

[Table of Contents](#)

performing equivalent functions) of any entity that has one or more of its executive officers serving on our board of directors or our compensation committee.

Director compensation

We have no formal policy relating to the granting of equity awards to our directors, however, the non-employee members of our board of directors who are not affiliated with our institutional investors generally receive stock option awards upon commencement of their service as directors. The following table presents the total compensation earned in the year ended December 31, 2013 for each non-employee member of our board of directors. Other than described below, we did not pay any fees to, reimburse any expenses of, make any equity awards or non-equity awards to, or pay any other compensation to the non-employee members of our board of directors. Nicholas Woodman, our Chief Executive Officer, received no compensation for his service as a director.

The following table provides information regarding compensation of our non-employee directors for 2013.

Name and principal position	Fees earned or paid in cash (\$)	Option awards \$(1)(2)	All other compensation (\$)	Total (\$)
Kenneth Goldman	\$ —	\$ 911,427	\$ —	\$911,427
John Ball	—	—	—	—
Edward Gilhuly	—	—	—	—
Michael Marks	—	—	—	—
Jill Woodman(3)	—	—	—	—

(1) The amounts reported in this column represent the aggregate grant date value of option awards made to directors in 2013 computed in accordance with FASB ASC Topic 718.

(2) The option vests as to 1/4th of the shares of Class B common stock underlying the option on the first anniversary of the vesting commencement date and as to 1/48th of the shares underlying the option each month thereafter. In addition, in the event of a qualified acquisition, the option shall vest as to an additional 1/4th of the total shares underlying the option.

(3) Jill Woodman resigned as a member of our board of directors effective as of [].

We have not yet determined our director compensation arrangements to be in effect following the closing of this offering. However, in the near future we intend to develop a policy to provide customary compensation to our non-employee directors for their services in that capacity following the completion of this offering.

[Table of Contents](#)

Executive compensation

2013 summary compensation table

The following table provides information regarding compensation received by our named executive officers for 2013.

Name and Principal Position	Salary (\$)(1)	Bonus (\$)(2)	Option awards (\$)(3)	All other compensation (\$)	Total (\$)
Nicholas Woodman Chief Executive Officer	\$800,000	\$1,003,200	\$ —	\$ 49,591(4)	\$1,852,791
Nina Richardson Chief Operations Officer	287,986	120,649	3,253,337	—	\$3,661,972
Paul Crandell Vice President, Marketing	267,981	116,909	542,628	—	\$ 927,518

(1) The amounts in this column include any salary contributed by the named executive officer to our 401(k) plan.

(2) The amounts reported in this column represent the named executive officer's bonus awards, which we awarded on a discretionary basis based on the compensation committee's determination of individual and overall company performance.

(3) The amounts reported in this column represent the aggregate grant date value of option awards made to the named executive officer in 2013 computed in accordance with FASB ASC Topic 718 and excluding the effect of estimated forfeitures.

(4) The amount reported in this column represents the cost of Mr. Woodman's personal use of cars provided by us, including depreciation attributed to his personal use of the cars, maintenance and repair costs, insurance premiums and registration fees.

Outstanding equity awards at December 31, 2013

The following table provides information regarding each unexercised stock option held by each of our named executive officers as of December 31, 2013.

Name	Number of securities underlying unexercised options(1)		Option exercise price(2)	Option expiration date
	Exercisable	Unexercisable		
Nicholas Woodman	—	—	—	—
Nina Richardson	0	450,000(3)	\$13.7200	02/18/2023
Paul Crandell	171,700	125,000	\$ 1.5167	10/25/2021
Paul Crandell	0	75,000	\$13.7200	02/18/2023

(1) Except as otherwise described in these footnotes, all options vest as to 1/4th of the shares of Class B common stock underlying the options on the first anniversary of the vesting commencement date and as to 1/48th of the shares underlying the option each month thereafter. The vesting commencement date for Ms. Richardson's option grant is February 12, 2013 and the vesting commencement date for Mr. Crandell's option grants are August 15, 2011 and February 19, 2013, respectively. Any options exercised prior to their vesting date would be subject to forfeiture as specified in the 2010 Plan. In addition, if the executive is subject to a qualified termination in connection with a change in control, then the shares underlying any unvested equity award shall vest immediately prior to the termination of the executive, pursuant to the severance and change in control policy adopted in January 2014 (described below).

(2) Represents the fair market value of a share of our Class B common stock, as determined by our board of directors, on the grant date. See the section titled "Management's discussion and analysis of financial condition and results of operations—Critical accounting policies and estimates—Stock-based compensation" for a discussion of the valuation of our Class B common stock.

(3) In addition to the time-based vesting indicated in footnote (1), if we achieve the goals approved by our board of directors under our 2014 Operating Plan, then an additional 25,000 of the shares will become vested and exercisable on February 12, 2015.

Pension benefits

None of our named executive officers is a participant in any defined benefit plans.

[Table of Contents](#)

Nonqualified deferred compensation

We do not offer any nonqualified deferred compensation plans.

Employment, severance and change in control agreements

Nina Richardson

In February 2013, we entered into an offer letter with Nina Richardson for her services as our Chief Operating Officer. The offer letter provided that Ms. Richardson's option to purchase 450,000 shares of Class B common stock would vest 25% on the 12 month anniversary of her commencement of employment and in equal monthly installments over the 36 months thereafter subject to her continuous service. In addition, the offer letter provides that 25,000 option shares would vest on the two-year anniversary of her commencement of employment in the event that we achieve our 2014 Operating Plan as approved and certified by our board of directors subject to her continuous service. In addition, the offer letter provides that in the event of a qualified termination within 12 months following a change of control, Ms. Richardson's stock option would receive 12 months of accelerated vesting. Subsequent to the execution of the offer letter, we entered into a Change in Control Severance Agreement with Ms. Richardson. The terms of the Change in Control Severance Agreement are described in detail below and it provides that in the event of a qualified termination following a change of control, Ms. Richardson shall be entitled to acceleration in full of all of her unvested option shares.

Paul Crandell

In July 2011, we entered into an offer letter with Paul Crandell for his services as Vice President, Brand Marketing. The offer letter provided that Mr. Crandell's option to purchase 300,000 shares of Class B common stock would be subject to the terms and conditions applicable to options granted under the 2010 Plan, as described in the 2010 Plan, and the applicable stock option agreement made available to Mr. Crandell at the time of his grant. Subsequent to the execution of the offer letter, we entered into a Change in Control Severance Agreement with Mr. Crandell. The terms of the Change in Control Severance Agreement are described in detail below and it provides that in the event of a qualified termination following a change of control, Mr. Crandell shall be entitled to acceleration in full of all of his outstanding unvested option shares.

Potential payments upon termination or change in control

In January 2014, we adopted a severance and change in control policy applicable to our executive officers and certain other employees pursuant to which each executive officer entered into a severance agreement. The severance agreement with each of our named executive officers has a term ending December 31, 2016 with automatic three-year renewals unless we give at least three months notice of non-renewal and requires us to pay certain benefits upon a qualifying termination, which occurs when the employee's employment is terminated by us without cause, or he or she resigns with good reason, within three months preceding or 12 months following a change in control. Under his agreement, Mr. Woodman would be eligible for severance benefits of 18 months of his then-current base pay, 150% of the greater of his target bonus or his most recent annual bonus, and \$3,000 per month for 18 months in lieu of employee benefits upon a qualifying termination. Under her or his respective agreement, each of Ms. Richardson and Mr. