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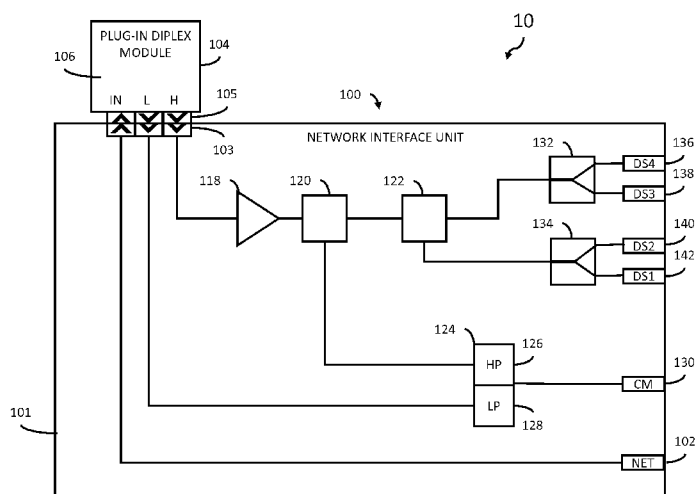


Fig. 1

(57) Abstract: Systems and Methods for CATV network interface units with plug-in modular bandplan selectivity are disclosed. In one embodiment, a network interface device comprises: a plug-in diplex module comprising an enclosure including high and low pass filters and a first set of plug connectors providing an external interface to the filters; and a network interface unit comprising a network connector to receive signals from and send signals to a CATV headend, a second set of plug connectors compatible to mate with the first set, wherein the network connector is electrically coupled to the filters via the first and second sets of plug connectors, and a cable modem port configured to output downstream RF signals to a cable modem and to receive upstream RF signals from the cable modem, wherein the cable modem port is electrically coupled to the high and low pass filters via the sets of plug connectors.

CATV NETWORK INTERFACE UNIT WITH PLUG-IN MODULAR BANDPLAN SELECTIVITY

BACKGROUND

[0001] Typically when a cable television (CATV) operator wants to change the upstream/downstream frequency plan/band, all amplifiers need to be replaced or reconfigured. The network interface unit (NIU) is a small amplifier in an end user premise. When the upstream/downstream frequency plan changes, the existing NIU is typically replaced with a new one configured for the new upstream/downstream frequency band.

SUMMARY

[0002] Systems and Methods for CATV network interface units with plug-in modular bandplan selectivity are disclosed. In one embodiment, a network interface device comprises: a plug-in diplex module comprising an enclosure including high and low pass filters and a first set of plug connectors providing an external interface to the filters; and a network interface unit comprising a network connector to receive signals from and send signals to a CATV headend, a second set of plug connectors compatible to mate with the first set, wherein the network connector is electrically coupled to the filters via the first and second sets of plug connectors, and a cable modem port configured to output downstream RF signals to a cable modem and to receive upstream RF signals from the cable modem, wherein the cable modem port is electrically coupled to the high and low pass filters via the sets of plug connectors.

DRAWINGS

[0003] Understanding that the drawings depict only exemplary embodiments and are not therefore to be considered limiting in scope, the exemplary embodiments will be described with additional specificity and detail through the use of the accompanying drawings, in which:

[0004] Figure 1 is a high level block diagram of an embodiment of a network interface device of the present disclosure.

[0005] Figure 2 is a diagram of an embodiment of a plug-in diplex module for use with a network interface unit of the present disclosure.

[0006] Figure 3 is a diagram of an embodiment of a plug-in dual diplex module for use with a network interface unit of the present disclosure.

[0007] Figures 4-9 are diagrams illustrating various alternative form-factors for a network interface unit of the present disclosure.

[0008] Figure 10 is a diagram of an example embodiments of a cable television network utilizing network interface units with plug-in diplex modules of the present disclosure.

[0009] Figure 11 is a flow chart depicting one embodiment of an exemplary method of the present disclosure.

DETAILED DESCRIPTION

[0010] In the following detailed description, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration specific illustrative embodiments. However, it is to be understood that other embodiments may be utilized and that logical, mechanical, and electrical changes may be made. Furthermore, the method presented in the drawing figures and the specification is not to be construed as limiting the order in which the individual steps may be performed. The following detailed description is, therefore, not to be taken in a limiting sense.

[0011] The embodiments described below enable an enhanced network interface unit to selectively utilize one of two or more frequency bands. Furthermore, the embodiments of the exemplary network interface units described herein are configured with a modular plug-in diplexer that is external to the network interface unit and can be installed or replaced by an end user.

[0012] Figure 1 is high level block diagram of one embodiment of an exemplary network interface device 10 comprising a network interface unit (NIU) 100 coupled with a Plug-In Diplex Module 104. In the embodiment shown in Figure 1, network interface unit 100 is a CATV network interface unit with changeable upstream/downstream frequency bands. As the terms are

used herein, “downstream” refers to a communication direction from a CATV headend toward an end user premise and “upstream” refers to a communication direction from the customer user premise toward the CATV headend. Thus, an upstream path refers to the components coupled together to communicate signals in the upstream direction and a downstream path refers to the components coupled together to communicate signals in the downstream direction. As used herein, a broadband signal refers to a signal covering two or more channels in the downstream RF band.

[0013] In the example shown in Figure 1, the NIU 100 includes a network connector 102 for all upstream/downstream radio frequency (RF) bands. In particular, in this embodiment, the network connector 102 is used for communicating an upstream RF band, and its associated downstream RF band, by communicatively coupling NIU 100 a CATV network. In particular, in this example, the network connector 102 is implemented as a coaxial RF connector, such as female F-connectors configured to mate with a corresponding male F-connector. Such connectors are known to one of skill in the art and not discussed in further detail herein. However, it is to be understood that other connector types can be used in other embodiments.

[0014] In one exemplary implementation, a first upstream/downstream RF band pair is used by NIU 100 that includes a first downstream RF band that covers an RF spectrum of approximately 87.5 MHz to approximately 1200 MHz and a first upstream RF band that covers an RF spectrum of approximately 15 MHz to approximately 65 MHz. In another exemplary implementation, a second upstream/downstream RF band pair is instead used by NIU 100 that includes a second downstream RF band that covers an RF spectrum of approximately 250 MHz to approximately 1200 MHz and the associated upstream RF band that covers an RF spectrum of approximately 15 MHz to approximately 200 MHz. However, it is to be understood that other frequency spectrums can be used for the respective upstream/downstream RF band pairs in other embodiments. With embodiments of the present disclosure, NIU 100 may be re-configured from using the first upstream/downstream RF band pair to using the second upstream/downstream RF band pair by selection and installation of an appropriate Plug-In Diplex Module 104. That is, a first Plug-In Diplex Module 104 configured for use with the first upstream/downstream RF band pair is removed from NIU 100, and a second Plug-In Diplex Module 104 configured for use with the

second upstream/downstream RF band pair is installed in its place. Plug-In Diplex Module 104 comprises electronics housed in an enclosure 106 separate from and external to the enclosure 101 housing the NIU 100. To facilitate installation and removal, each Plug-In Diplex Module 104 comprises a set of plug connectors 105 that mates with a compatible set of plug connectors 103 on the NIU 100. In one embodiment, each connector of the set of plug connectors 105 comprises a coaxial RF connector, such as male F-connectors configured to mate with a corresponding female F-connector of the set of plug connectors 103 on the NIU 100. Examples of specifications for connectors that may be used to implement plug connectors 103 and plug connectors 105 include, but are not limited to: IEC 61169-24_2009 Radio frequency connectors - type F; ANSISCTE02-2006-Specification for F port female indoor; ANSISCTE1242006 - Specification for F Connector, Male, Pin Type; and for IEC 9.5mm: IEC 60169-1965-Radio-frequency connectors part 2 coaxial unmatched connector. Such connectors are known to one of skill in the art and not discussed in further detail herein. However, it is to be understood that in other embodiments, other pluggable RF signal coupling devices may be used for plug connectors 103 and 105. The combination of the Plug-In Diplex Module 104 installed in the NIU 100 is referred to herein as a network interface device and is shown generally in Figure 1 at 10.

[0015] Each Plug-In Diplex Module 104, when installed into a NIU 100, is configured for use with a single upstream/downstream RF band pair. One example of such a Plug-In Diplex Module 104 is illustrated in Figure 2 by Plug-In Diplex Module 150. In this implementation, Plug-In Diplex Module 150 includes a high pass filter 108 which may, for example, have a cut off frequency of approximately 87.5 MHz (i.e. so that frequencies above 87.5 MHz are passed) and a low pass filter 110 that has a cut off frequency of approximately 65 MHz (i.e. so that frequencies below 65 MHz are passed). Here, the set of plug connectors 105 includes a signal line (labeled IN) coupled to both high pass filter 108 and low pass filter 110, a low pass line (labeled L) coupled to low pass filter 110 and a high pass line (labeled H) coupled to high pass filter 108. Hence, in this first example implementation the Plug-In Diplex Module 150 corresponds to the exemplary first upstream/downstream RF band pair example. In order to reconfigure NIU 100 to instead utilize the second upstream/downstream RF band pair, the first Plug-In Diplex Module 150 may be removed and replaced with another Plug-In Diplex Module 150 having the desired cut off frequencies. For example, to implement the second

upstream/downstream RF band pair, high pass filter 108 would instead have a cut off frequency of approximately 250 MHz (i.e. so that frequencies above 250 MHz are passed) and a low pass filter 110 that has a cut off frequency of approximately 200 MHz (i.e. so that frequencies below 200 MHz are passed).

[0016] Another example of a Plug-In Diplex Module 104 is illustrated in Figure 3 by Plug-In Diplex Module 155. In this implementation, Plug-In Diplex Module 155 is a dual diplex module, meaning that it includes 2 sets of high/low pass filters which may be alternately selected depending on the orientation of Plug-In Diplex Module 155 when it is plugged into NIU 100. In this embodiment, Plug-In Diplex Module 155 includes a first set of plug connectors 105-1 that mates with the compatible set of plug connectors 103 on the NIU 100. The set of plug connectors 105-1 includes a signal line (labeled IN) coupled to both a high pass filter 108-1 and a low pass filter 110-1, a low pass line (labeled L) coupled to low pass filter 110-1, and a high pass line (labeled H) coupled to high pass filter 108-1. The high pass filter 108-1 in Plug-In Diplex Module 155 has a cut off frequency of approximately 87.5 MHz (i.e. frequencies above 87.5 MHz are passed) and the low pass filter 110-1 has a cut off frequency of approximately 65 MHz (i.e. frequencies below 65 MHz are passed). Hence, when Plug-In Diplex Module 155 is installed into NIU 100 by orienting Plug-In Diplex Module 155 to mate the first set of plug connectors 105-1 with plug connectors 103, NIU 100 becomes configured to use the exemplary first upstream/downstream RF band pair.

