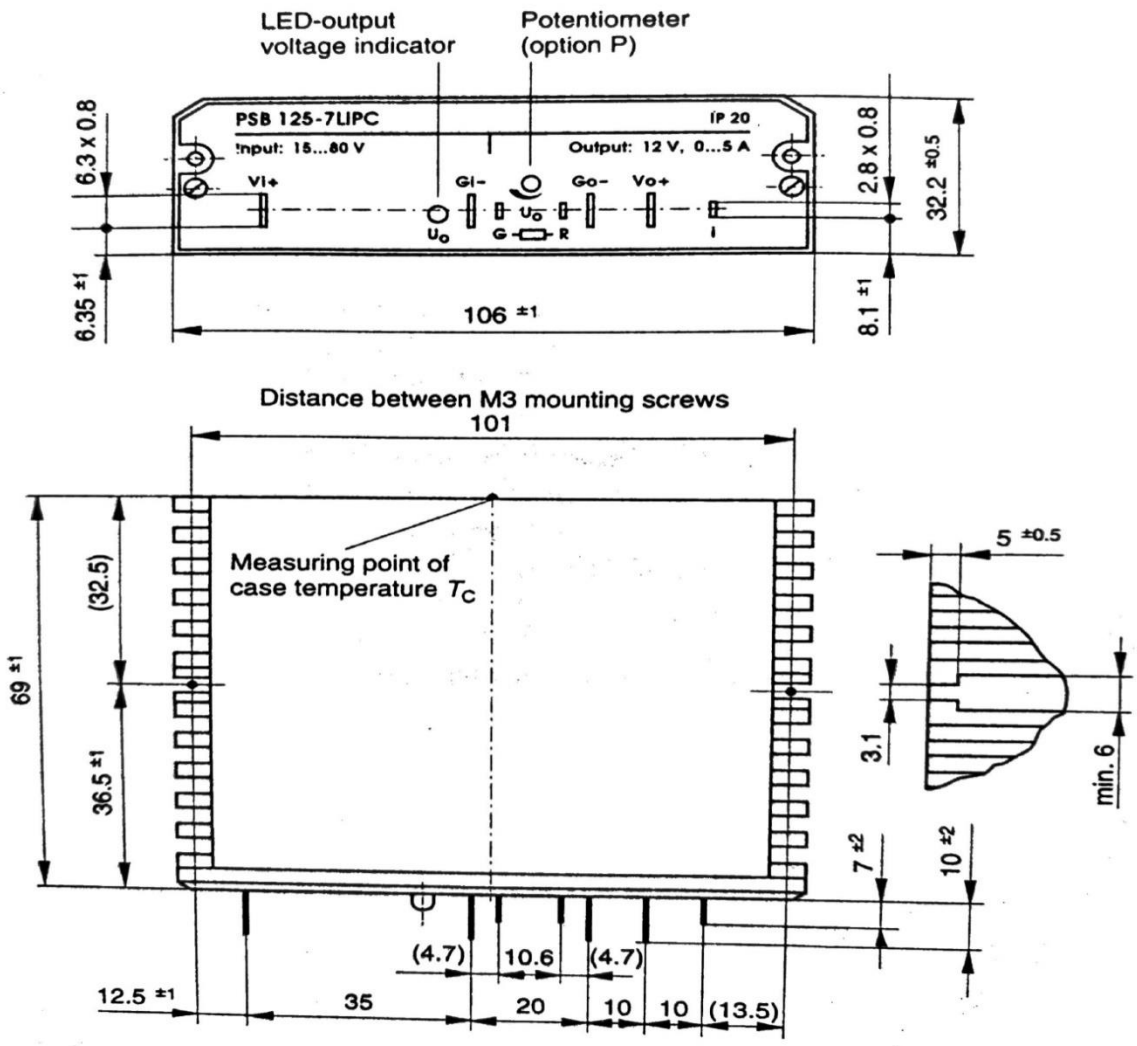
OEM Model No.

1) MEC-PSB-243-7 LIR B02…….110V/24V DC-DC Converter

2) MEC-PSB-483-7 LIR B02…….110V/48V DC-DC Converter

MECHANICAL DIMENSIONS:

Existing Drawing for reference only.



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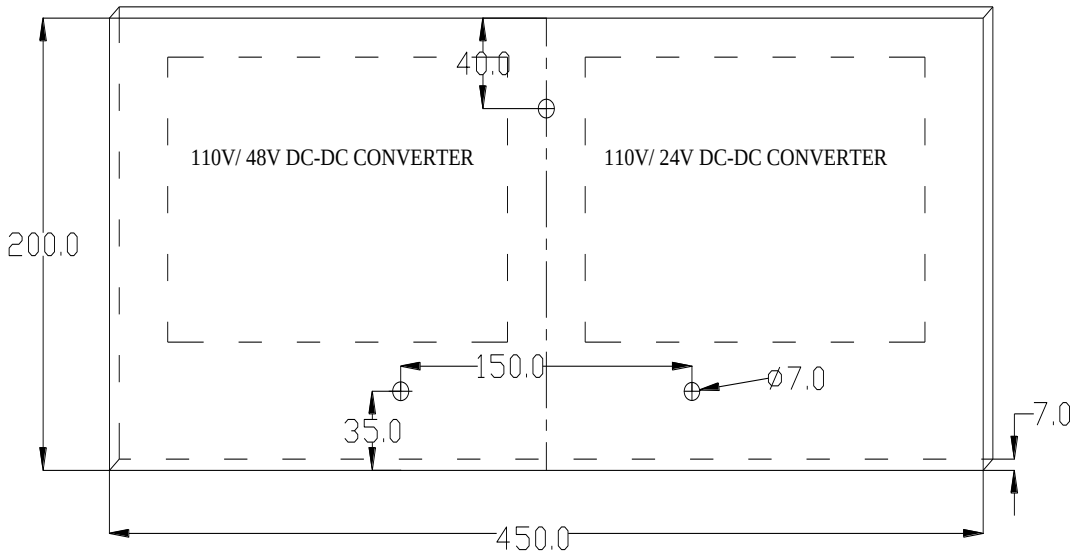
Checked By: AEE/SEE	DY.CEE/D-II	Date: 07.03.1999 SPECIFICATION FOR DC-DC Converter DRG. NO. CLW/ES/3/SK-1/0054 Alt ~~'B'~~ C

Existing drawing no CLW/ES/3/SK-1/0054 Alt-B in the specification which is for reference only.

The Maximum overall allowable Dimension of DC-DC Converter are as follows: -

1. Max. Length: 183 mm
2. Max. Width: 124 mm
3. Max. Height: 89 mm

Dimension of Panel Mounting Plate of DC-DC Converter:



Note:-

1. All dimensions are in mm.
2. BAKELITE/ GLASS EPOXY sheet thickness 7mm±1
3. Two DC-DC Converters (110V/24V and 110V/48V) must be fitted with Panel mounting plate without any fouling Panel mounting holes.

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