

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HUM INDUSTRIAL TECHNOLOGY, INC.
Petitioner

v.

AMSTED RAIL COMPANY, INC.
Patent Owner

Case IPR2023-00540
US Patent No. 10,137,915

Before JAMES P. CALVE, KEVIN W. CHERRY, and MICHAEL L. WOODS,
Administrative Patent Judges.

PETITIONER'S REPLY TO PATENT OWNER RESPONSE

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EXHIBIT LIST

Ex #	Exhibit Description
1001	U.S. Patent No. 10,137,915 (“the ’915 Patent”)
1002	Prosecution History of the ’915 Patent
1003	Expert Declaration of Steven Ricca
1004	<i>Curriculum Vitae</i> for Steven Ricca
1005	U.S. Patent Publication No. 2007/0152107 A1 to LeFebvre et al. (“LeFebvre”)
1006	U.S. Patent Publication No. 2011/0282540 A1 to Armitage et al. (“Armitage”)
1007	U.S. Patent Publication No. 2007/0208841 A1 to Barone et al. (“Barone”)
1008	U.S. Patent No. 7,706,213 to Winfree et al. (“Winfree”)
1009	Bonnie Baker, <u>Filtering? Before or After?</u> , EDN (February 20, 2003), https://www.edn.com/filtering-before-or-after/
1010	Potting and Encapsulation, Master Bond Inc., https://www.masterbond.com/applications/potting-and-encapsulation
1011	Amsted Rail Company, Inc.’s Complaint filed against Hum Industrial Technology, Inc. (ECF No. 1) filed on April 18, 2022
1012	Waiver of the Service of Summons upon Hum Industrial Technology, Inc. (ECF No. 4) dated June 14, 2022
1013	<i>Intentionally Omitted</i>
1014	<i>Intentionally Omitted</i>
1015	<i>Intentionally Omitted</i>
1016	Third Generation On-Board Monitoring and Control System Based on Controller Area Network Technology Dr. John Donelson III, et al.
1017	Defendants' Stipulation of Invalidity Contentions
1018	<i>Intentionally Omitted</i>
1019	<i>Intentionally Omitted</i>
1020	Transcript of Conference Call Before James P. Calve, Kevin W. Cherry, and Michael L. Woods (June 8, 2023)

Ex #	Exhibit Description
1021	International Heavy Haul Association Order Confirmation for Electronic Copy of 2007 Conference Proceedings (<i>Not Filed</i>)
1022	International Heavy Haul Association 2007 Conference Proceedings (<i>Not Filed</i>)
1023	June 18, 2011 Wayback Machine Web Capture of “Past Conferences” page on International Heavy Haul Association website (<i>Not Filed</i>)
1024	Declaration of Steven Ricca in support of Exhibits 1009-1010 (<i>Not Filed</i>)
1025	Expert Declaration of Steven Ricca in Support of Petitioner’s Reply
1026	MSP430F1611 Manual (Texas Instruments)
1027	MSP430FG4618 Manual (Texas Instruments)
1028	Expert Declaration of Steven Ricca in Support of Petitioner’s Opposition to Motion to Amend
1029	U.S. Patent Publication No. 2011/0231039 A1 to Leitel et al. (“Leitel”)

I. INTRODUCTION

Petitioner respectfully submits this Reply to Paper No. 15, Patent Owner's Response ("POR"), and in further support of Paper No. 1, Petition for *Inter Partes* Review of U.S. Patent No. 10,137,915 ("Petition").

Patent Owner's arguments in response to the Petition are focused on the prior art's alleged lack of disclosure of the "filtering" limitations of the claims of the '915 patent. Patent Owner's arguments, however, directly contradict the specification of the '915 patent. Specifically, the '915 patent teaches that its "digital data filter" *selects* data to be analyzed and that such "[d]ata selection can be based on, for example, direction (e.g. vertical or longitudinal components, frequency (e.g. high frequency clangs or low frequency rocking), overall magnitude (combination of 2 or 3 directional components), or other variations of the collected data." EX1001, 13:17-24. As discussed in detail below, this type of filtering is precisely what the prior art teaches.

II. CLAIM CONSTRUCTION

Patent Owner criticizes Petitioner for proposing the plain and ordinary meaning for all claims of the '915 patent, but it fails to explain how Petitioner's positions are inconsistent or incorrect, how the prior art was not applied to the plain and ordinary meaning of the claims, what it contends are the proper constructions of the "filter" limitations, or how any of the foregoing impacts the invalidity grounds

presented in the Petition. Notably, although Patent Owner criticizes Petitioner for allegedly inconsistent claim construction positions, *Patent Owner* proposed constructions for “digital filters” and “software filters” in the district court litigation while it maintains these terms require no construction in this proceeding. *Compare* EX2003 *with* Patent Owner Response, Paper No. 15 (“POR”), 2-3.

As explained in the Petition, it is unnecessary to construe any claims to determine invalidity in view of the asserted prior art, a position that Patent Owner does not dispute. Petition, Paper No. 1 (“Pet.”), 15-16; POR, 2-3. In contrast, Patent Owner’s *infringement* positions in the underlying district court litigation are inconsistent with the plain and ordinary meaning of the claim term “software filters,”¹ necessitating construction of that term for infringement purposes only.²

¹ Petitioner did not propose a construction for the term “digital filter” in district court. *See* EX2003, 26.

² Patent Owner’s cited cases are inapposite. *Ultratec, Inc. v. CaptionCall, LLC*, 872 F.3d 1267, 1273-75 (Fed. Cir. 2017) (expert’s potentially inconsistent statements unrelated to claim construction); *Google Inc. v. Intellectual Ventures II, LLC*, IPR2014-01031, Paper No. 41 (PTAB Dec. 7, 2015) (rejecting Patent Owner’s argument proposed construction should be adopted simply because Petitioner did not offer one).

Nevertheless, Petitioner’s proposed construction of “software filters” in district court is consistent with the plain and ordinary meaning of the term and Patent Owner does not argue otherwise. EX1025, ¶ 3.

