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CONFIDENTIAL TREATMENT REQUESTED

September 18, 2017

CONFIDENTIAL

VIA BY HAND DELIVERY

U.S. Securities and Exchange Commission

Division of Corporation Finance

101 F Street, NE

Washington, D.C. 20549

Attention: Suzanne Hayes, Assistant Director, Office of Healthcare and Insurance

Re: Rhythm Pharmaceuticals, Inc.

Amendment No. 1 to Registration Statement on Form S-1 (“Amendment No. 1”)

Expected to be Filed on or about September 25, 2017

SEC File No. 333-220337

Ladies and Gentlemen:

On behalf of Rhythm Pharmaceuticals, Inc. (the “*Company*”), we supplementally submit this letter and the following information in response to a comment from the staff (the “*Staff*”) of the Securities and Exchange Commission (the “*Commission*”) initially received in that certain comment letter from the Staff dated November 9, 2015, and verbally reiterated by the Staff in a telephone conversation on August 31, 2017 between Christine Westbrook of the Staff and Laurie Cerveny of this firm.

The purpose of this letter is to provide supplemental information to the Staff with respect to the accounting treatment for stock-based compensation for its consideration so that the Company may be in a position to file Amendment No. 1 and print a preliminary prospectus on the anticipated date of September 25, 2017, or as soon thereafter as practicable. We are respectfully requesting confidential treatment for certain portions of this letter pursuant to Rule 83 promulgated by the Commission, 17 C.F.R. Section 200.83. This letter is accompanied by such request for confidential treatment because of the commercially sensitive nature of the

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information discussed in this letter. A redacted letter will be filed via Edgar, omitting the confidential information contained in this letter.

The Company’s discussion of stock-based compensation is primarily contained within the section of the Company’s Registration Statement on Form S-1 filed on September 5, 2017 (the “*S-1*”) entitled “Management’s Discussion & Analysis of Financial Condition and Results of Operations — Critical Accounting Policies and Estimates — Stock-Based Compensation (the “*MD&A*”) and appears on pages 86-93 of the S-1. This section will be revised in Amendment No. 1 to include updated valuation information from August 2017, which is further discussed below.

The Staff’s comment is presented in italics and is followed by the Company’s response.

We may have additional comments on your accounting for equity issuances including stock compensation and beneficial conversion features. Once you have an estimated offering price, please provide us an analysis explaining the reasons for the differences between recent valuations of your common stock leading up to the IPO and the estimated offering price.

Response: In response to the Staff’s comment, the Company provides the following information:

The Company supplementally advises the Staff that, while not reflected in the S-1, based on discussions with the Company’s board of directors and reflecting input from the lead underwriters for its initial public offering (“*IPO*”) the Company currently intends on or about September 25, 2017 to file with the Commission Amendment No. 1 indicating that the Company’s public offering price range is anticipated to be within a \$[***] range between \$[***] and \$[***] (for example, \$[***] to \$[***]) (giving effect to an anticipated 1-for-[***] reverse stock split of all outstanding shares of the Company’s common stock that the Company plans to implement prior to effectiveness of the Registration Statement) (such price range, the “*Preliminary Price Range*”). The Estimated Equity Fair Value Per Share amounts used in this letter also reflect the 1-for-[***] reverse stock split.

The Company’s final post-split Preliminary Price Range remains under discussion between the Company and the lead underwriters, and a bona fide price range will be included in Amendment No. 1 prior to any distribution of the preliminary prospectus in connection with the Company’s road show. Given

the volatility of the public trading markets and the uncertainty of the timing of the offering, the actual price range to be included in a subsequent pre-effective amendment to the Registration Statement may be different from the Preliminary Price Range.

