

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GOOGLE LLC

Petitioner

v.

ECOFACTOR, INC.

(record) Patent Owner

Patent No. 11,835,394

IPR2025-00097

**PETITION FOR INTER PARTES REVIEW
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 ET. SEQ**

TABLE OF CONTENTS

I.	INTRODUCTION	10
A.	'394 Patent Disclosure	10
B.	Patent Family	10
C.	Prosecution History of the '394 Patent	11
D.	Collateral Estoppel Applies	12
E.	Claim Construction	13
II.	DETAILED EXPLANATION OF THE REASONS FOR UNPATENTABILITY	14
Ground 1.	Claims 1-3, 5, 10-12, and 14 are obvious over Hildebrand in view of Shah.....	14
A.	Effective Prior Art Date	14
B.	Overview of the Ground	15
1.	Overview of Hildebrand	15
2.	Overview of Shah	17
C.	Motivation (Rationale) Supporting Obviousness	18
1.	Shah's Thermal Time Constant as Operating Profile/Operational Efficiency	18
2.	Database	20
3.	Shah's Thermostat	21
D.	<i>Graham</i> Factors.....	22
E.	Reasonable Expectation of Success	23
F.	Analogous Art	24
G.	Claim Mapping	24

Ground 2. Claims 1-5, and 10-14 are obvious over Hildebrand and Shah in view of Rosen.....	53
A. Effective Prior Art Date of Rosen.....	53
B. Overview of the Ground	54
C. Motivation (Rationale) Supporting Obviousness	54
D. Reasonable Expectation of Success	56
E. Analogous Art	56
F. Claim Mapping	56
Ground 3. Claims 1-3, 5-6, 10-12, and 14-15 are obvious over Hildebrand and Shah in view of Van Ostrand.	59
A. Effective Prior Art Date of Van Ostrand	59
B. Overview of the Ground	59
1. Overview of Van Ostrand	60
C. Motivation (Rationale) for the Combination	62
D. Reasonable Expectation of Success	63
E. Analogous Art	63
F. Claim Mapping	64
Ground 4. Claims 1-6 and 10-15 are obvious over Hildebrand, Shah, Rosen and Van Ostrand.....	71
Ground 5. Claims 7-9 and 16-18 are obvious over Hildebrand, Shah, Rosen, and Van Ostrand, further in view of McNulty	72
A. Effective Prior Art Date of McNulty	72
B. Overview of the Ground and Motivation (Rationale) for the Combination.....	72
C. Overview of McNulty	73

D.	Reasonable Expectation of Success	73
E.	Analogous Art	74
F.	Claim Mapping	74
III.	No Discretionary denial	80
IV.	CONCLUSION.....	81

TABLE OF EXHIBITS

Exhibit No.	Description
1001	U.S. Patent No. 11,835,394 (“ the ’394 patent ”).
1002	Declaration of Rajendra Shah.
1003	C.V. of Rajendra Shah.
1004	U.S. Patent No. 5,729,474 (“ Hildebrand ”).
1005	U.S. Pat. App. Pub. 2005/0171645 A1 (“ Oswald ”).
1006	U.S. Patent No. 5,555,927 (“ Shah ”).
1007	U.S. Pat. App. Pub. 2005/0159846 A1 (“ Van Ostrand ”).
1008	U.S. Patent No. 6,216,956 (“ Ehlers ”).
1009	U.S. Patent No. 6,789,739 (“ Rosen ”).
1010	Public Copy of Initial Determination in <i>Smart HVAC Systems, and Components Thereof</i> 337-TA-1185 (ITC).
1011	File History of U.S. App. Ser. No. 18/104,767 (“ the ’767 Application ”).
1012	U.S. Pat. App. Pub. US 2004/0117330 A1 (“ Ehlers ’330 ”).
1013	Chart of Prior Determinations Involving Related Patents.
1014	List of Prior Proceedings.
1015	U.S. Patent No. 8,423,322 (“ the ’322 patent ”).
1016	U.S. Patent No. 8,019,567 (“ the ’567 patent ”).
1017	IPR2021-01218, Paper 2 (Petition).
1018	IPR2021-01218, Paper 22 (Final Written Decision).

1019	Request for Reexamination of U.S. Patent No. 8,423,322, dated August 4, 2022 in Reexamination App. No. 90/015,086.
1020	Non-Final Action dated February 7, 2023 in Reexamination App. No. 90/015,086.
1021	Reexamination Certificate dated August 23, 2023 in Reexamination App. No. 90/015,086.
1022	U.S. Patent No. 5,934,554 (“ Charles ”).
1023	U.S. Patent No. 6,029,092 (“ Stein ”).
1024	U.S. Pat. App. Pub. 2011/0251726 (“ McNulty ”).
1025	EcoFactor Opposition to Motion to Dismiss, <i>EcoFactor, Inc. v. Google LLC</i> , No. 4:24-cv-00175 (N.D. Cal. Apr. 23, 2024).
1026	EcoFactor Complaint, <i>EcoFactor, Inc. v. Google LLC</i> , No. 5:24-cv-00175 (N.D. Cal. Jan. 9, 2024).
1027	EcoFactor Complaint, Ex. 2 (Claim Chart), <i>EcoFactor, Inc. v. Google LLC</i> , No. 5:24-cv-00175 (N.D. Cal. Jan. 9, 2024).
1028	Public Copy of Commission Opinion in <i>Smart HVAC Systems, and Components Thereof</i> 337-TA-1185 (ITC).
1029	File History of U.S. App. Ser. No. 17/700,409.
1030	File History of U.S. App. Ser. No. 16/806,779.
1031	File History of U.S. App. Ser. No. 15/905,251.
1032	Case Schedule in <i>EcoFactor, Inc. v. Google LLC</i> , Case No. 4:24-cv-00175 (N.D. Cal. June 25, 2024).
1033	Transcript of July 8, 2022 deposition of Dr. John Palmer in IPR2021-01218.
1034	Claim Construction Order in Certain <i>Smart Thermostat Systems, Smart HVAC Systems, Smart HVAC Control Systems and Components Thereof</i> 337-TA-1258 (ITC).

1035	Public Copy of Commission Opinion in Certain <i>Smart Thermostat Systems, Smart HVAC Systems, Smart HVAC Control Systems and Components Thereof</i> 337-TA-1258 (ITC).
1036	<i>Google LLC v. EcoFactor, Inc.</i> , No. 23-1757 (Fed. Cir. July 15, 2024)
1037	Joint Claim Construction Statement in <i>EcoFactor, Inc. v. Google LLC</i> , Case No. 4:24-cv-00175 (N.D. Cal. October 22, 2024).
1038	PCT Application Publication WO2007/128783 A1

Petitioner respectfully requests *inter partes* review under 35 U.S.C. § 311 of claims 1-18 of U.S. Pat. No. 11,835,394 (“’394 Patent”).

NOTICE OF LEAD AND BACKUP COUNSEL

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NOTICE OF THE REAL-PARTIES-IN-INTEREST

The real-party-in-interest for this petition is Google LLC (“Google”).

NOTICE OF RELATED MATTERS

The ’394 patent is currently at-issue in the following litigation:

- *EcoFactor, Inc. v. Google LLC*, Case No. 4-24-cv-00175 (N.D. Cal.).

Proceedings that are relevant to the present proceeding are detailed in Exhibit 1013.

NOTICE OF SERVICE INFORMATION

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GROUND FOR STANDING

Petitioner hereby certifies that the patent for which review is sought is available for *inter partes* review, and that the Petitioner is not barred or estopped from requesting an *inter partes* review on the grounds identified in the petition.

STATEMENT OF PRECISE RELIEF REQUESTED

Petitioner respectfully requests that claims 1-18 of the '394 patent be canceled based on the following:

Ground 1: Claims 1-3, 5, 10-12, and 14 are obvious over Hildebrand in view of Shah.

Ground 2: Claims 1-5 and 10-14 are obvious over Hildebrand in view of Shah, further in view of Rosen.

Ground 3: Claims 1-3, 5-6, 10-12, and 14-15 are obvious over Hildebrand in view of Shah, further in view of Van Ostrand.

Ground 4: Claims 1-6 and 10-15 are obvious over Hildebrand, Shah, Rosen and Van Ostrand.

Ground 5: Claims 7-9 and 16-18 are obvious over Hildebrand, Shah, Rosen and Van Ostrand, further in view of McNulty.

THRESHOLD REQUIREMENT FOR INTER PARTES REVIEW

This petition presents “a reasonable likelihood that the Petitioner would prevail with respect to at least one of the claims challenged in the petition,” 35 U.S.C. § 314(a), as shown in the Grounds below.

I. INTRODUCTION

A. '394 Patent Disclosure

The '394 Patent relates to HVAC systems and thermostats, having an internal temperature sensor and allowing a user to set a target temperature, or “setpoint.” (Ex. 1001, Abstract, 1:48-65)(Ex. 1002, ¶¶34-37). The thermostat compares the setpoint to the actual temperature, and switches the HVAC on or off in an attempt to achieve the setpoint. (*Id.*). The challenged claims involve calculating a current operating profile for a climate control device and evaluating whether its operational efficiency has decreased. (Ex. 1001, claims 1, 10)(Ex. 1002, ¶¶38-41).

B. Patent Family

The '394 Patent is in a chain of patents, including U.S. Patent Nos. 8,019,567 (“’567 Patent”) and 8,423,322 (“’322 Patent”) (collectively, the “related patents”)(Exs. 1015, 1016). The related patents originally issued with claims that have been found unpatentable over the same prior art relied on in this petition.¹ EcoFactor kept the family open by filing and abandoning continuation applications

¹ Prior determinations regarding the related patents are summarized in Exhibit 1013. (See Exs. 1017, 1018, 1016, 1019, 1020, 1021, 1015, 1010, pp.482-493, 1028). Many of the same and similar issues raised herein have previously been resolved against EcoFactor.

for years. (Exs. 1029-1031). Then, EcoFactor used a Track One request to expedite issuance of the '394 Patent (Ex. 1011, p.60), and immediately filed another lawsuit against Google. (Ex. 1026)(Ex. 1002, ¶¶42-44).²

C. Prosecution History of the '394 Patent

In prosecuting the application leading to the '394 patent, EcoFactor did not disclose the primary references used in prior PTAB, ITC, and *ex parte* proceedings involving related patents with similar claims. (Ex. 1011, pp.67-74). Nor did EcoFactor disclose the existence of those co-pending proceedings.³ And despite the Board having issued a final written decision invalidating several '567 patent claims over Hildebrand and Van Ostrand, and the CRU having rejected all '322 patent claims over Hildebrand, EcoFactor never disclosed Hildebrand during prosecution of the '394 patent. Rather, during prosecution, EcoFactor submitted terminal disclaimers for the related patents to overcome double-patenting rejections. (Ex. 1011, pp.125, 138). The '394 patent issued on December 5, 2023. (Ex. 1002, ¶¶42-44).

² A list of prior related proceedings is provided in Exhibit 1014.

³ EcoFactor has emphasized the “similar[ity] [of the] limitations” in the patents. (See Ex. 1025, pp.006, 021).

D. Collateral Estoppel Applies

The parent '567 Patent was the subject of IPR2021-01218, in which Petitioner argued, the Board agreed, and the Federal Circuit affirmed, that several claims were obvious over Hildebrand, Van Ostrand, and Rosen. (Ex. 1018)(Ex. 1036). “It is well established that collateral estoppel... applies in the administrative context.” *MaxLinear, Inc. v. CF CRESPE LLC*, 880 F.3d 1373, 1376 (Fed. Cir. 2018). Application of collateral estoppel requires that: “(1) the identical issue was actually litigated; (2) the issue was actually decided in a final decision on the merits; (3) the issue was necessary to the final decision; and (4) the party being estopped was adequately represented in the prior action.” *Alphatec Holdings, Inc. et al. v. Nuvasive, Inc.*, IPR2019-00361, Paper 59, at 25 (PTAB July 8, 2020). Here, all factors are met for certain issues.

First, the following issues were actually litigated in IPR2021-01218 and are identical to issues presented herein: (1) whether Hildebrand teaches (1.i) comparing inside and outside temperatures over time (Ex. 1018, pp.22-24), (1.ii) a database (Ex. 1018, pp.26-32), and (1.iii) determining whether the operational efficiency has decreased over time (Ex. 1018, pp.22-24); and (2) whether there is motivation and reasonable expectation of success to combine Hildebrand with Van Ostrand and Rosen (Ex. 1018, pp.32-38). **Second**, these issues were decided in the FWD and affirmed on appeal, which is a final decision on the merits. (Ex. 1018)(Ex. 1036).

Third, resolution of these issues was essential to the FWD—Hildebrand, Rosen, and Van Ostrand were relied upon to invalidate claims of the '567 patent, which necessarily involved determining the above issues. **Fourth**, EcoFactor was adequately represented during the '567 IPR and appeal.

Accordingly, the Board should find that EcoFactor is collaterally estopped from relitigating whether Hildebrand teaches elements (1.i), (1.ii), (1.iii) above and from relitigating the obviousness of combining Hildebrand with Van Ostrand or Rosen.

E. Claim Construction

“In an [IPR], a claim...shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b).” 37 C.F.R. §42.100(b). The Grounds render obvious the challenged claims under any reasonable construction, including plain meaning.⁴ (Ex. 1002, ¶¶48-51).

EcoFactor has previously contended that “operational efficiency” should be construed as “energy or time to change inside temperature by any given amount for a set of one or more indoor or outdoor conditions.” (Ex. 1010, p.32)(Ex. 1034,

⁴ EcoFactor has not identified any terms requiring express construction in the accompanying litigation. (See Ex. 1037)(see *id.*, p.017)(EcoFactor’s proposal for “operational efficiency”).

p.021)(Ex. 1035, pp.49-53). Below, Petitioner applies this apparent understanding of this term. Petitioner also highlights and applies EcoFactor’s apparent claim interpretations in the co-pending litigation in certain instances as explained below.⁵ *See Western Digital Corp. v. SPEX Techs., Inc.*, IPR2018-00084, Paper 14, at 10-12 (April 25, 2018)(Ex. 1002, ¶¶48-51).

II. DETAILED EXPLANATION OF THE REASONS FOR UNPATENTABILITY

Ground 1. Claims 1-3, 5, 10-12, and 14 are obvious over Hildebrand in view of Shah.

Claims 1-3, 5, 10-12, and 14 are obvious under 35 U.S.C. § 103(a) over U.S. Pat. No. 5,729,474 (“**Hildebrand**”)(Ex. 1004) in view of U.S. Pat. No. 5,555,927 (“**Shah**”)(Ex. 1006). (Ex. 1002, ¶52).

Neither Hildebrand nor Shah was of record in the application leading to the ’394 patent. (Ex. 1002, ¶53).

A. Effective Prior Art Date

Hildebrand issued on March 17, 1998, and is prior art under pre-AIA 35 U.S.C. §102(b).

Shah issued on Sep. 17, 1996, and is prior art under pre-AIA 35 U.S.C.