III. ARGUMENT

A. Ground 1: Petitioner has shown claims 1, 1, 22, 24-25, 27-30, and 36-37 are obvious in view of Armitage and Barone

The Board correctly found Armitage in view of Barone discloses every limitation of independent claims 1, 30, and 36. Regarding the independent claims, Patent Owner only disputes that Armitage teaches the “filtering” limitation (Limitation 1(d)) and motivation to combine Armitage with the filtering of Barone.³

1. Armitage Discloses Filtering (Limitation 1(d))

Petitioner respectfully disagrees with the Board’s initial determination that Armitage does not teach “one or more filters configured to filter at least a portion of

³ Patent Owner does not provide any additional arguments for patentability of claims 21-24, 26, 27, 29, 30, 36, and 37 aside from those raised with respect to claims 1, 25, and 28. POR, 28-30, 35-38. The Petition shows by a preponderance of the evidence that all claims of the ’915 patent are invalid as obvious under Grounds 1-6 and will not repeat arguments from the Petition that Patent Owner did not address in its Patent Owner Response.

the accelerations.” The ’915 patent teaches its “digital data filter” selects certain categories of data and ignores others:

These **sensor sections select the data to be analyzed using a digital data filter** 1204, 1210 or 1216, and passes this data on to a feature detector 1206, 1212 or 1218. **Data selection can be based on, for example, direction** (e.g. vertical or longitudinal components), **frequency** (e.g. high-frequency clangs or low frequency rocking), **overall magnitude** (combination of 2 or 3 directional components), or other variations of the collected data.

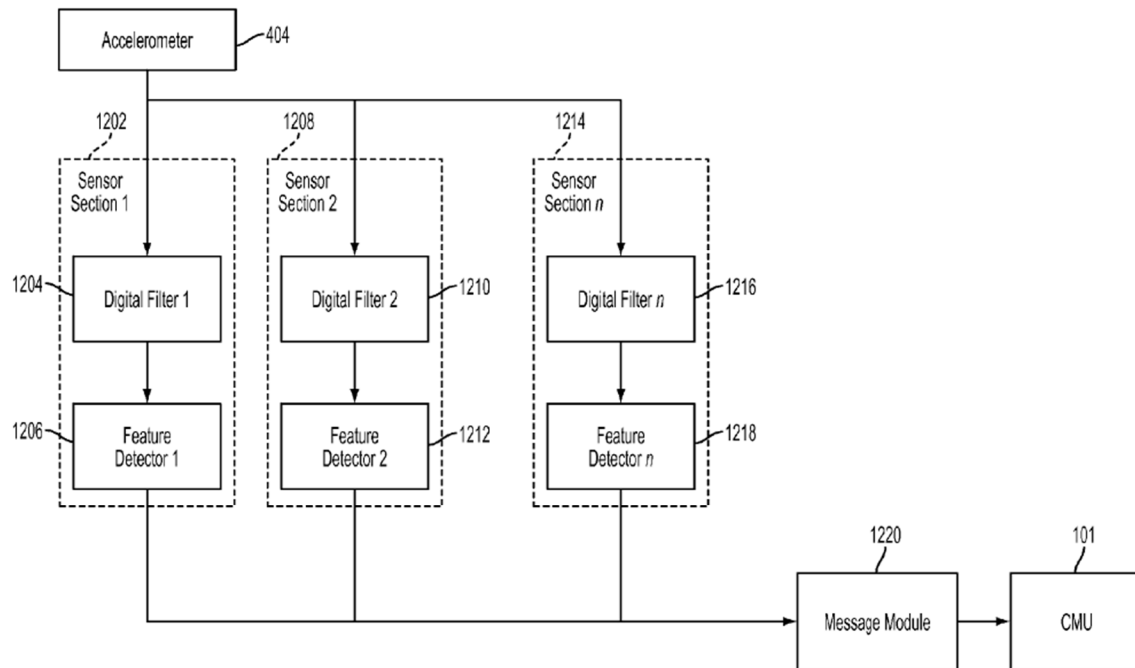


FIG. 12

EX1001, 13:17-24⁴; FIG. 12.

⁴ All emphasis added unless otherwise noted.

The '915 patent provides specific embodiments of the system illustrated in Figure 12, including one wherein the digital data filter selects data from the accelerometer along the longitudinal, lateral, and vertical axes. “One possible implementation of the analysis system of FIG. 12 is shown in FIG. 13,” wherein the “first section 1302 selects data from the longitudinal direction down the length of the railcar 103 and uses Longitudinal Section 1304 to extract longitudinal impact data,” “second section 1308 selects data from the lateral direction across the railcar 103 and uses Lateral Section 1310 to extract lateral oscillation data” and “[t]hird section 1314 selects data from the vertical direction and uses Vertical Section 1316 to extract vertical oscillation data.” EX1001, 13:36-51; FIG. 13.