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Historical Fair Value Determination and Methodology

The Company (or, its predecessor, Motus Therapeutics, Inc. (the “**Predecessor**”) or its prior parent entity, Rhythm Holding Company, LLC (the “**LLC entity**”)) has performed a contemporaneous valuation of its equity at least once per quarter since May 2015, and in some cases more often than quarterly, in each case with the assistance of an independent third-party valuation specialist (the “**Specialist**”). The Company’s most recent common stock valuation was as of August 31, 2017. In conducting these valuations, management, the board of directors and the Specialist considered all objective and subjective factors believed to be relevant. The valuations included the best estimate of business conditions, prospects and operating performance at the valuation date. As discussed in the Company’s MD&A, other significant factors considered included:

- The lack of an active public market for the Company’s and the LLC entity’s common and preferred equity;
- The prices at which the Company and the LLC entity sold preferred equity to outside investors in arm’s length transactions, and the rights, preferences and privileges of that preferred equity, relative to common equity;
- The Company’s and the LLC entity’s results of operations, financial position and the status of each entity’s research and clinical development efforts;
- The material risks related to the Company’s and the LLC entity’s business;
- The market performance of publicly traded companies in the life sciences and biotechnology sectors, and recently completed mergers and acquisitions comparable to the Company and the LLC entity;
- The likelihood of achieving a liquidity event for holders of the Company’s and the LLC entity’s common equity, such as an IPO or sale of the Company given prevailing market conditions; and
- Any recent contemporaneous valuations of the Company’s and the LLC entity’s common equity prepared in accordance with the methodologies outlined in the American Institute of Certified Public Accountants Practice Aid, *Valuation of Privately-Held Company Equity Securities Issued as Compensation* (the “**Practice Aid**”).

Additionally, as described in the S-1, valuations of the Company’s and the LLC entity’s common equity at each valuation date were prepared utilizing the Discounted Cash Flow Method (“**DCFM**”), the Guideline Public Company Method (“**GPCM**”), the Option-Pricing Method (“**OPM**”), the Probability-Weighted Expected Return Method (“**PWERM**”) or a hybrid of the PWERM and OPM (the “**Hybrid Method**”).

DCFM: Under the DCFM, projected cash flows are converted to present value by applying a discount rate based on an estimated cost of equity or an estimated cost of debt. The cost of equity

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is estimated based on rates of return required by outside investors. An estimated cost of debt is applied when future cash flows are adjusted for the probability of success in clinical trials.

GPCM: Under the GPCM, future value in an IPO is estimated based on a comparison to clinical-stage companies which have completed IPOs.

OPM: Under the OPM, common and preferred equity is valued by creating a series of call options with exercise prices based on the liquidation preferences and conversion terms of each equity class. Under the OPM, common equity only has value if the funds available for distribution to common equity holders exceeds the value of the liquidation preferences at the time of a liquidity event, such as a strategic sale or merger. Under the OPM, the value of one security, such as preferred equity, is used to determine the value of that equity and the corresponding value of the common equity.

PWERM: The PWERM is a scenario-based analysis that estimates the value per share based on the probability-weighted present value of expected future investment returns, considering each of the possible outcomes available to each entity, as well as the economic and control rights of each equity class.

Hybrid Method: The Hybrid Method is a PWERM where the equity value in one of the scenarios is calculated using the OPM.

The Company employed a Hybrid Method that considered two types of future-event scenarios: an initial public offering and a remain-private scenario.(1) The Company used the OPM to allocate equity value for the unspecified liquidity event.

- The enterprise value for the initial public offering scenario was determined using a market approach. Under the market approach, the Company estimated enterprise value using the GPCM. The GPCM includes comparisons to publicly traded companies in the relevant industry that recently completed initial public offerings. Future equity value is converted to present value as of the appraisal date by applying a discount rate derived from studies of the rates of return required by venture capital investors.
- For the remain-private scenario, equity value is estimated by using the OPM to backsolve to the adjusted price of the Company’s series A preferred shares.

(1) Prior to January 1, 2017, stock-based compensation expense was allocated between the LLC entity and the Company as further discussed in our S-1 at “2. Summary of Significant Accounting Policies — Basis of Presentation”. As allocated LLC entity stock compensation associated with recent valuations was insignificant during the 12 months prior to the date of this letter, the remainder of this letter will be focused on the Company’s recent valuations of its common stock.

Beginning with its March 31, 2017 valuation, as the Company anticipated its future and its goals became somewhat more defined by the board to consist of a near-term IPO or sale or an additional private financing, the Company used a modified Hybrid Method that considered two scenarios: a near-term IPO or sale and a remain-private scenario.