⁵ Petitioner reserves the right to argue alternative constructions in other proceedings, including indefiniteness.

§102(b).

B. Overview of the Ground

Hildebrand teaches or suggests all elements of the independent claims. (Ex. 1002, ¶¶54-56). However, this Ground is also presented in view of Shah because EcoFactor may present arguments regarding the claimed “operating profile” and “operational efficiency” including that an operational efficiency must be measured in unit time. (See, e.g., Ex. 1037, p.017). To the extent this is not already in Hildebrand, it would have been obvious to implement Hildebrand’s efficiency values using Shah’s thermal time constants (measured in unit time), which form an operating profile and measure operational efficiency. (Ex. 1002, ¶56).

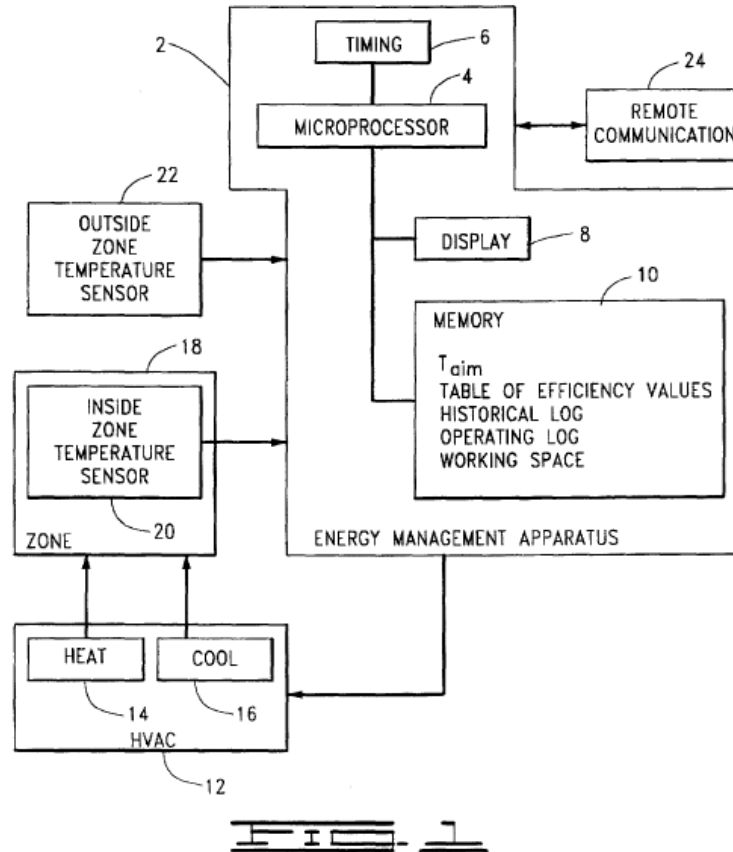
Furthermore, to the extent Hildebrand does not already disclose a database, it would have been obvious to implement Hildebrand’s memory to include a database. (Ex. 1002, ¶57).

Hildebrand and Shah further render obvious dependent claims 2-3, 5, 11-12, and 14. Principally, to the extent that Hildebrand does not teach a programmable thermostat, a person having ordinary skill in the art (“PHOSITA”) would have been motivated to implement Hildebrand using a programmable thermostat, such as Shah’s thermostat, and display an efficiency evaluation result. (Ex. 1002, ¶58).

1. Overview of Hildebrand

Hildebrand “anticipat[es] potential HVAC failure”. (Ex. 1004, Title)(Ex.

1002, ¶59). Hildebrand's overall system (Fig. 1) contains, among other things, an "HVAC system 12," inside temperature sensor 20, outside temperature sensor 22, microprocessor 4 to analyze data, and memory 10.



(Ex. 1004, Fig. 1, 3:32-4:34)(Ex. 1002, ¶59).

Hildebrand collects indoor and outdoor temperatures and calculates HVAC operational efficiency values (K) over time. (Ex. 1004, Abstract, 6:12-8:20)(Ex. 1002, ¶60). Hildebrand compares the K values over time to determine whether efficiency has decreased. (Ex. 1004, Abstract, 6:12-8:20)(Ex. 1002, ¶60). If so, Hildebrand sends a signal requesting maintenance. (Ex. 1004, Abstract, 1:50-

52)(Ex. 1002, ¶60).

2. Overview of Shah

Shah's thermostat 12 controls a "space temperature control unit 27," which heats and cools a controlled space 10 (e.g., building):

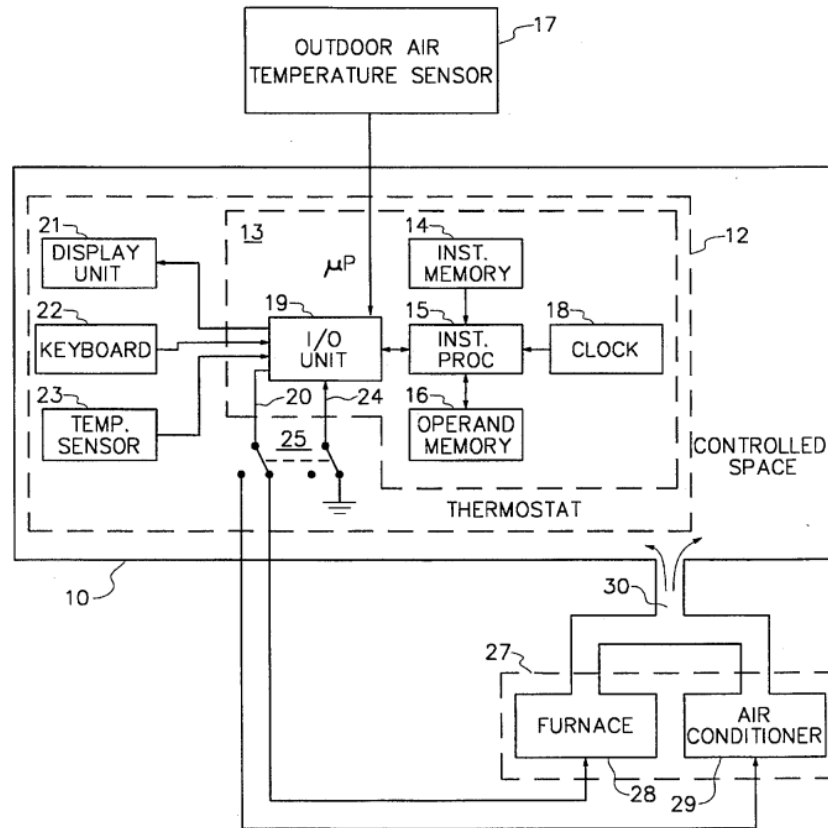


Fig. 1

(Ex. 1006, Fig. 1, 8:19-43)(Ex. 1002, ¶61).

Shah uses inside and outside temperatures to compute "thermal time constants" (τ), which are operational efficiency values with unit time. (Ex. 1002, ¶62). Differences in τ on different days are reflected with ξ , defined in Eqs. (8)-(9).

(Ex. 1006, 4:21-45)(Ex. 1002, ¶62). The value ξ “provides an ability to monitor the integrity of the thermal system” for “diagnostics purposes.” (Ex. 1006, 4:63-5:10)(Ex. 1002, ¶62).

C. Motivation (Rationale) Supporting Obviousness

1. Shah’s Thermal Time Constant as Operating Profile/Operational Efficiency

A PHOSITA would have been motivated to incorporate Shah’s thermal time constant (τ) in Hildebrand to evaluate HVAC efficiency and use Hildebrand’s processor to perform efficiency calculations in view of Shah. (Ex. 1002, ¶63).

Hildebrand calculates efficiency values K as a ratio between a time period Δt and a temperature difference, expressed as $\Delta t/|T_{\text{start}}-T_{\text{aim}}|$, where Δt is “the amount of time[] it takes for the energized HVAC system 12 to change the actual temperature in the zone 18 from the respective T_{start} to the respective T_{aim} .” (Ex. 1004, 6:26-64). The temperature change $T_{\text{start}}-T_{\text{aim}}$ (expressed as ΔT) occurs over the time period Δt . (*Id.*). Hildebrand’s K forms part of an **operating profile** because it indicates how efficiently the HVAC operates over time in order to achieve a temperature change ΔT , and has unit time/temperature, which renders obvious this claim language. (Ex. 1002, ¶64).

To the extent the claimed **operating profile** is determined to be or reflects an **operational efficiency** that must be measured in units of energy or time (*see* Ex. 1010, p.32), it would have been obvious to use Shah’s τ in Hildebrand. (Ex. 1002,

¶65).

Shah computes τ for day N in Eq. 5 as a ratio of $[T_s - T_{oa}]_N$ (“the average temperature difference between the current sensed space temperature and the outdoor air temperature during a time period when the space conditioning plant is ‘ON’”) and $[dT_s / dt]_N$ (“the time rate of change of the sensed space temperature during this same time period”):

$$\tau_{s,N} = \frac{[T_s - T_{oa}]_N}{[dT_s / dt]_N} \quad (5)$$

(Ex. 1006, 3:21-4:35)(Ex. 1002, ¶66). Shah’s τ therefore has units of (temperature/(temperature/time)), which is *time*. (See Ex. 1010, p.32)(Ex. 1002, ¶66).

Both Hildebrand and Shah use efficiency values to evaluate whether the HVAC’s efficiency has decreased over time. (Ex. 1004, 7:5-17)(Ex. 1006, 4:21-45, 4:63-5:10)(Ex. 1002, ¶67). Both also account for outside temperature. Hildebrand stores the K values in a table indexed by T_{out} and compares efficiencies for the same T_{out} . (Ex. 1004, 6:65-7:62). Shah also accounts for outside temperature, and does so directly in calculating the numerator for τ . (Ex. 1002, ¶68). By accounting for T_{out} directly in its efficiency calculation, Shah compares efficiencies between “any two” different days (*see* Ex. 1006, 4:21-26), rather than being limited (like Hildebrand) to comparisons between time periods with the “same” T_{out} . (Ex. 1002,

¶68).

A PHOSITA would have therefore been motivated to modify Hildebrand to implement Shah's τ values indexed by day in addition to or instead of Hildebrand's efficiency table of K values indexed by T_{out} . (Ex. 1002, ¶69). This would have provided predictive diagnostics which are valid for a greater range of times and conditions. (Ex. 1002, ¶69). It would have further been obvious to use Hildebrand's microprocessor to perform the K and/or τ efficiency calculations. (Ex. 1002, ¶70).

Additionally, using Shah's τ values in Hildebrand would have involved using a known technique to improve Hildebrand in a known way, without unpredictable results (Ex. 1002, ¶71), and is thus obvious under *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 416-18 (2007).

2. Database

To the extent that Hildebrand does not teach a database, it would have been obvious to implement Hildebrand with a database to store temperatures and operating profiles over time. (Ex. 1002, ¶72). A PHOSITA would have been motivated to use a database for storing and organizing data, including Hildebrand's efficiency values indexed by outside temperature. (*Id.*, ¶73). Databases were widely used to store and organize information, including for climate control devices, and would have been used predictably for that purpose with no unexpected results. (*Id.*, ¶73)(citing Ex. 1005, ¶¶0056-0059, Ex. 1023, Abstract, Fig. 2, 9:26-50, Ex. 1022,

1:64-66).

3. Shah's Thermostat

To the extent that Hildebrand does not teach a programmable thermostat, a PHOSITA would have been motivated to implement Hildebrand using a programmable thermostat, including Shah's thermostat, communicating with the climate control device and displaying the result of an efficiency evaluation (*see* dependent claims 2/11, 5/14). (Ex. 1002, ¶74). Hildebrand already uses a sensor to measure indoor temperature (Ex. 1004, 4:11-15, Fig. 1) and further discloses thermostats and microprocessor-based HVAC controllers, which a PHOSITA would have understood to be a programmable thermostat. (Ex. 1004, 1:10-17)(Ex. 1002, ¶75). Moreover, as the '394 patent recognizes, programmable thermostats were already "prevalent" at the relevant time. (Ex. 1001, 1:60-65)(Ex. 1002, ¶75).

A PHOSITA would have been motivated to 1) implement Hildebrand's energy management apparatus to include a programmable thermostat, or 2) to implement Hildebrand's inside temperature sensor to be part of a programmable thermostat. (Ex. 1002, ¶76). Programmable thermostats were commonly used to communicate with HVACs in the relevant timeframe, provide indoor temperature data in a convenient and cost effective manner, and display HVAC and temperature information. (Ex. 1009, 1:18-55)(Ex. 1006, 1:59-67)(Ex. 1002, ¶76). Moreover, a PHOSITA would have recognized that, when implementing Hildebrand in a building

with a pre-existing programmable thermostat, it would have been convenient and cheaper to keep the building's existing thermostat. (*See* Ex. 1004, 4:45-52)(Ex. 1002, ¶76). Also, for multi-zone buildings, as Hildebrand contemplates (Ex. 1004, 4:46-52, 4:55-5:17, 5:29-39), it would have been obvious to implement user setpoint and inside temperature data in a programmable thermostat, as in Shah, because this would allow a user to view inside temperature and modify the setpoint from any control location. (Ex. 1002, ¶¶76-77).

D. *Graham* Factors

This *Graham* factors discussion applies to all Grounds.

The **level of ordinary skill** encompassed a (1) Bachelor's degree in engineering, computer science, or a comparable field of study, and (2) five years of (i) professional experience in building energy management and controls, or (ii) relevant industry experience. Additional relevant industry experience may compensate for lack of formal education or vice versa. (Ex. 1002, ¶¶27-33).

Petitioner notes that with respect to a related patent, the Board has previously made a slightly different finding regarding the level of ordinary skill. (Ex. 1018, 9-10). Petitioner submits that the challenged claims are rendered obvious under either definition. (Ex. 1002, ¶¶27-33).

The **scope and content of the prior art** are discussed throughout the ground.

The **differences between the prior art and the claims** are discussed in the

“Overview” and in the claim mapping, below.

Petitioner is not aware of any **secondary considerations** that would make an inference of non-obviousness more likely.

E. Reasonable Expectation of Success

(Time Constant as Operating Profile/Operational Efficiency): A PHOSITA would have had a reasonable expectation of success incorporating Shah’s use of τ values into Hildebrand. (Ex. 1002, ¶¶78-79). The art was relatively predictable in the relevant timeframe (2007). (*Id.*). Shah and Hildebrand, moreover, are software-based systems with well-known components, and were thus predictable in nature. (*Id.*).

(Database): A PHOSITA would have had a reasonable expectation of success implementing a database in Hildebrand because this is merely combining prior art elements according to known methods to yield predictable results (*i.e.*, using a database to save and index data over time). *See KSR*, 550 U.S. at 416-421. (Ex. 1002, ¶80).