[0017] Plug-In Diplex Module 155 also includes a second set of plug connectors 105-2 that mates with the compatible set of plug connectors 103 on the NIU 100. The set of plug connectors 105-2 includes a signal line (labeled IN) coupled to both a high pass filter 108-2 and a low pass filter 110-2, a low pass line (labeled L) coupled to low pass filter 110-2, and a high pass line (labeled H) coupled to high pass filter 108-2. The high pass filter 108-2 in Plug-In Diplex Module 155 has a cut off frequency of approximately 250 MHz (i.e. frequencies above 250 MHz are passed) and the low pass filter 110-2 has a cut off frequency of approximately 200 MHz (i.e. frequencies below 200 MHz are passed). Hence, when Plug-In Diplex Module 155 is installed into NIU 100 by orienting Plug-In Diplex Module 155 to mate the second set of plug

connectors 105-2 with plug connectors 103, NIU 100 becomes configured to use the exemplary second upstream/downstream RF band pair.

[0018] Returning to Figure 1, downstream signals received at connector 102 are supplied to the signal line (IN) of Plug-In Diplex Module 104 via the mated plug connections 103 and 104. In the downstream direction, high pass filtered output of Plug-In Diplex Module 105 (from high pass line H) is amplified by an amplifier 118 in this example. Suitable amplifiers for amplifying the downstream RF signal are known to one of skill in the art. The amplified downstream RF signal is then split in splitter 120 in this example. The splitter 120 outputs the amplified signal to a splitter 122 and to a diplexer 124.

[0019] The splitter 122 provides a copy of the downstream RF signal to each of splitters 132 and 134 in this example. Splitter 132 splits the received downstream RF signal to provide a copy of the downstream RF signal to each of connectors 136 and 138. Similarly, the splitter 134 splits the received downstream RF signal to provide a copy of the downstream RF signal to each of connectors 140 and 142. Connectors 136, 138, 140, and 142 (also referred to herein as distributive ports) may each be implemented as coaxial RF connectors similar to connector 102. The connectors 136, 138, 140, and 142 provide ports for distribution of the downstream signal to multiple devices at the end user premise. It is to be understood that the splitters 122, 132, and 134 can be implemented using passive RF splitters. Each splitter is selected/configured to keep signal loss within a predetermined maximum value, as known to one of skill in the art.

[0020] Diplexer 124 includes a high pass filter 126 and a low pass filter 128. As shown in Figure 1, high pass filter 126 is coupled to splitter 120 while low pass filter is coupled to the low pass filter connection (L) of Plug-In Diplex Module 104. In this exemplary embodiment, the high pass filter 126 has a cut off frequency of approximately 250 MHz and the low pass filter 128 has a cut off frequency of approximately 200 MHz, which may, or may not necessarily, be similar to the pass bands of Plug-In Diplex Module 104. The diplexer 124 outputs the downstream RF signal received from the splitter 120 to connector 130 (also referred to herein as a cable modem port). The connector 130 is configured to couple NIU 100 to a cable modem via a respective cable. In some embodiments, the connector 130 is also a coaxial RF connector similar to connector 102.

[0021] In the upstream direction, a signal received from the cable modem over the connector 130, is provided to the low pass filter 128 of diplexer 124. The upstream signals are passed from the diplexer 124 to the low pass filter connection (L) of Plug-In Diplex Module 104. The upstream signals are then passed out from NIU 100 via network connector 102

[0022] Since the NIU 100 is easily reconfigurable to support multiple upstream/ downstream RF frequency band pairs simply by exchanging one Plug-In Diplex Module 104 for another, or alternately by removing, rotating, and then reinstalling Plug-In Diplex Module 104 (in the case of a Plug-In Dual Diplex Module), a technician does not is not needed to perform complex rewiring or NIU replacement in order to change the RF frequency bands used. In fact, because the Plug-In Diplex Module 104 is external to the main body of the NIU 100, it can be installed/ replaced by an end user without the assistance of a technician. It is to be understood that the NIU 100 can include other components not shown. For example, in some embodiments an amplifier similar to amplifier 118 can be included in the upstream path between low pass filter 128 and Plug-In Diplex Module 104.

[0023] Depending on various field conditions, different form factors may be used to ensure clearances for removing and installing the Plug-In Diplex Module 104. Figures 4-9 are diagrams illustrating various alternative form-factors for different implementations of network interface unit 100 and Plug-In Diplex Module 104.

[0024] Figure 4 illustrates an NIU 400 and Plug-In Diplex Module 404, each of which are functionally identical to the corresponding elements NIU 100 and Plug-In Diplex Module 104 discussed above. As shown at 410, NIU 400 comprises a first set of plug connectors 403 that are compatible with receiving the connection plug connectors 405 of the Plug-In Diplex Module 404 to couple Plug-In Diplex Module 404 to NIU 400 as shown at 420. In this particular example embodiment Plug-In Diplex Module 404 is coupled to a top surface of NIU 400 to permit installation and removal of Module 404 from the top.

[0025] Figure 5 illustrates an NIU 500 and Plug-In Diplex Module 504, each of which are functionally identical to the corresponding elements NIU 100 and Plug-In Diplex Module 104 discussed above. As shown at 510, NIU 500 comprises a first set of plug connectors 503 that are compatible with receiving the connection plug connectors 505 of the Plug-In Diplex Module 504

to couple Plug-In Diplex Module 504 to NIU 500 as shown at 520. In this particular example embodiment Plug-In Diplex Module 504 is coupled to a side surface of NIU 500 to permit installation and removal of Module 504 from the side.

[0026] Figure 6 illustrates an NIU 600 and Plug-In Diplex Module 604, each of which are functionally identical to the corresponding elements NIU 100 and Plug-In Diplex Module 104 discussed above. As shown at 610, NIU 600 comprises a first set of plug connectors 603 that are compatible with receiving the connection plug connectors 605 of the Plug-In Diplex Module 604 to couple Plug-In Diplex Module 604 to NIU 600 as shown at 620. In this particular example embodiment Plug-In Diplex Module 604 is coupled to a front facing surface of NIU 600 to permit installation and removal of Module 604 from the front.

[0027] For some applications, it may be desirable for a Plug-In Diplex Module to be fully or partially recessed into an NIU when installed.

[0028] Figure 7 illustrates an NIU 700 and Plug-In Diplex Module 704, each of which are functionally identical to the corresponding elements NIU 100 and Plug-In Diplex Module 104 discussed above. As shown at 710, NIU 700 comprises a first set of plug connectors 703 that are compatible with receiving the connection plug connectors 705 of the Plug-In Diplex Module 704 to couple Plug-In Diplex Module 704 to NIU 700 as shown at 720. Here, the housing of NIU 700 comprises a recessed port 730 (accessible from the top surface of NIU 700) having dimensions compatible with partially receiving Module 704 so that the module is partially recessed into NIU 700 when installed and plug connectors 703 are located within the recessed port 730.

[0029] Figure 8 illustrates an NIU 800 and Plug-In Diplex Module 804, each of which are functionally identical to the corresponding elements NIU 100 and Plug-In Diplex Module 104 discussed above. As shown at 810, NIU 800 comprises a first set of plug connectors 803 that are compatible with receiving the connection plug connectors 805 of the Plug-In Diplex Module 804 to couple Plug-In Diplex Module 804 to NIU 800 as shown at 820. Similar to NIU 700, the housing of NIU 800 comprises a recessed port 830 accessible from the top surface of NIU 800. Here, recessed port 820 has dimensions compatible with fully receiving Module 804 so that the

module is fully recessed into NIU 800 when installed. As with NIU 700, the plug connectors 803 for NIU 800 are located within the recessed port 830.

[0030] Figure 9 illustrates an NIU 900 and Plug-In Diplex Module 904, each of which are functionally identical to the corresponding elements NIU 100 and Plug-In Diplex Module 104 discussed above. As shown at 910, NIU 900 comprises a first set of plug connectors 903 that are compatible with receiving the connection plug connectors 905 of the Plug-In Diplex Module 904 to couple Plug-In Diplex Module 904 to NIU 900 as shown at 920. Here, the housing of NIU 900 comprises a recessed port 930 accessible from the front facing surface of NIU 900. Recessed port 920 has dimensions compatible with at least partially receiving Module 904 so that the module is fully recessed into NIU 900 when installed. The plug connectors 903 for NIU 900 are located within the recessed port 930.

[0031] For any of the above form factors, the Plug-In Diplex Module may be secured to the NIU by a friction fit. Alternatively, specific fastening features such as mechanical tabs or other devices may be utilized for this purpose.

[0032] Figure 10 is a block diagram of an exemplary CATV network 1000 utilizing one or more network interface units 1021 such as the NIUs discussed above with respect to any of Figures 1-9. The network 1000 includes a CATV headend 1001. The CATV headend 1001 includes a Cable Modem Termination System (CMTS) 1003, a Public Switched Telephone Network (PSTN) gateway 1005, and an RF combiner 1013. The PSTN gateway 1005 is coupled to the public switched telephone network 1009 and the CMTS 1003 is coupled to a wide area network, such as the internet 1011. Downstream real time communication signals from the PSTN 1009 are received at the PSTN gateway 1005 and communicated to the CMTS 1003. The CMTS 1003 combines the signals from the PSTN gateway 1005 with downstream data signals from the internet 1011 and outputs the combined signals to the RF combiner 1013. The RF combiner 1013 combines the signals from the CMTS 1003 with television (TV) program feeds. The TV program feeds can be obtained from a satellite, antenna, or terrestrial distribution system, as known to one of skill in the art. The combined RF signal from the RF combiner 1013 is communicated over a network 1015 to end user premises 1017. The network 1015 can be implemented using suitable physical layer cabling, such as but not limited to, fiber optic cables

and copper cables. The downlink signals are distributed to the end user premises 1017 using techniques known to one of skill in the art. In particular, the RF signals are communicated over a predetermined downlink frequency band.

[0033] Each of the NIUs 1021 are configured to support more than one downlink frequency band via the selection and installation of a Plug-In Diplex Module 1004 corresponding to an upstream/downstream RF band pair in use by network 1015. The network 1015 can be implemented using suitable physical layer cabling, such as but not limited to, fiber optic cables and copper cables. The downlink signals are distributed to the end user premises 1017 using techniques known to one of skill in the art. In particular, the RF signals are communicated over a predetermined downlink frequency band. Through the selection of the Plug-In Diplex Module 1004, an end user can selectively choose the downlink frequency band. For example, an operator may increase the downstream RF band to provide more bandwidth and/or shift the downstream RF band to accommodate an increased corresponding upstream RF band. The NIUs 1021 are easily re-configured to utilize the upstream/downstream RF bands, as discussed above. In conventional systems, a technician would have to replace or internally reconfigure the NIU to accommodate the change in upstream/downstream RF bands. However, through the use of the NIUs 1021 discussed above, the switch in RF frequency bands can be made without the technician having to enter or replace the NIU 1021. Thus, the NIUs 1021 described herein can facilitate updates or changes to a network, such as transitioning from Data Over Cable Service Interface Specification (DOCSIS) 3.0 to DOCSIS 3.1, for example.

[0034] The NIUs 1021 can provide downstream signals to multiple devices. For example, the NIUs 1021 can provide downstream TV programming to television sets 1031 and downstream data signals to a cable modem 1023. The cable modem, in turn, can communicate signals to one or more end user devices 1025, such as, but not limited to, an internet protocol (IP) phone, a computer, wireless devices, etc. In addition, upstream signals from the one or more end user devices 1025 are sent upstream via the cable modem 1023 and the NIU 1021. At the cable headend 1001, the CMTS 1003 and PSTN gateway 1005 direct the upstream signals to the PSTN 1009 or internet 1011 accordingly, using techniques known to one of skill in the art.