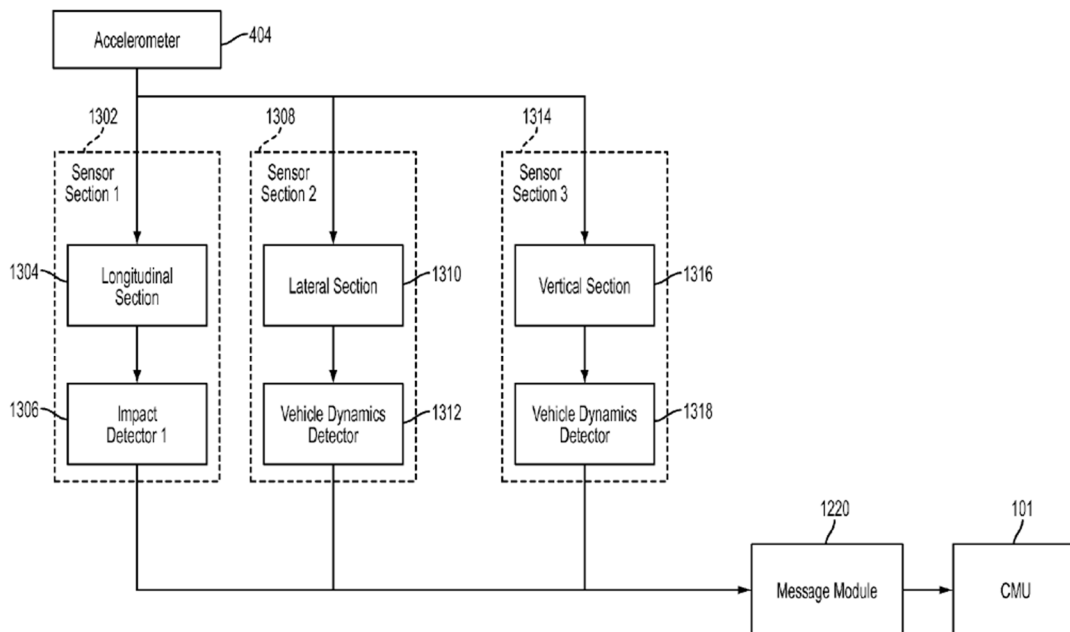


FIG. 13

EX1001, FIG. 13; *see also* EX1001, 13:57-14:9, FIG. 14 (describing another implementation of the analysis system of Figure 12 that selects data in the vertical direction to assess potential defaults).

A PHOSITA would understand the '915 patent's "digital data filter" filters data by *selection* of data along certain axes or combinations of axes measured by the accelerometer and ignoring unselected data. EX1025, ¶¶ 4-6. Armitage, too, teaches the selection of acceleration data in certain axes (i.e., horizontal x-axis, vertical y-axis, and/or axial z-axis) while ignoring data from unselected axes:

The accelerations monitored by the **3-D accelerometer** are interpreted as vibrations. **In some examples, axial vibration is monitored along a single axis, such as a z-axis aligned with the axle of a particular wheel or wheel assembly, and vibrations in other axes are ignored, such as radial axes including an x-axis aligned with the horizontal and a y-axis aligned with the vertical** with respect to the railway car or wheel. At high sampling rates of the accelerometer, the sampling only occurs for a portion of a wheel rotation, and radial acceleration or vibration (x-axis or y-axis) data could be ignored.

EX1006, ¶ [0045]; EX1025, ¶¶ 6-7; Pet. 10-11, 25-26; EX1003, ¶¶ 49, 76.

The manner in which Armitage's preferred embodiment processes the output of the three-dimensional accelerometer—selecting data corresponding to one axis and ignoring or discarding data corresponding to the other two axes—is precisely the type of filtering that is encompassed by Limitation 1(d) of the '915 patent. EX1006, ¶ [0045]; EX1025, ¶ 8. And both the '915 patent and Armitage teach why

it is beneficial to select acceleration data along only certain selected axes. For example, the '915 patent teaches accelerometer data from vertical direction is used to detect characteristic frequencies of derailment, wheel damage, and vertical impact. EX1001, 13:57-14:9; EX1025, ¶ 8. Similarly, Armitage explains why, in the context of detecting wheel damage, it is beneficial to consider only accelerations along the z-axis (“axial” accelerations), and to ignore accelerations along the x- and y-axes (“radial” accelerations):

Ignoring radial acceleration can allow for gravity and wheel balance effects to be minimized in the processing of vibration data for the wheel assemblies or wheels. Axial vibration data could still indicate wheel flat conditions, which are typically high impact, “loud” events, vibrationally.

EX1006, ¶ [0045]; EX1025, ¶¶ 8-9; Pet. 10-11, 25-26; EX1003, ¶¶ 49, 76. In other words, the '915 patent and Armitage both teach that filtering the output of a three-dimensional accelerometer to isolate vibrations from a single axis is useful to detect failure conditions, such as wheel damage, that are associated with vibrations along a single axis. *Id.*

In view of the foregoing, a PHOSITA would understand that Armitage teaches the same filtering of acceleration data performed by the “digital data filter” of the '915 patent. EX1025, ¶ 10. Accordingly, Armitage teaches the filtering of limitation 1(d) and identical limitation 30(c) and 36(d).

2. Claim 1 does not include a temporal limitation for when accelerations are filtered

Patent Owner's argument that claim 1 requires filtering *after* the data is collected is unsupported by the claim language and specification. POR, 7-8. Nothing in independent claim 1 (or independent claims 30 and 36) requires filtering accelerations *after* they are collected by the sensors. Instead, the claims simply requires "one or more filters configured to filter at least a portion of the accelerations." EX1001, Claims 1 and 36; *see also* Claim 30 ("filtering, by one or more filters, at least a portion of the accelerations"). "[T]he accelerations" of limitation 1(d) refers to "accelerations of the railcar" of limitation 1(c). *Id.* "Accelerations of the railcar" does *not* refer to "measured" accelerations as Patent Owner contends, but rather the accelerations of the railcar generally, whether measured or unmeasured. EX1001, Claims, 1, 30, and 36; EX1025, ¶ 11. Indeed, claim 1 does not claim "measured 'accelerations of the railcar'" as Patent Owner insinuates. POR, 9; *Compare* EX1001, limitation 1(c) ("one or more sensors configured to measure accelerations of the railcar") *with* limitation 1(d) ("one or more filters configured to filter at least a portion of the accelerations"). Accordingly, nothing in the claim language requires filtering of "measured" accelerations or filtering to occur before or after the acceleration data is collected. EX1001, Claims, 1, 30, and 36; EX1025, ¶ 11.