(Programmable Thermostat): A PHOSITA would have had a reasonable expectation of success implementing Hildebrand with a programmable thermostat displaying an evaluation result (per certain dependent claims) because the implementation is merely combining prior art elements according to known methods to yield predictable results (*i.e.*, using a thermostat that provides the inside

temperature data and displays evaluations, to save on cost)(*see, e.g.*, Ex. 1009, 3:3-30)(Ex. 1012, ¶¶0017, 0149, 0238)(Ex. 1002, ¶81). A PHOSITA would have found it obvious to implement Hildebrand to include such a thermostat, and it would have been well within ordinary skill to make standard modifications to a thermostat to communicate and to display information regarding the functioning of the system. (*Id.*)(*see also* Ex. 1004, 7:63-8:11, 2:7-10, 3:46-49, 4:22-34)(Ex. 1001, 1:60-65); *See KSR*, 550 U.S. at 416-421. (Ex. 1002, ¶81).

F. Analogous Art

Hildebrand and Shah are analogous art because they relate to energy management systems that track HVAC efficiency (Ex. 1004, Abstract)(Ex. 1006, Abstract), they are in the same field as the '394 patent (building energy management and controls), and their teachings would have been reasonably pertinent to the problems facing the named inventors. (Ex. 1004, Abstract)(Ex. 1006, Abstract)(Ex. 1001, Abstract)(Ex. 1002, ¶82). *See Wyers v. Master Lock Co.*, 616 F.3d 1231, 1238 (Fed. Cir. 2010).

G. Claim Mapping

This section maps the challenged claims to the relevant disclosures of Hildebrand and Shah, where the claim text appears in bold-italics, and the relevant mapping follows. Petitioner has added numbering and lettering in brackets (*e.g.*, 1[a], [1b]) to certain claim elements, to facilitate the discussion. Petitioner addresses

independent claims 1 and 10 first. (Ex. 1002, ¶83).

CLAIM 1

“1[a]. A control system for an environment inside a structure, comprising:”

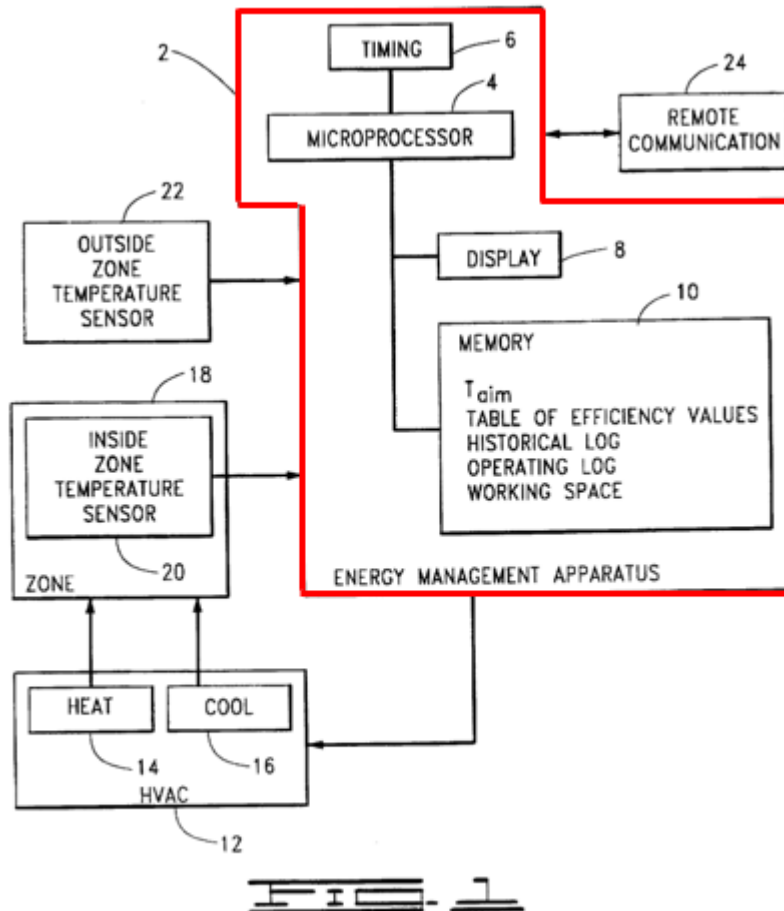
Hildebrand discloses this limitation. (Ex. 1002, ¶84).

Hildebrand’s “Fig. 1 is a block diagram of a system,” which is a **control system for an environment inside a structure**. (Ex. 1004, 3:21-54, 4:55-5:60)(Ex. 1002, ¶85). Specifically, Hildebrand’s Fig. 1 system (the **control system**) includes an energy management apparatus 2 that “**control[s]**” a temperature modification device, such as HVAC system 12. (Ex. 1004, 1:11-18, 3:61-63, 4:1-10). Energy management apparatus 2 operates the HVAC system 12 to “heat or cool a zone (such as the zone 18)” in a building (*id.*, 4:46-63), which is **an environment inside a structure** (*id.*, 3:61-4:54)(*see also* Ex. 1006, 8:37-43, 4:63-66, 3:35-37, Fig. 1)(Shah describing similar control system)(Ex. 1002, ¶¶85-86).

“[1b] a climate control device in the structure that receives first temperatures from inside the structure;”

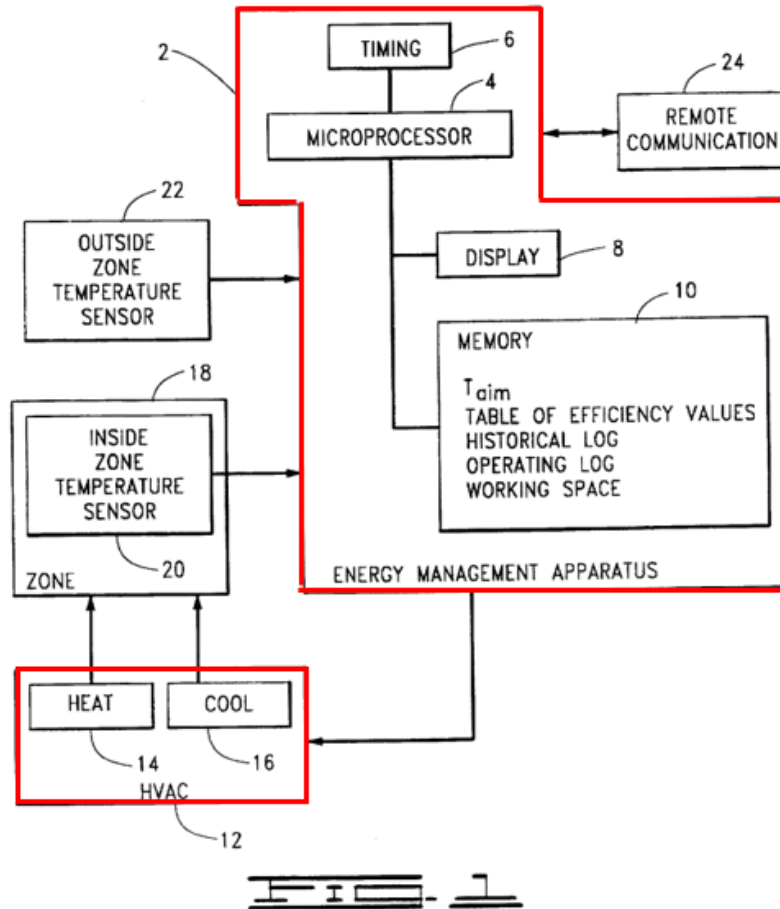
Hildebrand discloses and renders obvious this limitation. (Ex. 1002, ¶87). Hildebrand teaches a **climate control device** in two principal alternative ways. (Ex. 1002, ¶88). Petitioner presents alternative mappings in view of EcoFactor’s apparent litigation positions. (Ex. 1002, ¶88).

In a first mapping, Hildebrand's energy management apparatus 2 (outlined in red below) is a **climate control device**:



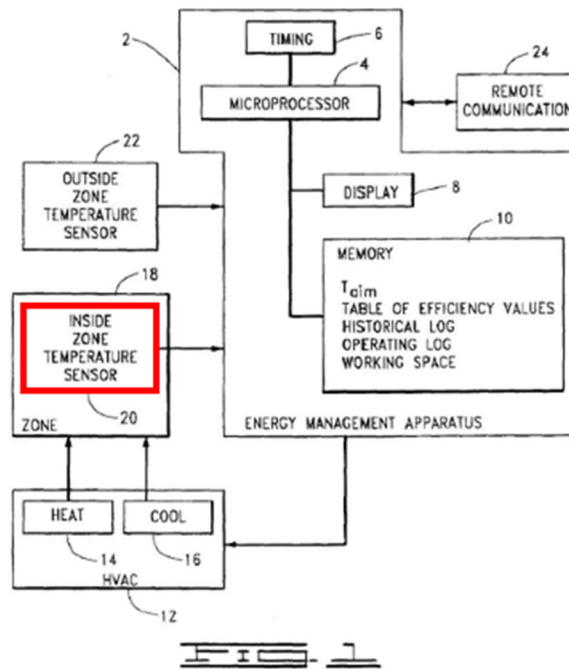
(Ex. 1004, Fig. 1, 3:41-43)(Ex. 1002, ¶89). This mapping is based on EcoFactor's apparent litigation interpretation that the climate control device is a device that operates, but excludes, the HVAC equipment (Ex. 1027, p.12). Based on this interpretation, Hildebrand's energy management apparatus 2 is a **climate control device** because it operates the HVAC equipment to control the climate to maintain particular temperatures. (Ex. 1004, 2:55-67, 5:3-10, 5:40-44)(Ex. 1002, ¶89).

In a second mapping, Hildebrand's energy management apparatus 2 and HVAC system 12, together form a **climate control device** (outlined in red below) because together, they operate to control the climate of the zone:



(Ex. 1004, Fig. 1, 3:41-43)(Ex. 1002, ¶90).

For either mapping, the inside zone temperature sensor 20 (whose input reflects and is used to control the climate) also forms a part of the **climate control device**. (Ex. 1002, ¶91).



(Ex. 1004, Fig. 1, 4:11-15)(Ex. 1002, ¶91).

In either mapping, the climate control device **receives first temperatures from inside the structure** because Hildebrand’s energy management apparatus 2 receives temperatures from the “inside zone temperature sensor 20,” which is inside the zone and building. (Ex. 1004, 4:11-14, 5:11-17, 6:12-16)(Ex. 1002, ¶92). Moreover, in either mapping, the energy management apparatus 2 is **in the structure**. (Ex. 1004, 4:45-52)(Ex. 1004, 7:63-8:11, 1:64-2:10, Fig. 1)(Ex. 1002, ¶93). For the second mapping, Hildebrand’s HVAC system 12 is also **in the structure** because it is “implemented... in a building where the energy management apparatus 2 [is]... installed.” (Ex. 1004, 4:45-52)(*see also* Ex. 1006, 5:22-27, 7:27-33, 8:40-43, 8:63-67, 9:21-25, 9:56-10:2, 12:53-59, 9:1-11, 5:14-15, 5:27-30, claims

3, 10-11)(Shah disclosing similar system)(Ex. 1002, ¶¶94-95).

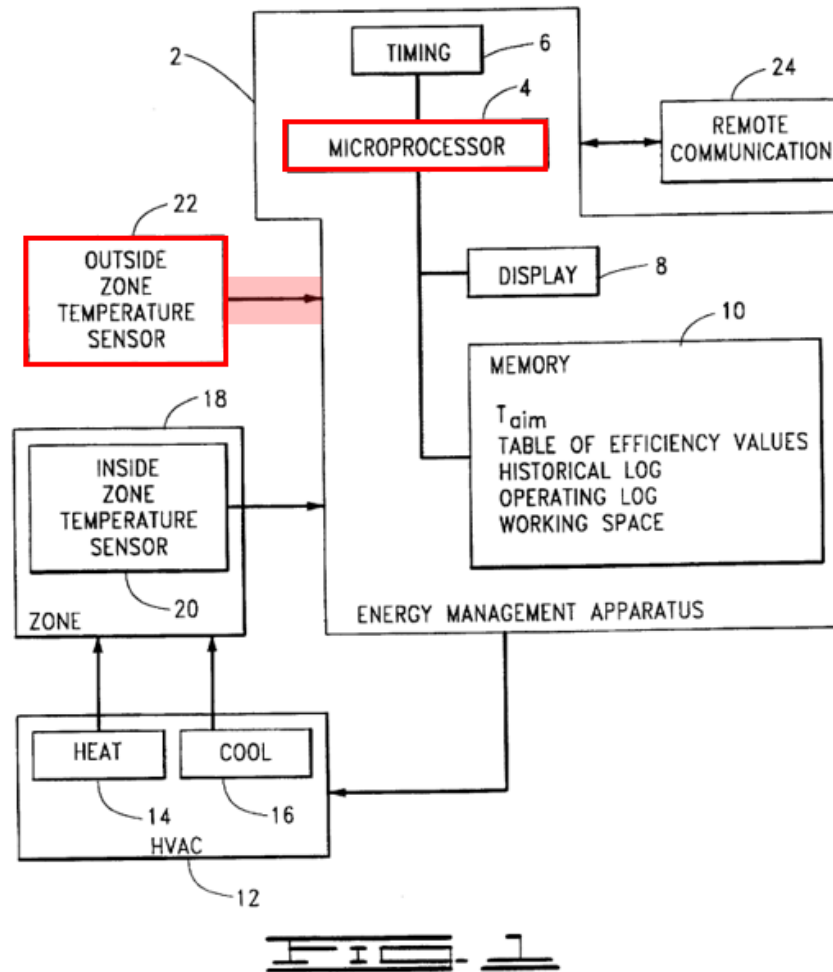
“[1c] a processor that: receives second temperatures from outside the structure from at least one source outside the structure; and”

Hildebrand discloses and renders obvious this limitation. (Ex. 1002, ¶96).

Hildebrand’s microprocessor 4 is **a processor**, which performs Hildebrand’s rate-of-change and efficiency calculations.⁶ (Ex. 1004, Fig. 1, 3:41-44, 4:55-64)(Ex. 1002, ¶97).

Hildebrand’s microprocessor 4 **receives** outside temperatures (T_{out} , **second temperatures**):

⁶ Under EcoFactor’s apparent litigation interpretation, the **processor** can be part of the **climate control device**. (Ex. 1027, pp.25-26)(*see also* Ex. 1001, 6:4-7:20, 7:31-49, 7:5-20, Figs. 2, 4). *See Linear Tech. v. ITC*, 566 F.3d 1049, 1055 (Fed. Cir. 2009).



(Ex. 1004, Fig. 1, 4:16-21, 5:65-6:5)(Ex. 1002, ¶98). The microprocessor 4 receives T_{out} because T_{out} is stored in memory 10 and is used in efficiency calculations (both tasks carried out by the microprocessor). (Ex. 1004, 5:65-6:28, 6:44-58, 7:18-23, 7:45-50, 14:32-48)(Ex. 1002, ¶98).