[0035] Figure 11 is a flow chart depicting one embodiment of an exemplary method 1100 of configuring a network interface unit. It should be understood that elements of method 1100 may be used in conjunction with, in combination with, or substituted for elements of any of the other embodiments described herein. Further, the functions, structures and other description of elements for such embodiments described above may apply to like named elements and *vice versa*.

[0036] The method begins at 1110 with operating a cable television (CATV) headend comprising a cable modem termination system (CMTS) coupled to a wide area network and an RF combiner configured to combine downstream signals from the CMTS with downstream television program feed, wherein the CATV headend is configured to communicate over a CATV network using first upstream RF band and a first downstream RF band. The method proceeds to 1120 with selecting a Plug-In Diplex Module having a first low pass filter configured pass the first upstream RF band and a first high pass filter configured to pass the first downstream RF band. The method proceeds to 1130 with plugging the Plug-In Diplex Module into an external port of a network interface unit, where the network interface unit is coupled to the CATV headend by the CATV network.

Example Embodiments

[0037] Example 1 includes a network interface device, the network interface device comprising: a plug-in diplex module, the plug-in diplex module comprising: a first enclosure that includes a first high pass filter and a first low pass filter; and a first set of plug connectors providing an external interface to the first high pass filter and the first low pass filter; and a network interface unit comprising: a network connector configured to receive signals from and send signals to a cable television (CATV) headend; a second set of plug connectors compatible to mate with the first set of plug connectors, wherein the network connector is electrically coupled to the first high pass filter and the first low pass filter via the first and second sets of plug connectors; a cable modem port configured to output downstream RF signals to a cable modem and to receive upstream RF signals from the cable modem, wherein the cable modem port is electrically coupled to the first high pass filter and the first low pass filter via the first and second sets of plug connectors.

[0038] Example 2 includes the network interface device of example 1, wherein the first set of plug connectors of the plug-in diplex module includes a first plug connector that mates with a first plug connector of the second set of plug connectors of the network interface unit to couple the downstream RF signals and the upstream RF signals between the plug-in diplex module and the network connector.

[0039] Example 3 includes the network interface device of example 2, wherein the first set of plug connectors of the plug-in diplex module includes a second plug connector that mates with a second plug connector of the second set of plug connectors of the network interface unit to couple the upstream RF signals from the cable modem port to the plug-in diplex module.

[0040] Example 4 includes the network interface device of example 3, wherein the first set of plug connectors of the plug-in diplex module includes a third plug connector that mates with a third plug connector of the second set of plug connectors of the network interface unit to couple the downstream RF signals from the plug-in diplex module to the cable modem port.

[0041] Example 5 includes the network interface device of any of examples 1-4, wherein the first high pass filter is configured for a first downstream radio frequency (RF) band and the first low pass filter configured for a corresponding first upstream RF band.

[0042] Example 6 includes the network interface device of any of examples 1-5, wherein the first high pass filter filters the downstream RF signals provided as output by the cable modem port to the cable modem; and wherein the first low pass filter filters the upstream RF signals received by the cable modem port from the cable modem.

[0043] Example 7 includes the network interface device of any of examples 1-6, wherein the network interface unit is enclosed in a housing separate from the first enclosure of the plug-in diplex module, wherein the housing includes a recessed port having dimensions compatible for receiving at least part of the first enclosure of the plug-in diplex module; and wherein the second set of plug connectors are located within the recessed port.

[0044] Example 8 includes the network interface device of example 7, wherein the plug-in diplex module is secured within the recessed port by a friction fit.

[0045] Example 9 includes the network interface device of any of examples 1-8, the network interface unit further comprising an amplifier configured to amplify downstream signals from the first high pass filter.

[0046] Example 10 includes the network interface device of example 9, the network interface unit further comprising one or more distributive ports coupled to the amplifier and configured to output downstream RF signals received at the network interface unit from the CATV headend.

[0047] Example 11 includes the network interface device of any of examples 1-10, the network interface unit further comprising a diplexer comprising a second high pass filter and a second low pass filter, each having a respective cut off frequency; wherein the diplexer is coupled between the cable modem port and the second set of plug connectors; wherein each of the first high pass filter and the first low pass filter are respectively coupled to the cable modem port via the diplexer and the second set of plug connectors.

[0048] Example 12 includes the network interface device of any of examples 1-11, wherein either: the cut off frequency for the first high pass filter is approximately 87.5 MHz, the cut off frequency for the first low pass filter is approximately 65 MHz, or the cut off frequency for the first high pass filter is approximately 250 MHz, and the cut off frequency for the first low pass filter is approximately 200 MHz.

[0049] Example 13 includes the network interface device of any of examples 1-12, wherein the plug-in diplex module further comprises: a second high pass filter and a second low pass filter; and a third set of plug connectors providing an external interface to the second high pass filter and the second low pass filter, wherein the third set of plug connectors is compatible to mate with the second set of plug connectors on the network interface unit.

[0050] Example 14 includes the network interface device of example 13, wherein the cut off frequency for the first high pass filter is approximately 87.5 MHz, and the cut off frequency for the first low pass filter is approximately 65 MHz; and the cut off frequency for the second high pass filter is approximately 250 MHz, and the cut off frequency for the second low pass filter is approximately 200 MHz.

[0051] Example 15 includes a cable television (CATV) network, the CATV network comprising: a CATV headend comprising a cable modem termination system (CMTS) coupled to a wide area network and an RF combiner configured to combine downstream signals from the CMTS with downstream television program feeds; and a plurality of network interface devices communicatively coupled to the CATV headend, each of the plurality of network interface units located in a respective end user premise; wherein the CATV headend and the plurality of network interface devices are configured to utilize a first upstream RF band and a first downstream RF band; wherein at least one of the plurality of network interface devices comprises: a network interface unit comprising a network connector configured to receive signals from and send signals to a cable television (CATV) headend; and a plug-in diplex module enclosed in a housing external to the network interface unit, the plug-in diplex module comprising: a first low pass filter configured pass the first upstream RF band and a first high pass filter configured to pass the first downstream RF band; and a first set of plug connectors providing an external interface to the first high pass filter and the first low pass filter, wherein the first set of plug connectors is compatible to mate with a second set of plug connectors on the network interface unit.

[0052] Example 16 includes the CATV network of example 15, wherein the first set of plug connectors of the plug-in diplex module includes a first plug connector that mates with a first plug connector of the second set of plug connectors of the network interface unit to couple downstream RF signals and upstream RF signals between the plug-in diplex module and the network connector.

[0053] Example 17 includes the CATV network of example 16, wherein the first set of plug connectors of the plug-in diplex module includes a second plug connector that mates with a second plug connector of the second set of plug connectors of the network interface unit to couple the upstream RF signals from the cable modem port to the plug-in diplex module.

[0054] Example 18 includes the CATV network of example 17, wherein the first set of plug connectors of the plug-in diplex module includes a third plug connector that mates with a third plug connector of the second set of plug connectors of the network interface unit to couple the downstream RF signals from the plug-in diplex module to the cable modem port.

[0055] Example 19 includes the CATV network of any of examples 15-18, wherein either: the cut off frequency for the first high pass filter is approximately 87.5 MHz, and the cut off frequency for the first low pass filter is approximately 65 MHz, or the cut off frequency for the first high pass filter is approximately 250 MHz, and the cut off frequency for the first low pass filter is approximately 200 MHz.

[0056] Example 20 includes the CATV network of any of examples 15-19, wherein the network interface unit has a form factor that includes a recessed port having dimensions compatible for receiving at least part of the plug-in diplex module; and wherein the second set of plug connectors are located within the recessed port.

[0057] Example 21 includes the CATV network of example 20, wherein the plug-in diplex module is secured within the recessed port by a friction fit.

[0058] Example 22 includes the CATV network of any of examples 15-21, wherein the network interface unit further comprises: a cable modem port configured to output downstream RF signals to a cable modem and to receive upstream RF signals from the cable modem, wherein the cable modem port is electrically coupled to the first high pass filter and the first low pass filter via the first and second sets of plug connectors.

[0059] Example 23 includes the CATV network of example 22, wherein the network interface unit further comprises a diplexer comprising a second high pass filter and a second low pass filter, each having a respective cut off frequency; wherein the diplexer is coupled between the cable modem port and the second set of plug connectors; wherein each of the first high pass filter and the first low pass filter are respectively coupled to the cable modem port via the diplexer and the second set of plug connectors.

[0060] Example 24 includes the CATV network of any of examples 15-23, wherein the network interface unit further comprises an amplifier configured to amplify downstream signals from the first high pass filter.

[0061] Example 25 includes the CATV network of example 24, wherein the network interface unit further comprises one or more distributive ports coupled to the amplifier and configured to output downstream RF signals received at the network interface unit from the CATV headend.

[0062] Example 26 includes a method of configuring a network interface unit, the method comprising: operating a cable television (CATV) headend comprising a cable modem termination system (CMTS) coupled to a wide area network and an RF combiner configured to combine downstream signals from the CMTS with downstream television program feed, wherein the CATV headend is configured to communicate over a CATV network using first upstream RF band and a first downstream RF band; selecting a Plug-In Diplex Module having a first low pass filter configured pass the first upstream RF band and a first high pass filter configured to pass the first downstream RF band; and plugging the Plug-In Diplex Module into an external port of a network interface unit, where the network interface unit is coupled to the CATV headend by the CATV network.

[0063] Example 27 includes the method of example 26, wherein the first downstream RF band covers an RF spectrum of approximately 87.5 MHz to approximately 1200 MHz; or wherein the first downstream RF band covers an RF spectrum of approximately 250 MHz to approximately 1200 MHz.

[0064] Example 28 includes the method of any of examples 26-27, wherein the Plug-In Diplex Module comprises a first set of plug connectors providing an external interface to the first high pass filter and the first low pass filter, wherein the first set of plug connectors is compatible to mate with a second set of plug connectors on the network interface unit; and wherein the network interface unit comprises a network connector configured to couple to the CATV network and receive signals from and send signals to the CATV headend.

[0065] Example 29 includes the method of example 28, wherein first set of plug connectors of the plug-in diplex module includes a first plug connector that mates with a first plug connector of the second set of plug connectors of the network interface unit to couple downstream RF signals and upstream RF signals between the plug-in diplex module and the network connector.

[0066] Example 30 includes the method of example 29, wherein the first set of plug connectors of the plug-in diplex module includes a second plug connector that mates with a second plug connector of the second set of plug connectors of the network interface unit to couple the upstream RF signals from the cable modem port to the plug-in diplex module.

[0067] Example 31 includes the method of example 30, wherein the first set of plug connectors of the plug-in diplex module includes a third plug connector that mates with a third plug connector of the second set of plug connectors of the network interface unit to couple the downstream RF signals from the plug-in diplex module to the cable modem port.

