## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent of Hidetoshi Kitanaka
U.S. Patent No. 8,278,855

Filed: October 29, 2007
Issued: October 2, 2012
Title: CONTROLLER OF MOTOR PREVENTING AN INCREASE IN INVERTER LOSS

| $\S$ Request for Ex Parte Reexamination |
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| $\S$ Attorney Docket No. NEX855 |
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| $\S$ Customer No. 165774 |
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## REQUEST FOR EX PARTE REEXAMINATION <br> UNDER 35 U.S.C. §§ 302-306

Mail Stop Ex Parte Reexam
Hon. Commissioner for Patents
P.O. Box 1450

Alexandria, VA 22313-1450
Dear Sir:
Pursuant to the provisions of 35 U.S.C. §§ 302-306, Unified Patents, LLC ("Requester") hereby requests an ex parte reexamination of claims 1-2, 5-10, and 13 ("Challenged Claims") of U.S. Patent No. 8,278,855 ("the '855 patent," EX1001) that issued on October 2, 2012, to Hidetoshi Kitanaka, resulting from U.S. Patent Application No. 12/675,159, which entered the U.S. national stage on February 25, 2010 and was filed as PCT application PCT/JP2007/071017 on October 29, 2007.

Requester hereby asserts that the Challenged Claims of the ' 855 patent are invalid over prior art grounds and arguments that were not previously before the Patent Office. Requester submits that this Request presents prior art references and analysis that are non-cumulative of the prior art that was before the Examiner during the original prosecution of the ' 855 patent and raise substantial new questions of patentability, and that the Challenged Claims are invalid over these references. Requester therefore requests that an order for reexamination and an Office Action rejecting the Challenged Claims be issued.

## Ex Parte Patent Reexamination Filing Requirements

Pursuant to 37 C.F.R. § 1.510 (b)(1), statements pointing out at least one substantial new question of patentability based on material, non-cumulative references for the Challenged Claims of the ' 855 Patent are provided in Section II of this Request.

Pursuant to 37 C.F.R. § $1.510(\mathrm{~b})(2)$, reexamination of claims 1-2, 5-10, and 13 of the ' 855 Patent is requested, and a detailed explanation of the pertinence and manner of applying the cited references to the Challenged Claims of the '855 Patent is provided in Section III of this Request. The material and analysis in the request are fully supported by the expert testimony of Dr. Baker (EX1003).

Pursuant to 37 C.F.R. § $1.510(b)(3)$, copies of every patent or printed publication relied upon or referred to in the statement pointing out each substantial new question of patentability or in the detailed explanation of the pertinence and manner of applying the cited references are provided as Exhibits 1004-1005 of this Request.

Pursuant to 37 C.F.R. $\S 1.510(b)(4)$, a copy of the ' 855 Patent is provided as EX1001 of this Request, along with a copy of any disclaimer, certificate of correction, and reexamination certificate issued corresponding to the patent.

Pursuant to 37 C.F.R. § $1.510(\mathrm{~b})(5)$, the attached Certificate of Service indicates that a copy of this Request, in its entirety, has been served on the Patent

Owner at its correspondence address of record in the patent file of the ' 855 Patent, in accordance with 37 C.F.R. § 1.33(a) and (c):

21839 - BUCHANAN, INGERSOLL \& ROONEY PC 1737 KING STREET<br>SUITE 500<br>ALEXANDRIA, VA 22314-2727<br>UNITED STATES

Also submitted herewith is the fee set forth in 37 C.F.R. § 1.20(c)(2).
Pursuant to 37 C.F.R. § 1.510 (b)(6), Requester hereby certifies that the statutory estoppel provisions of 35 U.S.C. § 315(e)(1) and 35 U.S.C. § 325(e)(1) do not prohibit Requester from filing this ex parte patent reexamination request.

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## I. CERTIFICATION REGARDING ESTOPPEL

In accordance with 37 C.F.R. § 1.510(b)(6), Requester hereby certifies that the estoppel provisions of 35 U.S.C. § 315(e)(1) or 35 U.S.C. § 325(e)(1) do not prohibit Requester from filing this ex parte reexamination request. Requester has not
previously challenged the ' 855 patent and has not been involved in any proceeding involving the ' 855 patent.

## II. STATEMENT POINTING OUT SUBSTANTIAL NEW QUESTIONS OF PATENTABILITY

Prior to describing the substantial new questions of patentability presented in this Request, provided below is an overview of the ' 855 patent, a discussion of claim construction, and a listing of the prior art being discussed in the present Request.

## A. Overview of the ' $\mathbf{8 5 5}$ Patent

The '855 patent is generally directed to a "power conversion device to drive an alternating-current motor for an electric vehicle." EX1001, Abstract. The patent explains that conventional control systems for electric vehicle motors include a "maximum-torque/current control for generating a maximum torque at a certain current and a maximum efficiency control for maintaining maximum efficiency of the motor." Id., 1:31-35. Such control methods include "a torque current (a q-axis current) and a magnetic-flux current (a d-axis current) [that] are adjusted to optimum values corresponding to rotation speed of the motor and a magnitude of an output torque." Id., 1:45-49. Inverters, such as those that include "high-withstand switching element[s]," can be in such systems to deliver voltage to the motor. Id., 1:45-67. However, such switching elements may suffer from "a large switching loss and a large conduction loss" when they are driven at high frequencies (e.g., over 1200 hertz) and consequently may require a significant "cooler constituted by a radiator
and a cooling fan to cool down the loss." Id., 1:45-2:12, 2:59-65. Such a cooler may be problematic as it may prevent the power conversion device from being "a small size, light weight, or at a low cost." Id., 2:65-67. Thus, the ' 855 patent describes a "controller of a motor to make it possible to configure a cooler in a small size, light weight, and at a low cost while avoiding size increase, in configuring a power conversion device to drive a motor for an electric vehicle." Id., 3:1-6. An example of such a controller is shown in Figure 1, reproduced below.

FIG. 1


EX1001, Fig. 1

As shown by Figure 1, controller 100 receives an "input of a torque command T* from an external controller," and controller 100 is "configured to control the inverter 2 so that a generation torque T of the motor 6 corresponds to the torque command T*." EX1001, 4:59-63, Fig. 1. Specifically, current-command generating unit 10 generates a " d -axis current command id * and a q -axis current command iq* from the torque command $\mathrm{T}^{*}$ input from the outside and from the inverter output angular frequency $\omega$." Id., 5:6-10. For example, "as a generation method, there are optimum control methods based on the maximum-torque/current control for generating a maximum torque at a certain current, and a maximum efficiency control for maintaining maximum efficiency of the motor, and the like. These optimum control methods are systems of adjusting an actual current of the motor 6 to match an optimum torque current command (the q -axis current command iq *) and a magnetic-flux current command (the d-axis current command id *) obtained by storing beforehand in arithmetic expressions and tables by using the rotation speed and magnitude of an output torque of the motor as parameters." Id., 6:314 (emphasis added).

D-axis-current control unit 20 generates a " d -axis current error pde" by "conducting a proportional-integral controlling of a difference between the d-axis current command id* and the d-axis current" and " q -axis- current control unit 23 " generates a " $q$-axis current error pqe" by "proportional-integral control[] [of] a
difference between the q -axis current command $\mathrm{iq}^{*}$ and the q -axis current." Id., 5:10-16. Q-axis decoupling calculator 21 calculates a " $q$-axis feed-forward voltage vqFF from the d -axis current command id* and from the inverter-output angular frequency $\omega$ " and d-axis decoupling calculator 22 that calculates a " d -axis feed forward voltage vdFF from the q -axis current command iq* and from the inverteroutput angular frequency $\omega$. Id., 5:16-22. Modulation factor calculator 30 "calculates a modulation factor PMF" from (1) a d-axis voltage command $\mathrm{vd}^{*}$," that is a "sum of the d-axis current error pde and the d-axis feedforward voltage vdFF," (2) a "a q-axis voltage command $v q$ *," that is "a sum of the $q$-axis current error pqe and the q -axis feedforward voltage vqFF ," (3) the reference phase angle $\theta e$, and (4) a voltage EFC of the voltage detector 8. Id., 5:22-28. Controlphase angle calculator 40 calculates a "control phase angle $\theta$ " from d-axis voltage command $\mathrm{vd}^{*}, \mathrm{q}$-axis voltage command $\mathrm{vq}^{*}$, and the reference phase angle $\theta e . I d$., 5:28-34. Voltage- command/PWM-signal generating unit 50 then generates gate signals $\mathrm{U}, \mathrm{V}, \mathrm{W}, \mathrm{X}, \mathrm{Y}$, and Z from the modulation factor PMF and the control phase angle $\theta$, and these signals are output to inverter 2. Id., 5:34-37. According to these signals, "switching elements that are embedded in the inverter 2 are controlled by PWM (Pulse Width Modulation)" such that inverter 2 "converts a direct current voltage of the capacitor 1 to an alternating current voltage of an arbitrary frequency"
and outputs this voltage to motor 6 so that "generation torque T of the motor 6 corresponds to the torque command $\mathrm{T}^{*}$." Id., 4:28-32, 4:52-63.

The functionality of controller 100 is further explained with reference to Figures 4 and 6, reproduced below.


$$
\text { EX1001, Fig. } 4
$$

As shown by Figure 4, at operation times (1) to (3), "inverter 2 is started, and a voltage is applied to the motor 6 to start acceleration." EX1001, 10:45-49, 13:3541. Between times (1) and (2) "torque command $T^{*}$ is increased from 0 to 1300 Nm in a ramp form" and "output current of the inverter 2" (also referred to as "inverter current IA") is "increased from 0 ampere to 180 amperes in a ramp form," where this current "is equal to a current of the motor 6." Id.; id., 10:49-55. Once the torque command T* reaches 1300 NM, the inverter current IA is controlled at a constant value of 180 amperes and the motor 6 is accelerated by outputting a constant torque until the operation time (3), and the modulation factor PMF of inverter 2 increases in proportion to the inverter output frequency. $I d$., 10:55-61. When the modulation factor PMF becomes 0.785 or more at operation time (2)-1, a pulse mode of the inverter 2 is changed from asynchronous to synchronous pulse mode; from operation time (2) to (2)-1, inverter current IA and switching frequency are constant, making inverter loss P (sum of a conduction loss and a switching loss) constant. Id., 11:313. However, at operation time (2)-1, pulse mode of inverter 2 becomes synchronous three-pulse mode and switching frequency is reduced to a value synchronous with three times the inverter output frequency; thus, inverter loss decreases. Id. From operation time (2)-1 to (3), the pulse mode of inverter 2 is synchronous three-pulse mode and switching frequency increases synchronously with the increase of the
inverter output frequency; along with the increase in switching frequency, inverter loss P increases. Id., 11:14-19. Between operation points (3) and (4), modulation factor PMF becomes 1.0 and a magnitude of output voltage of inverter 2 reaches a ceiling at a maximum value determined by the input voltage. Here, torque command T* is controlled to be reduced to maintain maximum torque/current control and inverter current IA is also reduced along with this control. Id., 11:28-38.