In Hildebrand, the microprocessor 4 receives T_{out} **from** the outside zone temperature sensor 22, which is **at least one source outside the structure** because it is “outside the building in which the zone 18 is defined.” (Ex. 1004, Fig. 1, 4:16-21, 5:65-6:5)(Ex. 1002, ¶99). It is further obvious for the outside temperature sensor

to be located **outside the structure** in order to most accurately measure the outside temperature. (Ex. 1002, ¶99)(*see also* Ex. 1006, 1:59-67, 5:11-40, 7:22-33, 8:26-33, 8:44-9:11, 9:21-25, 9:64-67, 10:3-36, 14:33-44, claims 1, 3, 9-10)(Shah describing similar receipt and use of outside temperatures)(Ex. 1002, ¶100).

“[1d] [a processor that: ...] compares the first temperatures and the second temperatures over time to calculate a current operating profile for the climate control device; and”

Hildebrand alone or in view of Shah teaches this limitation. (Ex. 1002, ¶101).

Hildebrand

Hildebrand’s microprocessor 4 (**processor**) **compares** the inside (**first**) **temperatures and** the outside (**second**) **temperatures over time to calculate a current operating profile for the climate control device.** (Ex. 1002, ¶102).

Hildebrand’s microprocessor continuously monitors inside and outside temperatures over a period of time that the HVAC system 12 (connected to or part of **the climate control device** as mapped under [1b]) is **operating**, and then uses the **temperatures** to calculate a **current** “present computed efficiency value” for the corresponding outside **temperature.** (Ex. 1004, 2:29-61, 5:40-8:49)(Ex. 1002, ¶103). The efficiency values are for the energy management apparatus 2 because the apparatus calculates them from data that it receives and stores, and operation is controlled by the apparatus. (Ex. 1004, 4:35-6:11, 2:29-61)(Ex. 1002, ¶103). Hildebrand calculates the efficiency values K as $\Delta t / |T_{\text{start}} - T_{\text{aim}}|$, where the time

period Δt is “the amount of time [] it takes for the energized HVAC system 12 to change the actual temperature in the zone 18 from the respective T_{start} to the respective T_{aim} ,” and where Δt is divided by a temperature change ΔT occurring over that time period. (Ex. 1004, 6:26-64, 13:50-14:52, 5:11-17, 9:35-39)(Ex. 1002, ¶104).

Upon calculating the efficiency value (calculated using inside temperatures), Hildebrand’s microprocessor stores it in a table indexed by the corresponding outside temperature (**compares the first temperatures and the second temperatures**). (Ex. 1004, 6:65-7:17, 7:38-62, 6:17-40)(*see also* Ex. 1004, 1:58-2:3, 6:17-40, 7:45-55, 6:34-37)(Ex. 1002, ¶105). Hildebrand’s microprocessor repeatedly uses inside temperature and time to calculate a rate of change of inside temperature, at the current outside temperature for that particular time. (Ex. 1004, 12:66-13:37, 6:17-7:44)(Ex. 1002, ¶105). The result is a table with three columns (Ex. 1004, 7:45-62) for T_{out} , cooling rates, and heating rates, which together describe the efficiency (for heating and cooling cases) for different outside temperatures, where the rates are for different times (**over time**). (*Id.*)(*See also* Ex. 1018, p.27)(Ex. 1004, 1:59–2:10, 6:65–67)(Ex. 1002, ¶¶105-106).

The currently **calculate[d]** efficiency value together with its corresponding outside temperature form **a current operating profile for the climate control device** because they represent the “current actual rate at which the temperature

modification device changes the sensed temperature” “for the then sensed at least one ambient condition” (T_{out}). (Ex. 1004, 6:65-7:17, 7:38-8:49)(Ex. 1002, ¶107).⁷ In other words, the efficiency value indexed by outside temperature **profile[s]** how **the climate control device operat[es]** under **current** conditions. (Ex. 1002, ¶107). Hildebrand calculates efficiency values multiple times per day—each time the HVAC system is “activate[d]” to change the indoor temperature. (Ex. 1004, 5:40-50)(Ex. 1002, ¶108). These multiple efficiency values together with corresponding outside temperatures for a current time period (*e.g.*, the current day) are also a **current operating profile** for similar reasons. (Ex. 1002, ¶108).

Hildebrand-Shah

The claimed comparison is also obvious in view of Shah. Shah **calculate[s]** **a[n] operating profile for the climate control device** by “determin[ing] $\tau_{s,N}$, the thermal time constant of the system on day N”:

$$\tau_{s,N} = \frac{[T_s - T_{oa}]_N}{[dT_s/dt]_N} \quad (5)$$

(Ex. 1006, 4:9-20, 3:21-5:10)(Ex. 1002, ¶109). Shah’s $\tau_{s,N}$ (indexed by day) is a

⁷ To the extent “**current operating profile**” is supported by the ’394 Patent, it encompasses Hildebrand’s efficiency. (Ex. 1001, 9:50-10:18; *see also* Figs. 6-7, 9-13, 9:1-13:61, element [1f])(Ex. 1002, ¶107).

representation or summary (**profile**) of the **operat[ion]** of the **climate control device** on a given day. (*Id.*). Both the numerator (“ $[T_s - T_{oa}]_N$ is the average temperature difference... during a time period when the space conditioning plant is ‘ON’”) and the denominator (“ $(dT_s/dt)_N$ is the time rate of change... during this same time period”) are computed when the **climate control device** is **operating**, and therefore are for an **operating profile for the climate control device**. (*Id.*).

Shah’s $\tau_{s,2}$ is a **current** operating profile because it is computed on any day after the day that $\tau_{s,1}$ is computed, including the **current** day, and includes the data for the “ON” cycles of the “space conditioning plant” (the heating/cooling equipment) for that day.

$$\tau_{s,2} = \frac{[T_s - T_{oa}]_2}{[dT_s/dt]_2} ; \quad (7)$$

(Ex. 1006, 4:9-49, 12:4-20)(Ex. 1002, ¶110). A PHOSITA would have understood and found obvious that the $\tau_{s,N}$ values for the most recent set of days (e.g., the last seven days) together are also a **current operating profile** for the same reasons. (Ex. 1002, ¶110).

Shah calculates $\tau_{s,2}$ by **compar[ing]** the **first temperatures and the second temperatures over time**, as shown in the numerator of Equation (7). (Ex. 1002, ¶111). The difference $T_s - T_{oa}$ is a **compar[ison]** of the current sensed space temperature (**first temperature**) and outdoor air temperature (**second**

temperature). (Ex. 1006, 4:9-20, 3:21-5:10). This comparison is performed **over time** because it “is the average temperature difference... during a time period when the space conditioning plant is ‘ON’.” (*Id.*).

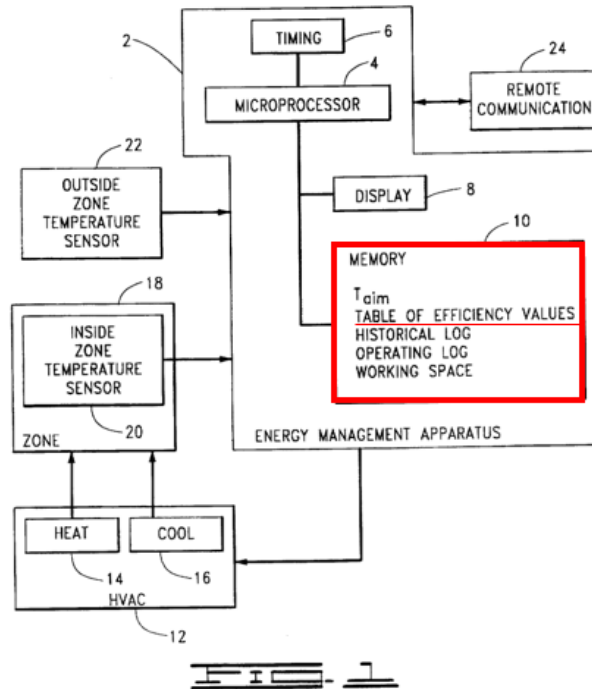
Shah’s processor 15 calculates τ , because it executes the program of Figures 4A-4D, including the τ calculations (see elements 38 and 82 of Fig. 4A). (Ex. 1006, 10:3-5, 10:32-36, 11:59-61, 12:2-20, 7:22-33). It would have been obvious to incorporate Shah’s calculations into Hildebrand’s system and for Hildebrand’s microprocessor to perform these calculations for the reasons set forth under the “Motivation” section above. (Ex. 1002, ¶112).

“[1e] a database that stores the current operating profile for the climate control device,”

Hildebrand discloses and renders obvious this limitation and Hildebrand in view of Shah renders obvious this limitation. (Ex. 1002, ¶113).

Hildebrand

Hildebrand “store[s]” the calculated efficiency value “in the table of efficiency values retained in memory 10” and “in correspondence with the value of the sensed at least one ambient condition,” which is T_{out} . (Ex. 1004, 6:65-7:4). Hildebrand’s table “is indexed by T_{out} so that the calculated efficiency value is stored at the index corresponding to the actually sensed T_{out} .” (*Id.*).



(Ex. 1004, 6:65-7:4, 3:63-67, 7:38-62, 9:35-39, 1:63-67)(Ex. 1002, ¶114).

Because Hildebrand teaches that this data is stored in a table structure and indexed, Hildebrand teaches the claimed **database**. (Ex. 1002, ¶115). EcoFactor has previously admitted that Hildebrand provides organizational structure (*e.g.*, a table) for storing *efficiency values*. (Ex. 1018, pp.27-28). The Board has also found that “[b]ecause the data [in Hildebrand] is stored in an indexed table, it is stored in a database.” (Ex. 1018, pp.31, 27-32)(*see also* Ex. 1033, 22:2-22)(Ex. 1002, ¶115).

Alternatively, a PHOSITA would also have found it obvious to implement Hildebrand’s memory as a **database**, for storing efficiency values indexed with outside temperatures (**the current operating profile for the climate control device**) for the reasons set forth under the “Motivation” section above. (Ex. 1002,

¶116).

Hildebrand-Shah

It would have been obvious to store Shah's τ values indexed by day (**current operating profile(s)**) in Hildebrand's memory 10 or another, standard database for the reasons set forth under the "Motivation" section above. (Ex. 1002, ¶117).

"[1f] wherein the processor (a) compares a portion of the current operating profile for the climate control device with a stored temperature profile that represents a previous operating profile for the climate control device calculated at a different time to evaluate whether an operational efficiency of the climate control device has decreased over time, and"

Hildebrand alone or in view of Shah teaches this limitation. (Ex. 1002, ¶118).

Hildebrand

Hildebrand's microprocessor 4 (**processor**) compares efficiency values **to evaluate whether an operational efficiency of the climate control device has decreased over time**. (Ex. 1004, 7:18-33, 2:29-3:6, 5:51-8:57, 2:2-10)(Ex. 1002, ¶119). Hildebrand explains:

"The present computed efficiency value is **compared** with a prior computed efficiency value which was computed contemporaneously with sensing ambient temperature... outside the zone at the same value of T_{out} "

(Ex. 1004, 7:18-33). In Hildebrand, if the present value exceeds the prior value ("the present value indicates it is taking longer to effect a 1° F. temperature change"), "this

represents a decrease in efficiency of the HVAC equipment.” (*Id.*) Otherwise, if the prior value exceeds the present value (“representing a faster temperature change rate at the present calculation time”), “this represents an increase in efficiency of the HVAC equipment.” (*Id.*) In Hildebrand, the same values “represent unchanged efficiency.” (*Id.*)(Ex. 1002, ¶119).

By comparing the present efficiency with a prior efficiency, Hildebrand “determin[es] whether the efficiency of the HVAC system changes over time,” which **evaluate[s] whether an operational efficiency of the climate control device has decreased over time.** (Ex. 1004, 2:29-61, 8:25-50)(*see* [1d] analysis)(Ex. 1002, ¶120). Hildebrand’s “efficiency value” is or represents **an operational efficiency of the climate control device** because it represents how efficiently the energy management apparatus 2, alone or together with the HVAC system, is operating. (Ex. 1004, 2:29-51, 4:35-5:60, 6:18-7:4)(Ex. 1002, ¶121). It also renders obvious EcoFactor’s prior interpretation of **operational efficiency** because it represents a time to change the temperature in the zone for the given indoor and outdoor temperatures. (Ex. 1004, 6:26-64, 7:18-33, 8:25-50)(*see* Ex. 1010, p.32)(Ex. 1002, ¶121).

Moreover, as discussed under [1d], Hildebrand’s “present computed” efficiency value(s) together with the corresponding outside temperature(s) is **a current operating profile for the climate control device**, so that Hildebrand’s

“present computed” efficiency value(s) is **a portion of the current operating profile for the climate control device**. (Ex. 1002, ¶122).

Hildebrand’s “prior computed efficiency value” indexed by outside temperature is **a previous operating profile for the climate control device** for similar reasons above for the **current** operating profile, except that it represents a previous time (*see* above and element [1d]). (Ex. 1004, 7:18-33, 2:29-61, 5:51-8:57)(Ex. 1002, ¶123).

Hildebrand’s “prior computed efficiency value” is also **a stored temperature profile that represents the previous operating profile** because it is stored in memory, and is a value that **profile[s] how the temperature** changes over time due to operation of the **climate control device**. (*See* [1d] analysis)(Ex. 1002, ¶124). The combination of Hildebrand’s “computed efficiency value” along with the corresponding outside temperature is also the claimed **stored temperature profile** for similar reasons. (Ex. 1002, ¶124). Furthermore, to the extent necessary, it would also be obvious to store inside temperatures (a **stored temperature profile**) in order to use them to compute Hildebrand’s efficiency values. (Ex. 1004, 1:58–2:9, 5:11-17, 6:12–16, 6:65–7:4, col. 9)(Ex. 1002, ¶125).

Hildebrand’s “prior computed efficiency value” indexed by outside temperature is **calculated at a different time** because it was computed, earlier than (for example, one month prior to) to the current operating profile for the same outside

temperature. (Ex. 1004, 2:29-61, 7:18-44, 8:25-50)(Ex. 1002, ¶126).

Hildebrand-Shah

Shah also renders obvious this claim element, as Shah's τ values (which have unit time) are used to **evaluate whether an operational efficiency** has decreased. (Ex. 1002, ¶127). In the Hildebrand-Shah combination, as set forth in the "Motivation" section above, Shah's τ values are saved in a table indexed by day. (Ex. 1002, ¶127). Furthermore, as Shah discloses, the τ values are compared to each other in order to **evaluate whether an operational efficiency** has decreased. (Ex. 1002, ¶127).

