

DIFFERENTIAL HYBRID CIRCUIT



DESCRIPTION OF CHD-4

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1 INTRODUCTION

1.1 GENERAL

The CHD-4 type differential hybrid transformer is used for two kinds of applications. The first is to connect a Power Line Carrier (PLC) terminal to two or three phases of a power line in order to improve the reliability of transmission. The second kind is the parallel coupling of two PLC terminals which use adjacent frequency-bands, in order to avoid interferences between them due of the increased number of channels transmitted on the same physical medium.

1.2 CONSTITUTION

As can be seen in FIGURE 1, the CHD-4 unit is made of one differential transformer, with a $1:\sqrt{2}$ turn ratio between primary and secondary windings, and one resistor, whose value is the half of the nominal impedance, connected between the secondary centre tap and the shields of coaxial wires connected at the secondary. As protection when coupling two PLC terminals to the same line, it includes a gas surge arrester between the primary winding terminals. In order to make extraction easier, this gas surge arrester can be supplied on demand mounted in a support.

All the elements mentioned are contained in a cabinet prepared for outdoor mounting.

On the other hand, as can be seen in section 2.1, *PHASE-TO-PHASE OR THREE-PHASE COUPLINGS*, two CHD-4 units are necessary to carry out three-phase coupling.

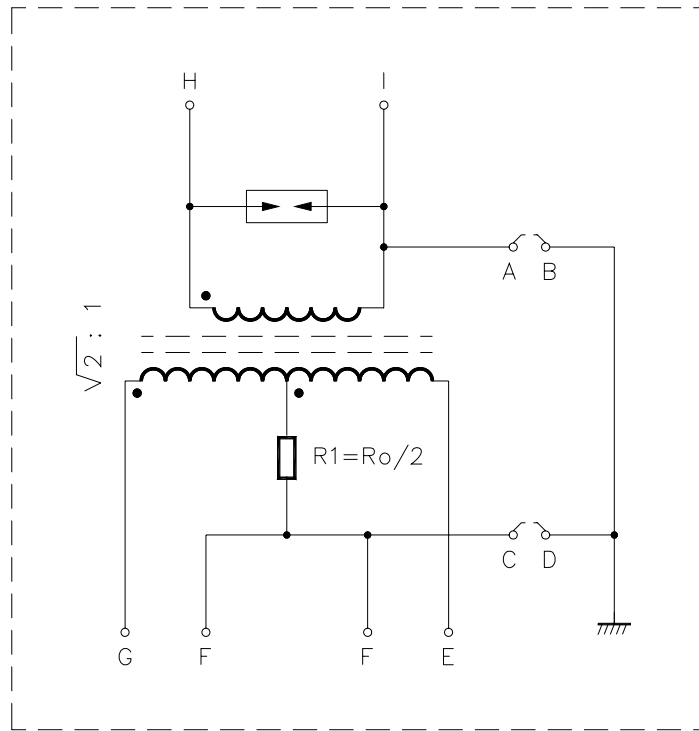


FIGURE 1 Electrical schema of the CHD-4 unit

1.3 TECHNICAL CHARACTERISTICS

1.3.1 Electrical characteristics

Application	Phase-to-phase coupling Two PLC terminals coupling Three-phase coupling
Nominal impedance	75 Ω. Others on request
Bandwidth	40 ÷ 500 kHz
Nominal peak-envelope power	400 W
Distortion and intermodulation	Better than 80 dB below the nominal power level

CHD-4

Insulation between primary and secondary windings	>2.5 kV _{rms} / 50 Hz
Insulation between the CHD-4 connection terminals and chassis	>1.5 kV _{rms} / 50 Hz
Insertion losses	< 0.25 dB in the whole band
Return loss	> 25 dB in the whole band
Gas surge arrester	
Type	CG2-350L
Sparkover voltage	350 V _{rms}
Discharge current	20 kA (8/20 μs)