Patent Owner also argues the Board erred in finding dependent claim 26 is within the scope of claim 1, and thus claim 1 does not, in fact, encompass mechanical filtering. POR, 9. This argument is without merit. Claim 26 requires “wherein the one or more filters [of claim 1] comprise one or more mechanical filters.” Because construction of an independent claim that excludes explicitly claimed embodiments in the dependent claims is inconsistent with the plain language of the claims, the Board correctly determined mechanical filters, and thus filtration of acceleration data *before* it is collected by the sensors, are within scope of claim 1. Paper 10, 26-27 (citing *Baxalta Inc. v. Genentech, Inc.*, 972 F.3d 1341, 1346 (Fed. Cir. 2020)). Moreover, the ’915 patent explains “the analyzed signal (which is not filtered out by the mechanical filter 410 or potting material), originates with the accelerometer hardware 404 and is passed to one or more sensor sections 1202, 1208 or 1214,” which “select the data to be analyzed using a digital data filter 1204, 1210 or 1216.” EX1001, 13:13-18. The specification and plain language of the claims both indicate the claimed filtering can occur before or after acceleration data is collected by the sensors. EX1001, Claims, 1, 26, 30, and 36, 13:13-18; EX1025, ¶ 12.

To circumvent this well-established law, Patent Owner argues claim 26 contains a drafting error and should have instead recited “further comprising one or more mechanical filters.” POR, 9. This alleged “drafting” error is more than a minor or trivial typo—this is a substantive change to the claim to try to get around the prior

art. The Board should not interpret the claim as Patent Owner now suggests because “interpret[ing] the claim differently just to cure a drafting error . . . would unduly interfere with the function of claims in putting competitors on notice of the scope of the claimed invention.” *Hoganas AB v. Dresser Industries, Inc.*, 9 F.3d 948, 951 (Fed. Cir. 1993).

3. A PHOSITA Would Have Been Motivated to Combine Armitage and Barone

Patent Owner does not dispute the Board’s finding that Barone teaches filtering of accelerations data, but rather disputes the motivation to combine Armitage with the filtering of Barone.

Patent Owner accuses Petitioner of engaging in hindsight analysis based on the ’915 patent’s description of the advantages of filtering (POR, 10-14). A patent owner, however, cannot repeat a well-known advantage of a claimed feature and then proclaim it as its own novel discovery. Here, Patent Owner suggests that it discovered filters “decrease noise from unwanted acceleration frequencies and increase signals from acceleration frequencies of interest.” POR, 10 (citing EX1001, 5:40-42). But, as Mr. Ricca explained (EX1025, ¶ 13), these advantages were well-known at the time of the ’915 patent and a PHOSITA would have known, and the prior art corroborates, that it is advantageous to remove unwanted data and noise in any data analysis, and in particular acceleration frequencies, through filtering. Pet.,

26-29; EX1003, ¶¶ 78-82; EX1025, ¶ 13; EX1006, ¶¶ [0029] (recognizing noise affects sensor signals); EX1007, ¶ [0175] (noting the advantage of filtering and processing data is to “enhance the quality of data”); EX1008 at 2:25-29 (“The structure is designed and used as a filter to selectively transmit, attenuate, or amplify various frequencies of incident elastic waves that would otherwise propagate from the environment and into the sensor.”).

Nevertheless, there is no requirement that the prior art expressly teach or suggest the motivation to combine. *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1379 (Fed. Cir. 2023) (“The motivation-to-combine analysis is a flexible one.”); *see also Cross Med. Prods., Inc. v. Medtronic Sofamor Danek, Inc.*, 424 F.3d 1293, 1322 (Fed. Cir. 2005) (“[T]he motivation to combine need not be found in prior art references, but equally can be found in the knowledge generally available to one of ordinary skill in the art...” (internal quotation and citation omitted)). Indeed, “universal” motivations known in a particular field to improve technology provide “a motivation to combine prior art references *even absent any hint of suggestion* in the references themselves.” *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 797–99 (Fed. Cir. 2021) (cleaned up) (emphasis in original)). Contrary to Patent Owner’s argument, expert testimony is sufficient to demonstrate a motivation to combine. *Id.*; *Intel Corp.*, 61 F.4th at 1379.

Patent Owner also criticizes the Armitage/Barone combination for allegedly

frustrating Armitage's purpose of identifying outlier sensor data. POR, 11-12. But the '915 patent does not explain how its claimed system filters data without removing outlier data indicative of anomalous operational conditions or failures. Patent Owner cannot expect more from the prior art than what the '915 Patent teaches. *Lockwood v. Am. Airlines, Inc.*, 107 F.3d 1565, 1570 (Fed. Cir. 1997).

Patent Owner further mischaracterizes the “outliers” described in Armitage. Patent Owner points to paragraphs 30 and 40-44 of Armitage in support of its argument that modifying Armitage to add the filtering of Barone would undermine Armitage's ability to identify outlier sensor data, but these paragraphs all teach the comparison of data from a sensor unit with data from other sensor units to determine whether *the entire sensor unit* is an “outlier.” EX1006, ¶ [0042]; EX1025, ¶ 14. Patent Owner points to nothing in Armitage that requires the identification of a single data point as an “outlier” to accomplish the objective of Armitage. POR, 10-14; EX1025, ¶ 14. Armitage illustrates this further by outlining several examples of *outlier sensors* and what type of condition they may indicate. EX1006, ¶ [0042]; EX1025, ¶ 14.

Patent Owner also fails to explain why every single sensor data point is required for the various statistical analyses described in Armitage. POR, 12-14; EX1025, ¶ 15. Indeed, a PHOSITA would have understood that a single data outlier from an enormous population of data would not indicate a failure condition and

would rather result in repeated false failure conditions. EX1025, ¶ 14. Armitage expressly teaches this:

Statistically significant **deviations are derived from a series of sensor data captured over time** for one or several members of the population of sensors. Each of sensor nodes 121-124 typically measure similar conditions for the undercarriage elements even though the conditions themselves may change or trend together. Deviations from these similar conditions are monitored. **When one or more of the sensor nodes begin to deviate from the others in the population, then a failure condition could be determined.** In this example, the **deviations are not deviations of data of a single data reading** or a single undercarriage element, but instead deviations from a time series of data readings for all undercarriage elements of railway car 110.

EX1006, ¶ [0030]; Pet., 32; EX1003, ¶ 88; EX1025, ¶ 15. Patent Owner's arguments regarding standard deviations and "dynamic normalization" suffer from the same deficiencies. EX1006 at ¶¶ [0041], [0043]; EX1025, ¶ 15. Consistent with Armitage's teachings, a PHOSITA would have understood that collection, transmission, analysis, and storage of every single data point collected by sensors would be impractical, requiring higher speed communication links, a higher processing power control node, and a more powerful energy source. EX1025, ¶ 15.

