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(54) Modular connector.

(57) A modular connector includes a jack (20) having contacts and an insulating housing (22), a modular plug (40) to be fitted in the jack (20) to establish electrical connection therebetween, and shield plates (32,48) respectively covering at least a surface (25) of said jack (20) formed with an opening (24) for fitting the plug (40) and surfaces (49) of the plug (40) in parallel with an inserting direction (50) of the plug (40) into the jack (20) to effect magnetic shielding. The shield plate (32) for said jack (20) is provided with leaf spring pieces (38) on both sides of the contacts. The shield plate (32) for the jack (20) is electrically connected with the shield plate (48) for the plug (40) through the leaf spring pieces (38) when the plug (40) is inserted into the jack (20). The shield plate (32) for the jack (20) is integrally formed with tabs (33) which are inserted with their elastic deformations into apertures (16) formed in a printed circuit substrate (10) to provisionally fix it to the jack (20) when the substrate is loaded in the jack .

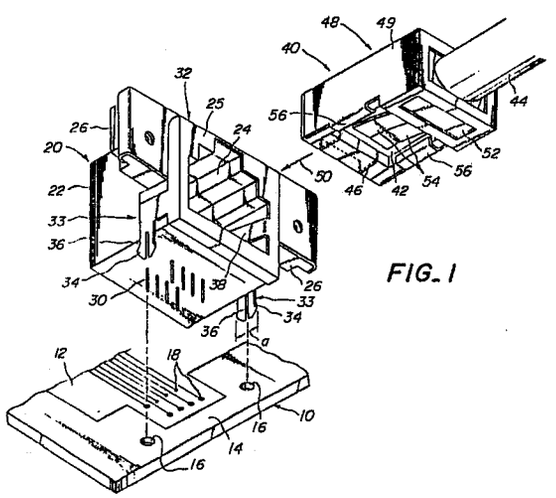

FIG. 1

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Description

Modular connector

This invention relates to a modular connector with magnetic shields, and more particularly to a modular connector whose magnetic shielding effect is improved.

Modular connectors with magnetic shields providing against EMI (electromagnetic interference) have been known. However, in general, their leakage attenuation or magnetic shielding effect is not sufficient. Therefore, it has been expected to improve the magnetic shielding effect for many years.

On the other hand, magnetic shield plates for modular connectors are required to be reliably earthed. With the known modular connectors loaded with printed circuit substrates, however, various problems often arise in their manufacturing processes. For example, a jack is often inadvertently removed from a printed circuit substrate, when they are soldering in a dipping bath after the jack is preliminarily fixed to the printed circuit substrate.

It is an object of the invention to provide an improved modular connector whose magnetic shielding effect is improved to an extent sufficient to fulfill current requirements.

It is a further object of the invention to provide a modular connector whose shield plates are earthed in a reliable manner.

In order to achieve these objects in a modular connector including a jack having contacts and an insulating housing, a plug in the form of a parallelepiped to be fitted in the jack to establish electrical connection therebetween, a shield plate covering at least a surface of said jack formed with an opening for fitting said plug and a further shield plate covering surfaces of said plug in parallel with an inserting direction of the plug into the jack to effect magnetic shielding, according to the invention said shield plate for said jack is provided with leaf spring pieces on both sides of said contacts, and said shield plate for said jack is electrically connected with said shield plate for the plug through said leaf spring pieces when the plug is inserted into the jack.

In a preferred embodiment of the invention, the shield plate for the jack is integrally formed with tabs which are inserted with their elastic deformations into apertures formed in a printed circuit substrate to provisionally fix it to the jack when the substrate is loaded in the jack.

In a further embodiment, the shield plate for the plug is provided with tongues extending in an inserting direction of the plug into the jack to improve the magnetic shielding effect.

Functions of the above arrangement will be explained hereinafter.

When the plug is fitted in the jack, side surfaces of the shield for the plug and the leaf spring pieces of the jack are electrically connected. In this case, as the leaf spring pieces are arranged on the both sides of the contacts so that the leaf spring pieces are connected to the shield plate for the plug, the leakage attenuation or magnetic shielding effect is improved.