[0068] Example 32 includes a network interface unit, the network interface unit comprising: a network connector configured to receive signals from and send signals to a cable television (CATV) headend; a cable modem port configured to output downstream RF signals to a cable modem and to receive upstream RF signals from the cable modem; a first set of plug connectors compatible to receive and mate with a second set of plug connectors of a plug-in diplex module, wherein the plug-in diplex module comprises electronics housed in an enclosure separate from and external to an enclosure housing the network interface unit.

[0069] Example 33 includes the network interface unit of example 32, wherein the plug-in diplex module comprises a first high pass filter and a first low pass filter; wherein a first plug connector of the first set of plug connectors is communicatively coupled to the network connector; and wherein downstream RF signals and upstream RF signals are communicated between the plug-in diplex module and the network connector via the first plug connector.

[0070] Example 34 includes the network interface unit of example 33, wherein a second plug connector of the first set of plug connectors communicatively couples first low pass filter to the cable modem port; and wherein upstream RF signals are communicated between the plug-in diplex module and the cable modem port via the second plug connector.

[0071] Example 35 includes the network interface unit of examples 34, wherein a third plug connector of the first set of plug connectors communicatively couples first high pass filter to the cable modem port; and wherein downstream RF signals are communicated between the plug-in diplex module and the cable modem port via the third plug connector.

[0072] Example 36 includes the network interface unit of any of examples 32-35, wherein the enclosure housing the network interface unit comprises a form factor that includes a recessed port having dimensions compatible for receiving at least part of the plug-in diplex module; and wherein the first set of plug connectors are located within the recessed port.

[0073] Example 37 includes a plug-in diplex module, the module comprising: a first set of plug connectors compatible to mate with a second set of plug connectors of a network interface unit, wherein the plug-in diplex module comprises a first enclosure separate from and external to a second enclosure housing the network interface unit; a first low pass filter within the first enclosure, wherein a first port of the first low pass filter is coupled to a first plug connector of the first set of plug connectors, and a second port of the first low pass filter is coupled to a second plug connector of the first set of plug connectors; and a first high pass filter within the first enclosure, wherein a first port of the first high pass filter is coupled to the first plug connector of the first set of plug connectors, and a second port of the first high pass filter is coupled to a third plug connector of the first set of plug connectors.

[0074] Example 38 includes the module of example 37, wherein either: the cut off frequency for the first high pass filter is approximately 87.5 MHz, and the cut off frequency for the first low pass filter is approximately 65 MHz, or the cut off frequency for the first high pass filter is approximately 250 MHz, and the cut off frequency for the first low pass filter is approximately 200 MHz.

[0075] Example 39 includes a plug-in diplex module, the module comprising: a first set of plug connectors compatible to mate with a set of plug connectors of a network interface unit, wherein the plug-in diplex module comprises a first enclosure separate from and external to a second enclosure housing the network interface unit; a first low pass filter within the first enclosure, wherein a first port of the first low pass filter is coupled to a first plug connector of the first set of plug connectors, and a second port of the first low pass filter is coupled to a second plug connector of the first set of plug connectors; a first high pass filter within the first enclosure, wherein a first port of the first high pass filter is coupled to the first plug connector of the first set of plug connectors, and a second port of the first high pass filter is coupled to a third plug connector of the first set of plug connectors; a second set of plug connectors compatible to mate with the set of plug connectors of the network interface unit; a second low pass filter within the first enclosure, wherein a first port of the second low pass filter is coupled to a first plug connector of the second set of plug connectors, and a second port of the second low pass filter is coupled to a second plug connector of the second set of plug connectors; and a second high pass

filter within the first enclosure, wherein a first port of the second high pass filter is coupled to the first plug connector of the second set of plug connectors, and a second port of the first high pass filter is coupled to a third plug connector of the second set of plug connectors.

[0076] Example 40 includes the module of example 39, wherein: the cut off frequency for the first high pass filter is approximately 87.5 MHz, and the cut off frequency for the first low pass filter is approximately 65 MHz, and the cut off frequency for the second high pass filter is approximately 250 MHz, and the cut off frequency for the second low pass filter is approximately 200 MHz.

[0077] Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement, which is calculated to achieve the same purpose, may be substituted for the specific embodiments shown. Therefore, it is manifestly intended that embodiments be limited only by the claims and the equivalents thereof.

CLAIMS

What is claimed is:

1. A network interface device, the network interface device comprising:
a plug-in diplex module, the plug-in diplex module comprising:
a first enclosure that includes a first high pass filter and a first low pass filter; and
a first set of plug connectors providing an external interface to the first high pass filter and the first low pass filter; and
a network interface unit comprising:
a network connector configured to receive signals from and send signals to a cable television (CATV) headend;
a second set of plug connectors compatible to mate with the first set of plug connectors, wherein the network connector is electrically coupled to the first high pass filter and the first low pass filter via the first and second sets of plug connectors;
a cable modem port configured to output downstream RF signals to a cable modem and to receive upstream RF signals from the cable modem, wherein the cable modem port is electrically coupled to the first high pass filter and the first low pass filter via the first and second sets of plug connectors.
2. The network interface of claim 1, wherein the first set of plug connectors of the plug-in diplex module includes a first plug connector that mates with a first plug connector of the second set of plug connectors of the network interface unit to couple the downstream RF signals and the upstream RF signals between the plug-in diplex module and the network connector.

3. The network interface of claim 2, wherein the first set of plug connectors of the plug-in diplex module includes a second plug connector that mates with a second plug connector of the second set of plug connectors of the network interface unit to couple the upstream RF signals from the cable modem port to the plug-in diplex module.
4. The network interface of claim 3, wherein the first set of plug connectors of the plug-in diplex module includes a third plug connector that mates with a third plug connector of the second set of plug connectors of the network interface unit to couple the downstream RF signals from the plug-in diplex module to the cable modem port.
5. The network interface device of claim 1, wherein the first high pass filter is configured for a first downstream radio frequency (RF) band and the first low pass filter configured for a corresponding first upstream RF band.
6. The network interface device of claim 1, wherein the first high pass filter filters the downstream RF signals provided as output by the cable modem port to the cable modem; and
wherein the first low pass filter filters the upstream RF signals received by the cable modem port from the cable modem.
7. The network interface device of claim 1, wherein the network interface unit is enclosed in a housing separate from the first enclosure of the plug-in diplex module, wherein the housing includes a recessed port having dimensions compatible for receiving at least part of the first enclosure of the plug-in diplex module; and
wherein the second set of plug connectors are located within the recessed port.

8. The network interface device of claim 7, wherein the plug-in diplex module is secured within the recessed port by a friction fit.
9. The network interface device of claim 1, the network interface unit further comprising an amplifier configured to amplify downstream signals from the first high pass filter.
10. The network interface device of claim 9, the network interface unit further comprising one or more distributive ports coupled to the amplifier and configured to output downstream RF signals received at the network interface unit from the CATV headend.
11. The network interface device of claim 1, the network interface unit further comprising a diplexer comprising a second high pass filter and a second low pass filter, each having a respective cut off frequency;

 wherein the diplexer is coupled between the cable modem port and the second set of plug connectors;

 wherein each of the first high pass filter and the first low pass filter are respectively coupled to the cable modem port via the diplexer and the second set of plug connectors.
12. The network interface device of claim 1, wherein either:

 the cut off frequency for the first high pass filter is approximately 87.5 MHz, the cut off frequency for the first low pass filter is approximately 65 MHz, or

 the cut off frequency for the first high pass filter is approximately 250 MHz, and the cut off frequency for the first low pass filter is approximately 200 MHz.

13. The network interface device of claim 1, wherein the plug-in diplex module further comprises:
 - a second high pass filter and a second low pass filter; and
 - a third set of plug connectors providing an external interface to the second high pass filter and the second low pass filter, wherein the third set of plug connectors is compatible to mate with the second set of plug connectors on the network interface unit.
14. The network interface device of claim 13, wherein the cut off frequency for the first high pass filter is approximately 87.5 MHz, and the cut off frequency for the first low pass filter is approximately 65 MHz; and
 - the cut off frequency for the second high pass filter is approximately 250 MHz, and the cut off frequency for the second low pass filter is approximately 200 MHz.
15. A cable television (CATV) network, the CATV network comprising:
 - a CATV headend comprising a cable modem termination system (CMTS) coupled to a wide area network and an RF combiner configured to combine downstream signals from the CMTS with downstream television program feeds; and
 - a plurality of network interface devices communicatively coupled to the CATV headend, each of the plurality of network interface units located in a respective end user premise;
 - wherein the CATV headend and the plurality of network interface devices are configured to utilize a first upstream RF band and a first downstream RF band;
 - wherein at least one of the plurality of network interface devices comprises:

a network interface unit comprising a network connector configured to receive signals from and send signals to a cable television (CATV) headend; and

a plug-in diplex module enclosed in a housing external to the network interface unit, the plug-in diplex module comprising:

a first low pass filter configured pass the first upstream RF band and a first high pass filter configured to pass the first downstream RF band; and

a first set of plug connectors providing an external interface to the first high pass filter and the first low pass filter, wherein the first set of plug connectors is compatible to mate with a second set of plug connectors on the network interface unit.

16. The CATV network of claim 15, wherein the first set of plug connectors of the plug-in diplex module includes a first plug connector that mates with a first plug connector of the second set of plug connectors of the network interface unit to couple downstream RF signals and upstream RF signals between the plug-in diplex module and the network connector.
17. The CATV network of claim 16, wherein the first set of plug connectors of the plug-in diplex module includes a second plug connector that mates with a second plug connector of the second set of plug connectors of the network interface unit to couple the upstream RF signals from the cable modem port to the plug-in diplex module.
18. The CATV network of claim 17, wherein the first set of plug connectors of the plug-in diplex module includes a third plug connector that mates with a third plug connector of

the second set of plug connectors of the network interface unit to couple the downstream RF signals from the plug-in diplex module to the cable modem port.

19. The CATV network of claim 15, wherein either:
 - the cut off frequency for the first high pass filter is approximately 87.5 MHz, and the cut off frequency for the first low pass filter is approximately 65 MHz, or
 - the cut off frequency for the first high pass filter is approximately 250 MHz, and the cut off frequency for the first low pass filter is approximately 200 MHz.
20. The CATV network of claim 15, wherein the network interface unit has a form factor that includes a recessed port having dimensions compatible for receiving at least part of the plug-in diplex module; and
 - wherein the second set of plug connectors are located within the recessed port.
21. The CATV network of claim 20, wherein the plug-in diplex module is secured within the recessed port by a friction fit.
22. The CATV network of claim 15, wherein the network interface unit further comprises:
 - a cable modem port configured to output downstream RF signals to a cable modem and to receive upstream RF signals from the cable modem, wherein the cable modem port is electrically coupled to the first high pass filter and the first low pass filter via the first and second sets of plug connectors.
23. The CATV network of claim 22, wherein the network interface unit further comprises a diplexer comprising a second high pass filter and a second low pass filter, each having a respective cut off frequency;

wherein the diplexer is coupled between the cable modem port and the second set of plug connectors;

wherein each of the first high pass filter and the first low pass filter are respectively coupled to the cable modem port via the diplexer and the second set of plug connectors.