At operation time (4), torque command T* is "squeezed" and thereafter, at time (6) the torque command $\mathrm{T}^{*}$ is set to zero. This mode "assumes a case of reducing the torque command $\mathrm{T}^{*}$ because the speed of an electric vehicle has been sufficiently increased, or a case of stopping the inverter 2 by reducing the Torque $\mathrm{T}^{*}$ to stop acceleration of the electric vehicle." EX1001, 13:42-48. Using this control, "inverter current IA also decreases toward zero" and the modulation factor PMF is "maintained as 1.0 " so the pulse mode "remains in the one-pulse mode," which allegedly differs from a conventional technique cited by the patent. Id., 13:49-58. Specifically, from operation time (4) to (5), the pulse mode remains in the one-pulse mode and inverter current IA decreases, which causes the conduction loss and switching loss of inverter 2 to decrease. Id., 13:59-64.

FIG. 4


EX1001, Fig. 4

This function allegedly differs from a conventional technique cited by the patent, where at operation time (4), the pulse mode is changed from one-pulse mode to the synchronous three phase mode. Id., 12:26-32, 12:48-52, Fig. 6.


EX1001, Fig. 6

Instead, as shown by Figure 4, at operation time (5) the pulse mode is changed over from one-pulse mode to the synchronous three phase mode, and between operation times (5) and (6) inverter current IA decreases toward zero, causing inverter loss to also decrease. Id., 14:4-24.

With reference to Figure 5 (alleged invention), at time (4) the current command is calculated to maintain a path along the voltage limit curve for as long as possible (until Id $=0$ ). Accordingly, the PMF remains at 1 because the output voltage of the inverter is maintained at a maximum as shown in Equation (9) (PMF $\left.=\mathrm{Vd}^{*} / \mathrm{Vdmax}\right)$, and the pulse mode is maintained in one-pulse mode.

FIG. 5


EX1001, Fig. 5, annotated

In contrast, as shown below, the conventional technique (Figure 7) cited by the patent generates a current command that follows the minimum current condition curve at time (4) to time (5). Thus, following the minimum current condition curve leads to a current command that causes the PMF to decrease below 1, which causes a mode switch driving up the switching frequency and increasing the inverter loss.

FIG. 7


EX1001, Fig. 7, annotated

Claim 1 is attempts to capture this operational aspect of the ' 855 patent in an apparatus claim, but is broader in scope. Specifically, claim 1 recites:
[1a-preamble] A controller of a motor comprising:
[1b] a voltage-command generating unit that generates a pulse-width modulation signal to control a switching element provided in an inverter, to the inverter [1c] connected to a direct-current power source and outputting a three-
phase alternating current of an arbitrary frequency and an arbitrary voltage to an alternating-current motor; and
[1d] a current-command generating unit that generates and outputs a current command to cause the alternating-current motor to generate torque based on an input torque command,
[1e] wherein the current-command generating unit is configured to output the current-command that is calculated based on a relationship between the torque command and a state quantity of the alternating-current motor,
[1f] to maintain a terminal voltage of the alternating-current motor to a maximum value that can be generated under the direct current power source, and
[1g] to output a current command adjusted to maintain or decrease a loss of the inverter under a predetermined condition in which the loss of the inverter increases or estimated to increase.

## B. Prosecution History and Reasons for Allowance

The ' 855 patent issued from U.S. Patent Application No. 12/675,159, which entered the U.S. national stage on February 25, 2010 and was filed as PCT application PCT/JP2007/071017 on October 29, 2007.

No rejections issued during prosecution of the ' 855 patent. Instead, when the application entered the U.S. national stage, the applicant filed a substitute
specification and preliminary amendments to the claims. EX1002, 325-332, 354. While the applicant stated the claim amendments were to "correct minor informalities" (id., 354), the amendments to claim 1 were substantive as shown below: ${ }^{1}$

A controller of a motor comprising:
a voltage-command generating unit that generates a pulse-width modulation signal to control a switching element provided in an inverter, to the inverter connected to a direct- current power source and outputting a three-phase alternating current of an arbitrary frequency and an arbitrary voltage to an alternating-current motor; and
a current-command generating unit that generates and outputs a current command to cause the alternating-current motor to generate torque based on an input torque command, wherein
the current-command generating unit is adjusted not to configured to output the current-command that is calculated based on a relationship between the torque command and a state quantity of the alternating-current motor, to maintain a terminal voltage of the alternating-current motor to a

[^0]maximum value that can be generated under the direct-current power source, and to output a current command adjusted to maintain or decrease inerease a loss of the inverter under a predetermined condition in which the loss of the inverter increases or estimated to increase, and outputs a current command to cause the alternating current motor to generate a torque based on the terque command.

EX1002, 325
The applicant thereafter filed multiple Information Disclosure Statements (See, e.g., EX1002, 371-448) and a Notice of Allowance issued, indicating that the pending claims were allegedly allowable because "the Prior Art does not teach the current-command generating unit is configured to output the current-command that is calculated based on a relationship between the torque command and a state quantity of the alternating-current motor, to maintain a terminal voltage of the alternating-current motor to a maximum value that can be generated under the directcurrent power source, and to output a current command adjusted to maintain or
decrease a loss of the inverter under a predetermined condition in which the loss of the inverter increases or estimated to increase" as recited by claim 1. EX1002, 456. ${ }^{2}$

But these aspects of claim 1 (as well as the rest of the Challenged Claims) were not new and are taught by the prior art discussed herein.

## C. Priority Date of the ' $\mathbf{8 5 5}$ Patent

The '855 patent issued from U.S. Patent Application No. 12/675,159, which entered the U.S. national stage on February 25, 2010 and was filed as PCT application PCT/JP2007/071017 on October 29, 2007. This Request treats the ' 855 patent's priority date as October 29, 2007, but does not concede that the patent is indeed entitled to this priority date. Accordingly, the pre-AIA statutory framework applies.

## D. Level of Ordinary Skill in the Art

A person of ordinary skill in the art ("POSITA") at the time of filing of the ' 855 patent (EX1001) would have had at least the equivalent of a Bachelor's degree

[^1]in electrical engineering or a related subject and two or more years of experience in the field of power electronics. Less work experience may be compensated by a higher level of education, such as a Master's Degree, and vice versa. EX1003, $\mathbf{9} 9440-$ 43.

## E. Claim Construction

The '855 Patent is not expired. Thus, this Request analyzes the Challenged Claims according to their broadest reasonable interpretation in light of the specification. MPEP 2258 § I.G. For purposes of this Request, all terms should be interpreted in accordance with their broadest reasonable interpretation and a specific construction is not necessary for any claim term. No express construction is necessary to show the unpatentability of the claims. See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co., 868 F.3d 1013, 1017 (Fed. Cir. 2017) (construing terms "only to the extent necessary to resolve the controversy"); MPEP 2111.01; EX1003, $\boldsymbol{\text { ब }} 44$.

The '855 patent is involved in two pending district court matters. See Section V. At the time of this Request's filing, to the best of Requester's knowledge, no district court has issued a claim constriction order in any of these cases.

## 1. Means Plus Function

Because the Challenged Claims do not recite the term "means," the claim terms are not presumed to be "means-plus-function" terms that invoke 35 U.S.C.
§112 (\$6). In addition, the Examiner did not identify any terms that invoked means-plus-function analysis during prosecution. Further, a POSITA would have understood that the terms in the Challenged Claims have sufficient structure or recite a function with sufficient structure for performing that function. EX1003, T44. This is because, for example, the claimed controller of a motor of claim 1 provides structure for executing the claimed features of claim 1 found in elements [1b] - [1g]. Indeed, a POSITA would have recognized that a controller of a motor has a sufficiently definite and known meaning as a controller that controls functionality of a motor. EX1003, $\boldsymbol{\text { I44 }}$; EX1001, 18:23-26 ("controller of a motor for an electric vehicle"); EX1004, 16:38-40, 16:65-66 ("Control function 160 [is] carried out by real time controller 501"), 17:38-18:1]. And controllers for motors are a known class of structures that are implemented by various known elements, such as microprocessors. EX1003, $\boldsymbol{\uparrow 4 4}$. Accordingly, the terms of the Challenged Claims should not be treated as means-plus-function terms. EX1003, $\boldsymbol{\uparrow} \boldsymbol{4 4}$. Nonetheless, even if the Challenged Claims are found to be indefinite, the cited art referenced herein are sufficient to render the Challenged claims unpatentable under 35 U.S.C. § 103. See, Intel Corp. v. Qualcomm Inc., 21 F.4th 801, 813 (Fed. Cir. 2021) (holding that it is possible to adjudicate a prior-art challenge even when some aspect of a claim renders the claim indefinite.).

To the extent the following terms are considered as means-plus-function terms, the following analysis is provided.

## 2. "a voltage-command generating unit that generates a pulsewidth modulation signal to control a switching element provided in an inverter"

The term voltage-command generating unit is not presumed to be a means plus-function term because it does not employ the word "means." Williamson $v$. Citrix Online, LLC, 792 F.3d 1339, 1348 (Fed. Cir. 2015). Further, a POSITA would have understood that the voltage-command generating unit has sufficient structure or recites a function with sufficient structure for performing that function because it is part of the claimed controller of claim 1 that provides structure for executing the claimed function as discussed above. EX1001, claim 1; EX1003, $\uparrow 44$.

Although the original Examiner did not mention means-plus-function during prosecution, to the extent $\S 112$ ( $\$ 6$ ) does apply, the recited function is: generates $a$ pulse-width modulation signal to control a switching element provided in an inverter. EX1001, Claim 1; EX1003, $\uparrow 47$.

The structure includes the arrangement of "voltage-command/PWM-signal generating unit 50" shown in Figures 1 and 2 and equivalents thereof. EX1001, 7:1324, Fig. 2; EX1003, $\uparrow 48$.