Patent Owner's final argument against modifying Armitage in view of Barone mischaracterizes the argument set forth in the Petition. POR, 15-16. Petitioner referenced power savings to explained why a PHOSITA would have modified

Armitage, where filtering occurs at the CMU level (i.e., the control node), with the filtering of Barone, which occurs at the sensor level. Pet., 25-28; EX1003, ¶¶ 76-81. Namely, that a PHOSITA would have understood that data filtering could occur at any point in the system and that power consumption is an important consideration in determining where filtering should occur in a wireless system that collects and processes data in real time. Pet., 25-28; EX1003, ¶¶ 76-81; EX1025, ¶ 16. For example, filtering at the sensor level may require more power overall, while sending all the data to the CMU and filtering at the CMU level may require less power but require the transmission of more data. *Id.*

B. Ground 1: Dependent Claims 25 (Software Filter) and 28 (Digital Filter)

Petitioner agrees with Patent Owner that a software filter is a species of the digital filter genus, so to the extent Barone teaches a software filter, there can be no dispute Barone also teaches a digital filter. POR, 26; EX1025, ¶ 17.

1. Barone’s Filtering is Not Limited to Analog/Electronic Signals

Barone is not limited to filtering analog/electronic signals—it also teaches the filtering of digitized signals through digital and software filtering. Barone discloses “[t]he output of the accelerometers is *preferably* analog signals” but does not limit the sensors of its system to analog sensors. EX1007, ¶ [0175]; EX1025, ¶ 18. Indeed, none of Barone’s independent claims limit the sensor “output signal” that is analyzed

and filtered to analog/electronic signals.⁵ Barone further teaches micro-controller 177 is programmed to receive sensor data “via ... comparator 181 *and/or* analog/digital converter 183.”). EX1007, ¶ [0116], FIG. 8; EX1025, ¶ 19; Pet., 27-29; EX1003, ¶ 79-82. Barone’s micro-controller 177 uses software to process data, which requires digital signals. *Id.* Accordingly, a PHOSITA would understand that because an analog/digital convertor 183 is optional in Barone’s system, the data received and processed by the software in the micro-controller 177 may be digital in its original form (i.e., no conversion from analog to digital is necessary). *Id.*

Contrary to Patent Owner’s arguments, a PHOSITA would understand that high, low, and band pass filters (EX1007, ¶¶ [0176], [0178]) are not exclusively electronic and would recognize Barone’s pass filters are not so limited. EX1025, ¶

⁵ Dr. Shamos argues there is no need for further digital filtering in Barone because its analog signal is already filtered by the analog/electronic filter. EX2006, ¶ 70. This argument, however, is inconsistent with the ’915 patent, which teaches a combination of mechanical and digital/software filtering. EX1001, 5:35-42. Expert testimony that is inconsistent with a patent’s teachings should be disregarded. *Ericsson Inc. v. Intell. Ventures I LLC*, 890 F.3d 1336, 1346 (Fed. Cir. 2018); *Homeland Housewares, LLC v. Whirlpool Corp.*, 865 F.3d 1372, 1378 (Fed. Cir. 2017).

20. Pass filters can filter digital data (i.e., digital filter) and can use software to execute the same type of pass filtering on digital data (i.e., software filter). Pet., 27-29; EX1003, ¶¶ 79-82; EX1025, ¶ 20. As shown in Figures 7 and 8 of Barone, “node 125 also includes a low-power micro-controller 177 such as the MSP430F1611 or MSP430FG4618 sold by Texas Instruments, programmed with algorithms to determine the health of bearings through vibration and acoustic trending ...” EX1007, ¶ [0116]; FIGS. 7-8. The micro-controller 177 receives digital data output from the A/D converter 183:

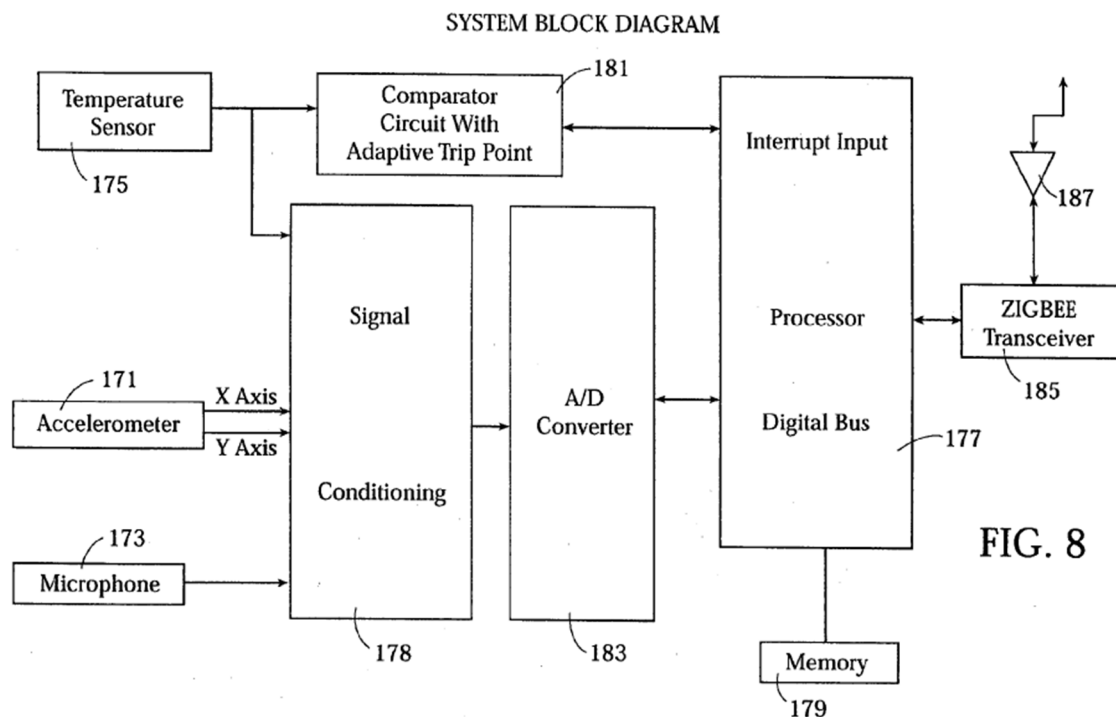


FIG. 8

Id. The Texas Instrument micro-controllers incorporated by reference in Barone as “micro-controller 177” receive digital data from the A/D Converter 183 and include

a “Low Pass Filter” that filters digital data and is controlled by software. EX1007, ¶ [0116], FIG. 8; EX1026, EX1027; EX1025, ¶¶ 20-21.