24. The CATV network of claim 15, wherein the network interface unit further comprises an amplifier configured to amplify downstream signals from the first high pass filter.
25. The CATV network of claim 24, wherein the network interface unit further comprises one or more distributive ports coupled to the amplifier and configured to output downstream RF signals received at the network interface unit from the CATV headend.
26. A method of configuring a network interface unit, the method comprising:
 - operating a cable television (CATV) headend comprising a cable modem termination system (CMTS) coupled to a wide area network and an RF combiner configured to combine downstream signals from the CMTS with downstream television program feed, wherein the CATV headend is configured to communicate over a CATV network using first upstream RF band and a first downstream RF band;
 - selecting a Plug-In Diplex Module having a first low pass filter configured pass the first upstream RF band and a first high pass filter configured to pass the first downstream RF band; and
 - plugging the Plug-In Diplex Module into an external port of a network interface unit, where the network interface unit is coupled to the CATV headend by the CATV network.

27. The method of claim 26, wherein the first downstream RF band covers an RF spectrum of approximately 87.5 MHz to approximately 1200 MHz; or
- wherein the first downstream RF band covers an RF spectrum of approximately 250 MHz to approximately 1200 MHz.
28. The method of claim 26, wherein the Plug-In Diplex Module comprises a first set of plug connectors providing an external interface to the first high pass filter and the first low pass filter, wherein the first set of plug connectors is compatible to mate with a second set of plug connectors on the network interface unit; and
- wherein the network interface unit comprises a network connector configured to couple to the CATV network and receive signals from and send signals to the CATV headend.
29. The method of claim 28, wherein first set of plug connectors of the plug-in diplex module includes a first plug connector that mates with a first plug connector of the second set of plug connectors of the network interface unit to couple downstream RF signals and upstream RF signals between the plug-in diplex module and the network connector.
30. The method of claim 29, wherein the first set of plug connectors of the plug-in diplex module includes a second plug connector that mates with a second plug connector of the second set of plug connectors of the network interface unit to couple the upstream RF signals from the cable modem port to the plug-in diplex module.
31. The method of claim 30, wherein the first set of plug connectors of the plug-in diplex module includes a third plug connector that mates with a third plug connector of the second set of plug connectors of the network interface unit to couple the downstream RF signals from the plug-in diplex module to the cable modem port.

32. A network interface unit, the network interface unit comprising:
- a network connector configured to receive signals from and send signals to a cable television (CATV) headend;
 - a cable modem port configured to output downstream RF signals to a cable modem and to receive upstream RF signals from the cable modem;
 - a first set of plug connectors compatible to receive and mate with a second set of plug connectors of a plug-in diplex module, wherein the plug-in diplex module comprises electronics housed in an enclosure separate from and external to an enclosure housing the network interface unit.
33. The network interface unit of claim 32, wherein the plug-in diplex module comprises a first high pass filter and a first low pass filter;
- wherein a first plug connector of the first set of plug connectors is communicatively coupled to the network connector; and
 - wherein downstream RF signals and upstream RF signals are communicated between the plug-in diplex module and the network connector via the first plug connector.
34. The network interface unit of claim 33, wherein a second plug connector of the first set of plug connectors communicatively couples first low pass filter to the cable modem port; and
- wherein upstream RF signals are communicated between the plug-in diplex module and the cable modem port via the second plug connector.

35. The network interface unit of claim 34, wherein a third plug connector of the first set of plug connectors communicatively couples first high pass filter to the cable modem port; and

wherein downstream RF signals are communicated between the plug-in diplex module and the cable modem port via the third plug connector.

36. The network interface unit of claim 32, wherein the enclosure housing the network interface unit comprises a form factor that includes a recessed port having dimensions compatible for receiving at least part of the plug-in diplex module; and

wherein the first set of plug connectors are located within the recessed port.

37. A plug-in diplex module, the module comprising:

a first set of plug connectors compatible to mate with a second set of plug connectors of a network interface unit, wherein the plug-in diplex module comprises a first enclosure separate from and external to a second enclosure housing the network interface unit;

a first low pass filter within the first enclosure, wherein a first port of the first low pass filter is coupled to a first plug connector of the first set of plug connectors, and a second port of the first low pass filter is coupled to a second plug connector of the first set of plug connectors; and

a first high pass filter within the first enclosure, wherein a first port of the first high pass filter is coupled to the first plug connector of the first set of plug connectors, and a second port of the first high pass filter is coupled to a third plug connector of the first set of plug connectors.

38. The module of claim 37, wherein either:

the cut off frequency for the first high pass filter is approximately 87.5 MHz, and the cut off frequency for the first low pass filter is approximately 65 MHz, or

the cut off frequency for the first high pass filter is approximately 250 MHz, and the cut off frequency for the first low pass filter is approximately 200 MHz.

39. A plug-in diplex module, the module comprising:

a first set of plug connectors compatible to mate with a set of plug connectors of a network interface unit, wherein the plug-in diplex module comprises a first enclosure separate from and external to a second enclosure housing the network interface unit;

a first low pass filter within the first enclosure, wherein a first port of the first low pass filter is coupled to a first plug connector of the first set of plug connectors, and a second port of the first low pass filter is coupled to a second plug connector of the first set of plug connectors;

a first high pass filter within the first enclosure, wherein a first port of the first high pass filter is coupled to the first plug connector of the first set of plug connectors, and a second port of the first high pass filter is coupled to a third plug connector of the first set of plug connectors;

a second set of plug connectors compatible to mate with the set of plug connectors of the network interface unit;

a second low pass filter within the first enclosure, wherein a first port of the second low pass filter is coupled to a first plug connector of the second set of plug connectors, and a second port of the second low pass filter is coupled to a second plug connector of the second set of plug connectors; and

a second high pass filter within the first enclosure, wherein a first port of the second high pass filter is coupled to the first plug connector of the second set of plug connectors, and a second port of the first high pass filter is coupled to a third plug connector of the second set of plug connectors.

40. The module of claim 39, wherein:

the cut off frequency for the first high pass filter is approximately 87.5 MHz, and
the cut off frequency for the first low pass filter is approximately 65 MHz, and

the cut off frequency for the second high pass filter is approximately 250 MHz,
and the cut off frequency for the second low pass filter is approximately 200 MHz.