FIG. 1


EX1001, Fig. 1

FIG. 2


EX1001, Fig. 2
3. "a current-command generating unit that generates and outputs a current command to cause the alternating-current motor to generate torque based on an input torque command, wherein the current-command generating unit is configured to output the current-command that is calculated based on a
relationship between the torque command and a state quantity of the alternating-current motor,
to maintain a terminal voltage of the alternating-current motor to a maximum value that can be generated under the direct current power source, and
to output a current command adjusted to maintain or decrease a loss of the inverter under a predetermined condition in which the loss of the inverter increases or estimated to increase"

The term current-command generating unit is not presumed to be a means plus-function term because it does not employ the word "means." Williamson $v$. Citrix Online, LLC, 792 F.3d 1339, 1348 (Fed. Cir. 2015). Further, a POSITA would have understood that the current-command generating unit has sufficient structure or recites a function with sufficient structure for performing that function because it is part of the claimed controller of claim 1 that provides structure for executing the claimed function as discussed above. EX1001, claim 1; EX1003, $\uparrow 49$.

Although the original Examiner did not mention means-plus-function during prosecution, to the extent $\S 112$ ( $\$ 6)$ does apply, the recited function is:

- generates and outputs a current command to cause the alternating-current motor to generate torque based on an input torque command; (EX1001, 5:410)
- output the current-command that is calculated based on a relationship between the torque command and a state quantity of the alternating-current motor; (EX1001, 4:64-5:10, 5:39-64)
- maintain a terminal voltage of the alternating-current motor to a maximum value that can be generated under the direct current power source; and $(E X 1001,13: 42-64,14: 11-31 ; 14: 44-63)^{3}$
- output a current command adjusted to maintain or decrease a loss of the inverter under a predetermined condition in which the loss of the inverter increases or estimated to increase. (EX1001, 13:42-64, 14:11-31; 14:44-63) EX1001, Claim 1; EX1003, $\uparrow 50$.

The structure includes motor controller circuitry that implements "currentcommand generating unit $10^{\prime \prime}$ and executes an algorithm for performing the above functions, and equivalents thereof. EX1001, 4:27-28, 5:65-6:16, 8:44-49, 13:50-58, 16:3-13, 16:45-56, Fig. 1; EX1003, $\mathbb{1} \mid 51$. For example, the ' 855 Patent discloses "storing beforehand in arithmetic expressions and tables by using the rotation speed and magnitude of an output torque of the motor as parameters" to adjust "an actual current of the motor 6 to match an optimum torque current command (the q-axis current command $\mathrm{iq}^{*}$ ) and a magnetic-flux current command (the d-axis current

[^2]command id*)." EX1001, 6:3-14; EX1003, 『51. Thus, a POSITA would have understood that the "current-command generating unit 10 " would have included at least stored "arithmetic expressions and tables" or equivalents thereof to perform the recited functions. ${ }^{4}$

## F. Citation of Prior Art Patents and Printed Publications

## 1. Prior Art Qualification of Cited Prior Art Patents and Printed Publications

The following references are pertinent to the grounds of unpatentability explained below: and are each prior art to the ' 855 patent under 35 U.S.C. §§ 102(a), 102(b), and/or 102(e):

- U.S. Patent No. 6,166,514 ("Ando") (published December 26, 2000) (EX1005). Ando is prior art under pre-AIA 35 U.S.C. § 102(b)

[^3]- U.S. Patent No. 7,332,837 ("Ward") (filed July 29, 2004; published February 17, 2005) (EX1004). Ward is prior art under pre-AIA 35 U.S.C. § 102(b).

Ando and Ward were not previously considered by the Office during prosecution of the ' 855 patent and are not cumulative of art considered during prosecution. Thus, denial under 35 U.S.C. §325(d) is not warranted.

## G. Summary of Proposed Rejection

In accordance with 37 C.F.R. § $1.510(\mathrm{~b})(2)$, reexamination of the Challenged Claims of the ' 855 Patent is requested based on the following proposed rejection:

| Proposed Rejection | Claim(s) | Obviousness Basis under § 103 |
| :---: | :---: | :--- |
| 1 | $1,5-7$, and 13 | Ward |
| 2 | 1,2, and 5-10 | Ando |

As shown below and confirmed in the Declaration of Dr. Baker (EX1003), the technology claimed in the ' 855 Patent was not new. The references presented in this Request render obvious the Challenged Claims, which should be canceled as unpatentable.

## H. Identification of Substantial New Questions of Patentability

This Request raises substantial new question of patentability (SNQ) as set forth below. The Challenged Claims are taught by both Ward and Ando, and thus an SNQ is raised by the references. $I d$.

## 1. Ward Raises a Substantial New Question of Patentability

Ward raises a SNQ because Ward discloses the allegedly allowable features of claim 1 indicated during prosecution and was not considered during prosecution. Specifically, Ward teaches the "current-command generating unit" as recited by claim 1, which was cited by the Examiner in the Notice of Allowance as allegedly novel over the prior art. Accordingly, Ward raises a SNQ.

## 2. Ando Raises a Substantial New Question of Patentability

Ando raises a SNQ because Ando discloses the allegedly allowable features of claim 1 indicated during prosecution and was not considered during prosecution. Specifically, Ando teaches the "current-command generating unit" as recited by claim 1, which was cited by the Examiner in the Notice of Allowance as allegedly novel over the prior art. Accordingly, Ando raises a SNQ.

## III. DETAILED EXPLANATION OF THE PERTINENCE AND MANNER OF APPLYING THE PRIOR ART REFERENCES TO EVERY CLAIM FOR WHICH REEXAMINATION IS REQUESTED

The proposed rejections detailed below, supported by the declaration of Dr. Baker (EX1003), show that claims 1, 2, 5-10, and 13 of the ' 855 Patent are unpatentable.

## A. Proposed Rejection 1: Claims 1, 5-7, and 13 would have been obvious over Ward

The Office has not considered Ward individually in relation to the ' 855 patent. Requester shows below that Ward renders obvious every element of at least claims 1 and 5-13 of the ' 855 Patent.

## 1. Overview of Ward

Ward is generally directed to a method and apparatus to cool an electric motor and handle the reactive torque of the motor. Ward discloses a motor control system process architecture 160, as shown below in Figures 20A, 20B, and 22.


Ward, Fig. 20A


Ward, Fig. 20B


Ward, Fig. 22

Relevant to this request, Ward discloses an optimized current command table 162 that generates a current command ( $\mathrm{Iq}^{*}, \mathrm{Id}^{*}$ ) based on the torque command $\mathrm{T}^{*}$, motor speed $\omega_{\mathrm{r}}$, bus voltage Vdc and stored machine properties. The current command is used to maintain the terminal voltage of an AC motor to maximum value that can be generated under the AC source, and to output a current command to that is optimized to account for inverter loss.

Ward is analogous art to the ' 855 patent because it is from the same field of endeavor as the ' 855 patent, "an alternating-current motor to drive an electric vehicle." ${ }^{5}$ EX1001, 1:5-10; EX1004, 1:13-16. Further, Ward is reasonably pertinent to the particular problem the ' 855 Patent was trying to solve, "to configure a cooler in a small size, light weight, and at a low cost while avoiding size increase, in configuring a power conversion device to drive a motor for an electric vehicle." EX1001, 2:65-3:7. For example, Ward is directed to the problem of providing efficient heat removal and weight minimization. See, e.g., EX1004, 1:53-67.

[^4]
## 2. Claim 1 would have been obvious over Ward

a) [1a-preamble] "A controller of a motor comprising:"

To the extent limiting, Ward discloses or at least renders obvious the preamble. EX1003, $\mathbb{4} 58$. Ward describes "computer based system 500 suitable for carrying out the control processes of the present invention" has "controller 501" ([a] controller) that implements "motor control system process architecture 160 " to "drive" motor $30^{6}$ and provides "real time control of motor 30 " (of a motor). Ward, 16:38-40, 16:65-66 ("Control function 160 [is] carried out by real time controller 501"), 17:38-18:1, 24:7-36, Figs. 20A-20B, 22; EX1003, 『58.


Ward, Fig. 20A

[^5]

Ward, Fig. 20B


Ward, Fig. 22
b) [1b] "a voltage-command generating unit that generates a pulse-width modulation signal to control a switching element provided in an inverter, to the inverter

Ward discloses or at least renders obvious limitation [1b]. EX1003, $\uparrow 59$.
Ward describes that controller 501 implements control function 160's "duty cycle calculator 180" (a voltage-command generating unit) that "determines the width of the pulses" of a "pulse width modulation (PWM)" signal used to operate inverter 182 and generates associated "inverter duty cycles $\mathrm{Da}, \mathrm{Db}$, and Dc for each phase $\mathrm{a}, \mathrm{b}, \mathrm{c}$ needed" of the PWM signal (that generates a pulse-width modulation signal). Ward, 16:38-43, 16:65-66 ("Control function 160 [is] carried out by real time controller 501"), 19:14-28, Figs. 20A-20B, 22. The generated inverter duty cycles $\mathrm{Da}, \mathrm{Db}$, and Dc are provided to inverter 182 "so that inverter 182 will produce the commanded voltages UD* and UQ* at the machine terminals to produce the desired phase currents $\mathrm{Ia}, \mathrm{Ib}, \mathrm{Ic}$ " (to control a switching element provided in an inverter, to the inverter). Id. A POSITA would have understood or at least found obvious that the duty cycles $\mathrm{Da}, \mathrm{Db}$, and Dc control a switching element in inverter 182 because duty cycles of PWM signals are well known as the technique by which inverters are conventionally controlled. EX1003, $\uparrow 159$.


160
FIG. 20A

Ward, Fig. 20A


Ward, Fig. 20B


FIG. 22
Ward, Fig. 22
To the extent element [1b] is interpreted as a means-plus-function element, Ward discloses or at least renders it obvious. Ward discloses or at least renders obvious the identified functionality of generates a pulse-width modulation signal to control a switching element provided in an inverter, to the inverter for the reasons discussed above in the analysis of this element.