- The enterprise value for the IPO and sale scenarios was determined using a market approach. Under the market approach, the Company estimated enterprise value using the GPCM. The GPCM includes comparisons to clinical-stage life science companies that recently completed IPOs. Future equity value is converted to present value as of the appraisal date by applying a discount rate derived from studies of the rates of return required by venture capital investors.
- For the remain-private scenario, equity value is estimated by using the OPM to backsolve to the adjusted price of the Company's Series A preferred shares.

Discussion of Most Recent Fair Value Determinations

Consistent with the discussion above regarding the Company's modified Hybrid Method, the Company performed a valuation of its common stock as of each of June 30, 2016, September 30, 2016, November 16, 2016, December 31, 2016, March 31, 2017, June 30, 2017 and August 31, 2017 to coincide with the issuance of certain equity compensation grants. The Company valued its equity and allocated equity value using the Hybrid Method. The Hybrid Method considered an IPO and a remain-private scenario in which value is allocated using the OPM. The Company relied on the GPCM to estimate equity value in the IPO scenario. In the remain-private scenario, equity value was determined using an OPM backsolve calculation (a market approach that derives an implied total equity value from the sale price of the Company's equity securities in a recent arm's-length transaction). As discussed in the S-1, the March 31, 2017, June 30, 2017 and August 31, 2017 valuations also included a valuation of the Company's 2017 Series A Investor Instrument, determined to be the sum of the fair values of the 2017 Series A Investor Right/Obligation and 2017 Series A Call Option. The Company valued the 2017 Series A Investor Right/Obligation as the probability-weighted present value of the future benefit associated with the sale of Series A Preferred Stock in August 2017 and valued the 2017 Investor Call Option using the Black-Scholes option model.

As of June 30, 2016, the Company's management and the board of directors assessed the probability of an IPO in February 2017 as [***]% and remain-private scenario in February 2017 as [***]%. The Company believes that the potential future liquidity event scenarios used in the June 30, 2016 valuation and the probability of weighting each future event were appropriate at the time in light of (1) the Company's state of development and operating results, (2) the most recent data generated by the Company from its clinical trials, (3) prospects for an IPO in the near term, including the amount of time that had passed since the Company's first confidential filing in October 2015, (4) general conditions in the capital markets, including with respect to IPOs, and (5) the

relative likelihood of achieving a liquidity event such as an IPO in light of prevailing market conditions. The timing of these future liquidity event scenarios was determined based primarily on input from the board of directors and management. Based on this valuation, the Company determined that as of June 30, 2016 its estimated fair value per share of its common stock ("Estimated Equity Fair Value Per Share") was \$[***].

As of September 30, 2016, the Company's management and the board of directors assessed the probability of an IPO in May 2017 as [***]% and remain-private scenario in May 2017 as [***]%. The Company believes that the potential future liquidity event scenarios used in the September 30, 2016 valuation and the probability of weighting each future event were appropriate at the time in light of (1) the Company's state of development and operating results, (2) the most recent data generated by the Company from its clinical trials, (3) prospects for an IPO in the near term, including the amount of time that had passed since the Company's first confidential filing in October 2015, (4) general conditions in the capital markets, including with respect to IPOs, and (5) the relative likelihood of achieving a liquidity event such as an IPO in light of prevailing market conditions. The timing of these future liquidity event scenarios was determined based primarily on input from the board of directors and management. Based on this valuation, the Company determined that as of September 30, 2016 its Estimated Equity Fair Value Per Share was \$[***].

As of November 16, 2016, the Company's management and the board of directors assessed the probability of an IPO in May 2017 as [***]% and remain-private scenarios in May 2017 as [***]%. The Company believes that the potential future liquidity event scenarios used in the November 16, 2016 valuation and the probability of weighting each future event were appropriate at the time in light of (1) the Company's state of development and operating results, (2) the most recent data generated by the Company from its clinical trials, (3) prospects for an IPO in the near term, including the amount of time that had passed since the Company's first confidential filing in October 2015, (4) general conditions in the capital markets, including with respect to IPOs, and (5) the relative likelihood of achieving a liquidity event such as an IPO in light of prevailing market conditions. The Company also considered the fact that the liquidation preference on its Series A Preferred Stock was continuing to increase as a result of an 8% cumulative dividend, and the fact that the Company's cash position had decreased approximately \$[***] million since the valuation in June 2016. The timing of the future liquidity event scenarios was determined based primarily on input from the board of directors and management. Based on this valuation, the Company determined that as of November 16, 2016 its Estimated Equity Fair Value Per Share was \$[***].