Fig. 4 illustrates the difference in leakage attenuation between shield plates with and without leaf spring pieces on both the sides of contacts (quoted from CISPR Pub.16). As can be seen from Fig. 4, the shield plate having leaf spring pieces on both sides of contacts exhibits leakage attenuation several dB larger throughout all frequencies than that in a case leaf spring pieces are not arranged on both sides of contacts. Power inputted in a connector half is outputted into the other connector half, while part of the inputted power is dissipated as disturbing waves. The larger the outputted power, the disturbing waves are less and the leakage attenuation is larger. In Fig. 4, the leakage attenuation is indicated by outputted power in dB.

According to the invention, the tabs are inserted into the apertures of the printed circuit substrate and lower ends of the contacts are inserted into apertures of printed circuit board. Thereafter, they may be dipped in a soldering bath. As the tabs 33 are not removed from the apertures of the substrate, there is no risk of the jack being moved away from the substrate. The shield plate for the jack is earthed through the tabs and an earthing conductor of the printed circuit substrate.

Moreover, when the plug 40 is fitted in the jack, the tongues of the shield plate for the plug are inserted in a plug fitting opening to improve the magnetic shield effect.

Further, in order to make little the unshielded area of a bottom surface of the plug to which an application of magnetic shielding is difficult, the fixed tongues of the shield plate for the plug are bent so as to snugly fit with the insulating housing for the plug, thereby fixing the shield plate and the insulating housing.

In other words, the jack is provided with the leaf spring pieces to establish the electrical connection between the shield plates of the jack and plug on both sides of the contacts. Therefore, as shown in Fig. 4, the shield plate having leaf spring pieces on both dies of contacts exhibits leakage attenuation larger throughout all frequencies than in a case leaf spring pieces are not arranged on both sides of contacts.

Moreover, the shield for the jack is provided with one or more tabs adapted to be inserted into the apertures of the printed circuit substrate with elastic deformations to preliminarily fix the jack to the substrate. At least one of the tabs is electrically connected to the shield plate for the jack. Therefore, the preliminary fixation of the jack to the printed circuit substrate is effected in a reliable manner. Moreover, the shield plates for the jack and plug are earthed by means of the tabs. Therefore, in loading the printed circuit substrates onto jacks by an automatic machine, inadvertent removal of the modular jacks from the substrates is eliminated to accomplish reliable earthing.

The invention will be more fully understood by

referring to the following detailed specification and claims taken in connection with the appended drawings.

Fig. 1 is an exploded perspective view of a modular connector according to the invention;

Fig. 2 is a plan view of a jack and a plug of the connector shown in Fig. 1;

Fig. 3 is a side view of the jack and the plug; and

Fig. 4 is a graph illustrating characteristics of shield plates with and without leaf spring pieces on both sides of contacts.

Figs. 1-3 illustrate the preferred embodiment of the invention. In Fig. 1, a jack 20 and a plug 40 are shown perspectively looked up from below, and a printed circuit substrate 10 looked down from above, respectively. Figs. 2 and 3 illustrate the jack 20 and the plug 40, among which only the jack 20 is in section in horizontal and vertical planes in Figs. 2 and 3, respectively.

The printed circuit substrate 10 includes an earthing conductor 14 and a printed circuit board 12 formed with apertures 16 for fixing the jack 20 and apertures 18 for lower end 30 of contacts 28. The jack 20 comprises an insulating housing 22 in the form of a cube or parallelepiped block in its entirety having a plug fitting opening 24 and extensions 26 arranged on both sides of a surface 25 formed with the opening 24. The jack 20 includes contacts 28 (Figs. 2 and 3) whose lower ends 30 extend through a bottom surface of the insulating housing 22 (Fig. 3).