Ward further discloses, or at least renders obvious, an equivalent to the ' 855 patent's identified structure of voltage-command generating unit for at least the following reasons. Ward's controller 501 implementing control function 160's "duty cycle calculator $180^{\prime \prime}$ forms an equivalent because it performs the function of generat[ing] a pulse-width modulation signal to control a switching element provided in an inverter, to the inverter in substantially the same way (in Ward, by
generating "inverter duty cycles $\mathrm{Da}, \mathrm{Db}$, and Dc for each phase $\mathrm{a}, \mathrm{b}, \mathrm{c}$ needed" of the PWM signal (Ward, 16:38-43, 16:65-66, 19:14-28, Figs. 20A-20B, 22); in the '855 patent, by generating "gate signals" that "thereby" control inverter switching elements by "PWM (Pulse Width Modulation)" (EX1001, 4:52-55)) and produce substantially the same results (in Ward and the 855 patent, PWM signals that control an inverter (Ward, 16:38-43, 16:65-66, 19:14-28, Figs. 20A-20B, 22; EX1001, 4:5255)) as the identified structure of the ' 855 patent. Kemco Sales, Inc. v. Control Papers Co., 208 F.3d 1352, 1364 (Fed. Cir. 2000); M.P.E.P. 2183; EX1003, $\uparrow 61$.

A POSITA would have further recognized the interchangeability of Ward's controller 501 implementing control function 160's "duty cycle calculator 180" for the identified structure of the 855 patent's voltage-command generating unit. Caterpillar Inc. v. Deere \& Co., 224 F.3d 1374, 1380 (Fed. Cir. 2000); M.P.E.P. 2183. As shown by Ward, using controller 501 implementing control function 160 's "duty cycle calculator 180 " was a known alternative to using voltage-command/PWM-signal generating unit 50 for generat[ing] a pulse-width modulation signal to control a switching element provided in an inverter, to the inverter. Ward, 16:38-43, 16:65-66, 19:14-28, Figs. 20A-20B, 22; EX1001, 4:5255, 5:34-37, 7:13-24. Interchanging such elements and configuring controller 501 would have been routine and well within the capabilities of a POSITA at least because both elements generate PWM signals to control functionality of an inverter.
$I d$. Also, for the same reasons, there are merely insubstantial differences between Ward's controller 501 implementing control function 160's "duty cycle calculator 180 " and the ' 855 patent's voltage-command/PWM-signal generating unit 50. IMS Technology, Inc. v. Haas Automation, Inc., 206 F.3d 1422, 1436 (Fed. Cir. 2000); Minks v. Polaris Industries, Inc., 546 F.3d 1364, 1379 (Fed. Cir. 2008); Odetics, Inc. v. Storage Technology Corp., 185 F.3d 1259, 1268 (Fed. Cir. 1999); M.P.E.P. 2183. Moreover, Ward's controller 501 implementing control function 160's "duty cycle calculator 180" are not excluded by any explicit definition in the ' 855 patent's specification for an equivalent to voltage-command/PWM-signal generating unit 50. EX1001, 5:33-41, 6:44-48 (explaining "many modifications and variations of the present invention are possible"); Paice LLC v. Toyota Motor Corp., 54F.3d 1293, 1310-11 (Fed. Cir. 2007) (finding equivalence in the doctrine of equivalents context when the patent's specification did not disavow the equivalent); M.P.E.P. 2183; EX1003, 962.
c) [1c] [the inverter] connected to a direct-current power source and outputting a three-phase alternating current
of an arbitrary ${ }^{7}$ frequency and an arbitrary voltage to an alternating-current motor; and"

Ward discloses or at least renders obvious limitation [1c]. EX1003, థ63. Ward describes inverter 182 receives a DC voltage Vdc from a battery via lead 183 ([the inverter] connected to a direct-current power source). Ward, 18:34-53, 19:14-43 (referring to "battery voltage Vdc"), 24:28-29, Figs. 20A-20B, 22. Ward also describes inverter 182 outputs "phase currents Ia, Ib, Ic" (and outputting a threephase current) of a certain frequency and commanded voltage to alternating current (AC) motor 30 (of an arbitrary frequency and an arbitrary voltage to an alternatingcurrent motor) Id., 18:54-55 ("[t]he approximately sinusoidal signals being supplied to machine 30 have a certain frequency"), 19:14-43 ("inverter 182 will produce the commanded voltages UD* and UQ* at the machine terminals to produce the desired currents Ia, Ib, Ic."), Figs. 20A-20B, 22; EX1003, $\uparrow 63$.

[^6]

Ward, Fig. 20A


Ward, Fig. 20B


Ward, Fig. 22
d) [1d] "a current-command generating unit that generates and outputs a current command to cause the alternatingcurrent motor to generate torque based on an input torque command,"

Ward discloses or at least renders obvious limitation [1d]. EX1003, $\mathbb{\top 6 4 .}$
Similar to the '855 Patent's disclosure of "arithmetic expressions and tables (i.e., current-command generating unit 10)," Ward describes that controller 501 implements control function 160 's "optimized current command table 162 " and calculations for determining commanded current (implementing a current-command generating unit) that generates and outputs "commanded d-axis current Id* and the commanded q-axis current Iq*" (that generates and outputs a current command).


See, e.g., Ward, 13:65-14:5 ("method 790 for calculating optimized control parameters...can be carried out, for example, by computation system 500 " which is implemented by controller 501), 16:38-43, 16:65-66 ("Control function 160 [is] carried out by real time controller 501"), 17:38-56 ("table 162 provides the commanded d-axis current Id* and the commanded q -axis current $\mathrm{Iq}^{*}$ "), 21:50-54 ("current command table 162 generates (e.g., looks-up) the d -axis and q -axis current commands Id*, Iq* that should drive the machine most efficiently to meet these performance expectations"), Figs. 17, 20A-20B, 22; EX1003, $\uparrow 64$. Ward discloses
that commanded d-axis current $\mathrm{Id*}^{*}$ and the commanded q -axis current Iq are generated when looked up by table 162, and output by table 162 (a current-command generating unit that generates and outputs a current command). Ward, 21:50-54 ("current command table 162 generates (e.g., looks-up) the d-axis and q-axis current commands Id*, Iq* that should drive the machine most efficiently to meet these performance expectations"); 17:38-56 ("table 162 provides the commanded d-axis current Id* and the commanded q-axis current Iq*"). Ward also discloses that the commanded d-axis current Id* and the commanded q -axis current Iq* are generated in an additional way-by controller 501 using Figure 17's "method 790 for calculating optimized control parameters"-and then stored and output by table 162 (a current-command generating unit that generates and outputs a current command). Id. Ward, 13:65-15:67 (describing calculation of "control parameters (dand the q-axes currents)" and that control parameters are stored in look-up table 162 after they are determined), 17:38-56 ("table 162 provides the commanded d-axis current Id* and the commanded q-axis current Iq*"), Figs. 17, 20A-20B, 22; EX1003, 964.


Ward, Fig. 20A


Ward, Fig. 20B


Ward, Fig. 22
The "commanded q-axis current Iq*" generated and output by command table 162 is input into current regulator 185 ; the "commanded q -axis current $\mathrm{Iq}^{*}$ " generated and output by command table 162 is used by a SUM function 199 to generate a modified d-axis current $\mathrm{Id}^{* *}$ that is also input into current regulator 185. Ward, 17:51-17:66, Figs. 20A-20B, 22. Then, current regulator 185 "computes the necessary drive duty cycles 185 for inverter 182 that, in turn, drives machine 30 ," to "achieve the commanded torque $\mathrm{T}^{*}$ at speed $\omega_{\mathrm{r}}$ " (to cause the alternating-current motor to generate torque based on an input torque command). Id., 17:66-18:1, Figs. 20A-20B, 22. Indeed, the output of "commanded d-axis current Id* and the commanded q -axis current Iq*" and achieved (i.e., generate[d]) torque of motor 30 (also referred to as "machine 30 ") are based on the "user input commanded torque
$\mathrm{T}^{*}$ " that a user inputs by, for example, an "accelerator pedal position" (based on an input torque command). Id., 17:38-18:1, 24:24-36, Figs. 20A-20B, 22; EX1003, $\mid 65$. The "commanded d-axis current $\mathrm{Id}^{*}$ and the commanded q -axis current Iq "" are further generated based on an "input torque command ( $\mathrm{T}^{*}$ )" (based on an input torque command) during the method 790 for calculating optimized control parameters. Ward, 13:65-14:14, 16:38-43, 16:65-66, 17:38-56 ("table 162 provides the commanded d-axis current Id * and the commanded q -axis current Iq*"), Figs. 17, 20A-20B, 22; EX1003, 『65.

In view of the foregoing, Ward discloses the claimed current-command generating unit.

## e) [1e]"wherein the current-command generating unit is configured to output the current-command that is calculated based on a relationship between the torque command and a state quantity of the alternating-current motor,

Ward discloses or at least renders obvious limitation [1e]. EX1003, 966 . Ward describes that controller 501 implements control function 160's "optimized current command table 162" and calculations for determining commanded current (implementing the current-command generating unit) that outputs "commanded daxis current Id * and the commanded q -axis current Iq *" (is configured to output the current command). Ward, 13:65-14:5 ("method 790 for calculating optimized control parameters...can be carried out, for example, by computation system 500"
which is implemented by controller 501), 16:38-43, 16:65-66 ("Control function 160 [is] carried out by real time controller 501"), 17:38-56 ("table 162 provides the commanded d-axis current Id* and the commanded $q$-axis current $\mathrm{Iq}^{* \prime}$ ), 21:50-54, Figs. 17, 20A-20B, 22; EX1003, ©66; (limitation [1d]). Ward further explains that the commanded d-axis current $\mathrm{Id*}^{*}$ and the commanded q -axis current $\mathrm{Iq}^{*}$ (current command) are calculated for output by table 162 " $[\mathrm{b}]$ ased on: (i) the actual rotor speed $\omega_{\mathrm{r}}$ (state quantity of the alternating-current motor) obtained from measured quantities function 184 " and "(ii) user input commanded torque $\mathrm{T}^{* "}$ such that they "achieve the commanded torque $T^{*}$ at speed $\omega_{\mathrm{r}}$ " where $\omega_{\mathrm{r}}$ is the " $[\mathrm{r}]$ otor speed in $\mathrm{rad} / \mathrm{sec}$ " of motor 30 (that is calculated based on a relationship between the torque command and a state quantity of the alternating-current motor). Id., 17:4-5, 17:4617:54, Figs. 20A-20B, 22.