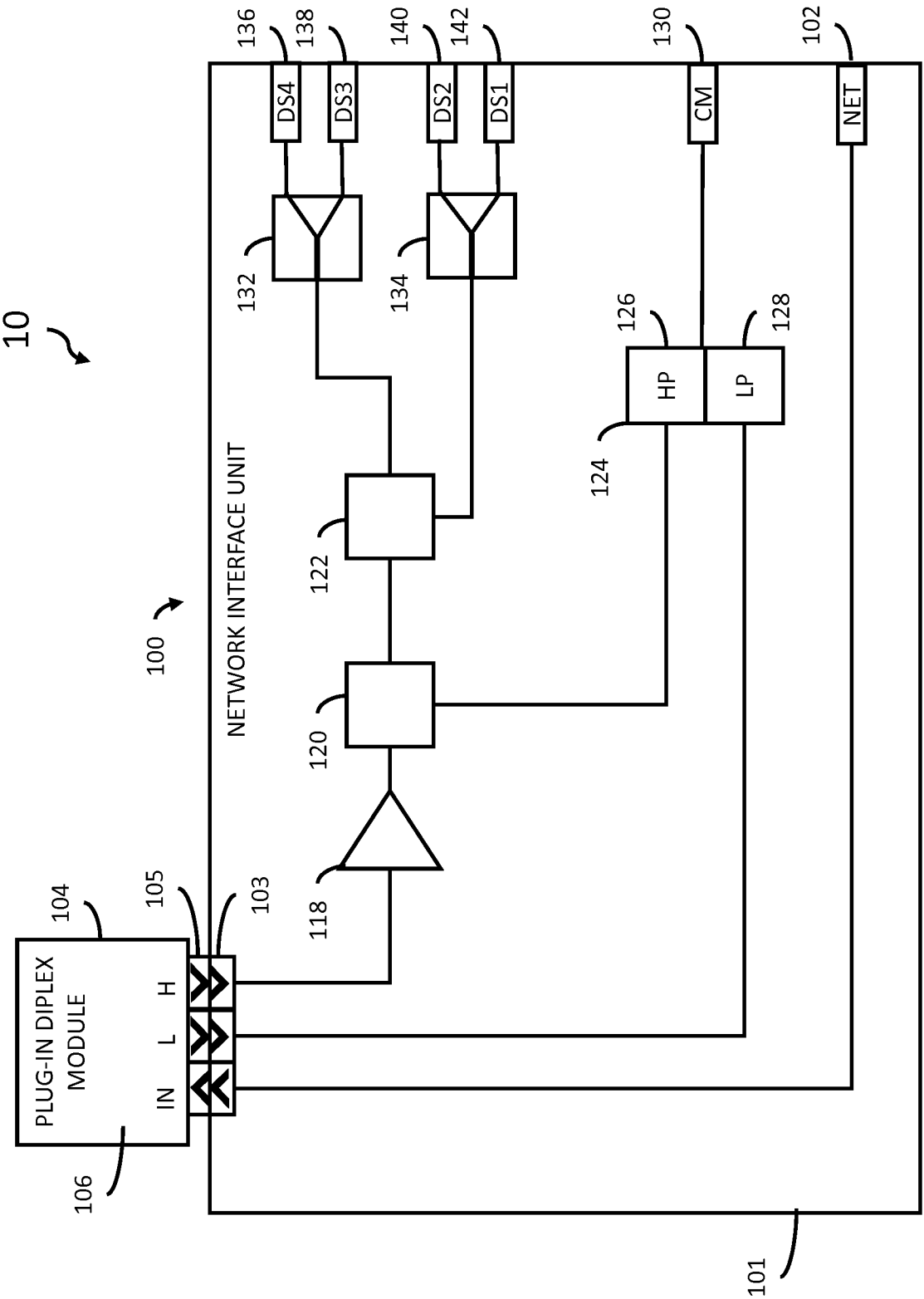


Fig. 1

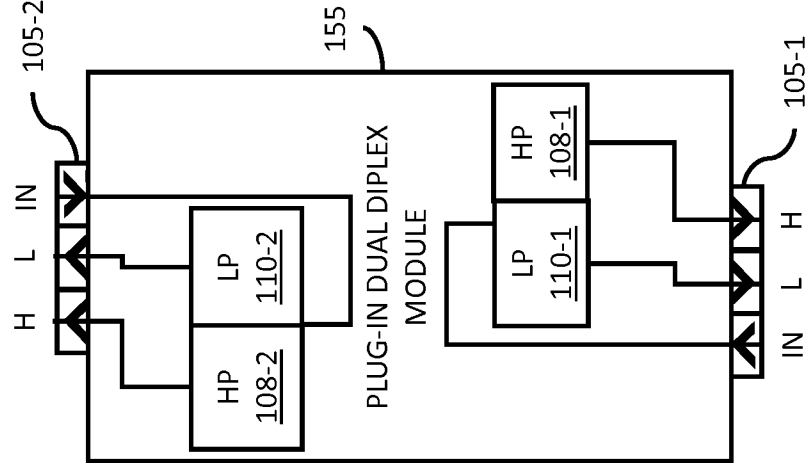


Fig. 3

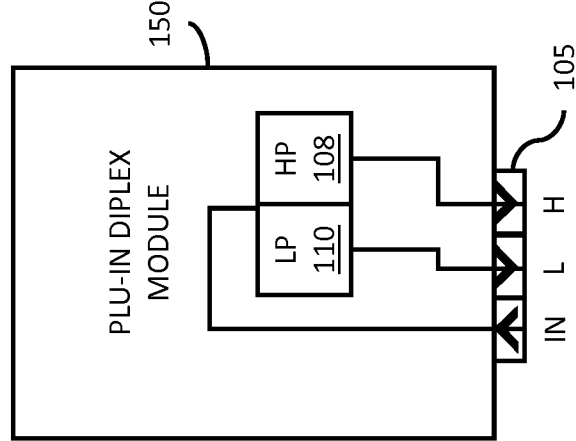


Fig. 2

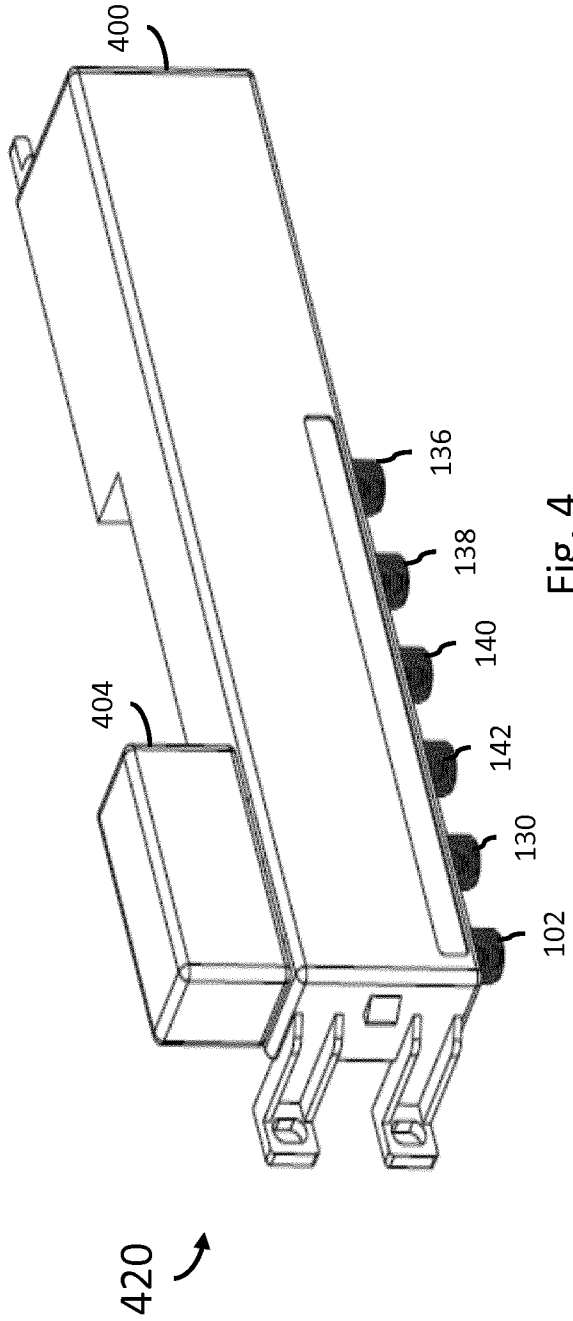
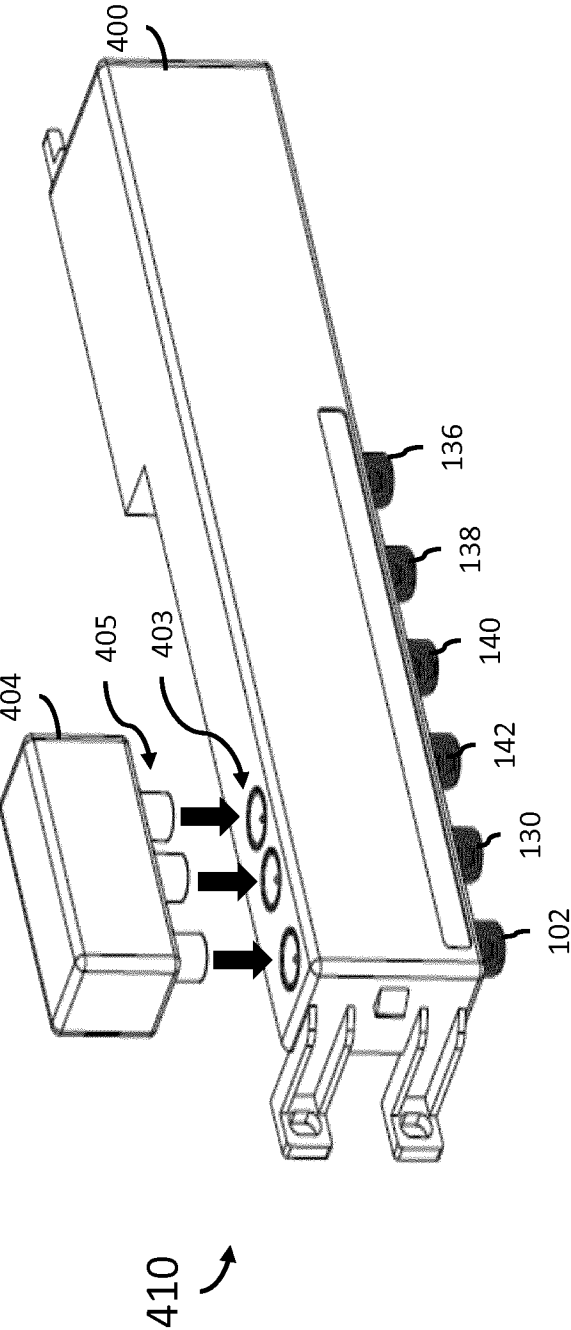


Fig. 4

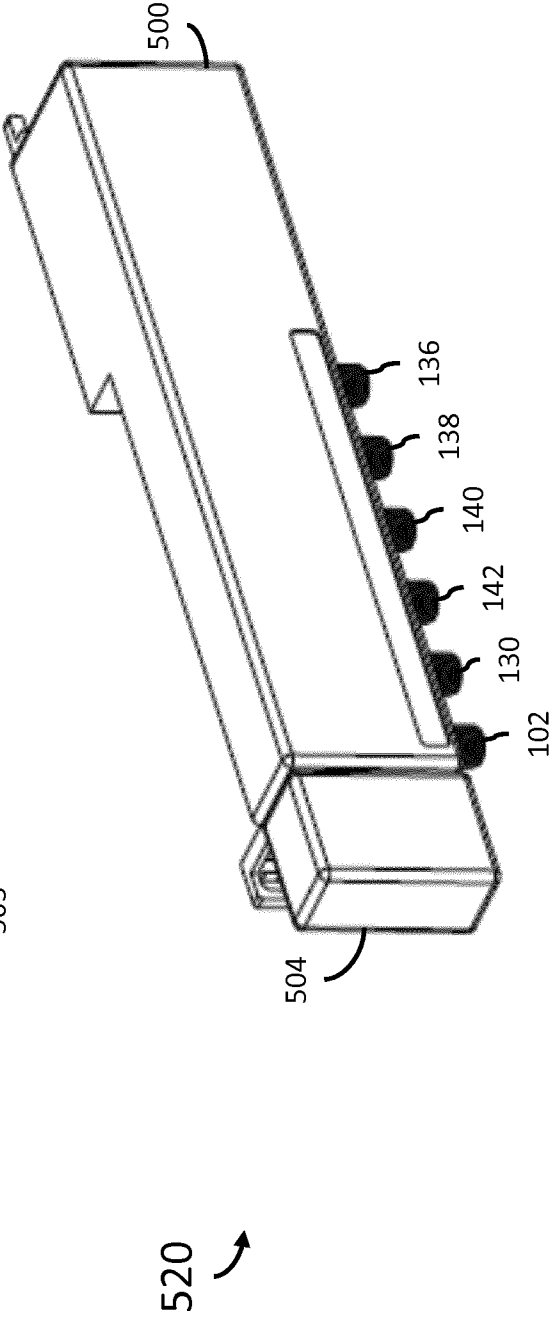
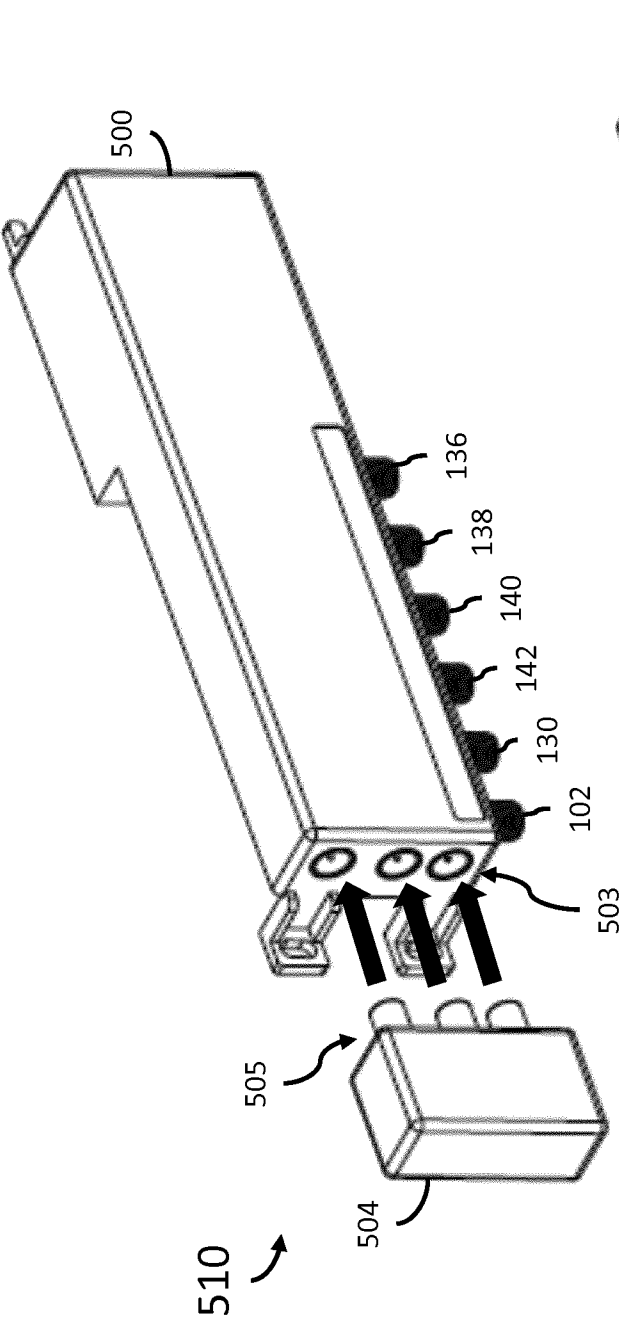