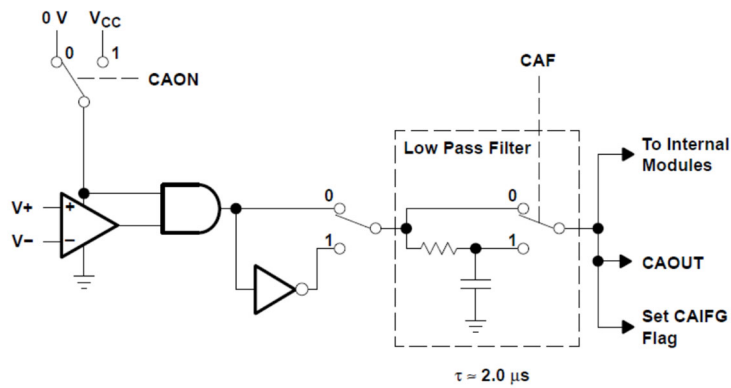


Figure 8. Block Diagram of Comparator_A Module

Figure 1. MSP430F1611 (EX1026 at Fig. 8)

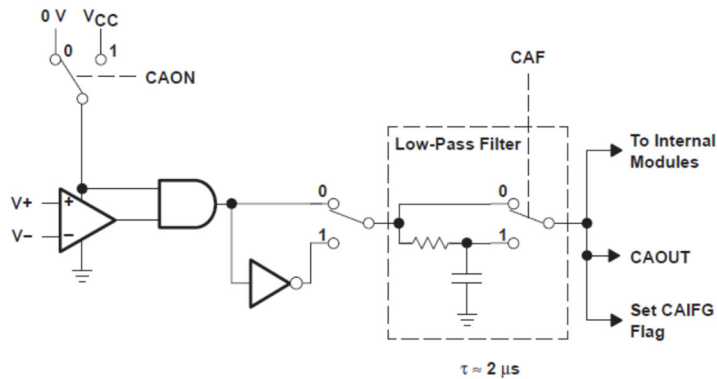
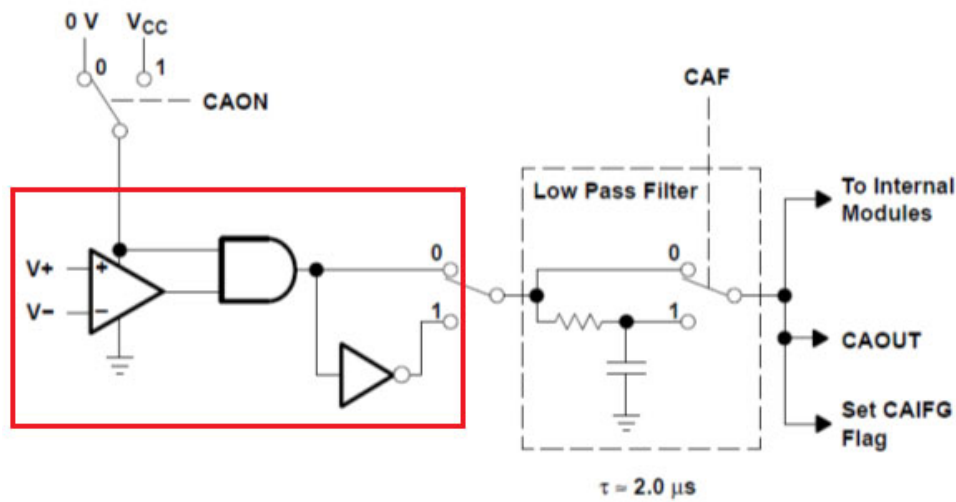


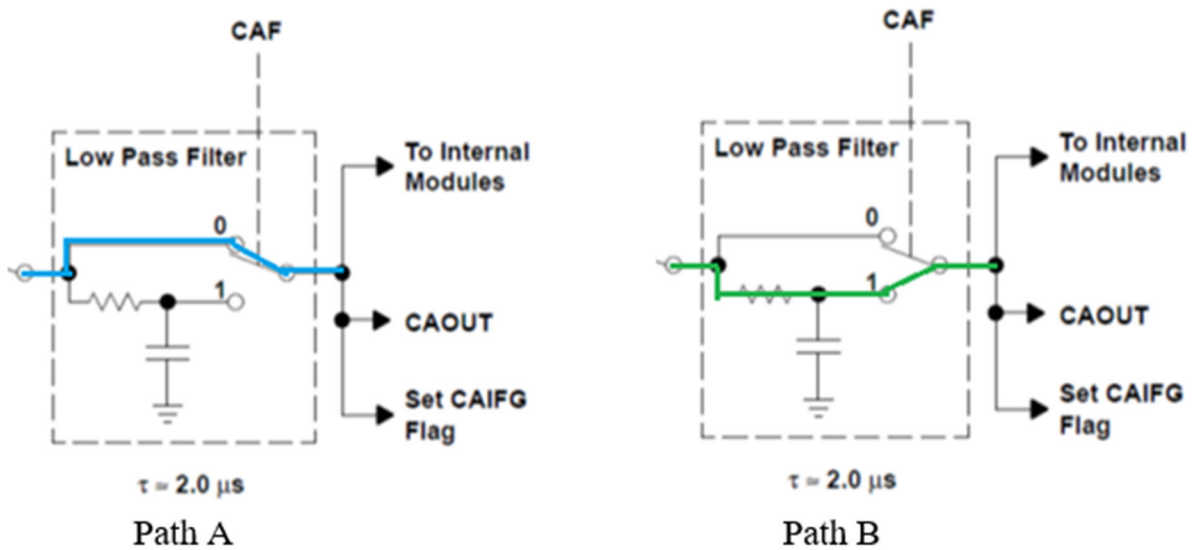
Figure 8. Block Diagram of Comparator_A Module

Figure 2. MSP430FG4618 (EX1027 at Fig. 8)

Specifically, as shown in the block diagram below, an incoming signal is passed through a series of digital logic gates and is presented to the Low-Pass Filter as a stream of digital data. EX1025, ¶ 22.