Additionally, the commanded d-axis current $\mathrm{Id}^{*}$ and the commanded q -axis current Iq* (the current-command) are calculated by controller 501 using Figure 17's "method 790 for calculating optimized control parameters" in relation to input values of "torque command $\left(T^{*}\right)$ and "the rotor speed $\left(\omega_{r}\right)$," and the "optimized control parameter for all torque-speed ( $\mathrm{T}-\omega_{\mathrm{r}}$ ) operating points of the machine for a range of operating battery voltages" is calculated (that is calculated based on a relationship between the torque command and a state quantity of the alternatingcurrent motor). Id., 14:2-12; id., 13:65-15:67 (describing calculation of "control
parameters (d- and the q-axes currents)" and that control parameters are stored in look-up table 162 after they are determined), 17:38-56 ("table 162 provides the commanded d-axis current Id* and the commanded q-axis current Iq*"), Figs. 17, 20A-20B, 22; EX1003, 967.
f) [1f] " $[$ the current-command generating unit is configured] to maintain a terminal voltage of the alternating-current motor to a maximum value that can be generated under the direct current power source, and"

Limitation [1f], as written, is merely an intended use of the claimed controller as a whole. There is no disclosure in the ' 855 Patent that would lead a POSITA to understand how the current-command generating unit itself maintains a terminal voltage of the AC motor. Notably, limitation [1f] does not recite that this function is performed through the current command. ${ }^{8}$ In order to "maintain" the terminal voltage of the AC motor to a maximum value that can be generated by the DC power source, the current-command generating unit would require some indication of the state of the DC power source (i.e., VMmax defined by equation (9), which requires

[^7]the voltage of the capacitor EFC)). This is simply not found in the ' 855 Patent. Rather, as shown in FIG. 1, the only inputs to the current-command generating unit are the torque command $\left(\mathrm{T}^{*}\right)$, which comes from outside the controller, and the angular frequency [rotor speed] $\omega$. Notably missing as an input is the EFC or voltage of the DC power source. Rather, EFC is input to the modulation factor calculator 30 to calculate a PMF (equation (8)). Id. 6:47-65. Further, in the controller of the ' 855 Patent, the inverter and the voltage command generating unit are responsible for maintaining or altering the voltage from the DC power source to the motor. ${ }^{9}$ See, e.g., limitations [1b], [1c]. EX1003, 968 .

Thus, the current-command generating unit cannot be "configured" to perform the function of "maintain[ing] a terminal voltage of the alternating-current motor" Instead, the current-command generating unit's output (i.e., current command id*, iq*) is used by other components of the controller to perform this

[^8]function, and limitation [1f] is merely an intended use of the controller. ("apparatus claims cover what a device is, not what a device does," Hewlett-Packard Co. v. Bausch \& Lomb Inc., 909 F.2d 1464, 1468 (Fed. Cir. 1990)). Thus, limitation [1f] is not entitled to patentable weight. See, MPEP 2114(II).

To the extent that limitation [1f] is deemed to have patentable weight, or is considered under the broadest reasonable interpretation to be a function performed by the current-command generating unit ${ }^{10}$ through the current-command, Ward discloses or at least renders obvious limitation [1f]. EX1003, $\boldsymbol{9} 70$.

Ward describes that controller 501 implements control function 160's "optimized current command table 162 " and calculations for determining commanded current (implementing the current-command generating unit) to output "commanded d-axis current Id* and the commanded q -axis current $\mathrm{Iq}^{*}$ " which are which are used to produce desired phase currents Ia , Ib , and Ic according to a "modulation index Mindex" that "defines the amount of voltage (i.e., Vdc) utilized by the inverter." Id. (parenthetical added). Mindex=1.0 indicates " $100 \%$ utilization

[^9]of the dc bus voltage" by the inverter, i.e., "full battery voltage Vdc is being applied to the machine terminal" by inverter 182. Ward, 17:29-31, 17:46-18:53; 19:14-28 22:57-23:31; EX1003, 971 . Thus, Ward discloses, Mindex will be at the "upper limit" i.e., causing inverter 182 to deliver a maximum steady state value of bus voltage Vdc to a terminal of motor 30. Id. Thus, a POSITA would have understood or at least found obvious that controller 501 implements control function 160 's "optimized current command table 162 " and calculations for determining commanded current (the current-command generating unit) and is configured to provide current commands Id* and Iq* calculated such that they "maximize system performance while properly utilizing the bus voltage (battery voltage Vdc)" delivered to terminals of motor 30 (is configured to maintain a terminal voltage of the alternating-current motor), where the bus voltage (battery voltage Vdc ) is maintained at an upper limit voltage when the required modulation index is set as Mhigh, i.e., the "upper limit of operation of the over-modulation region" (to a maximum value that can be generated under the direct current power source). Id., 23:2-27.
g) [1g] " th e current-command generating unit is configured] to output a current command adjusted to maintain or decrease a loss of the inverter under a predetermined condition in which the loss of the inverter increases or estimated to increase."

Ward discloses or at least renders obvious limitation [1g]. EX1003, ¢72. Ward describes that controller 501 implements control function 160's "optimized current command table $162^{\prime \prime}$ and calculations for determining commanded current (implementing the current-command generating unit) to output "commanded d-axis current Id* and the commanded q -axis current Iq *" (configured to output a current command). Ward, 13:65-14:5 ("method 790 for calculating optimized control parameters...can be carried out, for example, by computation system 500 " which is implemented by controller 501), 16:38-43, 16:65-66 ("Control function 160 [is] carried out by real time controller 501"), 17:38-56 ("table 162 provides the commanded d-axis current Id* and the commanded $q$-axis current $\mathrm{Iq}^{*}$ "), 21:50-54, Figs. 17, 20A-20B, 22; EX1003, $\mathbb{1} 72$; (limitation [1d]). Ward describes that in the commanded d-axis current Id* and the commanded q -axis current $\mathrm{Iq}^{*}$ can be adjusted to a new value depending on new conditions experienced by the control system (i.e., more or less torque required by motor 30 depending on input Torque T*). Id., 13:65-15:67; EX1003, 972 . Ward further discloses that the commanded daxis current $\mathrm{Id}^{*}$ and the commanded q -axis current $\mathrm{Iq}^{*}$ can be generated by controller 501 using Figure 17's "method 790 for calculating optimized control parameters," and the optimization accounts for "inverter loss (IL)." Ward, 15:33-67. Thus, a POSITA would have understood or at least found obvious that commanded d -axis current Id * and the commanded q -axis current $\mathrm{Iq*}$ are adjusted such that a
newly commanded d-axis current $\mathrm{Id}^{*}$ and the commanded q -axis current $\mathrm{Iq}^{*}$ is used that minimizes or decreases inverter loss IL (current command adjusted to maintain or decrease a loss of the inverter), and in such a case inverter loss IL would be minimized or decreased in conditions where increased loss would occur or be expected (under a predetermined condition in which the loss of the inverter increases or estimated to increase). Id.; EX1003, $\llbracket 72$. That is, as conditions change and inverter loss increases, the commanded d-axis current Id* and the commanded q -axis current Iq* are changed based on the efficiency, which is calculated by accounting for the inverter loss. Id., 15:35.

## 3. Claims 5-7

Claims 5-7 recite various "predetermined conditions" that are essentially meaningless. ${ }^{11}$ In particular, claim 5 recites: wherein the predetermined condition includes one of a case that an output frequency of the inverter is equal to or larger than a predetermined value and a case that an output frequency of the inverter is estimated to become equal to or larger than a predetermined value.
(emphasis added) Claim 6 recites:
the predetermined condition includes one of a case that an output current of the inverter is equal to or larger than a predetermined value and a case that an output

[^10]Nonetheless, claims 5-7 would have been obvious in view of Ward's disclosure.
frequency of the inverter is estimated to become equal to or larger than a predetermined value.
(emphasis added) Claim 7 recites:

> the predetermined condition includes one of a case that a switching frequency of the switching element is equal to or larger than a predetermined value and a case that a switching frequency of the switching element is estimated to become equal to or larger than a predetermined value.
(emphasis added). However, all of these limitations are met by the mere existence of the parameters claimed. For example, because the term "predetermined value" is not defined, any value is contemplated. Thus, the mere existence of the parameter meets the limitation because it is equal to the "predetermined value." That is, a value associated with the parameter exists. EX1003, $972-75$.

Further, when the "predetermined value" is zero the value of the parameter (claim 5- output frequency of the inverter; claim 6- output current of the inverter, claim 7-switching frequency of the switching element) value will always be greater than or equal to the "predetermined value." There is no requirement that the "predetermined value" is set at any value other than zero. Thus, the "predetermined value" encompasses a value of zero. Accordingly, claims 5-7 are met at all times (the parameters are always equal to or larger than zero) in the controller of Ward at least because of the presence of an inverter and switching element, as discussed above. EX1003, ब72-75.

## 4. Claim 13

a) The controller of a motor according to claim 1, wherein when the alternating-current motor is a permanentmagnet synchronous motor and when the current command is defined by a dq coordinate system having a $d$-axis as a direction of a permanent magnet flux of the alternating-current motor and a q-axis as a direction orthogonal to the d-axis,

Ward discloses a permanent magnet synchronous motor. Ward, 1:36-49.
Ward also discloses " $[t]$ his two-phase representation is well known in the art as the d-q representation, where machine behavior can be described in terms of quadrature currents $\mathrm{I}_{\mathrm{d}}, \mathrm{I}_{\mathrm{q}}$, where the d-axis is customarily aligned with the permanent magnet axis and the q -axis leads the magnet axis by 90 degrees electrical. This is illustrated in FIG. 15, which provides a simplified representation of the d-q magnetic axes used in analyzing the motor of the present invention." (current command defined by a dq coordinate system having a d-axis as a direction of a permanent magnet flux of the alternating-current motor and a q-axis as a direction orthogonal to the d-axis.) Id., 12:45-53; 17:1-55, FIG. 15, Ex1003, $\uparrow 76$.
b) a current command adjusted to maintain or decrease the loss of the inverter is selected from any one of a value that a vector of the current command is present on the $q$ axis and a value satisfying a condition where an output voltage of the inverter at an output voltage of directcurrent power source is maximized.