Reference numeral 32 illustrates a metal plate for magnetic shield, which is referred to as "shield plate" hereinafter. The shield plate 32 is arranged on the insulating housing 22 to cover the surface 25 of the insulating housing 22 and front surfaces of the extensions 26. The shield plate 32 includes tabs 33 which are bent so as to be in contact with side surfaces of the insulating housing 22 and further extend downward. Each of the tabs 33 is formed in the proximity of a lower end with protrusions 34 extending onto both sides whose total width a (Fig. 1) is larger than a diameter of the apertures 16 of the printed circuit substrate 10. Each of the tabs 33 is further formed with a slit 36 starting from the lower end along a center longitudinal axis of the tab 33. The tabs 33 of the shield plate 32 could be forced into the apertures 16 so as to extend therethrough with the aid of the elasticity of the tabs 33. However, after once the tabs have been inserted through the apertures 16, removal of the tabs 33 from the printed circuit substrate 10 is prevented because of the protrusions 34 engaging lower surface of the substrate 10.

The shield plate 32 is formed with leaf spring pieces 38 which are formed by integral parts of the shield plate 32 extending rearward along inner surfaces of the insulating housing 22 (Figs. 2 and 3). As can be seen from Fig. 2, the leaf spring pieces 38 are positioned on both sides of contacts 28.

The plug 40 includes an insulating housing 42, a cable 44, contact portions 46 and a shield plate 48. The plug 40 is also substantially in the form of a parallelepiped.

The shield plate 48 completely covers an upper surface and side surfaces 49 which are parallel to an inserting direction shown by an arrow 50 in Fig. 1. The shield plate 48 further covers a rear portion of a lower surface of the insulating housing 42 except for an opening 52 for pressing the contact portions 46. The rear portion of the lower surface of the insulating housing 42 will be exposed out of the insulating housing 22 of jack 20 when the plug 40 has been fitted in the jack 20.

The shield plate 48 includes tongues 54 which may be formed by extending parts of the shield plate 48 in the inserting direction 50 of the plug 40. The tongues 54 have an area sufficient to cover substantially the bottom surface of the insulating housing 42 except for the contact portions 46.

The shield plate 48 further includes fixed tongues 56 which are parts of the shield plate 48 which have been once extended downward and bent so as to be snugly fitted on the insulating housing 42, whereby the shield plate 48 is more reliably fixed to the insulating housing 42. It further serves to make little the unshielded area of the bottom surface of the insulating housing 42.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details can be made therein without departing from the spirit and scope of the invention.

Claims

1. A modular connector including a jack having contacts and an insulating housing, a plug in the form of a parallelepiped to be fitted in the jack to establish electrical connection therebetween, a shield plate covering at least a surface of said jack formed with an opening for fitting said plug and a further shield plate covering surfaces of said plug in parallel with an inserting direction of the plug into the jack to effect magnetic shield, wherein said shield plate for said jack is provided with leaf spring pieces on both sides of said contacts and said shield plate for said jack is electrically connected with said shield plate for the plug through said leaf spring pieces when the plug is inserted into the jack.

2. A modular connector as set forth in claim 1, wherein said shield plate for the jack is integrally formed with tabs which are inserted with their elastic deformations into apertures formed in a printed circuit substrate to provisionally fix it to the jack when the substrate is loaded in the jack.

3. A modular connector as set forth in claim 2, wherein each of said tabs is formed in the proximity of a free end with protrusions extending onto both sides whose total width is larger than a diameter of said apertures of the printed circuit substrate and is further formed with a slit

starting from the free end along a center longitudinal axis of the tab.

4. A modulator connector as set forth in claim 1, wherein said shield plate for the plug is provided with tongues extending in an inserting direction of the plug into the jack.

5. A modular connector as set forth in claim 1, wherein said shield plate for the plug is provided with fixed tongues as integral parts which are bent to snugly fit on the insulating housing of the plug, thereby fixing the shield plate to the insulating housing.