1.3.2 Mechanical characteristics

Connection terminals	Screwed
Connection capacity	0.5 - 16 mm ² for rigid conductors 0.5 - 10 mm ² for flexible conductors
Connection to earth	By means of M10 rod
Ventilation	By means of a hole with DR type device
IP protection level	According to IP54 UNE 20.324-93
Operating temperature range	From -25 °C to +60 °C
Finish	Outdoor polyester powder paint, metallic grey (BJC Ref. B-8515)
Dimensions	264 x 214 x 132 mm
Weight	5 kg

2 PRINCIPLE OF OPERATION

The main functions done by the hybrid circuit are the 4-wire/2-wire conversion and the electric insulation between the inputs of the secondary winding. The following sections explain the use of these properties in the two kind of applications in which the CHD-4 unit is used.

2.1 PHASE-TO-PHASE OR THREE-PHASE COUPLINGS

The phase-to-phase or three-phase coupling modes distribute the power among the coupled phases, as can be seen in FIGURE 2 and FIGURE 3. The differential transformer, besides effecting this distribution, insulates the phases at the carrier frequency. For this reason, a fault in one of the phases used causes only a reduction in the received power, regardless of whether the fault is a short-circuit to ground or an open-circuit. Additional attenuation under fault is about 6 dB for phase-to-phase coupling, while for three-phase coupling may be from 2.5 dB if a single outer-phase fails to 12 dB if a centre-phase and one outer-phase fail simultaneously.

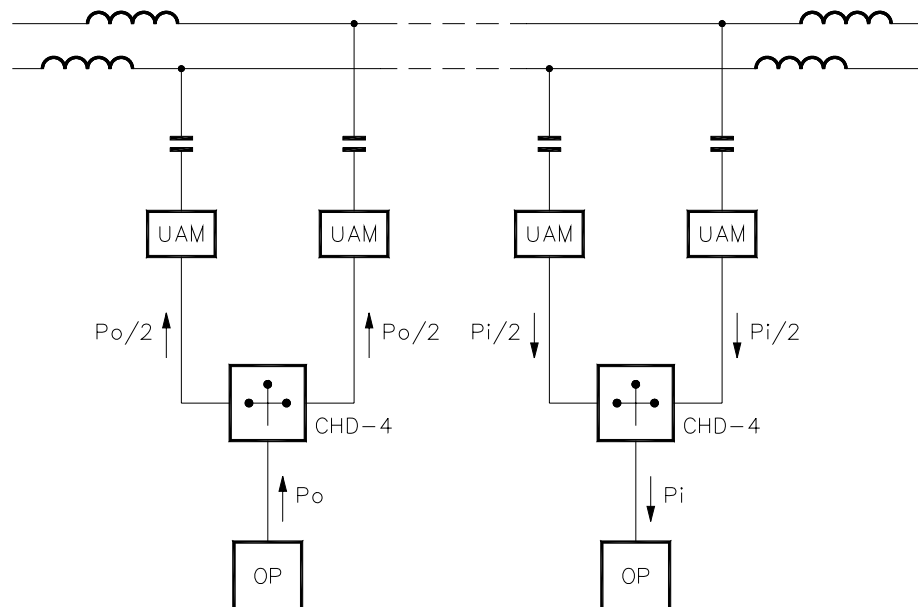


FIGURE 2 Power distribution in a PLC link with phase-to-phase coupling

As can be seen in FIGURE 3, for three-phase coupling two CHD-4 units are required.