Ward describes that controller 501 implements control function 160 's "optimized current command table 162 " and calculations for determining
commanded current (implementing the current-command generating unit) to output "commanded d-axis current Id* and the commanded q-axis current Iq*" (configured to output a current command). Ward, 13:65-14:5 ("method 790 for calculating optimized control parameters...can be carried out, for example, by computation system 500" which is implemented by controller 501), 16:38-43, 16:65-66 ("Control function 160 [is] carried out by real time controller 501"), 17:38-56 ("table 162 provides the commanded d-axis current Id * and the commanded q -axis current Iq *"), 21:50-54, Figs. 17, 20A-20B, 22; EX1003, [77-78; (limitation [1d]). Ward describes that in the commanded d-axis current Id* and the commanded q -axis current Iq* can be adjusted to a new value depending on new conditions experienced by the control system (i.e., more or less torque required by motor 30 depending on input Torque T*). EX1003, $977-78$. Ward further discloses that the commanded d-axis current Id* and the commanded q -axis current $\mathrm{Iq}^{*}$ can be generated by controller 501 using Figure 17's "method 790 for calculating optimized control parameters," and the optimization accounts for "inverter loss (IL)." Ward, 15:33-67.

Thus, a POSITA would have understood or at least found obvious that commanded d-axis current $\mathrm{Id}^{*}$ and the commanded q -axis current $\mathrm{Iq}^{*}$ can be adjusted such that a newly commanded d-axis current $\mathrm{Id}^{*}$ and the commanded qaxis current Iq* is used that minimizes or decreases inverter loss IL (current command adjusted to maintain or decrease a loss of the inverter), and in such a case
inverter loss IL would be minimized (output voltage of the inverter at an output voltage of direct-current power source is maximized.)

## B. Proposed Rejection 2: Claims 1-2, and 5-10 are obvious over Ando

## 1. Overview of Ando

Ando is directed to a control apparatus for an electric motor comprising an inverter for converting direct current to alternating current having a variable voltage and variable frequency in accordance with a pulse width modulation control. The control apparatus for the electric motor includes a current controller providing a current command based on a torque command and a velocity state associated with motor. Ando discloses a PWM signal executing means that generates a signal to control an inverter connected to a DC power source and outputting a three-phase alternating current to an AC motor. Ando discloses that as the speed of the motor increases (i.e., the inverter output frequency increases and inverter loss increases), the inverter is operated in one-pulse mode, which is the same solution offered by the '855 Patent.

Ando is analogous art to the ' 855 patent because it is from the same field of endeavor as the patent "an alternating-current motor to drive an electric vehicle." ${ }^{12}$ EX1001, 1:5-10 EX1005, 1:5-6. Ando is also directed to the same problem that the inventors of the ' 855 Patent were trying to solve. In particular, Ando is directed to the problem of providing control of an electric motor. EX1001, 3:25-33, EX1005, 2:10-34.

## 2. Claim 1 would have been obvious over Ando

## a) [1a-preamble] "A controller of a motor comprising:"

To the extent limiting, Ando discloses or at least renders obvious the preamble. EX1003, $\llbracket 80$. As shown by Figure 1, Ando describes "a control apparatus of an induction motor" such as induction motor 2 ([a] controller of a motor). EX1005, Abstract, 2:37-39, Fig. 1.

[^11]

EX1005, Fig. 1
b) [1b] "a voltage-command generating unit that generates a pulse-width modulation signal to control a switching element provided in an inverter, to the inverter

Ando discloses or at least renders obvious limitation [1b]. EX1003, 9 [81. Ando describes "PWM signal executing means 9 " (a voltage-command generating unit) that "generates ON, OFF pulses $\mathrm{Su}, \mathrm{Sv}$ and Sw " according to a modulation rate voltage Vc (that generates a pulse-width modulation signal), where pulses $\mathrm{Su}, \mathrm{Sv}$ and Sw are "supplied to" and control PWM inverter 1 (to control a switching element provided in an inverter). EX1005, 3:55-60, 4:48-5:16, 6:7-15, Fig. 1. PWM inverter 1 in turn converts "direct current voltage...to a three-phase alternating current, and
a corresponding alternating voltage is supplied by the PWM inverter 1 to an induction motor 2." Id., 2:56-61. A POSITA would have understood or at least found obvious that PWM inverter 1 included a switching element that was control[led] by input pulses $\mathrm{Su}, \mathrm{Sv}$, and Sw . EX1003, $\boldsymbol{\text { | }} 81-82$. This is because (1) inverters were well-known to include switches (i.e., a switching element) as these are the conventional components that form inverters (EX1003, $\mathbb{9 1 1 - 8 2 )}$ and Ando even teaches that inverters include switches by explaining that inverters can experience "switching loss"(EX1005, 1:15-20) and (2) input pulse signals (such as Su, Sv, and Sw) from a PWM signal generating device (such as "PWM signal executing means 9") were well-known to control switches of an inverter. EX1003, 9 181-82.


EX1005, Fig. 1

Accordingly, Ando discloses or renders obvious the limitations of claim 1[b].
c) [1c] [the inverter] connected to a direct-current power source and outputting a three-phase alternating current of an arbitrary 13 frequency and an arbitrary voltage to an alternating-current motor; and"

Ando discloses or at least renders obvious limitation [1c]. EX1003, 983 . Ando describes PWM inverter 1 (the inverter) is connected to "direct current power supply 11" (connected to a direct-current power source) and outputs "inverter output currents iu, iv and iw" that form a "three-phase alternating current" (and outputting a three-phase alternating current). EX1005, 2:12-16, 2:55-61, 3:32-36, Fig. 1. Ando describes that its output alternating current has "a variable voltage and variable frequency" (three-phase alternating current of an arbitrary frequency and an arbitrary voltage) and is output to induction motor 2 (to an alternating-current

[^12]motor). Id., 2:12-16, 2:49-61, Fig. 1. Induction motors are well-known alternating current motors. EX1003, 9 |83.


EX1005, Fig. 1
d) [1d] "a current-command generating unit that generates and outputs a current command to cause the alternatingcurrent motor to generate torque based on an input torque command, wherein"

Ando discloses or at least renders obvious limitation [1d]. EX1003, $984-87$.
Ando describes "current controller 4" (a current-command generating unit) that generates "torque current command $\mathrm{Iq}^{* *}$ " and outputs this command to "voltage
executing means 6" (that generates and outputs a current command). EX1005, 2:62-
3:8, Fig. 1.


EX1005, Fig. 1
Similar to the '855 Patent, Ando discloses the use of "arithmetic expressions" (e.g., Formula (2)) to calculate "Torque current command Iq**" (current command). Ando, 4:7-20. Torque current command Iq**" (current command) is used to control how PWM inverter 1 "converts [] direct current voltage...to a three-phase alternating current" such that a corresponding alternating voltage is supplied to induction motor 2 which is used as a "drive source" for an "electric vehicle" (to cause the alternating-current motor to generate torque). Id., 2:55-3:60, Fig. 1. Indeed, Ando describes that torque current command Iq** (current
command) cause[s] the alternating-current motor to generate torque at least because it is explicitly named as a "torque" current command. Id., 2:64-3:8. Moreover, because motor 2 is used as a "drive source" for a vehicle, a POSITA would have understood or at least found obvious that supplying voltage to motor 2 to adjust its function as discussed above would have caused it to generate various amounts of torque, e.g., more torque or less torque as needed. Id.; EX1003, $\uparrow 85$. And Figure 3(d) below further shows an example of the amount of torque generated by motor 2 in relation to Torque current command Iq** shown in Figure 3(c) below. Id., 7:27-8:5.


FIG. 3 (d)


EX1005, Figs. 3(a)-3(d)

The generating of torque current command $\mathrm{Iq}^{* *}$ and outputting of this command to "voltage executing means 6 " (generates and outputs a current command) is further
based on an input "torque current command Iq*" (single star) (based on an input torque command), where the torque current command Iq** (double star) output to voltage executing means 6 is "corrected in accordance with a deviation between the received torque current command value Iq* and a torque current detection value Iq, which is produced as an output of a coordinate converter 5." EX1005, 2:62-3:8, Fig. 1. Moreover, the generated torque by motor 2 is based on torque current command Iq* (single star) as this is an uncorrected version of torque current command $\mathrm{Iq}^{* *}$ output to voltage executing means 6 and used to control PWM inverter 1 as discussed above. Id., 2:55-3:60, Fig. 1. EX1003, $\boldsymbol{\|} 86$.

To the extent that limitation 1(d) is interpreted to be a means-plus-function term, Ando discloses the use of a mathematic formula to determine $\mathrm{Iq} * *$, e.g., Formula (2). Ando, 4:7-20; EX1003, 87. Thus, Ando discloses the same structure of an "arithmetic expression" with regard to current controller 4 (a current-command generating unit) as the ' 855 Patent.
e) [1e] "the current-command generating unit is configured to output the current-command that is calculated based on a relationship between the torque command and a state quantity of the alternating-current motor,

Ando discloses or at least renders obvious limitation [1e]. EX1003, 9 [88. Ando describes "current controller 4" (the current-command generating unit), which outputs "torque current command $\mathrm{Iq}^{* *}$ " (is configured to output the current
command), and that the torque current command $\mathrm{Iq}^{* *}$ (the current command) is calculated based on a deviation between received torque current command $\mathrm{Iq}^{*}$ (based on a relationship between the torque command) and torque current detection value Iq ( $a$ state quantity of the alternating-current motor). EX1005, 2:62-3:8, Fig.
1.


EX1005, Fig. 1
Torque current detection value Iq is a state quantity of the alternating-current motor because it accounts for a velocity state associated with motor 2. Id., 3:20-40, Fig. 1; EX1003, $\boldsymbol{\Phi}$ 89. Specifically, torque current detection value Iq is calculated from the "inverter output currents iu, iv and iw" that are supplied to motor 2 and "in accordance with the coordinate standard signal $\theta$," where coordinate standard signal
$\theta$ is determined by integrator 18 integrating the sum of induction motor velocity signal $\omega_{\mathrm{r}}$ of motor 2 and slip angle frequency command value $\omega \mathrm{s}^{*}$. Id. Induction motor velocity signal $\omega_{\mathrm{r}}$ of motor 2 "is detected by a velocity detector 16 " at motor 2 and indicates a velocity state associated with motor 2. Id.

> f) $\quad[1 f]$ "Ithe current-command generating unit is configured] to maintain a terminal voltage of the alternating-current motor to a maximum value that can be generated under the direct current power source, and"

Ando discloses or at least renders obvious limitation [1f]. EX1003, 990 . Ando describes "current controller 4" (the current-command generating unit) maintains a terminal voltage of induction motor 2 (to maintain a terminal voltage of the alternating-current motor) to a maximum voltage value Vc that PWM inverter 1 is capable of generating from DC voltage source 11 (to a maximum value that can be generated under the direct current power source). EX1005, 2:49-55, 3:45-60, 4:605:16, 7:8-12, Fig. 1, EX1003, 990 ; see (limitation [1a-preamble], limitation [1-c]).