Specifically, Shah calculates a metric ξ , which represents the ratio between two values for $\tau_{s,N}$ on different days:

$$\frac{\tau_{s,1}}{\tau_{s,2}} = \xi \quad (8)$$

$$\xi = \frac{\tau_{s,1}}{\tau_{s,2}} = \frac{[T_s - T_{oa}]_1 / [dT_s/dt]_1}{[T_s - T_{oa}]_2 / [dT_s/dt]_2} \quad (9)$$

(Ex. 1006, Eqs. 8-9, 4:21-5:10)(Ex. 1002, ¶128). According to Shah, ξ reflects any difference in $\tau_{s,N}$ on different days, and therefore "provides an ability to monitor the integrity of the thermal system" and can be used for "diagnostics purposes." (Ex. 1006, 4:9-20, 4:63-5:10)(Ex. 1002, ¶128). "Any degradation in the thermal performance of the system will be reflected in the value of ξ " because "the value of

ξ will change to reflect [] change in the building’s thermal integrity.” (*Id.*). Thus, ξ reflects **whether an operational efficiency of the climate control device has decreased over time**, because it reflects changes in the system’s ability to bring and maintain the building’s temperature to a desired value. (Ex. 1002, ¶128).

The denominator of $\xi (\tau_{s,2})$ is **a portion of the current operating profile for the climate control device**. (Ex. 1006, 4:9-59)(Ex. 1002, ¶129). Also, in the case that the **current operating profile** is the set of $\tau_{s,N}$ values for the most recent set of days (e.g., the last seven days), $\tau_{s,2}$ is **a portion of the current operating profile**. (Ex. 1002, ¶129).

Moreover, the numerator of $\xi (\tau_{s,1})$ is **a stored temperature profile that represents a previous operating profile for the climate control device calculated at a different time**. (Ex. 1002, ¶130). EcoFactor has contended in litigation that a **stored temperature profile** is “based on temperatures over the previous weeks or months”. (Ex. 1027, pp.43-44). This contention, if correct, would be satisfied by Shah’s $\tau_{s,1}$, as shown in Eqns. 9 and 5 (day 1 is any day occurring before day 2). (Ex. 1006, 4:21-59)(Ex. 1002, ¶130). The value for $\tau_{s,1}$ is or represents **a previous operating profile for the climate control device calculated at a different time** because it is a thermal time constant from a day that is earlier in time than $\tau_{s,2}$. (Ex. 1006, 4:9-59)(Ex. 1002, ¶130). Because $\tau_{s,2}$ (computed on day 2) and $\tau_{s,1}$ (computed on day 1) “could be any two days with day 2 occurring after day 1,” $\tau_{s,1}$ is both

previous and calculated at a different time from $\tau_{s,2}$. (Ex. 1006, 4:9-49, 12:4-20)(Ex. 1002, ¶130).

The value for $\tau_{s,1}$ is also **a stored temperature profile** because, as shown in Equation (6) and element 38 of Figure 4A, $\tau_{s,1}$ describes the rate of change of sensed temperature for a given set of inside and outside temperature conditions (*see* [1d]), and in the combination, it is stored in the same manner as $\tau_{s,2}$ (*see* [1e])(Ex. 1002, ¶131).

Shah's processor 15 "controls the entire operation of thermostat 12," including the comparison of τ values. (Ex. 1006, 10:3-5, 10:32-35). It would have been obvious to have Hildebrand's microprocessor (**the processor**) compare Shah's τ values, for the reasons set forth under the "Motivation" section above. (Ex. 1002, ¶132).

"[1g] [wherein the processor . . .] (b) outputs a result of the evaluation,"

Hildebrand alone or in view of Shah teaches this limitation. (Ex. 1002, ¶133).

Hildebrand

In Hildebrand, "[i]f less efficient operation ... is indicated by the aforementioned comparison, a control signal is generated for initiating inspection of the temperature modification device" (**outputs a result of the evaluation**). (Ex. 1004, 7:63-8:11, 2:3-10 ("one or more signals for initiating corrective action are

generated”), 2:56-61, 8:45-49, Abstract, 7:63-8:11)(Ex. 1002, ¶134). This control signal is generated “by the programmed microprocessor 4” (the **processor**). (Ex. 1004, 7:63-8:13)(Ex. 1002, ¶135).

Hildebrand-Shah

Similarly, Shah uses ξ “to monitor the integrity of the thermal system” for “diagnostics purposes.” (Ex. 1006, 4:63-5:10)(Ex. 1002, ¶136). In the combination with Hildebrand, it would similarly be obvious to output a result of the evaluation using Shah’s efficiency values to alert an operator to needed action. (Ex. 1002, ¶136).

“[1h] wherein: the portion of the current operating profile for the climate control device is limited to a specified first time interval, and the stored temperature profile is limited to a specified earlier second time interval.”

Hildebrand alone or in view of Shah teaches this limitation. (Ex. 1002, ¶137).

Hildebrand

Hildebrand’s “present computed efficiency value” (**the portion of the current operating profile**) and “prior computed efficiency value” (alone or with the corresponding outside temperature) (**the stored temperature profile**) are **limited to specified time intervals**. For example, Hildebrand’s “present computed efficiency value” is for one of the “predetermined periods of time during which the step of energizing is repeatedly performed,” which is **a specified first time interval**.

(Ex. 1004, 2:29-34, 5:40-60, 6:18-8:12)(*see also* Ex. 1004, 8:25-50)(Ex. 1002, ¶138).

Similarly, Hildebrand's "prior computed efficiency value" (**stored temperature profile**) is **limited to a specified earlier second time interval** because it is computed for a prior (**earlier**) one of the "predetermined periods of time during which the step of energizing is repeatedly performed." (Ex. 1004, 2:29-61, 5:40-60, 6:18-8:12)(*see also* Ex. 1004, 8:25-50)(Ex. 1002, ¶139).

Hildebrand-Shah

This claim limitation is also met by the Hildebrand-Shah combination. (Ex. 1002, ¶140). In Shah, $\tau_{s,2}$ (**the portion of the current operating profile for the climate control device**) is **limited to a specified first time interval** because it is computed "during a time period when the space conditioning plant is 'ON'" on day 2, and $\tau_{s,1}$ (**the stored temperature profile**) is **limited to a specified earlier second time interval** because it is computed "during a time period when the space conditioning plant is 'ON'" on day 1. (Ex. 1006, 4:9-49, 12:4-20)(Ex. 1002, ¶140). Because $\tau_{s,2}$ (computed on day 2) and $\tau_{s,1}$ (computed on day 1) "could be any two days with day 2 occurring after day 1," the **specified time interval** of $\tau_{s,1}$ is **earlier** from $\tau_{s,2}$. (Ex. 1006, 4:9-49, 12:4-20)(Ex. 1002, ¶140). Based on these teachings, it would be obvious to continue to also use Shah's efficiency values in the claimed manner. (Ex. 1002, ¶140).

CLAIM 10

Claim 10 is a restatement of claim 1 in method form. (Ex. 1002, ¶141).

“10[a]. A method for controlling an environment inside a structure, comprising:”

See claim element 1[a]. Hildebrand’s system has a corresponding **method**. (Ex. 1004, Title, 1:5-9, 1:43-46)(*see also* Ex. 1006, Abstract, 7:22-8:12, claim 3)(Ex. 1002, ¶142).

“[10b] receiving, with a processor, first temperatures inside the structure from a climate control device inside the structure;”

See claim element [1b]. (Ex. 1002, ¶143).

In Hildebrand, the inside temperatures are **receiv[ed] with the processor** (microprocessor 4). (Ex. 1004, 4:11-14, 5:11-17, 6:12-16)(*see also* Ex. 1004, 2:7-28, 5:11-17, 6:44-58, 5:51-7:44, 8:12-20)(Ex. 1002, ¶144).

According to EcoFactor’s apparent litigation interpretation that a device **receiv[es]** temperature data from a component within the device (Ex. 1027, p.12), Hildebrand’s microprocessor 4 receives first temperatures **from the climate control device** (including the energy management apparatus 2). (Ex. 1002, ¶145). Specifically, to perform efficiency calculations, the microprocessor 4 receives inside temperatures **from** the memory 10, which is part of **the climate control device**. (Ex. 1002, ¶145). Furthermore, because the inside zone temperature sensor 20 can also

be considered to be part of the **climate control device** (see claim element [1b]), Hildebrand's microprocessor 4 also **receive[s]** inside temperatures from that sensor. (Ex. 1004, 5:11-17)(Ex. 1002, ¶145).

Alternatively, it would have been obvious to implement Hildebrand's efficiency calculations using a remote processor (away from and outside of the **climate control device**) that communicates with the energy management apparatus 2, such that the remote processor (**processor**) receives the temperatures **from the climate control device**. (Ex. 1002, ¶146). Using remote processing capabilities (e.g., at a central server) in the context of HVAC system control was a known technique and would have provided the benefit of allowing a remote processor to split processing power over multiple devices, and of reducing the processing power required at the local device. (See, e.g., Ex. 1008, 11:5-18)(Ex. 1004, 4:23-34, 5:3-10, 8:1-4)(Ex. 1002, ¶146).

“[10c] receiving, with the processor, second temperatures outside the structure from at least one source outside the structure;”

See claim element [1c]. (Ex. 1002, ¶147).

“[10d] comparing, with the processor, the first temperatures and the second temperatures over time to calculate a current operating for the climate control device; and”

See claim element [1d]. (Ex. 1002, ¶148).

“[10e] storing, with the processor, the current operating profile for the climate control device in a database,”

See claim elements [1e], [10b]. (Ex. 1002, ¶149).

Hildebrand

Hildebrand’s microprocessor 4 (**processor**) stor[es] **the current operating profile** in the memory 10, which is a **database**, or would be obvious to implement as a database. (Ex. 1004, 4:11-14, 5:11-17, 6:12-16, 6:44-58)(Ex. 1002, ¶149).

Hildebrand-Shah

In the Hildebrand-Shah combination, it also would have been obvious to use Hildebrand’s **processor** to store the current operating profile determined using Shah’s calculations in memory 10, which is a database, or would be obvious to implement as a database. (Ex. 1002, ¶150).

“[10f] comparing, with the processor, a portion of the current operating profile for the climate control device with a stored temperature profile that represents a previous operating profile for the climate control device calculated at a different time to evaluate whether an operational efficiency of the climate control device has decreased over time, and”

See claim element [1f]. (Ex. 1002, ¶151).

“[10g] outputting, with the processor, a result of the evaluation,”

See claim element [1g]. (Ex. 1002, ¶152).

“[10h] wherein: the portion of the current operating profile for the climate control device is limited to a specified first time interval, and the stored temperature profile is limited to a specified earlier second time interval.”

See claim element [1h]. (Ex. 1002, ¶153).

CLAIMS 2 AND 11

“2. The control system of claim 1, wherein the first temperatures are received from a programmable thermostat located inside the structure communicating with the climate control device.”

“11. The method of claim 10, wherein the processor receives the first temperatures from a programmable thermostat located inside the structure communicating with the climate control device.”

Hildebrand alone or in view of Shah renders obvious both claims. (Ex. 1002, ¶154).

Hildebrand

Hildebrand discloses thermostats and microprocessor-based HVAC system controllers, which a PHOSITA would have understood to include a **programmable thermostat**. (Ex. 1004, 1:10-17, Fig. 1, 4:11-15)(see Ex. 1006, 1:59-67)(see also Ex. 1001, 1:60-65)(Ex. 1002, ¶155).

Under EcoFactor’s apparent litigation interpretation that a device can **receive** data from a component within the device itself and therefore communicate with itself (Ex. 1027, p.12), it would have been obvious to implement Hildebrand’s energy management apparatus in the form of a **programmable thermostat** as part of

Hildebrand's energy management apparatus (thus forming a part of the **climate control device**), because both devices control HVAC equipment to turn on or off based on inside temperature data. (Ex. 1002, ¶156). In such a configuration, inside temperatures (**first temperatures**) are **received** from the sensor in the **programmable thermostat** and which forms a part of and **communicates** with the **climate control device**. (Ex. 1002, ¶156).

Alternatively, it would have been obvious to implement Hildebrand's inside zone temperature sensor 20 as part of a **programmable thermostat** which **communicates** with Hildebrand's energy management apparatus. (Ex. 1002, ¶157). When sensor 20 is implemented as a sensor located in a **programmable thermostat**, it **communicat[es]** the inside temperatures (**first temperatures**) to the energy management apparatus 2 (forming the **climate control device** alone or together with the HVAC system) or more specifically, to its microprocessor 4 (**the processor**). (Ex. 1002, ¶157). The sensor 20 is also positioned within the inside zone of the building, so that the **programmable thermostat** is **located inside the structure**. (Ex. 1002, ¶157). Much like the sensor 20 can be considered to form a part of the **climate control device**, so too can the **programmable thermostat** such that in this configuration, the inside temperatures (**first temperatures**) are received from the **climate control device**. (Ex. 1002, ¶157).

Hildebrand-Shah

Shah discloses a **thermostat** 12 that includes a temperature sensor 23 and which is **programmable**. (Ex. 1006, 8:44-48, 9:12-38, 9:59-64, 1:59-67)(Ex. 1002, ¶158).

The proposed modifications involving the use of a programmable thermostat (such as that taught by Shah) are obvious for the reasons set forth under the “Motivation” section above. (Ex. 1002, ¶159).

CLAIMS 3 AND 12

“3. The control system of claim 1, wherein the evaluation of the operational efficiency of the climate control device detects a change in an overall operating profile of the climate control device between the specified first time interval and the specified earlier second time interval.”

“12. The method of claim 10, wherein the evaluation of the operational efficiency of the climate control device comprises the processor detecting a change in an overall operating profile of the climate control device between the specified first time interval and the specified earlier second time interval.”

Hildebrand alone or in view of Shah discloses and renders obvious these claims. (Ex. 1002, ¶160).

Hildebrand

Hildebrand’s present and prior efficiency calculations and corresponding T_{out} data (**current and previous operating profiles**) together form an **overall operating profile of the climate control device**. (Ex. 1002, ¶161). Hildebrand’s entire table of efficiency calculations and corresponding T_{out} data forms an **overall operating**

profile of the climate control device for the same reasons. (Ex. 1002, ¶161). Hildebrand **detects a change in the overall operating profile** in at least two ways. (Ex. 1002, ¶161).

First, because Hildebrand updates its table of efficiency values to have “the actual rates representing the most efficient operation,” Hildebrand detects an improvement in the **climate control device’s** operation, which is a **change** in its **overall operating profile between** the current time (**specified first time interval**), and the prior time (**specified earlier second time interval**). (Ex. 1004, 7:34-44, claim 6)(Ex. 1002, ¶162).

Second, when Hildebrand determines “HVAC performance degradation” has occurred by comparing the **current** and **previous** efficiency calculations, it **detects a change** in the **overall operating profile between** the current time (**specified first time interval**), and the prior time (**specified earlier second time interval**). (Ex. 1004, 8:28-50)(Ex. 1002, ¶163).

For claim 12, the **processor** (microprocessor 4) performs the claimed **detect[ing]**. (Ex. 1004, 2:29-51, 5:51-7:44, 8:12-20)(Ex. 1002, ¶164).

Hildebrand-Shah

Similarly, Shah’s indexed current and historical τ values together form **an overall operating profile of the climate control device**. (Ex. 1002, ¶165). **The evaluation of the operational efficiency of the climate control device** (*see* [1f])

between the **specified first and second time intervals** (see [1h]) would have involved **detecting a change** in τ (e.g., via Shah's ξ value). (Ex. 1002, ¶165). Furthermore, it would have been obvious for Hildebrand's microprocessor to perform the claimed detecting in the combination. (Ex. 1002, ¶165).