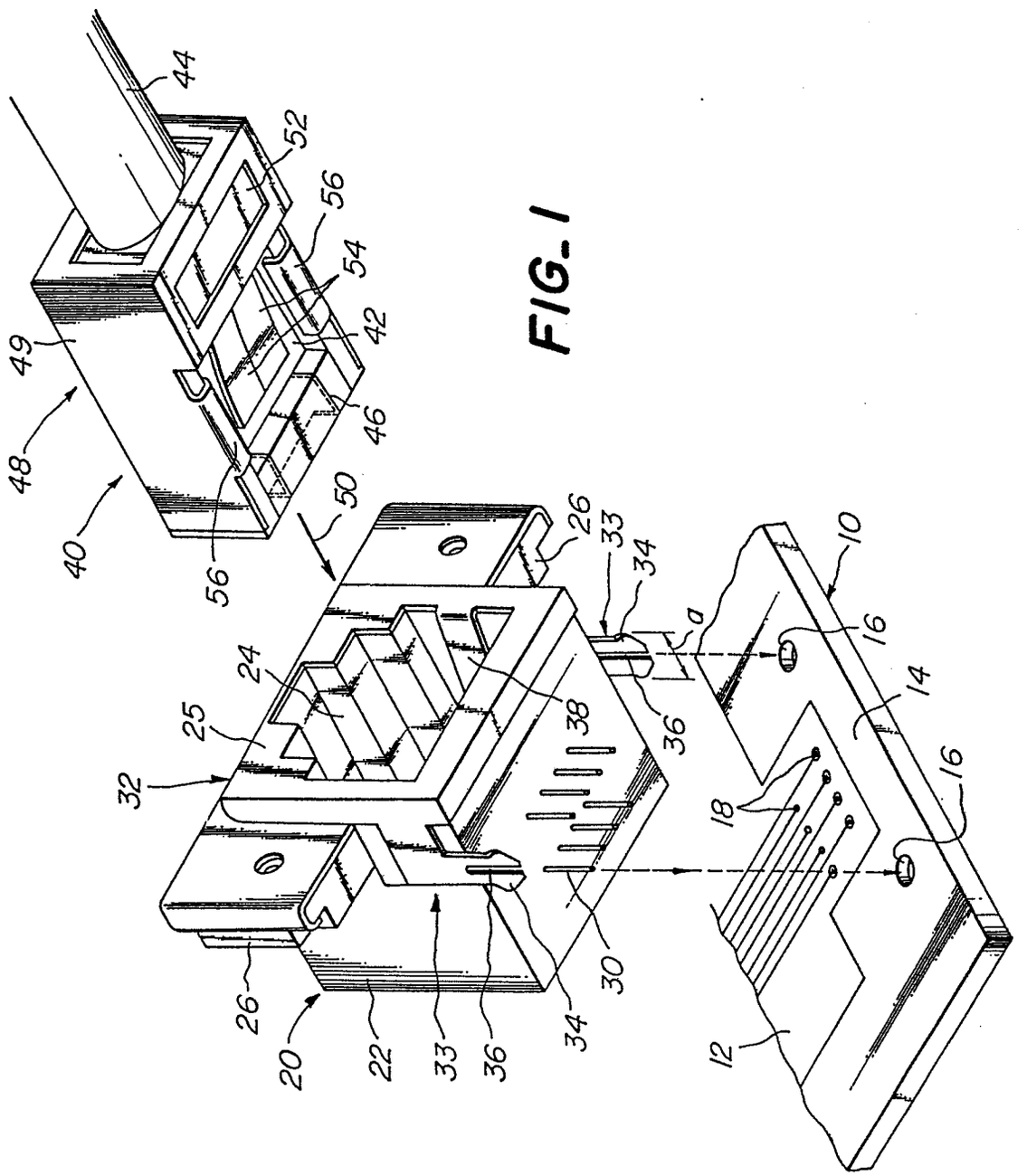
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FIG. 1