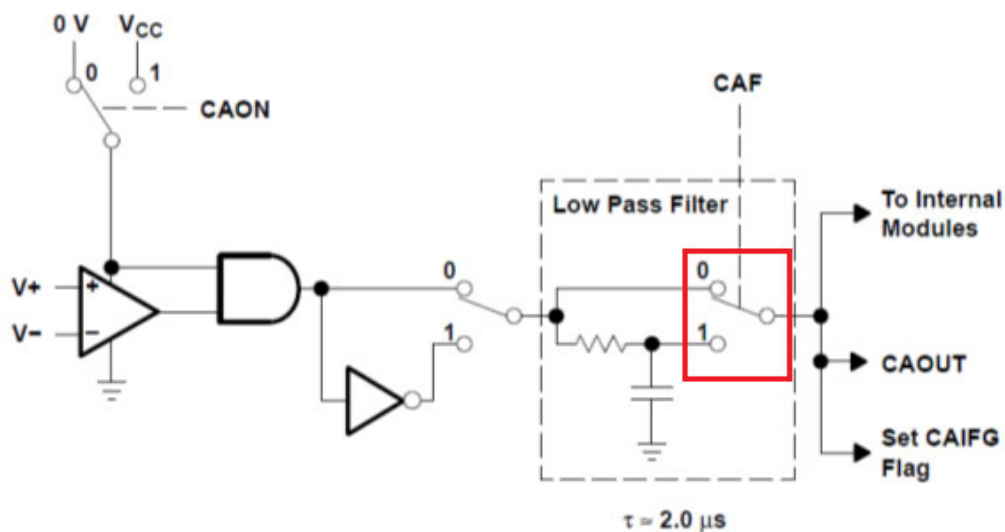
EX1026 at Fig. 8 (annotated).⁶ The digital data stream can take two potential paths through the Low-Pass Filter—Path A (marked in blue) and Path B (marked in green):



EX1026 at Fig. 8 (annotated); EX1025, ¶ 23. On Path A, the digital data is passed through the filter unchanged. *Id.* On Path B, the digital data is filtered. *Id.* Software

⁶ Fig. 8 in both EX1026 and EX1027 are identical, so citations are made only to Fig. 8 of EX1026.

running on the microcontroller determines which path is used at any given moment, which is indicated in the diagram by the switch (outlined in red below), where “0” enables Path A and “1” enables Path B. *Id.*



EX1026 at Fig. 8 (annotated); EX1025, ¶¶ 24-25. The Low-Pass Filter is configured to ignore changes in the digital signal (i.e., transitions from 0→1 or from 1→0) that occur more frequently than 2 microseconds. *Id.* The output of the microcontroller is a filtered digital data stream that can be passed to one or more downstream components of the system. *Id.*

Barone discloses a digital band-pass filter in the same paragraphs that Patent Owner cites to argue Barone does not have a digital filter. POR, 22-23. “[T]he discrete Fourier transform is further used to derive data values corresponding to the presence in the data samples of twenty (20) lines of frequencies in steps of 0.5 to 1 Hz *above and below the above-defined defect frequencies* and their harmonic

overtones, i.e., ± 0.5 or 1 Hz to 10 to 20 Hz of the identified exemplary frequencies. It may be noted that the *range of frequencies* is preferably enough to allow analysis of the defect frequency *plus and minus* the wheel rotation frequency.” EX1007, ¶ [0221]; EX1025, ¶ 26. Barone notes the band-pass filter is executed by software (i.e., software filter). EX1007, ¶ [0222]; EX1025, ¶ 26.

Barone therefore teaches both software and digital filters and as set forth in the Petition, a PHOSITA would have been motivated to modify the system of Armitage to include the filtering of Barone to remove unwanted data and noise, amplify particularly relevant data, and ensure “clean” data is analyzed to accurately detect fault conditions. EX1025, ¶ 27.

2. Patent Owner Mischaracterizes Barone’s Disclosure

Patent Owner’s mischaracterization of Barone—that “there is no need to filter the digitized signal and Barone explicitly acknowledges the same” (POR, 22)—is contradicted by the very paragraph Patent Owner cites. Barone explains that *in one specific type of signal conditioning*, there is no aliasing problem and filtering may not be required. EX1007, ¶ [0234]; EX1025, ¶ 28. Barone further describes filtering of the same signal—“the output of the conditioning circuit *is filtered for frequencies below about 290 or 300 Hz.*” *Id.* This is a digital pass filter. *Id.* Ultimately, at the time of the invention it was common knowledge to a PHOSITA that various filtering methodologies, including software filtering and digital filtering, were advantageous

to ensure the accuracy of data readings and correctly predict anomalous conditions of a railcar. Pet., 29, 57; EX1003, ¶¶ 81, 162; EX1025, ¶ 29.

C. Ground 4: Petitioner has shown Claims 1, 21-22, 25, 27-30, and 36-37 are obvious in view of LeFebvre and Barone⁷

Patent Owner does not dispute that LeFebvre and Barone disclose most limitations of the challenged independent claims, and only challenges the filtering limitation and motivation to combine LeFebvre with the filtering of Barone.