Fig. 5

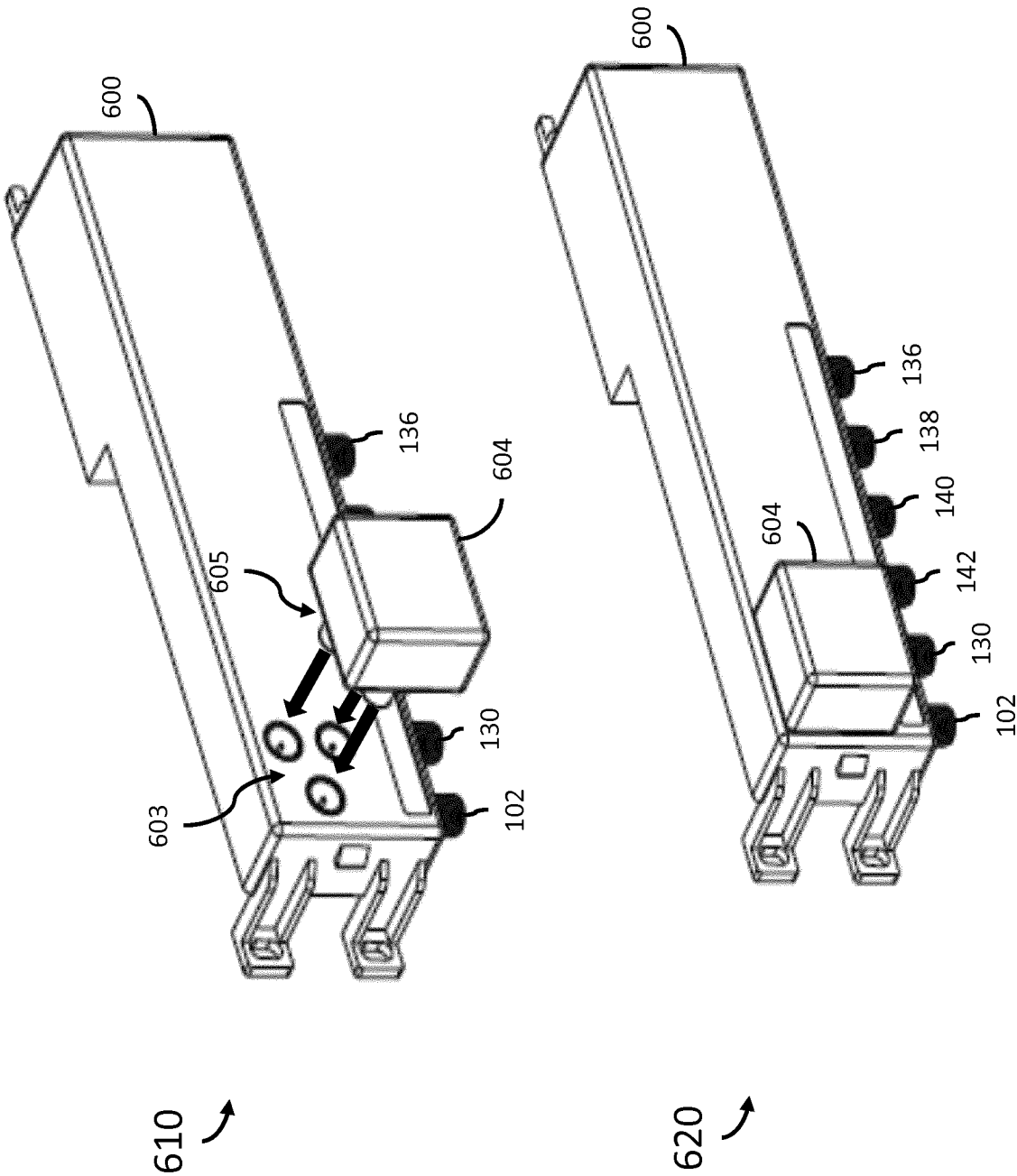


Fig. 6

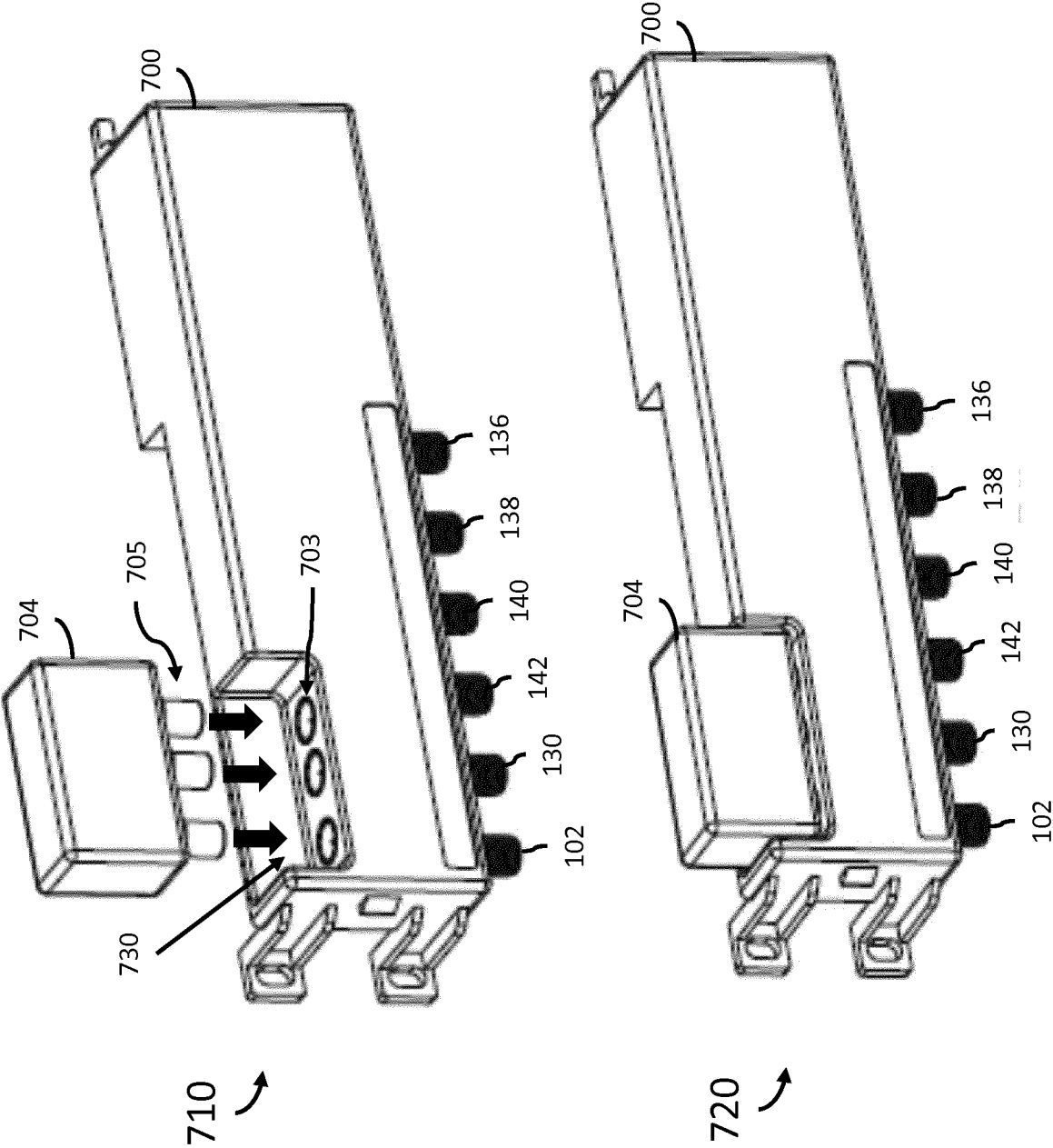


Fig. 7

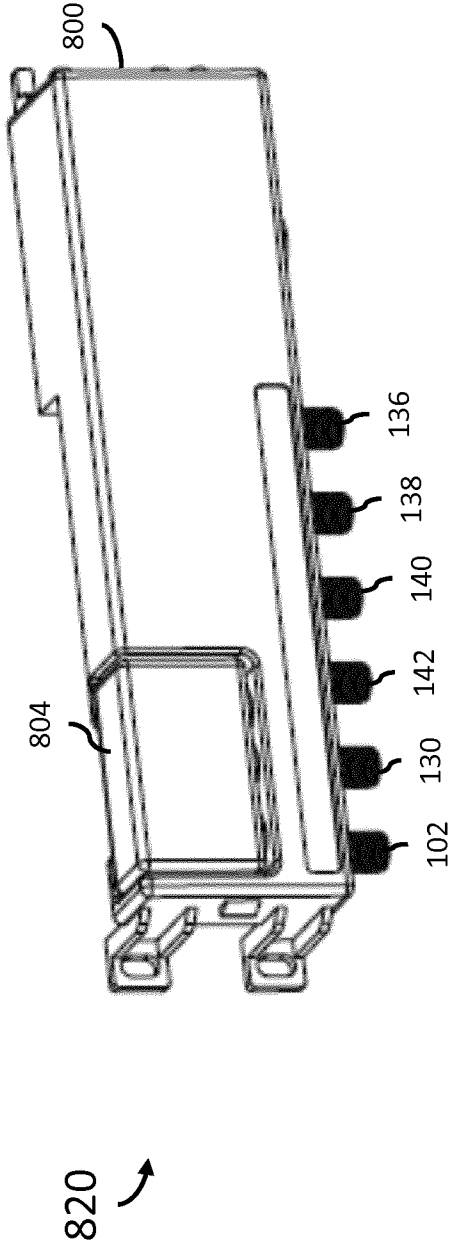
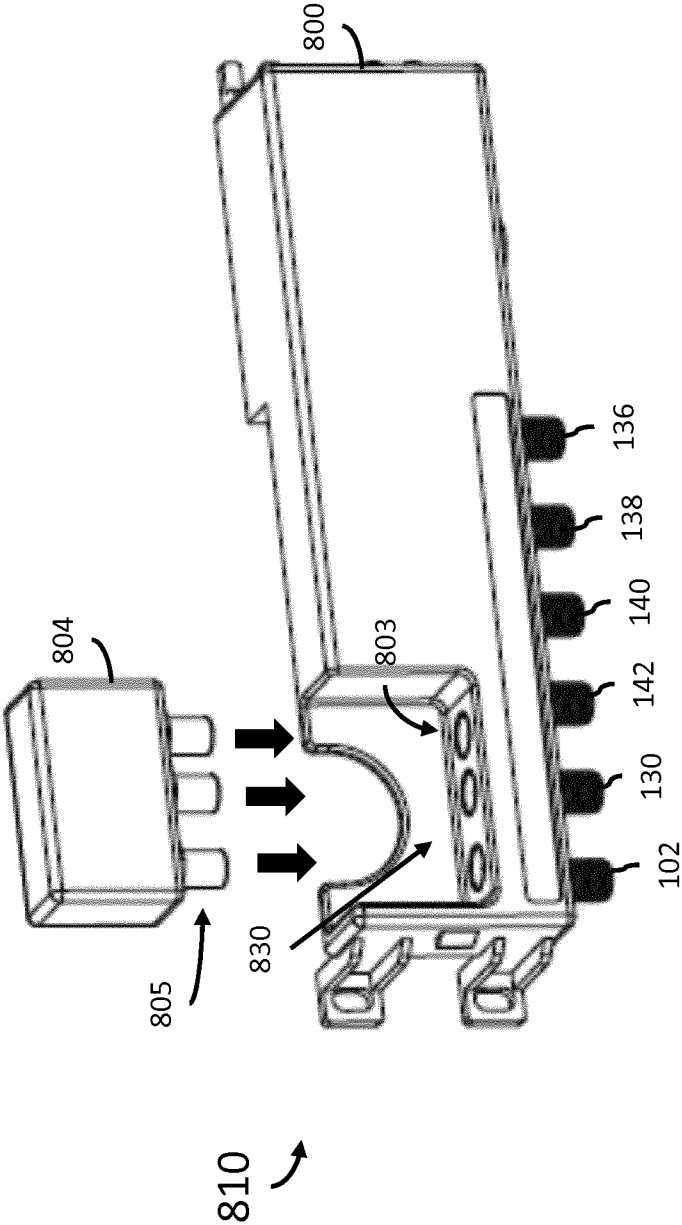
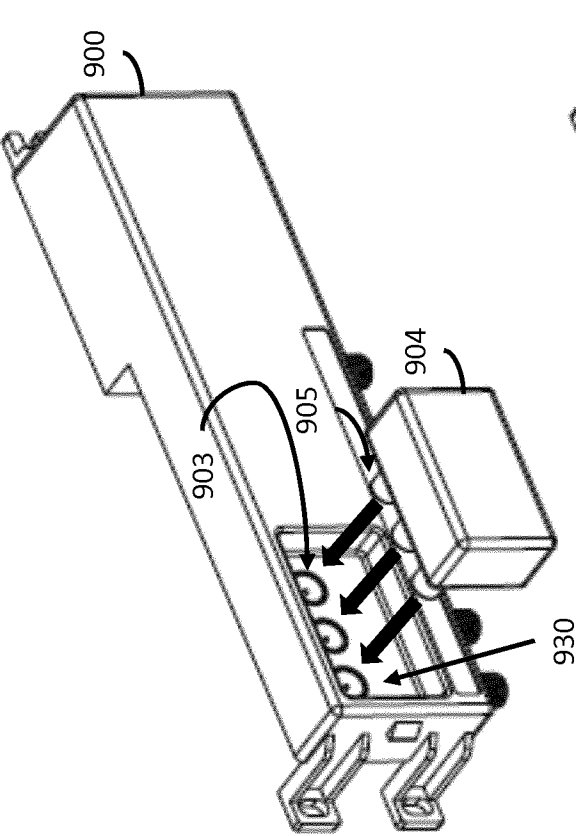
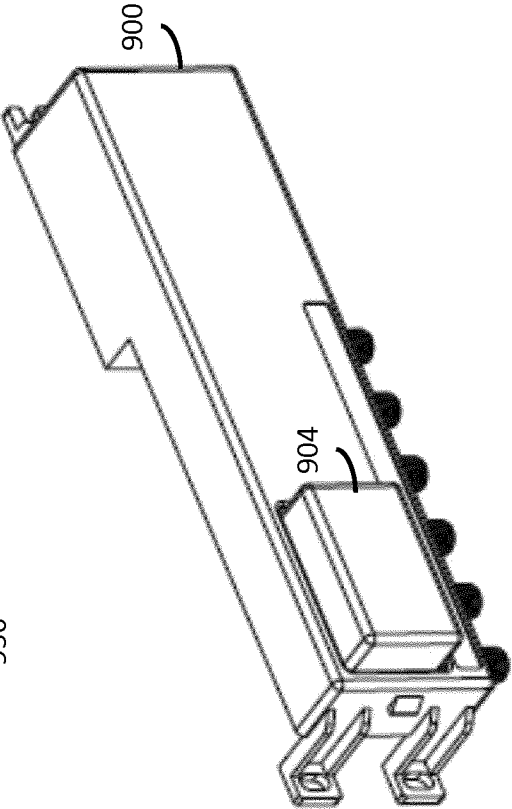