FIG_2

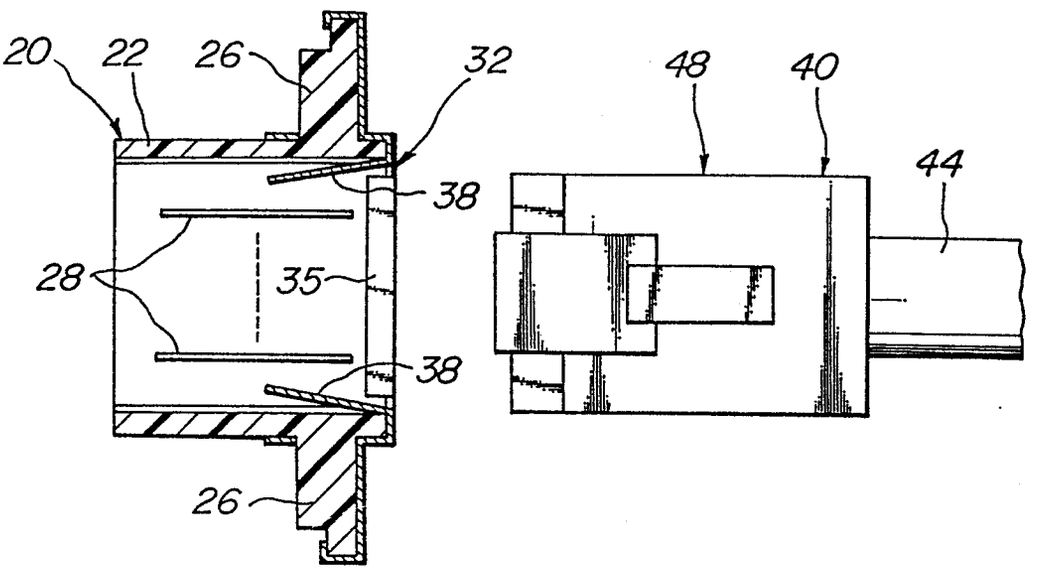
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FIG_3