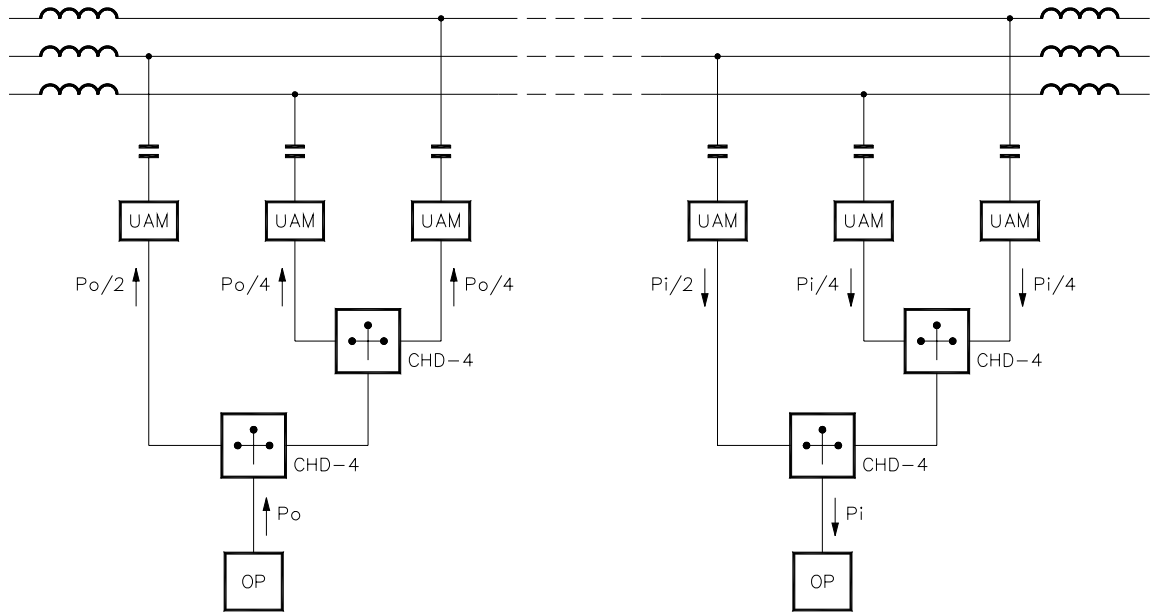


FIGURE 3 Power distribution in a PLC link with three-phase coupling

2.2 PARALLEL COUPLING OF TWO PLC TERMINALS

The CHD-4 unit can be used for coupling two PLC-equipment to the same transmission medium without noticeable interaction between them. As can be seen in FIGURE 4, CHD-4 units act as hybrid circuits, and so introduce 3 dB transmission losses at each end of the link.

This kind of coupling is normally used for PLC terminals whose bands are contiguous or very close. If the occupied bands are sufficiently far apart, the output filters of the PLC terminals perform the separating function and so there is no need to use a CHD-4 unit.

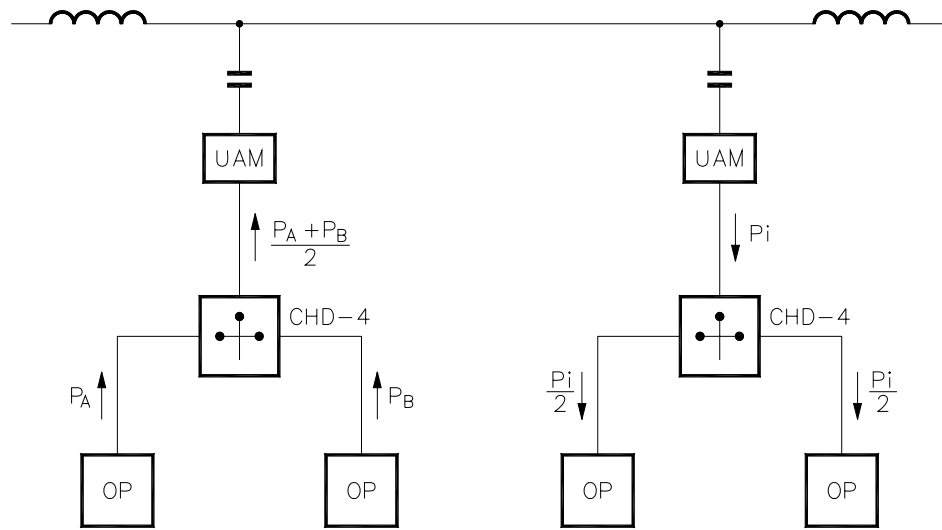


FIGURE 4 Transmitted and received power through hybrids when coupling two PLC terminals with adjacent frequency-bands

3 INSTALLATION AND ADJUSTMENT

3.1 INSTALLATION

As can be seen in chapter 2, *PRINCIPLE OF OPERATION*, the CHD-4 unit can be used for phase-to-phase coupling, for three-phase coupling and for the parallel coupling of two PLC terminals, in outdoor mounting. The internal front view of the CHD-4 unit can be seen in FIGURE 7. The overall dimensions of the CHD-4 unit are shown in FIGURE 8.