CLAIMS 5 AND 14

“5. The control system of claim 2, wherein the programmable thermostat includes a display device, and the result of the evaluation is displayed on the display device of the programmable thermostat.”

“14. The method of claim 11, wherein the programmable thermostat includes a display device, the processor outputs the result of the evaluation in a format to be displayed on the display device of the programmable thermostat.”

See claims 2/11. (Ex. 1002, ¶166).

Hildebrand's energy management apparatus 2 already includes a display 8 (**a display device**) that displays a message for initiating inspection of the temperature modification device (**the result of the evaluation is displayed on the display device**). (Ex. 1004, 7:63-8:11)(Ex. 1002, ¶167). It would have therefore been obvious to display the same or a similar message on the **display device of the programmable thermostat**, regardless of whether the energy management apparatus 2 includes the thermostat, or whether the sensor 20 is part of a thermostat, as it would have been desirable for the user to be able to view such information from any available display relating to HVAC operation. (Ex. 1004, 7:53-8:20)(Ex. 1002,

¶167).

For claim 14, Hildebrand's **processor** (microprocessor 4) **outputs** the result **in a format** suitable for display because it controls the display using "address, data and control buses." (Ex. 1004, 3:46-54)(Ex. 1002, ¶168).

Hildebrand-Shah

Shah's programmable thermostat has a display unit 21 (**display device**), which displays information "about the thermostat 12 operation." (Ex. 1006, 1:59-67, 9:11-22)(Ex. 1002, ¶169). It would have similarly been obvious to **output** the result **in a format** suitable for display on a programmable thermostat such as that taught by Shah. (Ex. 1002, ¶169).

Ground 2. Claims 1-5, and 10-14 are obvious over Hildebrand and Shah in view of Rosen.

Claims 1-5, and 10-14 are obvious under 35 U.S.C. §103(a) over **Hildebrand** and **Shah** in view of U.S. Pat. No. 6,789,739 ("**Rosen**") (Ex. 1009). (Ex. 1002, ¶170).

Rosen was made of record during prosecution of the '394 patent, but was never expressly analyzed or applied in a rejection. (Ex. 1002, ¶171).

A. Effective Prior Art Date of Rosen

Rosen issued on September 14, 2004, and is prior art under pre-AIA 35 U.S.C. § 102(b).

B. Overview of the Ground

This Ground applies Hildebrand and Shah as in Ground 1 (incorporated herein), with the following additions. (Ex. 1002, ¶¶172-173).

First, with respect to claims 2/11 and 5/14, Rosen teaches a programmable thermostat with an inside temperature sensor and display. It would have been obvious to use Rosen’s programmable thermostat to obtain inside temperatures and display Hildebrand’s evaluation result. (Ex. 1002, ¶¶174, 176-177).

Second, for claims 1/10 and 4/13, Rosen teaches obtaining outside temperatures over the Internet from a weather data provider. It would have been obvious to receive outside temperatures over the internet per Rosen and use them as the “second temperatures outside the structure” from a source outside the structure (claim limitations [1c] and [10c]) and in efficiency calculations instead of the inputs from Hildebrand’s outside temperature sensor. (Ex. 1002, ¶¶175-177).

C. Motivation (Rationale) Supporting Obviousness

(Programmable Thermostat): For claims 2/11, and 5/14, as explained in the Ground 1 “Motivation” section, it would have been obvious to implement Hildebrand’s energy management apparatus to include a programmable thermostat, or to implement Hildebrand’s inside temperature sensor to be part of a programmable thermostat. (Ex. 1002, ¶178). Rosen teaches a programmable thermostat. (Ex. 1009, 1:18-55, 2:2-6, 3:13-53, Fig. 1)(*see also* Ex. 1004, 4:11-15,

4:61-5:10)(Ex. 1002, ¶¶178-179).

(Internet Weather): For claims 1/10, and 4/13, it would have been obvious to receive outside temperatures using Rosen’s internet weather service as an alternative to or together with Hildebrand’s outside sensor 22 and for Hildebrand’s processor to use such information in efficiency calculations. (Ex. 1002, ¶180). Hildebrand measures outdoor temperature using a sensor, and connects its energy management apparatus to a remote network, and Shah uses an outdoor temperature sensor 17. (Ex. 1004, 4:16-34, 7:63-8:20)(Ex. 1006, Fig. 1). In Rosen, “local current weather information sources are widely available and are routinely accessed by, for example, using the Internet.” (Ex. 1009, 4:10-15)(*see also* Ex. 1001, 5:39-44)(outside temperature information is “widely available from various sources” including the Internet)(Ex. 1002, ¶180). Using Rosen’s internet weather service as a source of outside temperatures would have saved cost and time associated with installing on-site outdoor temperature sensors, which can be faulty or unreliable due to their placement, and is sometimes difficult or impossible. (Ex. 1002, ¶181). A PHOSITA would have understood the need for accurate outside temperatures (e.g., to accurately index Hildebrand’s table of efficiency values), and a PHOSITA would have been motivated to look to other means of providing such data without needing to purchase and install an outdoor sensor, which increases cost and complexity. (Ex. 1002, ¶181). Rosen provides a simple means to do so, by having a thermostat

programmed with the structure's ZIP code, which it provides over the Internet to a weather data provider. (Ex. 1009, 7:19-45, 6:50-61, 2:31-39, 7:58-8:41, 4:40-59)(Ex. 1002, ¶181).

D. Reasonable Expectation of Success

(Programmable Thermostat): For the same reasons as in Ground 1, the PHOSITA would have had a reasonable expectation of success in implementing Hildebrand and Shah with Rosen's programmable thermostat to obtain inside temperatures and to display Hildebrand's evaluation result. (Ex. 1002, ¶¶182-183).

(Internet Weather): A PHOSITA would have had a reasonable expectation of success in receiving and using outside temperature information from Rosen's internet weather service, because doing so merely combines prior art elements according to known methods to yield predictable results (*i.e.*, an internet weather service as a source for outside temperatures), with no unexpected results. *See KSR*, 550 U.S. at 416-421. (Ex. 1002, ¶184).

E. Analogous Art

Rosen is analogous art because it is in the same field as the '394 patent (building energy management and controls), and its methods would have been reasonably pertinent to the problems facing the named inventors. (Ex. 1001, Abstract)(Ex. 1009, 2:1-39)(Ex. 1002, ¶185). *See Wyers*, 616 F.3d at 1238.

F. Claim Mapping

Claims 1 and 10 (and 3/12) are mapped to the prior art in Ground 1, with the

changes to limitations [1c] and [10c] discussed in the Overview. (Ex. 1002, ¶186).

CLAIMS 2 AND 11

“2. The control system of claim 1, wherein the first temperatures are received from a programmable thermostat located inside the structure communicating with the climate control device.”

“11. The method of claim 10, wherein the processor receives the first temperatures from a programmable thermostat located inside the structure communicating with the climate control device.”

Hildebrand and Shah in view of Rosen render obvious these claims for the same reasons as articulated for Ground 1 (and “Motivation” section above), by implementing Hildebrand’s energy management apparatus 2 to include a **programmable thermostat**, or by implementing Hildebrand’s sensor 20 as part of a **programmable thermostat**. (Ex. 1002, ¶187).

Rosen discloses a **programmable thermostat** that is **located inside the structure** and has an indoor temperature sensor 5 for measuring the **first temperatures**. (Ex. 1009, 2:2-6, 1:17-28, 3:3-53, 6:62-7:9, Fig. 1)(Ex. 1002, ¶188). Rosen’s users can also program the thermostat with desired setpoint schedules. (*Id.*).

CLAIMS 4 AND 13

“4. The control system of claim 1, wherein the second temperatures comprise outside air temperatures for a geographic region surrounding the structure measured by one or more sensors positioned remotely from the structure.”

“13. The method of claim 10, wherein the second temperatures comprise outside air temperatures for a geographic region

surrounding the structure measured by one or more sensors positioned remotely from the structure.”

Hildebrand and Shah in view of Rosen renders obvious these claims. (Ex. 1002, ¶189).

Rosen obtains outside temperatures (**second temperatures comprise outside air temperatures**) from an online weather service, and those temperatures are localized to **a geographic region surrounding the structure**, *e.g.*, by ZIP code. (Ex. 1009, 7:19-57)(Ex. 1002, ¶190). Rosen’s “local current weather information” is obviously measured by **one or more sensors positioned remotely from the structure** because they are outside and away from the structure. (Ex. 1009, 4:10-15)(Ex. 1002, ¶190).

It would be obvious for Hildebrand’s **processor** to receive these outside temperatures via Hildebrand’s remote communication unit so that they can be used in efficiency calculations. (Ex. 1004, 4:23-33)(Ex. 1002, ¶191).

CLAIMS 5 AND 14

“5. The control system of claim 2, wherein the programmable thermostat includes a display device, and the result of the evaluation is displayed on the display device of the programmable thermostat.”

“14. The method of claim 11, wherein the programmable thermostat includes a display device, the processor outputs the result of the evaluation in a format to be displayed on the display device of the programmable thermostat.”

Hildebrand and Shah in view of Rosen renders obvious these claims for

similar reasons as articulated for Ground 1. *See, supra*, Ground 1, claim 5. Moreover, Rosen’s **programmable thermostat** includes a liquid crystal display (**a display device**) for displaying outputs of determinations, and it would have been obvious to use it to display the **result of the evaluation in a format to be displayed**. (Ex. 1009, 3:3-17, 4:40-59)(Ex. 1004, 7:63-8:11)(Ex. 1002, ¶192).

Ground 3. Claims 1-3, 5-6, 10-12, and 14-15 are obvious over Hildebrand and Shah in view of Van Ostrand.

Claims 1-3, 5-6, 10-12, and 14-15 are obvious under 35 U.S.C. §103(a) over **Hildebrand and Shah** in view of U.S. Pat. App. Pub. 2005/0159846 A1 (“**Van Ostrand**”)(Ex. 1007). (Ex. 1002, ¶193).

Van Ostrand was made of record in the application leading to the ’394 patent, but was never expressly analyzed or applied in a rejection. (Ex. 1002, ¶194).

A. Effective Prior Art Date of Van Ostrand

Van Ostrand published on July 21, 2005, and is prior art under pre-AIA 35 U.S.C. §102(b).

B. Overview of the Ground

Hildebrand and Shah are applied as set forth under Ground 1 (the entirety of which is incorporated herein), with the following exceptions. (Ex. 1002, ¶¶195-196). It also would have been obvious to use Van Ostrand’s rates of change in inside temperature to suggest which HVAC components are failing with Hildebrand’s

processor and Hildebrand and Shah's teachings of monitoring degradation in operational efficiency to determine when maintenance is needed. (Ex. 1002, ¶197).

1. Overview of Van Ostrand

Van Ostrand infers whether a specific HVAC component is functioning properly, or identifies which component has failed, based on efficiency values calculated as rate of change of the inside temperature (same as in Hildebrand). (Ex. 1007, ¶¶0029-0033, 0007)(Ex. 1002, ¶198).

In Van Ostrand, each heating and cooling device has one or more "stages" of heating and/or cooling capacity. (Ex. 1007, ¶¶0019-0029, Fig. 1 (reproduced below))(See Ex. 1033, 18:8-19:15).

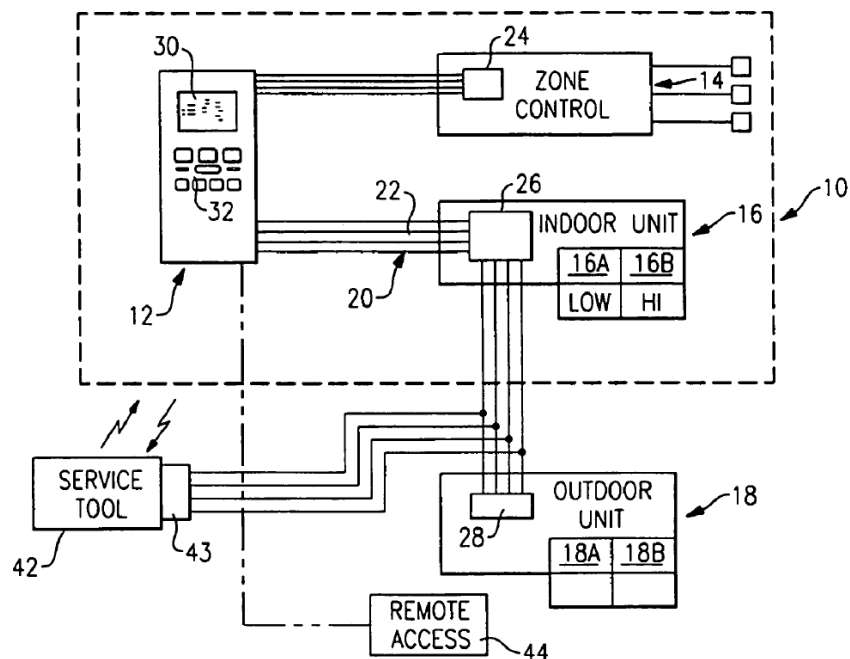


FIG. 1

A single stage might be used for most needs, with additional (usually more

expensive) stages of capacity used for more extreme needs. (Ex. 1007, ¶¶0004)(Ex. 1002, ¶199).

Van Ostrand monitors the rate of change in inside temperature during operation to detect failed HVAC components or stages. (Ex. 1007, ¶¶0006-0007)(Ex. 1002, ¶200). Van Ostrand's "slope to the controlled environment temperature vs. time" is the difference between inside temperatures divided by the span of time between the measurements (*i.e.*, $\Delta T/\Delta t$), or rate of change in inside temperature over a period of time. (Ex. 1007, Figs. 4, 5, ¶¶0029, 0031)(Ex. 1002, ¶200).

Van Ostrand uses this information in multiple ways to monitor HVAC operation. (Ex. 1007, ¶0031)(Ex. 1002, ¶201). Van Ostrand first determines the rate of change of the inside temperature during two time periods, before and after a stage or heating or cooling element is turned on. (*See* Ex. 1007, Figs. 4, 5, ¶¶0029-0031)(Ex. 1002, ¶201). Van Ostrand then compares these rates of change to determine whether a specific HVAC component has failed. (Ex. 1002, ¶201).

In addition to this method, Van Ostrand also "learn[s]" "the amount of change in the rate of change" over time and "[w]hen the system does not respond with the learned capacity, the controller 12 infers that there has been a failure". (Ex. 1007, ¶¶0033, 0029-0031, 0014-0015, Figs. 4, 5)(*see* additional discussion below)(Ex. 1002, ¶202).

C. Motivation (Rationale) for the Combination

A PHOSITA would have been motivated to use Van Ostrand's technique—diagnosing HVAC component failure using rates of change—in Hildebrand, or in Hildebrand-Shah. (Ex. 1002, ¶203).