Specifically, current controller 4 (the current-command generating unit) outputs torque current command value $\mathrm{Iq}^{* *}$ to voltage command executing means 6. EX1005, 2:62-3:8, Fig. 1.


EX1005, Fig. 1
Voltage command executing means 6 generates voltage values $\mathrm{Vd*}^{*}$ and $\mathrm{Vq}^{*}$ using torque current command value Iq ** according to Ando's "formula (3)" shown below. Id., 4:21-28.

$$
\left[\begin{array}{l}
V d^{*} \\
V q^{*}
\end{array}\right]=\left[\begin{array}{cc}
r l & -L s \sigma \omega I \\
L I \omega I^{*} & r I
\end{array}\right]\left[\begin{array}{c}
I d^{*} \\
I q^{* *}
\end{array}\right]
$$

Voltage values $\mathrm{Vd}^{*}$ and $\mathrm{Vq}^{*}$ are then output to polar coordinate converter 8 which determines voltage V0 according to Ando's "formula (6)" shown below. Id., 4:3949.

$$
V 0=\sqrt{\mathrm{Vd}^{+2}+V q^{+2}}
$$

Voltage V0 is then output to modulation rate executing means 10 that determines a "modulation rate" (also referred to as a "voltage command") value Vc. Id., 4:495:16. Value Vc is determined according to "formula (7)" below which operates to limit Vc to a "maximum value," referred to V0max, that the PWM inverter 1 can output to induction motor 2 ; in formula (7), this maximum value is set as $1 . I d$.; id., 2:5-8, 3:45-55, 4:60-5:16, 5:59-6:15 ("the voltage which is outputted to the induction motor becomes more than the maximum voltage which is capable of being output by the electric power converter [inverter] (the pulse mode of the PWM becomes one pulse) ${ }^{14}$ ), 7:8-8:33, 9:8-18, Fig. 2.

$$
V c=\min \left(\sqrt{\frac{2}{3}} \cdot \frac{\pi}{2} \cdot \frac{V 0}{V F C}, 1\right)
$$

Modulation rate executing means 10 outputs the determined voltage Vc to PWM signal executing means 9, which in turn delivers "ON, OFF pulses $\mathrm{Su}, \mathrm{Sv}$ and Sw in accordance with the output Vc" to PWM inverter 1. EX1005, 3:45-60, Fig. 1. PWM

[^13]inverter 1 then "converts the direct current voltage, which is received from the power supply" 11 , "to a three-phase alternating current" that is delivered to induction motor 2 based on the pulses $\mathrm{Su}, \mathrm{Sv}$, and Sw. Id., 2:55-3:8, 3:55-60, 7:8-26, Fig. 1 .

Ando further explains that the torque current command value $\mathrm{Iq} * *$ is increased when voltage Vc is limited to the maximum voltage $\mathrm{V} 0 \max$ to ensure the described vector control is carried out, making PWM inverter 1 operate in a "one pulse" mode. EX1005, 4:49-5:16, 5:59-6:15, 7:8-8:33. As shown by Figures 3(b) and 3(c), reproduced below, $\mathrm{Iq}^{* *}$ is increased as voltage Vc is limited, starting around time 18 seconds in the figures. Id.


EX1005, Figs. 3(b)-3(c)

In view of the above discussion, the torque current command value $\mathrm{Iq}^{* *}$ is therefore used to determine voltage V0 via formulas 3 and 6, and when torque current command value $\mathrm{Iq}^{* *}$ is increased, it increases the values of $\mathrm{Vd*}^{*}$ and $\mathrm{Vq}^{*}$ which
drives V0 higher, which in turn makes the $\sqrt{\frac{2}{3}} \cdot \frac{\pi}{2} \cdot \frac{V 0}{V F C}$ drives V0 higher, which in turn makes the component of formula 7 increase, causing Vc in formula 7 to be limited to the maximum voltage V0max, which is 1 in formula 7, and this maximum voltage is delivered to induction motor 2 via PWM inverter 1. Id., 2:5-8, 3:45-55, 4:49-5:16, 5:59-6:15, 7:8-8:33, 9:8-18, Figs. 2, 3(b), 3(c); EX1003, 991-97. Accordingly, a POSITA would have therefore understood or at least found obvious that when $\mathrm{Iq}^{* *}$ is continually increased, as disclosed by Ando, the voltage Vc is limited to a maximum value V 0 max , and this voltage continually delivered to and maintained at induction motor 2 via PWM inverter 1. Id. Thus, in such a case, a POSITA would have understood or at least found obvious that current controller 4 (the current-command generating unit) which generates and outputs $\mathrm{Iq}^{* *}$ is used to maintain a terminal voltage of induction motor 2 ([is configured] to maintain a terminal voltage of the alternating-current motor) to the maximum voltage value V0max that can be generated by PWM inverter 1 using DC power source 11 (to a maximum value that can be generated under the direct current power source). Id.; EX1003, 991-97.

Further, a POSITA would have understood or at least found obvious that this maximum voltage is delivered to a terminal of motor 2 because terminals are wellknown circuit components that receive voltages, and motor 2 is described as receiving the maximum voltage. EX1005, 2:55-3:8, 5:59-6:15, 7:8-8:33, Fig. 1; EX1003, 91-97.
g) [1g] " $[$ the current-command generating unit is configured] to output a current command adjusted to maintain or decrease a loss of the inverter under a predetermined condition in which the loss of the inverter increases or estimated to increase."

Ando discloses or at least renders obvious limitation [1g]. EX1003, ¢98. Ando describes "current controller 4" (the current-command generating unit) operates such that "in the high speed operating area, [current controller 4] operates to be consistent with the error between the output Iq* and the output Iq according to the inconsistency" between the voltage command values and the output voltages of the system. EX1005, 2:62-3:7, 6:31-37. Specifically, when Vc' (the non-limited V0 value, see Ando, Fig 2) is larger than V0max, "in response to the difference between them, the output $\mathrm{Iq} * *$ of the current controller 4 is increased relative to the output Iq* ([the current-command generating unit is configured] to output a current command adjusted), where this adjustment of $\mathrm{Iq}^{* *}$ provides operation in the high speed operating area such that PWM inverter 1 is in a "one pulse" mode and "good control" can be carried out. Id., 5:10-16, 5:59-63, 6:31-52, 8:21-33, 9:8-18, Fig. 2.

Ando explains that in such a "high speed operating area," operating in this "one pulse" mode provides a "decrease [in] the switching loss" of an inverter, such as PWM inverter." Id., 1:15-20. Thus, a POSITA would have understood or at least found obvious that the adjustment of $\mathrm{Iq}^{* *}$ by current controller 4 as described (([the current-command generating unit is configured] to output a current command adjusted) is provided to decrease the loss of PWM inverter 1 (to maintain or decrease a loss of the inverter) during operation in a "high speed operating area," which is a known type of operation where inverter loss occurs (under a predetermined condition in which the loss of the inverter increases or estimated to increase). Id.; id., 2:62-3:7, 5:10-16, 5:59-63, 6:31-52, 8:21-33, 9:8-18; EX1003, 498.

In view of the foregoing, Ando discloses or at least renders obvious all of the limitations of claim 1. Accordingly, claim 1 would have been obvious over Ando.

## 3. Claim 2

a) "The controller of a motor according to claim 1, wherein the predetermined condition includes a case that the torque command is reduced in a state that the inverter is outputting a maximum voltage that can be generated at an output voltage of the direct-current power source."

Ando discloses or renders obvious claim 2. As shown below in Figures 3(b) and $3(\mathrm{~d})$, the torque command $(\mathrm{T})$ is reduced at the same time (about 18 seconds)
that the inverter is outputting a maximum voltage that can be generated at an output voltage of the direct-current power source (Vc). Ando, 7:34-41; EX1003, - 100.


FIG. 3 (d)


## 4. Claim 5

a) "The controller of a motor according to claim 1, wherein the predetermined condition includes one of a case that an output frequency of the inverter is equal to or larger than a predetermined value and a case that an output frequency of the inverter is estimated to become equal to or larger than a predetermined value."

Ando discloses or renders obvious claim 5 of the ' 855 Patent. As discussed above with regard to limitation $1[\mathrm{~g}]$, Ando discloses or renders obvious "a current command adjusted to maintain or decrease a loss of the inverter under a predetermined condition in which the loss of the inverter increases or estimated to increase." The predetermined condition of claim 5 merely clarifies that the predetermined condition can be an increase (or estimated increase) in inverter output frequency. The ' 855 Patent relates the output frequency of the inverter (FINV) to the speed of the motor such that the output frequency of the inverter increases with speed. EX1001, 9:50-51. Ando discloses that as the speed of the motor increases (output frequency is equal to or larger than a predetermined value), the inverter is operated in one-pulse mode, which is the same solution offered by the ' 855 Patent. Ando, 5:13-15 ("an area of high speed operation where the voltage pulse is one pulse."). As discussed above, Ando explains that operating in this "one pulse" mode provides a "decrease [in] the switching loss" of an inverter, such as PWM inverter." Id., 1:15-20. Thus, a POSITA would have understood or at least found obvious that Ando discloses all of the limitations of claim 5. EX1003, $\mathbb{9} 101$.

## 5. Claim 6

a) "The controller of a motor according to claim 1, wherein the predetermined condition includes one of a case that an output current of the inverter is equal to or larger
than a predetermined value and a case that an output frequency of the inverter is estimated to become equal to or larger than a predetermined value."

For the same reasons that claim 5 is rendered obvious by Ando, claim 6 is also rendered obvious. For example, "a case that an output frequency of the inverter is estimated to become equal to or larger than a predetermined value" is addressed in claim 5 above. EX1003, $\mathbb{\|} 102$.

## 6. Claim 7

a) "The controller of a motor according to claim 1, wherein the predetermined condition includes one of a case that a switching frequency of the switching element is equal to or larger than a predetermined value and a case that a switching frequency of the switching element is estimated to become equal to or larger than a predetermined value."