The most common installations are discussed in the following sections.

3.1.1 Phase-to-phase coupling

The electrical schema for a phase-to-phase coupling is shown in FIGURE 5.

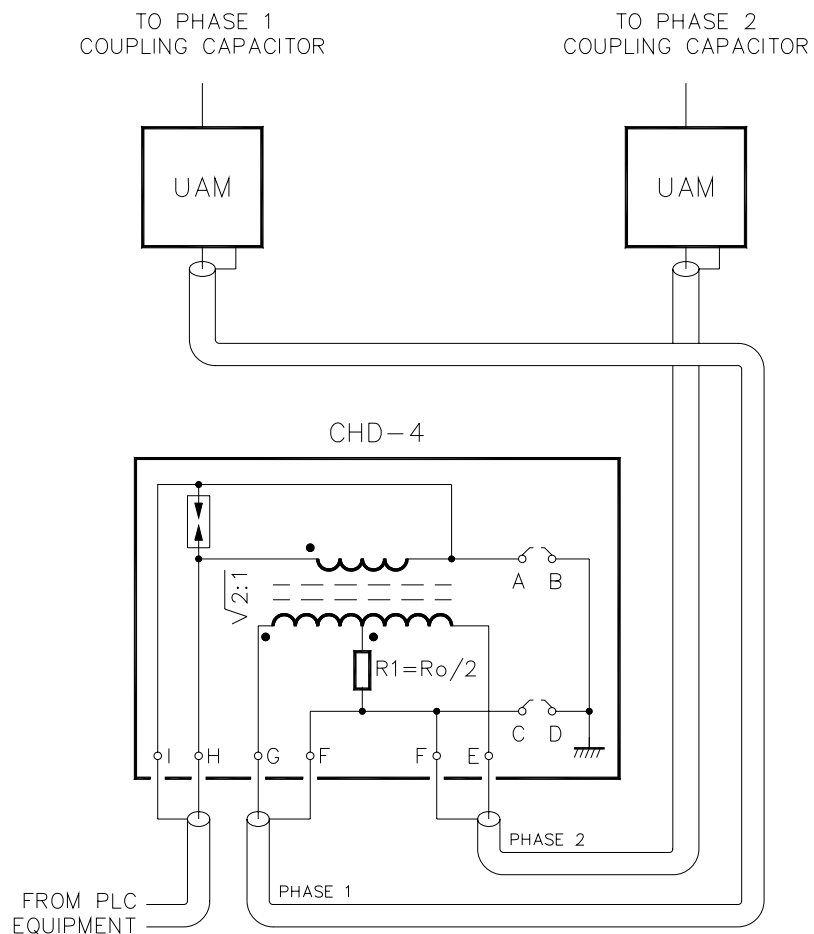


FIGURE 5 Connections for phase-to-phase coupling

CHD-4

The A-B strap of the CHD-4 allows to connect the shield of the coaxial connected to the primary winding to the ground terminal. The C-D strap allows to perform the same operation with the shield of the wires connected to the secondary. The physical position of these straps is shown in FIGURE 7.

3.1.2 Three-phase coupling

Two CHD-4 units are required for three-phase coupling. FIGURE 6 shows the connections for a three-phase coupling.