1. LeFebvre Discloses Filtering (Limitation 1(d))

As explained in the Petition, LeFebvre teaches filtering of acceleration data as that term is used in the '915 patent. Pet., 54-55; EX1005, ¶¶ [0034]-[0036], [0053]; EX1003, ¶¶ 156-157; EX1025, ¶ 30.

[T]he *burden of transmitting all the data that might be sampled* in performing such monitoring is extremely large and, for the most part, *detailed data is not significant*. Preferably, only the observations which imply some fault or misbehavior are recognized. To *reduce the radio traffic* to manageable proportions, the system is designed to process the raw sensor data, looking for signs of trouble and then *send only essential indicative information*.

⁷ Patent Owner does not provide any additional arguments for patentability of claims 21-24, 26, 27, 29, 30, 36, and 37 aside from those raised with respect to claims 1 and 25.

EX1005 at ¶ [0053]; EX1025, ¶ 30. The '915 patent similarly describes filtering by the selection of particularly relevant data for analysis—"sensor sections select the data to be analyzed using digital data filter 1204, 1210 or 1216" and "[d]ata selection can be based on, for example, direction (e.g. vertical or longitudinal components), frequency (e.g. high-frequency clangs or low frequency rocking), overall magnitude (combination of 2 or 3 directional components), or other variations of the collected data." EX1001, 13:17-24; *see also* 13:57-14:9 (describing the use of various filters to identify and extract specific types of data "characteristic" of certain fault conditions to streamline information sent to the CMU); EX1025, ¶ 30.⁸ LeFebvre emphasizes reducing the amount of data sent to the control node, citing cost and volume reasons, and noting the system is purposefully "designed to be tolerant of missing data." EX1005, ¶¶ [0010], [0095]-[0096]; *see also* Pet., 54-55; EX1005, ¶¶ [0034]-[0036], [0053]; EX1003, ¶¶ 156-157; EX1025, ¶ 31. A PHOSITA would

⁸ In support of his opinion that LeFebvre's transmission of "only essential indicative information" is not filtering, Dr. Shamos states the "selective transmission of data" is not filtering. The '915 patent, however, teaches its "digital data filter" "selects the data to be analyzed," including the selection of data in certain axial directions from a triaxial accelerometer. EX2006, ¶ 88; EX1001, 13:11-14:9, FIGS. 13-14.

have understood this disclosure underscores the advantages of data filtering, i.e., “data selection.” EX1025, ¶ 31.

2. A PHOSITA Would Have Been Motivated to Combine LeFebvre with the Filtering of Barone

Patent Owner’s arguments against modification of LeFebvre in view of Barone are generally the same as those asserted in opposition to Ground 1 and are equally unavailing with respect to Ground 4. *See* Section III.A.3, *supra*.

Similar to its unsupported arguments with respect to the Armitage grounds, Patent Owner argues for a solution to the alleged problems in the prior art that the ’915 patent does not even address. Specifically, Patent Owner’s argument that modifying LeFebvre in view of Barone’s filtering would frustrate LeFebvre’s purpose of detecting alarm conditions is the same “outlier” argument with respect to Armitage. But the ’915 patent, also directed to detection of fault conditions on railcars, does not explain how its filtering does not result in the same problem. *See* Section III.A.3, *supra*; EX1025, ¶ 32.

IV. CONCLUSION

Therefore, Patent Owner has failed to refute the persuasive arguments that instituted *inter partes* review, and all challenged claims of the ’915 Patent are invalid.

Case No. IPR2023-00540
US Patent No. 10,137,915

Respectfully submitted,

Dated: January 26, 2024

By: /Daisy Manning/
Eric J. Rakestraw, Reg. No. 68,740
Daisy Manning, Reg. No. 66,369
HUSCH BLACKWELL LLP
8001 Forsyth Boulevard, Suite 1500
St. Louis, MO 63105
(314) 480-1500 Telephone
(314) 480-1505 Facsimile
PTAB-ERakestraw@huschblackwell.com
PTAB-DManning@huschblackwell.com

Andrea L. Shoffstall, Reg. No. 75,426
HUSCH BLACKWELL LLP
1801 Wewatta Street, Suite 1000
Denver, CO 80202
303.749.7200 Telephone
303.749.7272 Facsimile
PTAB-AShoffstall@huschblackwell.com

Attorneys for Petitioner

CERTIFICATE OF WORD COUNT

The undersigned certifies pursuant to 37 C.F.R. § 42.24(d) that the foregoing document includes, as indicated by the word count of the word-processing system used to prepare the document (excluding the Cover, Table of Contents, Table of Authorities, Table of Exhibits, signatures, and Certificates of Service and Word Count), fewer than 5,600 words and specifically includes 4,552 words.

Respectfully submitted,

Dated: January 26, 2024

By: /Daisy Manning/
Daisy Manning, Reg. No. 66,369
Counsel for Petitioner

CERTIFICATE OF SERVICE

I hereby certify that on this 26th day of January 2024, the foregoing was served via electronic mail to the attorneys of record for the '915 Patent at the following address:

Jeff E. Schwartz Reg. No. 39,019 Fox Rothschild LLP 2020 K Street N.W., Suite 500 Washington, DC 20006 Tel: 202.696.1470 Fax: 202.461.3102 Email: jeschwartz@foxrothschild.com	Gary A. Hecht Reg. No. 36,826 Fox Rothschild LLP 2000 Market Street, 20th Floor Philadelphia, PA 19103-3222 Tel: 215.299.2416 Fax: 215.299.2150 Email: ghecht@foxrothschild.com
P. Marshall Ticer Reg. No. 74,653 Fox Rothschild LLP 2020 K Street N.W., Suite 500 Washington, DC 20006 Tel: 202.794.1237 Fax: 202.461.3102 Email: mticer@foxrothschild.com	Ryan North Miller Reg. No. 68,262 Fox Rothschild LLP 2000 Market Street, 20th Floor Philadelphia, PA 19103-3222 Tel: 215.299.2901 Fax: 215.299.2150 Email: rmiller@foxrothschild.com

By: /Daisy Manning/
Daisy Manning, Reg. No. 66,369
Counsel for Petitioner