As of December 31, 2016, the Company's management and the board of directors assessed the probability of an IPO in May 2017 as [***]% and remain-private scenario in May 2017 as [***]%. The Company believes that the potential future liquidity event scenarios used in the December 31, 2016 valuation and the probability of weighting each future event were appropriate at the time in light of (1) the Company's state of development and operating results, (2) the most recent data generated by the Company from its clinical trials, (3) prospects for an

IPO in the near term, including the amount of time that had passed since the Company's first confidential filing in October 2015, (4) general conditions in the capital markets, including with respect to IPOs, and (5) the relative likelihood of achieving a liquidity event such as an IPO in light of prevailing market conditions. In addition to the increasing liquidation preference on the Company's then-outstanding Series A Preferred Stock considered at the November 16, 2016 valuation, the Company also considered the fact that it anticipated issuing in January 2017 an additional \$20,475,000 of its Series A Preferred Stock also with an 8% cumulative dividend. The timing of the future liquidity event scenarios was determined based primarily on input from the board of directors and management. Based on this valuation, the Company determined that as of December 31, 2016 its Estimated Equity Fair Value Per Share was \$[***].

As of March 31, 2017, the Company's management and the board of directors assessed the probability of an IPO in August 2017 as [***]% and remain-private scenario in August 2017 as [***]%. The Company believes that the potential future liquidity event scenarios used in the March 31, 2017 valuation and the probability weighting of each future event were appropriate at the time in light of (1) the Company's state of development and operating results, (2) the most recent data generated by the Company from its clinical trials, (3) prospects for an IPO in the near term, (4) general conditions in the capital markets, including with respect to IPOs, and (5) the relative likelihood of achieving a liquidity event such as an IPO in light of prevailing market conditions. The timing of these future liquidity event scenarios was determined based primarily on input from the board of directors and management. Based on this valuation, the Company determined that as of March 31, 2017 its Estimated Equity Fair Value Per Share was \$[***].

As of June 30, 2017, the Company's management and the board of directors assessed the probability of an IPO in October 2017 as [***]% and remain-private scenario in October 2017 as [***]%. The Company believes that the potential future liquidity event scenarios used in the June 30, 2017 valuation and the probability weighting of each future event were appropriate at the time in light of (1) the Company's state of development and operating results, (2) the most recent data generated by the Company from its clinical trials in general and, in particular, from the clinical trial studying the use of use of the Company's product candidate for the treatment of Bardet-Biedl syndrome, (3) prospects for an IPO in the near term, (4) general conditions in the capital markets, including with respect to IPOs, and (5) the relative likelihood of achieving a liquidity event such as an IPO in light of prevailing market conditions. The timing of these future liquidity event scenarios was determined based primarily on input from the board of directors and management. Based on this valuation, the Company determined that as of June 30, 2017 its Estimated Equity Fair Value Per Share was \$[***].

As of August 31, 2017, the Company's management and the board of directors assessed the probability of an IPO in October 2017 as [***]% and remain-private scenario as [***]%. The Company believes that the potential future liquidity event scenarios used in the August 31, 2017 valuation and the probability weighting of each future event were appropriate at the time in light of (1) the Company's state of development and operating results, (2) the most recent data generated by the Company from its clinical trials in general and, in particular, from the clinical trial studying the use of use of the Company's product candidate for the treatment of Bardet-Biedl syndrome, (3) positive feedback received by the Company from investors in the context of "testing-the-waters" meetings conducted by the Company, (4) the addition of a Chief Financial Officer and a Chief Commercial Officer to the Company's management team, (5) prospects for an IPO in the near term, including the steps taken and to be taken by the Company towards being able to complete an IPO and preparation for a public filing of the Company's registration statement, (6) general conditions in the capital markets, including with respect to IPOs, and (7) the relative likelihood of achieving a liquidity event such as an IPO in light of prevailing market conditions. The timing of these future event scenarios was determined based primarily on input from the board of directors and management and the Company's investment bankers. Based on this valuation, the Company has preliminarily determined that as of August 31, 2017 its

Estimated Equity Fair Value Per Share was \$[***].