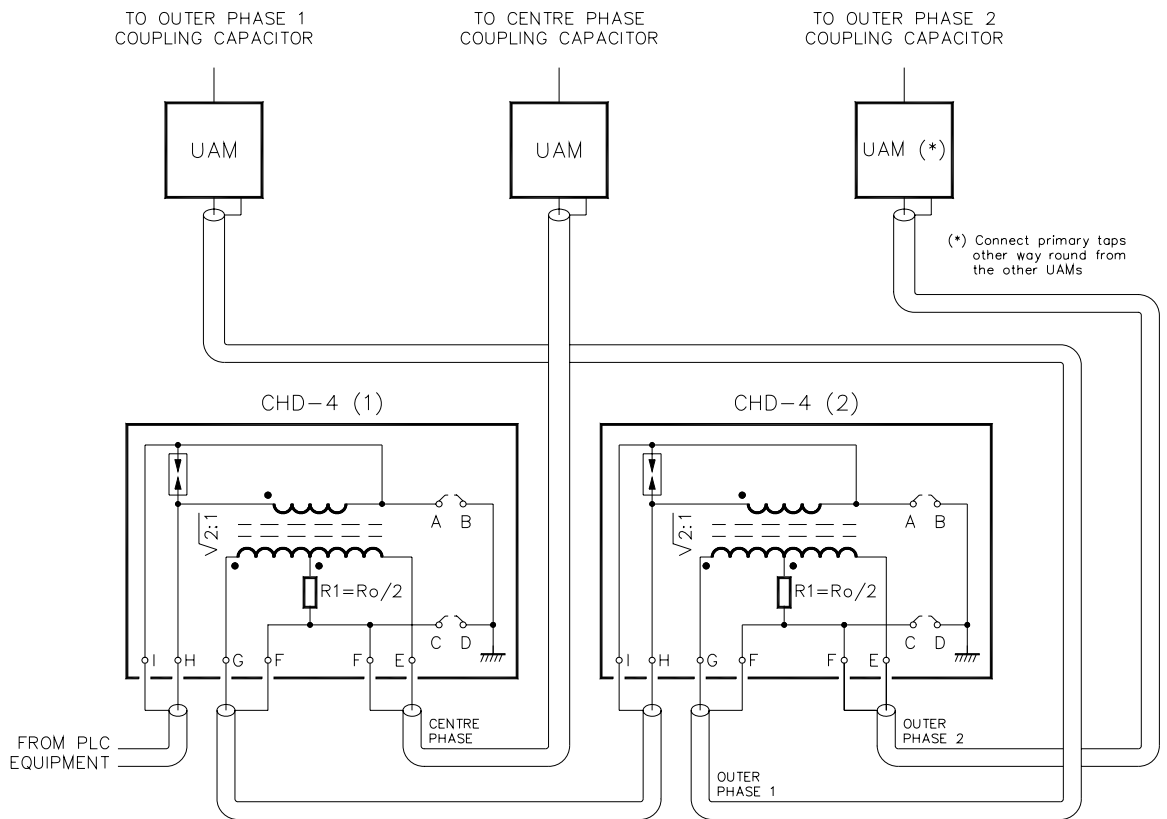


FIGURE 6 Connections for three-phase coupling

It must be noticed that in a three-phase coupling signals applied on external wires must have the same phase between them, and so must be in opposite phase in relation to the central conductor signal. Given that the hybrid of the second CHD-4 unit inverts the signal at OUTER PHASE 2 branch, a second inversion of this signal must be effected in the coupling unit to achieve a proper operation. Thus, the primary windings of the outer-phase matching transformers shall be connected in opposite way.

In the three-phase couplings, the shields of the coaxial cables which link the coupling units to the differential transformer may be connected to the ground terminal by setting the C-D straps of the CHD-4 (1) and CHD-4 (2). If the shield of the coaxial coming from the PLC terminal is not grounded at equipment-side, it may be connected to the ground terminal at the coupling-group side by means of the A-B strap of the CHD-4 (1). The physical position of the straps can be seen in FIGURE 7.

3.1.3 Parallel coupling

The parallel coupling of two PLC-terminals can be achieved with the CHD-4 unit.