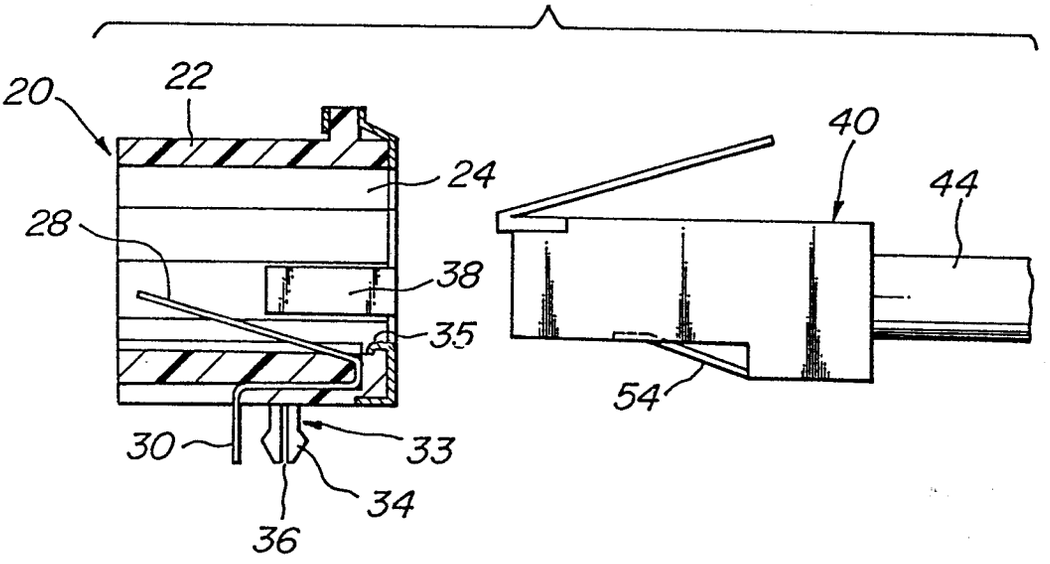
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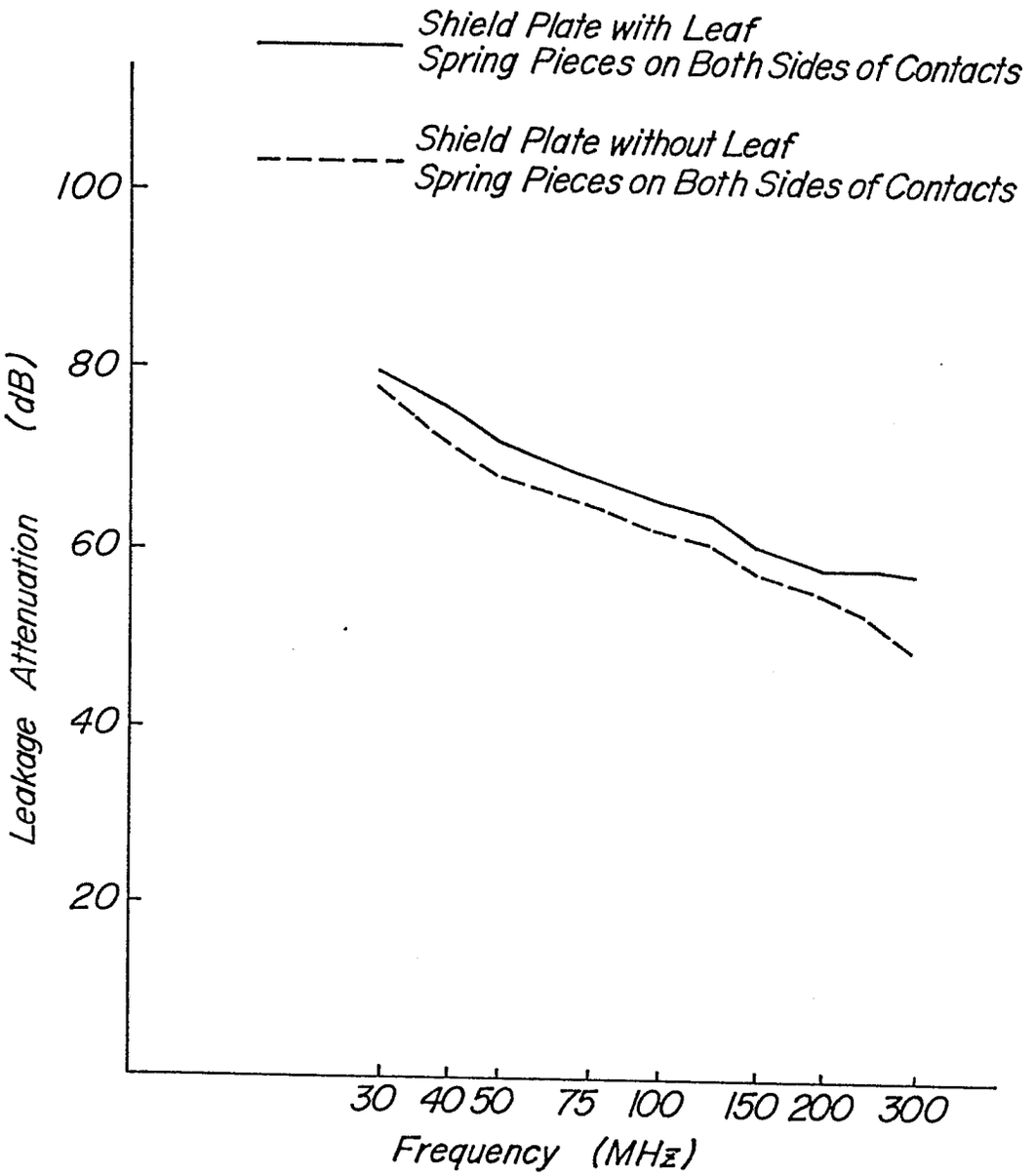
FIG_4


Shield Plate with Leaf Spring Pieces on Both Sides of Contacts
Shield Plate without Leaf Spring Pieces on Both Sides of Contacts
Leakage Attenuation (dB)
100
80
60
40
20
30
40
50
75
100
150
200
300
Frequency (MHz)