Hildebrand already monitors temperature data and rate calculations to detect degradation in operational efficiency, and initiates inspection of the HVAC equipment. (Ex. 1004, Abstract, 6:17-64, 7:63-8:20)(Ex. 1002, ¶203).

Van Ostrand's "slope" is the temperature difference divided by time difference (*i.e.*, $\Delta T/\Delta t$). (Ex. 1007, Figs. 4, 5, ¶¶0029, 0031)(Ex. 1002, ¶204). Hildebrand's efficiency values K are the reciprocal of Van Ostrand's slope: the time difference divided by the temperature difference. (Ex. 1004, 6:37-64, 13:50-14:52)(Ex. 1002, ¶¶204-205). A PHOSITA would have found it obvious that either expression is useful as a rate and a measure of efficiency. (Ex. 1002, ¶¶204-205).

A PHOSITA would have recognized that Van Ostrand's teachings are applicable to HVACs having one or more stages. (Ex. 1002, ¶206)(Ex. 1007, ¶¶0019-0020, 0030)(*See* Ex. 1033, 18:8-19:15). Multi-stage systems were commonplace and "typical," and would have been obvious to use in Hildebrand or Hildebrand-Shah. (Ex. 1007, ¶0004)(Ex. 1033, 14:21-15:17)(Ex. 1002, ¶206).

Van Ostrand uses the same information as Hildebrand to diagnose when specific HVAC components or stages have failed. (Ex. 1007, ¶¶0005, 0007, 0033,

0007, 0029-0033, Figs. 4 and 5)(Ex. 1002, ¶¶205, 207). It would have been advantageous to modify Hildebrand or Hildebrand-Shah to calculate an efficiency value (rate of change) for each component or stage, to “learn[]” the capacity of each state of the system,” so that when a component or stage fails, there can be a specific diagnosis. *Id.* This has Van Ostrand’s advantage of specifically diagnosing which stage or component has failed. *Id.*

Furthermore, Van Ostrand’s technique represents a known method that can be used to improve a known system ready for improvement (Hildebrand or Hildebrand-Shah) in a predictable way, without unexpected results. (Ex. 1002, ¶208). It was thus likewise obvious under *KSR*, 550 U.S. at 416-21.

D. Reasonable Expectation of Success

A PHOSITA would have had a reasonable expectation of success in combining Hildebrand, Shah, and Van Ostrand in each of the ways discussed in the Overview and Claim Mapping sections. (Ex. 1002, ¶209). Hildebrand, Shah, and Van Ostrand are software-based systems that use well-known components, and were thus predictable in nature. (*Id.*).

E. Analogous Art

Hildebrand, Shah, and Van Ostrand are analogous art because they are in the same field as the ’394 patent (building energy management and controls), and their methods would have been reasonably pertinent to the problems facing the named

inventors. (Ex. 1004, Abstract)(Ex. 1006, Abstract)(Ex. 1007, Abstract)(Ex. 1001, Abstract)(Ex. 1002, ¶210). *See Wyers*, 616 F.3d at 1238.

F. Claim Mapping

CLAIMS 1, 2, 3, 5, 10, 11, 12 and 14

Hildebrand and Shah are as applied in Ground 1, including use of the same processor (see Ground 1, [1c]) and database (see Ground 1, [1e]) discussed in Ground 1, with the modification that it would have been obvious to use the technique of Van Ostrand in Hildebrand or in Hildebrand-Shah, including by forming and storing rates of change by stage. Van Ostrand compares rates of change in inside temperature to determine whether the HVAC's operational efficiency has decreased over time. (Ex. 1007, ¶¶0007, 0029-0033, claim 12)(Ex. 1002, ¶¶211-212). Van Ostrand's "slope to the controlled environment temperature vs. time curve" is a rate of change in inside temperature. (Ex. 1007, ¶¶0029-0031, 0007)(Ex. 1002, ¶212). Van Ostrand explains:

"The central control 12 monitors the rate of change of a room temperature before and after it turns on the stage. If there is a change in the rate of change of room temperature, it can be inferred that the component is operating. If there is no change in the rate of change, the component can be assumed to be inoperative (FIG. 5)."

(Ex. 1007, ¶0007)(Emphasis added)(Ex. 1002, ¶212).

Van Ostrand's technique—which would have been obvious to use with

Hildebrand or Hildebrand-Shah—**compares a portion of the current operating profile for the climate control device with a stored temperature profile that represents a previous operating profile for the climate control device calculated at a different time to evaluate whether an operational efficiency of the climate control device has decreased over time.** This is because Van Ostrand’s rates of change (the slope of the temperature vs. time curve) are **operating profiles** (both **current** and **previous**) that indicate how the HVAC system “is operating.” (Ex. 1007, ¶¶0031, 0032-0034)(Ex. 1002, ¶213). As shown in Figs. 4-5, Van Ostrand’s **operating profiles** (including the **previous**) are **represent[ed]** by “stor[ed]” rates of change that are slopes of temperature value over time, meaning they are **stored temperature profile[s]**. (Ex. 1007, ¶¶0032, 0029-0031, 0033)(Ex. 1002, ¶213). For example, a “learned” rate of change may be computed by monitoring temperature over time “over a number of cycles.” (Ex. 1007, ¶¶0033, 0032)(Ex. 1002, ¶213).

Alternatively, to the extent necessary, it would have been obvious from Hildebrand and Van Ostrand to use temperature values instead of rates of change values. (Ex. 1002, ¶214). A PHOSITA would have been motivated based on Van Ostrand’s teaching of comparing rate values to compare the number of degrees traversed by the HVAC over a given amount of time because doing so would provide the same information as comparing rate values, with the additional benefit of earlier detection of decreased HVAC efficiency. (Ex. 1002, ¶214). In this case, the

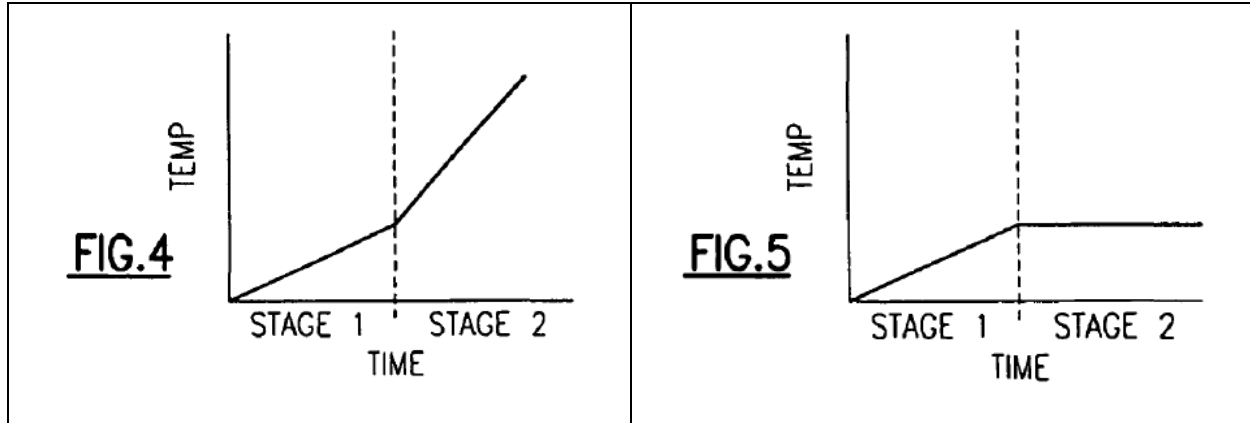
temperature value (represented by the number of degrees traversed in temperature) associated with the ambient temperature (**stored temperature profile**) would be compared in the same manner as Van Ostrand's slopes. (Ex. 1002, ¶¶214-216).

Van Ostrand's **current** and **previous** rates of change (**operating profiles**) are used to **evaluate whether an operational efficiency of the climate control device has decreased over time**. (Ex. 1007, ¶¶0033, 0030-0032, 0029)(Ex. 1002, ¶217). As Van Ostrand explains, its techniques "permit[] a **failure** in any one of several capacity producing components in a system to be found and identified." (Ex. 1007, ¶0030)(Emphasis added). This is performed by **compar[ing]** the presently computed rate of change value to the "learned capacity" of the stage. (Ex. 1007, ¶¶0033, 0029-0032)(Ex. 1002, ¶217). When Van Ostrand identifies a failed component, it removes it from the staging sequence (Ex. 1007, ¶0029) and provides an alert (Ex. 1007, ¶0033) (**outputs a result of the evaluation**). (Ex. 1002, ¶217).

Implementing Hildebrand and Shah's efficiency values as Van Ostrand's slopes also means that **the portion of the current operating profile for the climate control device is limited to a specified first time interval, and the stored temperature profile is limited to a specified earlier second time interval**. (Ex. 1002, ¶218).

For example, Van Ostrand identifies failure of an HVAC's second stage by comparing its slopes, shown in Figs. 4 (normal operation during an **earlier second**

time interval) and 5 (stage 2 malfunctioning during the specified first time interval), below:



Van Ostrand, Fig. 4

Van Ostrand, Fig. 5

(Ex. 1007, ¶¶0014-0015, 0029, 0033)(Ex. 1002, ¶219). The **earlier second time interval** may also be a time period over which the “learned” rate of change was aggregated “over a number of cycles.” (Ex. 1007, ¶0033)(Ex. 1002, ¶219). By monitoring the slope for a change between these two times (evaluati[on] of an operational efficiency... wherein: the portion of the current operating profile for the climate control device is limited to a specified first time interval, and the stored temperature profile is limited to a specified earlier second time interval), Van Ostrand specifically diagnoses the malfunction of Stage 2 (identifies that an operational efficiency of the climate control device has decreased over time) from one time interval to another. (Ex. 1007, ¶¶0029-0031)(Ex. 1002, ¶219).

CLAIM 6

“6. The control system of claim 3, wherein:

[6a] the database stores a plurality of separate diagnostic temperature profiles associated with a plurality of potential defects identified by changes in the operational efficiency of the climate control device over time; and”

The combination of Hildebrand, Shah, and Van Ostrand renders obvious this limitation. (Ex. 1002, ¶220). As explained in the “Overview” Section, Van Ostrand’s heating/cooling device can have one or more components or “stages” of capacity, where any component (including heating or cooling equipment) or stage can individually fail (**a plurality of potential defects**). (Ex. 1007, ¶¶0019-0030)(Ex. 1002, ¶220).

Van Ostrand “learns” each component/stage’s rate of change (**a plurality of separate diagnostic temperature profiles**), which is **store[d]** in memory. (Ex. 1007, Figs. 4, 5, ¶¶0006-0007, ¶¶0029, 0031, 0033 (discussing “learned capacity”), claims 12-17)(Ex. 1002, ¶221). Each rate is a **temperature profile** because it represents a change in inside temperature over time, and is **diagnostic** because it is used to detect failure of a specific component or stage. (Ex. 1002, ¶221). The rates are therefore also **associated with a plurality of potential defects**, because they are used to identify which component (including the heating or cooling equipment)(see Ex. 1004, 2:2-7, 6:41-64, 7:45-62) or stage has potentially failed, where each component or stage’s potential failure is a **potential defect** of the system. (Ex. 1002, ¶221).

In Hildebrand or Hildebrand-Shah, it would have been obvious to **store** these

profiles in Hildebrand's table in memory (**the database**, see element [1e]). (Ex. 1002, ¶222). Van Ostrand's rates of change are stored. (Ex. 1007, claims 12-17). It would have been obvious to store them in a database to track and organize them for later use in comparisons to detect degradations in efficiency. (Ex. 1002, ¶222).

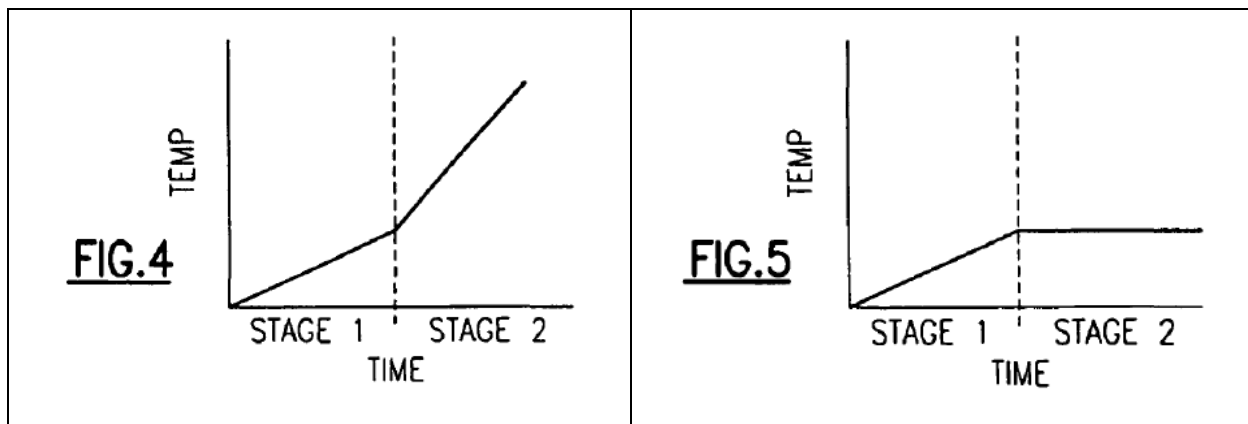
It would have been obvious to implement Hildebrand and Shah's efficiency or τ values as Van Ostrand's rates of change for each component/stage, where the failed components (including the heating or cooling equipment) or stages are **identified by changes in the operational efficiency of the climate control device over time**. (See Ex. 1004, 2:2-7, 6:41-64, 7:45-62)(Ex. 1002, ¶223). The "amount of change in the rate of change is learned" over time for each properly functioning component/stage, and then, the component/stage's potential failure (a **potential defect**) is **identified** "[w]hen the system does not respond with the learned capacity" (**changes in the operational efficiency of the climate control device over time**) at a later time. (Ex. 1007, ¶¶0033, 0030-0032)(Ex. 1002, ¶223).

"[6b] the processor identifies one or more of the potential defects based on the evaluation of the operational efficiency of the climate control device between the specified first time interval and the specified earlier second time interval."

The combination of Hildebrand, Shah, and Van Ostrand renders obvious this limitation. (Ex. 1002, ¶224). Van Ostrand compares a slope corresponding to a component or stage at different times to determine whether that component or stage

has failed. (Ex. 1007, ¶¶0014-0015, 0029-0031)(Ex. 1002, ¶224). Using Hildebrand's processor (see Ground 1, [1c]), implementing Hildebrand and Shah's efficiency values as Van Ostrand's slopes means that comparison is **the evaluation of the operational efficiency of the climate control device between the specified first time interval and the specified earlier second time interval**. (Ex. 1002, ¶224).