Assumed Preliminary Price Range

As discussed above, the anticipated Preliminary Price Range is expected to be between \$[***] and \$[***] (giving effect to an anticipated 1-for-[***] reverse stock split).

The Preliminary Price Range was derived using a combination of valuation methodologies, including: (a) a comparison of public companies at a similar stage of product development; (b) a comparison of comparable company valuations at the time of their respective IPOs; (c) a comparison of the valuation increases for comparable companies at the time of their respective IPOs; and (d) a discounted cash flow analysis. The following table summarizes the Company's anticipated pre-offering equity values (based on the low-end, mid-point and high-end of the Preliminary Price Range) (in millions except share data):

| | Low-End | Mid-Point | High-End |
|-------------------------------------|----------|-----------|----------|
| Pre-Offering Equity Value | \$ [***] | \$ [***] | \$ [***] |
| Pre-Offering Equity Value Per Share | \$ [***] | \$ [***] | \$ [***] |

Comparison of Preliminary Price Range and Estimated Equity Fair Value Per Share

The primary factor that accounts for the increase in the Preliminary Price Range over the Company's determination of Estimated Equity Fair Value Per Share on each of June 30, 2016, September 30, 2016, November 16, 2016, December 31, 2016, June 30, 2017 and August 31, 2017 is the difference in valuation methodology. In particular, because the PWERM utilizes a probability-weighted approach (as discussed above), the resulting Estimated Equity Fair Value Per Share reflects the potential for alternative liquidity events occurring at different future dates, which inherently decreases the Estimated Equity Fair Value Per Share due to the combination of (i) liquidity events other than IPO scenarios; (ii) the discounting to present value for the future business values at each liquidity event; and (iii) the application of a discount for lack of marketability.

Conversely, the Preliminary Price Range necessarily assumes only a single outcome, does not apply a discount to present value for the IPO and does not include a discount for lack of marketability, as an active trading market for the Company's common stock is expected to exist following the IPO. As a result, the Preliminary Price Range was neither reduced by the expected future business values (discounted to present value) from other potential liquidity events nor discounted for a lack of marketability. Additionally, the Preliminary Price Range assumes the

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conversion of all of the Company's preferred stock into common stock upon completion of the IPO. The corresponding elimination of the liquidation preferences and rights enjoyed by the holders of the Company's preferred stock results in a higher valuation for purposes of the Preliminary Price Range, compared to the Estimated Equity Fair Value Per Share, which included the effect of the liquidation preferences for the Company's preferred stock in relation to the allocations of value in the OPM.

While the Company believes the Preliminary Price Range is reasonable, the actual price of the offering, if successful, will be determined by a constantly changing market and actual investor demand.

Conclusion

In light of the fact that the increase in the Preliminary Price Range over the Estimated Equity Fair Value Per Share is primarily accounted for by the difference in valuation methodology described above, the Company believes that the deemed per share fair values used as the basis for determining its stock-based compensation expense for financial reporting purposes are reasonable and appropriate.

* * *

Rhythm Pharmaceuticals, Inc. respectfully requests that the information contained in this response be treated as confidential information and that the Commission provide timely notice to Keith Gottesdiener, Chief Executive Officer and President, Rhythm Pharmaceuticals, Inc., 500 Boylston Street, 11th Floor, Boston, MA 02116, (617) 857-4280, before it permits any disclosure of the omitted information in this letter.

We thank you in advance for your consideration of the foregoing. Please contact me at (617) 951-8901 or Keith Gottesdiener, Chief Executive Officer and President at the Company, at (857) 264-4280 with any questions or further comments regarding this letter or the Amendment.

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Sincerely,

/s/ Julio E. Vega

Julio E. Vega

cc: Christine Westbrook, U.S. Securities and Exchange Commission
Mary Beth Breslin, U.S. Securities and Exchange Commission
Keith Gottesdiener, Rhythm Pharmaceuticals, Inc.
Laurie A. Cerveny, Morgan, Lewis & Bockius LLP
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