For this kind of coupling, the PLC terminals are connected to the secondary winding, and the coupling unit to the primary. The wires that connect the equipment can be grounded through the same straps, but it must be remembered that the equipment-side is now the secondary winding (strap C-D) and the coupling-unit side is the primary (strap A-B).

3.2 ALIGNMENT AND MAINTENANCE

The differential hybrid transformer need no alignment nor maintenance.

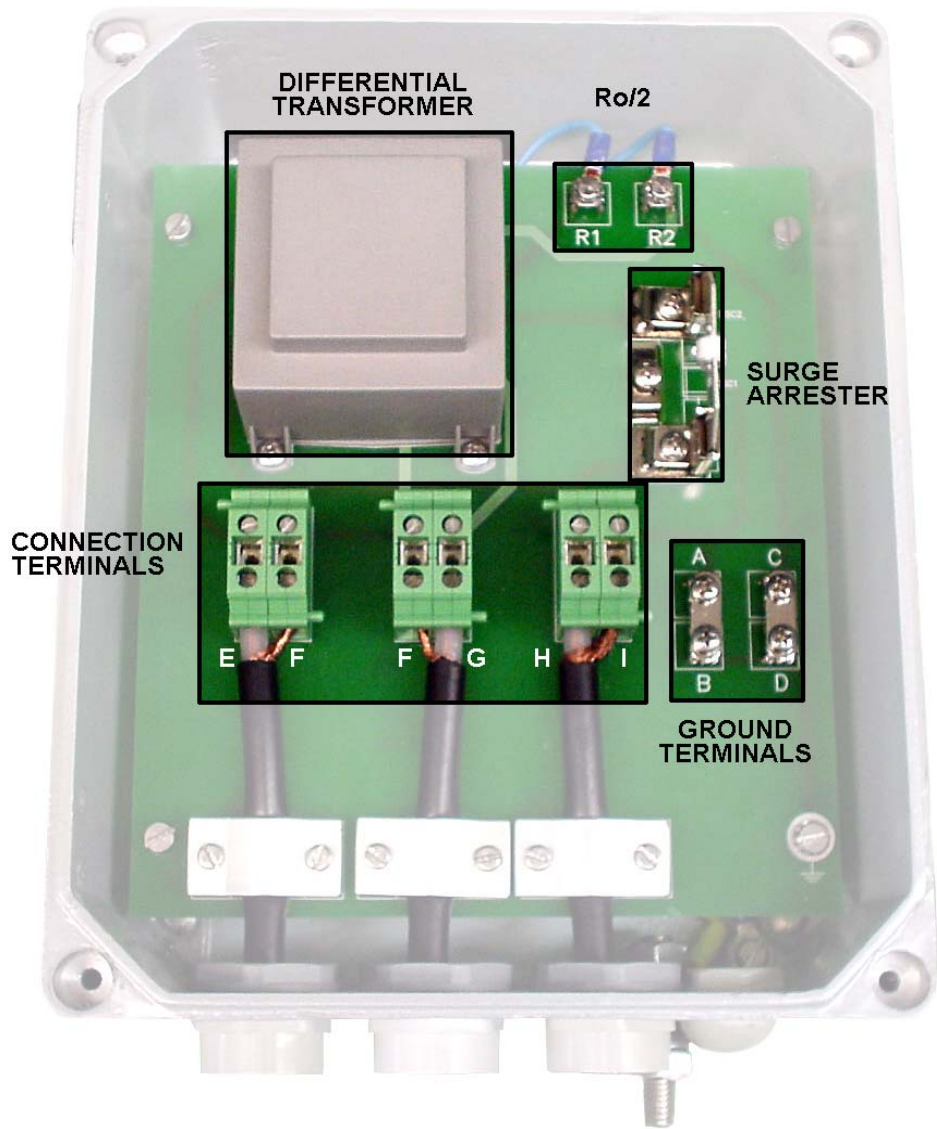


FIGURE 7 Internal front view of the CHD-4 unit

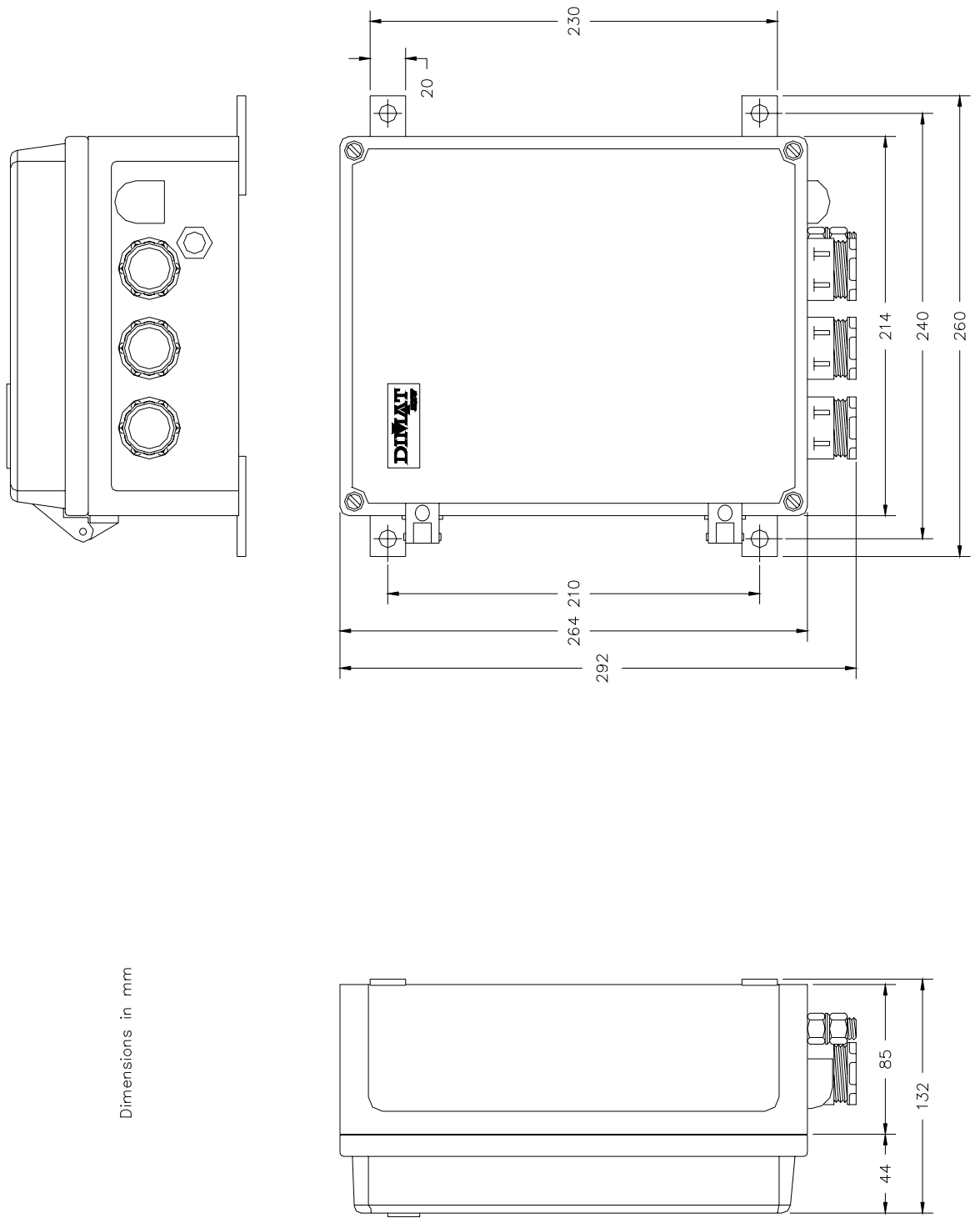


FIGURE 8 Overall dimensions of the CHD-4 unit