As discussed above regarding limitation 1c), a POSITA would have understood or at least found obvious that PWM inverter 1 included a switching element that was control[led] by input pulses $\mathrm{Su}, \mathrm{Sv}$, and Sw . EX1003, 103. This is because (1) inverters were well-known to include switches (i.e., a switching element) as these are the conventional components that form inverters (EX1003, 103) and Ando even teaches that inverters include switches by explaining that inverters can experience "switching loss" (EX1005, 1:15-20) and (2) input pulse signals (such as $\mathrm{Su}, \mathrm{Sv}$, and Sw ) from a PWM signal generating device (such as "PWM signal executing means 9 ") were well-known to control switches of an inverter. EX1003, 103. Thus, a POSITA would have understood that Ando discloses a case where a
"switching frequency of the switching element is equal to or larger than a predetermined value and a case that a switching frequency of the switching element is estimated to become equal to or larger than a predetermined value" at least because the switching element includes a switching frequency that has a value (i.e., the term "predetermined value" is not defined). EX1003, $\mathbb{9} 103$.

## 7. Claims 5-7

As discussed above for Ground 1, claims 5-7 recite various "predetermined conditions" that are essentially meaningless. Thus, the same analysis applied above in Ground 1 applies to this Ground. For example, the limitations recited in claims 57 are met by the mere existence of the parameters claimed. Further, there is no limitation associated with the "predetermined value," which can encompass any number including zero. Accordingly, claims 5-7 are met at all times (the parameters are always equal to or larger than zero) in the controller of Ward at least because of the presence of the recited structure, as discussed above. EX1003, $\mathbb{\|} 104$.

## 8. Claim 8

a) "The controller of a motor according to claim 1, wherein the predetermined condition includes a case that the inverter is stopped in a state that the alternating-current motor is operated by the inverter."

Ando discloses or at least renders obvious claim 1 for the reasons discussed above (claim 1). Ando further discloses or at least renders obvious claim 8. Ando describes a high speed operating area (the predetermined condition). See ite(element
[1g]). A POSITA would have understood or at least found obvious that in such a high speed operating area a user would have had the ability to stop commanded torque such that inverter 1 stops delivering voltage to motor 2 (the predetermined condition includes a case that the inverter is stopped) when Ando's motor 2 is operating in a state where previously commanded torque is being applied to motor 2 by inverter 1 (in a state that the alternating-current motor is operated by the inverter). Id.; EX1003, ©105.

## 9. Claim 9

a) "The controller of a motor according to claim 1, wherein the predetermined condition includes a case that the inverter is started from a stopped state, while the alternating-current motor is in a free-run rotation."

Ando discloses or at least renders obvious claim 1 for the reasons discussed above. Ando further discloses or at least renders obvious claim 9. Ando describes a high speed operating area (the predetermined condition). See (element [1g]). A POSITA would have understood or at least found obvious that in such high speed operating area a user would have had the ability to start commanding torque such that inverter 1 starts, from a stopped state, delivering voltage to motor 2 (the predetermined condition includes a case that the inverter is started from a stopped state) when Ando's motor 2 is operating in a state where no torque is being applied
to motor 2 and motor 2 is rotating freely (while the alternating-current motor is in a free-run rotation). Id.; EX1003, 106.

## 10. Claim 10

a) "a current command adjusted to maintain or decrease the loss of the inverter is a value at which an output voltage of the inverter becomes a maximum value at an output voltage of the direct-current power source."

To the extent that this claim is interpreted to include an output voltage that is the maximum output voltage of the inverter, Ando discloses or at least renders obvious this claim. ${ }^{15}$ See, limitation $1[\mathrm{f}]$ and $1[\mathrm{~g}]$ above discussing Ando's switching to one-pulse mode during high speed and the known result of decreasing inverter loss (e.g., switching loss). EX1003, $\mathbb{1} 107$.

## IV. THIS REQUEST IS NOT REDUNDANT AND SHOULD NOT BE DENIED UNDER 35 U.S.C. §325(D)

As discussed in Sections II and III above, this Request raises substantial new questions of patentability with respect to the Challenged Claims. This reexamination

[^14]Request should not be rejected under 35 U.S.C. §325(d) because the prior art is new and arguments in this Request are not "the same or substantially the same prior art or arguments" previously presented to the Office. See 35 U.S.C. § 325(d) ("In determining whether to institute or order a proceeding under this chapter, chapter 30, or chapter 31, the Director may take into account whether, and reject the petition or request because, the same or substantially the same prior art or arguments previously were presented to the Office."). The prior art and/or arguments in this Request is not cumulative of that considered during prosecution at least because this Request shows how both Ando and Ward teach the claimed "current-command generating unit" as recited by claim 1. Such arguments are not cumulative of any arguments made during prosecution. Thus, for at least these reasons, denial under §325(d) is inappropriate.

## V. DISCLOSURE OF CONCURRENT PROCEEDINGS

As of the filing date of this Request, and to the best knowledge of Requester, the ' 855 patent has been involved in the following district court litigations:

NexGen Control Systems, LLC v. Infineon Technologies AG et al., 1-23-cv-00315 (DDE)

NexGen Control Systems, LLC v. NXP Semiconductors NV et al., 5-23-cv-00025 (EDTX)

As of the filing date of this Request, and to the best knowledge of Requester, the ' 855 patent has not been involved in any post-grant proceedings.

## VI. LIST OF EXHIBITS

| Exhibit | Description |
| :---: | :--- |
| 1001 | U.S. Patent No. 8,278,855 |
| 1002 | File History of U.S. Patent No. 8,278,855 |
| 1003 | Declaration of Dr. R. Jacob Baker, Ph.D., P.E. |
| 1004 | U.S. Patent No. 7,332,837 ("Ward") |
| 1005 | U.S. Patent No. 6,166,514 ("Ando") |
| 1006 | curriculum vitae of Dr. Jacob Baker, Ph.D., P.E. |

## VII. CONCLUSION

For the reasons set forth above, substantial new questions of patentability are raised in connection with the Challenged Claims, by this Request for ex parte Reexamination, because the Challenged Claims are rendered obvious in view of the above-listed prior art references. Therefore, Requester asks that this Request for Reexamination be granted and that the Challenged Claims be canceled.

As identified in the attached Certificate of Service and in accordance with 37 C.F.R. $\S \S 1.33(\mathrm{c})$ and $1.510(\mathrm{~b})(5)$, a copy of the present Request, in its entirety, is being served to the address of the attorney or agent of record.

Please direct all correspondence in this matter to the undersigned.

Date: October 20, 2023
Respectfully Submitted,
/Timothy J. Murphy/

Timothy J. Murphy
Registration No. 62,585


[^0]:    ${ }^{1}$ Underlines indicate added elements; strikethroughs indicate removed elements.
    Claim 7 was canceled. EX1002, 326.

[^1]:    ${ }^{2}$ An Examiner-Initiated Interview was conducted before the Notice of Allowance issued, where the examiner and applicant apparently discussed "possible amendments to claims for possible 112 problems and [] possible changes to the broad title." EX1002, 470-474. While the title was amended via Examiner's amendment in the Notice of Allowance, no claims were amended. EX1002, 456.

[^2]:    ${ }^{3}$ Requester does not concede that this limitation, as written, has support or is enabled under 35 U.S.C. § 112. Nonetheless, solely for the purposes of this request, this limitation is interpreted as a function of the current command generated by the current-command generating unit, and not the unit itself.

[^3]:    ${ }^{4}$ Requester does not concede that the general disclosure of "arithmetic expressions and tables" is sufficient under pre-AIA 35 U.S.C. § 112 (ब2). Nonetheless, the disclosure of the prior art cited herein is described in a manner sufficient to render the claims obvious. See, Intel Corp. v. Qualcomm Inc., 21 F.4th 801, 813 (Fed. Cir. 2021) (holding that it is possible to adjudicate a prior-art challenge even when some aspect of a claim renders the claim indefinite.).

[^4]:    ${ }^{5}$ Patent Owner may argue for a narrower interpretation of the field of endeavor limiting the type of motor to a "permanent-magnet synchronous motor." However, such a narrow interpretation is not warranted in view of dependent claim 13, which limits the alternating-current motor of independent claim 1 to a permanent-magnet synchronous motor. EX1001, 20:23-25.

[^5]:    ${ }^{6}$ Motor 30 is also referred to as "machine 30 " by Ward.

[^6]:    ${ }^{7}$ Requester does not concede that the "arbitrary" renders the claims enabled or definite under 35 U.S.C. § 112. Nonetheless, for the purposes of determining patentability under 35 U.S.C. § 103, the term "arbitrary" is non-limiting and encompasses any value.

[^7]:    ${ }^{8}$ See, e.g., limitation [1g] "configured to output a current command adjusted to...," "limitation [1e] "configured to output the current-command...,"
    limitation 1[d] "a current-command generating unit that generates and outputs a current command to cause..."

[^8]:    ${ }^{9}$ The inverter maintains or adjusts the voltage output depending on the pulse mode (e.g., maximum inverter output voltage for asynchronous mode is 0.612 * EFC, synchronous three-pulse mode is 0.7797 * EFC, one-pulse mode is $1 *$ EFC). Id., 8:4-7.

[^9]:    ${ }^{10}$ Notably, Ward discloses a voltage (Vdc) as an input to the optimized current command table 162 (the current-command generating unit), unlike the embodiments of the ' 855 Patent.

[^10]:    ${ }^{11}$ Requester does not concede that claims 5-7 are valid under 35 U.S.C. § 112.

[^11]:    ${ }^{12}$ Patent Owner may argue for a narrower interpretation of the field of endeavor limiting the type of motor to a "permanent-magnet synchronous motor." However, such a narrow interpretation is not warranted in view of dependent claim 13, which limits the alternating-current motor of independent claim 1 to a permanent-magnet synchronous motor. EX1001, 20:23-25.

[^12]:    ${ }^{13}$ Requester does not concede that the "arbitrary" renders the claims enabled or definite under 35 U.S.C. § 112. Nonetheless, for the purposes of determining patentability under 35 U.S.C. § 103, the term "arbitrary" is non-limiting and encompasses any value.

[^13]:    ${ }^{14}$ Bracketing [] added, parenthetical () in original.

[^14]:    ${ }^{15}$ The claim as written appears to equate the maximum output voltage of the DC power source with the maximum voltage of the inverter. However, the ' 855 Patent recognizes VMmax (the maximum output voltage of the inverter) as a fraction of EFC (the output voltage of the DC power source). See, e.g., Equation (9), EX 1001, 6:47-65.