Fig. 8

Sheet 8 of 10



910 ↗



920 ↗

Fig. 9

1000 ↗

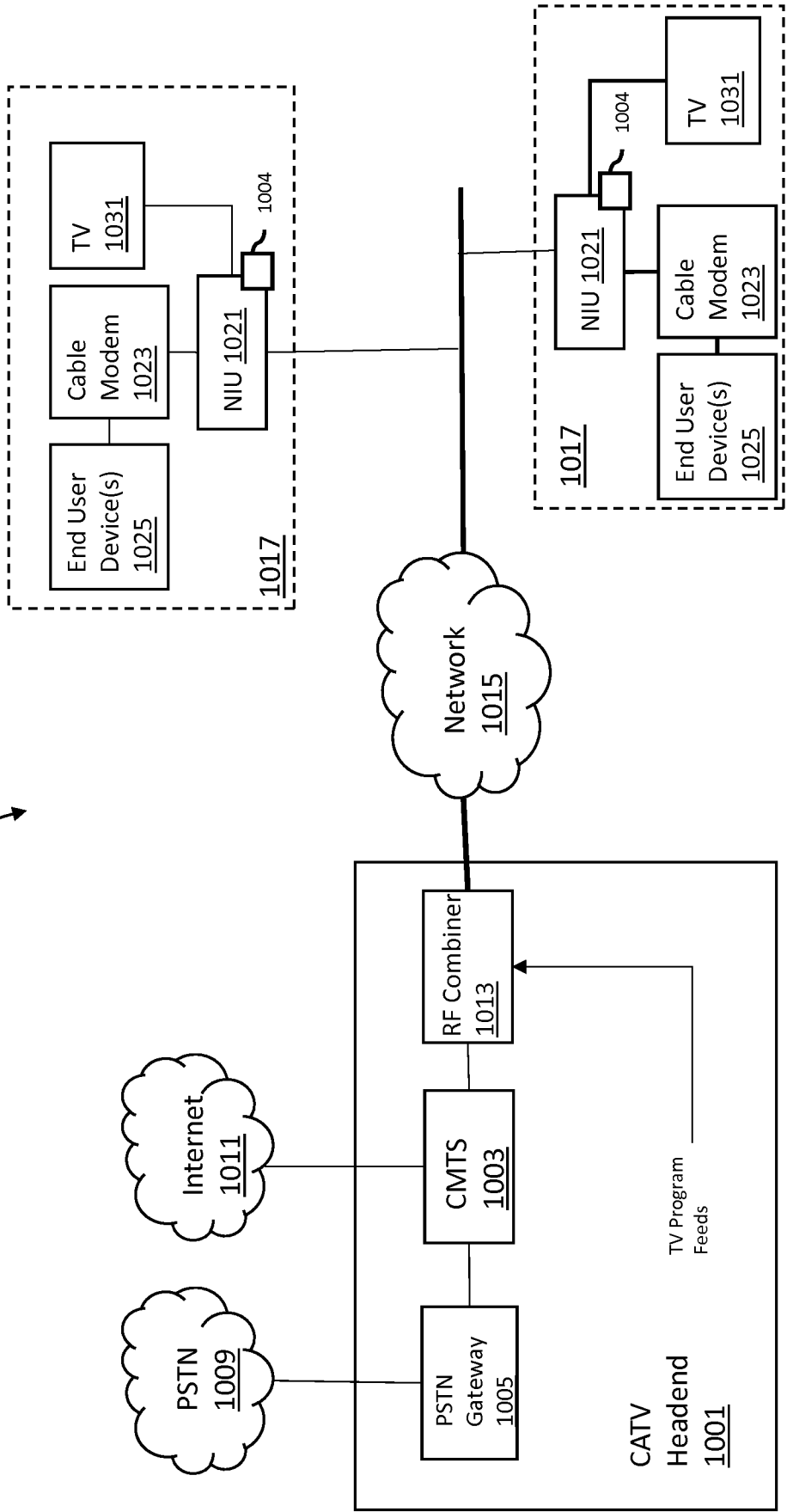


Fig. 10

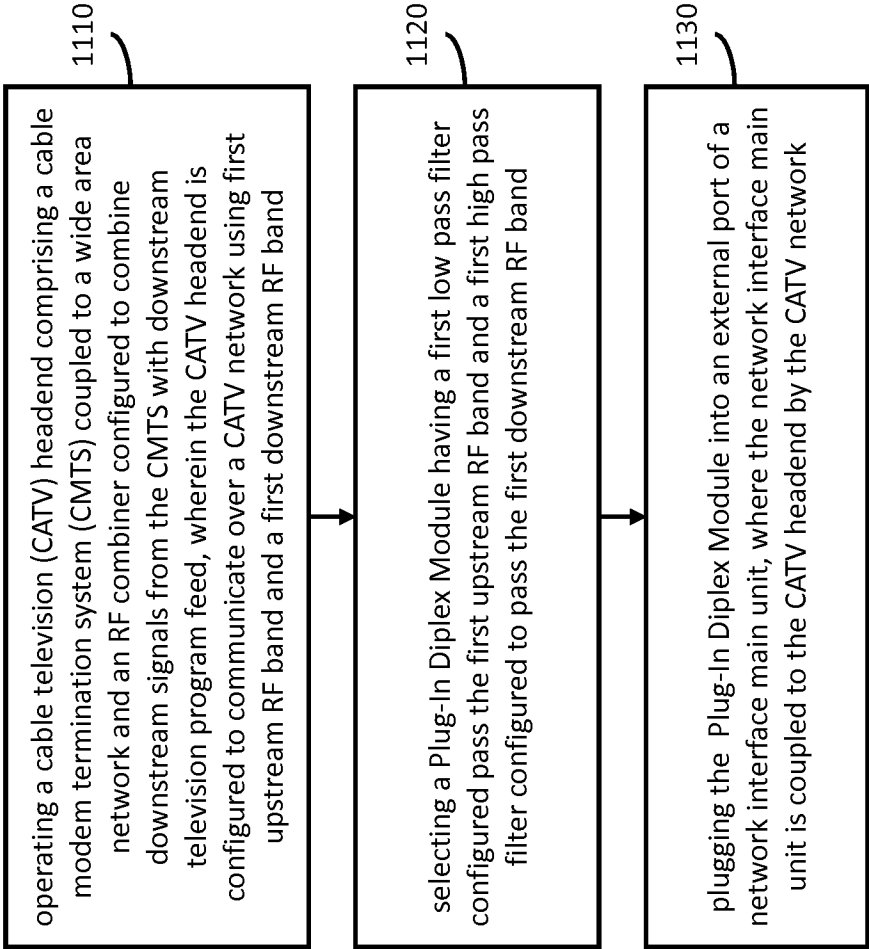


Fig. 11

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/058469

A. CLASSIFICATION OF SUBJECT MATTER		
INV.	H04N7/10 H04N21/61	H03H7/46 H03F3/62
	H04B1/00	H04L12/28
		H04N21/426
ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
H04N H03H H04B H04L H03F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	User Teleste: "ACcess Series AC800 Manual", 3 November 2006 (2006-11-03), pages 1-14, XP055272977, Retrieved from the Internet: URL: http://www.konturm.ru/catalog/paspeng/ac800_usermanual_003.pdf [retrieved on 2016-05-17] plugin diplex filter; pages 10, 13	1-40
X	----- US 6 091 301 A (VOGT STEPHAN W [US]) 18 July 2000 (2000-07-18) column 3, lines 39-46 column 4, lines 15-26 ----- -/-	1-40
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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INTERNATIONAL SEARCH REPORT

International application No
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