For example, Van Ostrand identifies failure of an HVAC's second stage by comparing its slopes, shown in Figs. 4 (normal operation during an **earlier second time interval**) and 5 (stage 2 malfunctioning during the **specified first time interval**), below:



Van Ostrand, Fig. 4

Van Ostrand, Fig. 5

(Ex. 1007, ¶¶0014-0015, 0029, 0031)(Ex. 1002, ¶225). By monitoring the slope for a change between these two times (**evaluation of the operational efficiency... between the specified first time interval and the specified earlier second time interval**), Van Ostrand specifically diagnoses Stage 2's malfunction (**identifies one**

or more of the potential defects) from one time interval to another. (Ex. 1007, ¶¶0029-0031)(Ex. 1002, ¶225).

CLAIM 15

“15. The method of claim 12, wherein:

[15a] the database stores a plurality of separate diagnostic temperature profiles associated with a plurality of potential defects identified by changes in the operational efficiency of the climate control device over time; and”

See claim element [6a]. (Ex. 1002, ¶226).

“[15b] the processor identifies one or more of the potential defects based on the evaluation of the operational efficiency of the climate control device between the specified first time interval and the specified earlier second time interval.”

See claim element [6b]. (Ex. 1002, ¶227).

Ground 4. Claims 1-6 and 10-15 are obvious over Hildebrand, Shah, Rosen and Van Ostrand.

Grounds 1-3 are fully incorporated herein. Claims 1-6 and 10-15 are further obvious under 35 U.S.C. §103(a) in view of the combination of Hildebrand, Shah, Rosen, and Van Ostrand, which are applied as set forth above. A PHOSITA would have been motivated to combine Hildebrand, Shah, Rosen, and Van Ostrand and would have had a reasonable expectation of success in using the combination for the reasons set forth above. (Ex. 1002, ¶228). The addition of Van Ostrand does not

change how a PHOSITA would consider the combination of Hildebrand, Shah, and Rosen (as set forth in Ground 2) nor the addition of Rosen to the combination of Hildebrand, Shah, and Van Ostrand (as set forth in Ground 3). (Ex. 1002, ¶228).

Ground 5. Claims 7-9 and 16-18 are obvious over Hildebrand, Shah, Rosen, and Van Ostrand, further in view of McNulty

Claims 7-9 and 16-18 are obvious under 35 U.S.C. §103(a) over **Hildebrand and Shah, Rosen, and Van Ostrand**, further in view of further in view of U.S. Pat. App. Pub. 2011/0251726 A1 (“**McNulty**”). (Ex. 1024)(Ex. 1002, ¶229).

McNulty was not of record in the application leading to the ’394 patent. (Ex. 1002, ¶230).

A. Effective Prior Art Date of McNulty

McNulty is a U.S. patent application publication that published from a national stage of a PCT application filed on May 3, 2007, which designated the US and published in English and is prior art under pre-AIA 35 U.S.C. §102(e). (Ex. 1038).

B. Overview of the Ground and Motivation (Rationale) for the Combination

Hildebrand, Shah, Rosen, and Van Ostrand are applied as set forth under Grounds 1-4, (the entireties of which are incorporated herein) as to independent claims 1/10 and dependent claims 4/13, from which claims 7-9 and 16-18 respectively depend. (Ex. 1002, ¶¶231-232). It also would have been obvious to

modify an operating interval of the device during the process of setback recovery in view of an evaluation of operational efficiency according to Van Ostrand’s teachings and further, it would be obvious to take into account forecasted outside temperatures in doing so per Rosen and McNulty. (Ex. 1002, ¶233).

The motivation to make the proposed modifications is detailed in the claim-mapping section. (Ex. 1002, ¶234).

C. Overview of McNulty

McNulty teaches a climate control system in which “predicted weather conditions may be provided from [an] external source via the internet” and “predicted values from the weather forecast” can be used to predict how the temperature inside the structure will behave under such conditions (“the [inside] temperature sometime into the future can be predicted”) in order to calculate control parameters such as “optimal start times and stop times” for a heating/cooling system. (Ex. 1024, ¶¶0054, 0063, 0014, 0027)(Ex. 1002, ¶235).

D. Reasonable Expectation of Success

A PHOSITA in the relevant timeframe would have had a reasonable expectation of success in combining Hildebrand, Shah, Rosen, Van Ostrand, and McNulty in each of the ways discussed in the Overview and Claim Mapping sections. (Ex. 1002, ¶236). McNulty is a software-based system that uses well-known components, and was thus predictable in nature. (*Id.*). Furthermore,

McNulty's techniques represent known methods that can be used to improve a known system ready for improvement in a predictable way, without unexpected results. (Ex. 1002, ¶236). It was thus likewise obvious under *KSR*, 550 U.S. at 416-21.

E. Analogous Art

Hildebrand, Shah, Rosen, Van Ostrand, and McNulty are analogous art because they are in the same field as the '394 patent (building energy management and controls), and their methods would have been reasonably pertinent to the problems facing the named inventors. (Ex. 1004, Abstract)(Ex. 1006, Abstract)(Ex. 1007, Abstract)(Ex. 1009, Abstract)(Ex. 1024, Abstract)(Ex. 1002, ¶237)(Ex. 1001, Abstract). *See Wyers*, 616 F.3d at 1238.

F. Claim Mapping

CLAIMS 7 and 16

“7. The control system of claim 4, wherein another temperature profile is developed and stored as a prediction of a coming change in the second temperatures.”

“16. The method of claim 13, wherein another temperature profile is developed and stored as a prediction of a coming change in the second temperatures.”

These claims are obvious in view of the combination of Hildebrand, Shah, Van Ostrand, and Rosen, further in view of McNulty. (Ex. 1002, ¶238).

See Ground 2, claims 4/13. Rosen’s “local weather” includes current outside temperatures as well as forecasted outside temperatures (**another temperature profile is developed**) at a “time into the future” (**a prediction**). (Ex. 1009, 7:19-57, 2:9-12, 6:28-44). For example, Rosen teaches receiving “a predicted significantly low temperature,” which is a **prediction of a coming change in the second temperatures**. (*Id.*, 6:32-44)(Ex. 1002, ¶239).

McNulty similarly teaches that “predicted weather conditions may be provided from [an] external source via the internet” (**another temperature profile is developed**) and discloses that that “predicted values from the weather forecast” (**prediction[s] of a coming change in the second temperatures**) can be used to predict how the temperature inside the structure will behave under such conditions (“the [inside] temperature sometime into the future can be predicted”) in order to calculate control parameters such as “optimal start times and stop times” for a heating/cooling system. (Ex. 1024, ¶¶0054, 0063, 0014, 0027)(Ex. 1002, ¶240).

It would be obvious in view of Rosen and McNulty to **store[]** such forecasted outside temperatures **as a prediction**, in order to use those forecasted temperatures to make predictive determinations using these values, including using the forecasted temperatures to make changes to the operation of the system which take into account the **coming changes in second [outside] temperatures**. (Ex. 1009, 6:28-44, 2:9-12)(Ex. 1024, ¶¶0054, 0063, 0014, 0027)(*see* claims 8/17, *infra*)(Ex. 1002, ¶241).

To the extent that the claimed **another temperature profile** must represent an operating profile of the climate control device and/or must represent changes in indoor temperature over time, (*see* claim 1), this claim element is also obvious over the combination. (Ex. 1002, ¶242). Specifically, it would have been obvious to use forecasted outside temperatures in the computations of Hildebrand/Shah/Van Ostrand in place of current or previous outside temperatures in order to **develop and store a prediction** of how the inside temperature will behave in the future under forecasted outside temperature conditions (**a coming change in the second temperatures**)(Ex. 1009, 6:28-44, 2:9-12)(Ex. 1024, ¶¶0054, 0063, 0014, 0027)(Ex. 1002, ¶242).

CLAIMS 8 and 17

“8. The control system of claim 7, wherein the processor references the evaluation of the operational efficiency of the climate control device to modify an operating interval for the climate control device based on the prediction.”

“17. The method of claim 16, wherein the processor references the evaluation of the operational efficiency of the climate control device to modify an operating interval for the climate control device based on the prediction.”

These claims are obvious in view of the combination. (Ex. 1002, ¶243).

First, it would be obvious for the **claimed processor** to **reference[] the**

evaluation of the operational efficiency of the climate control device.⁸ It would be obvious to take into account the previously determined **evaluation** in order to decide whether and how to **modify an operating interval for the climate control device,**⁹ as specifically taught by Van Ostrand. (Ex. 1002, ¶244). Van Ostrand teaches **modifying an operating interval for the climate control device** when an **evaluation of the operational efficiency of the climate control device** indicates certain changes. (Ex. 1002, ¶245). Van Ostrand specifically discloses **referenc[ing] of the evaluation of the operational efficiency of a climate control device** component or stage to be used during setback recovery. (Ex. 1007, ¶0035)(*See also* Ex. 1006, 1:7-3:20)(Shah discussing setback recovery)(Ex. 1004, 1:58-2:10, 8:33-50)(Hildebrand discussing setback recovery)(Ex. 1024, ¶0057)(McNulty discussing setback recovery)(Ex. 1002, ¶245). Van Ostrand teaches that based on **the evaluation**, the system modifies the necessary recovery time by modifying the time at which a stage or component is turned on (an **operating interval**) to begin recovery

⁸ Petitioner assumes for the purposes of this proceeding that “**the evaluation**” refers to claim 1’s **evaluat[ion]**. (Ex. 1002, ¶244).

⁹ Petitioner assumes for the purposes of this proceeding that this claim language refers to affecting or changing the operation of the climate control device during or over some duration of time. (Ex. 1002, ¶244).

to a comfort temperature. (Ex. 1007, ¶0035)(Ex. 1002, ¶245).

It would also be obvious for this modification of an **operating interval** to be **based on the prediction**. (Ex. 1002, ¶246).¹⁰ As Van Ostrand states, the goal of a setback recovery is to “achieve a designated [indoor] temperature at a desired time.” (Ex. 1007, ¶0035). Setback recovery can involve the prediction of how the indoor temperature will change in advance of a desired time in the future. (*See, e.g.*, Ex. 1006, 5:10-14, 2:47-67)(Ex. 1002, ¶246). McNulty specifically teaches that “predicted values from the weather forecast” can be used to “estimate[]” “optimal start times and stop times” for a heating/cooling system. (Ex. 1024, ¶0063)(*See also* Ex. 1024, ¶0057)(Ex. 1002, ¶246). It would be obvious to utilize a forecast of the outdoor temperature to develop more accurate predicted rates of change of indoor temperature (**operating profile[s]**) which take into account expected future outside temperatures, in order to predict more accurate future recovery times, (the time needed to return to a comfortable temperature after an energy-saving setback in temperature) and thereafter modify the time at which the recovery period begins. (Ex. 1007, ¶0035)(Ex. 1024, ¶¶0054, 0063, 0014, 0027, 0057)(Ex. 1009, 6:28-44,

¹⁰ Petitioner assumes for the purposes of this proceeding that “**the prediction**” refers to claim 7’s **prediction of a coming change in the second temperatures**. (Ex. 1002, ¶246).

2:9-12)(Ex. 1002, ¶246).

CLAIMS 9 and 18

“9. The control system of claim 8, wherein the processor modifies at least one of (a) an ‘on’ or an ‘off’ time for the climate control device, and (b) an ‘on’ or an ‘off’ temperature for the climate control device.”

“18. The method of claim 17, wherein the processor modifies at least one of (a) an ‘on’ or an ‘off’ time for the climate control device, and (b) an ‘on’ or an ‘off’ temperature for the climate control device.”

These claim elements are obvious from the combination. (Ex. 1002, ¶247). Modification of the time at which recovery is scheduled to begin (*see* claims 8/17) is **modifi[cation] of an “on” time for the climate control device** and modification of the time at which the climate control device stops running is an **“off” time**. (Ex. 1002, ¶247). A PHOSITA would readily recognize that this modification can also be implemented by changing the setpoint (both **an “on” temperature and an “off” temperature**) at a particular time so that the system begins to recover to ultimately achieve that setpoint temperature. (Ex. 1002, ¶247).

Furthermore, Hildebrand teaches that users may change (**modif[y]**) “via operator control” the “desired temperature setpoint” of the climate control device, and that changes are implemented using microprocessor 4 (**the processor**). (Ex. 1004, 4:64-5:10)(Ex. 1002, ¶248). For example, Hildebrand teaches the conventional functionality to “each morning... to bring the temperature for a

controlled zone from its more energy conserving nighttime level to its more comfortable daytime level.” (Ex. 1004, 1:54-57, 8:25-50)(Ex. 1002, ¶248). Every daytime setpoint obviously includes at least an **“on” time for the climate control device**, and (b) an **“off” temperature for the climate control device**, while every nighttime setpoint obviously includes at least an **“off” time** and (b) an **“on” temperature**. (Ex. 1002, ¶248).

III. NO DISCRETIONARY DENIAL

The Board should not exercise its discretion to deny the petition under 35 U.S.C. §325(d). *See Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte G.m.b.H.*, IPR2019-01469, Paper 6, at *8-9 (PTAB Feb. 13, 2020) (precedential). Hildebrand, Shah and McNulty were not of record during the application leading to the ’394 patent. *See Advanced Bionics* at *8-9. While Rosen and Van Ostrand were of record, they were not cited or applied in a rejection.

Nor should the Board deny the petition under 35 U.S.C. §314(a). *See Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential)(“*Fintiv*”).

The *Fintiv* factors weigh in favor of institution:

Factor 1. Google intends to move for a stay pending *inter partes* review, should the review be instituted.

Factor 2. The district court case against Google does not have a trial date,

and is still in early stages. No claim construction briefing has taken place and no expert reports have been served. Petitioner also filed this Petition after receiving EcoFactor’s amended infringement contentions on September 6, 2024.

Factor 3. Because the district court case against Google is in the early stages, the parties and the court have invested very little in the proceeding. (Ex. 1032).

Factor 4. Because the district court case against Google is in the early stages, it is too early to say what the extent of overlap at trial will be.

Factor 5. Google is a party to the parallel litigation.

Factor 6. The petition’s merits are compelling, and the Board should institute on this basis alone.

IV. CONCLUSION

Petitioner respectfully requests that claims 1-18 of the ’394 patent be canceled.

Date: <u>November 1, 2024</u>	<u>/Matthew A. Smith/ (RN 49,003)</u> Matthew A. Smith Matthew A. Smith Reg. No. 49,003 SMITH BALUCH LLP 700 Pennsylvania Ave. SE Second Floor Washington, D.C. 20003 (202) 669-6207 smith@smithbaluch.com <i>Counsel for Petitioner Google LLC</i>
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CERTIFICATE OF SERVICE

The undersigned hereby certifies that the foregoing petition for *inter partes* review, together with all exhibits and other documents filed therewith, was served by Express Mail on November 1, 2024, on the Patent Owner's counsel of record at the United States Patent & Trademark Office having the following address:

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Date: November 1, 2024

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CERTIFICATE OF WORD COUNT

The undersigned hereby certifies that the foregoing petition for *inter partes* review contains 13,998 words according to the word processing program used to prepare it.

Date: November 1, 2024

/Matthew A. Smith/ (RN 49,003)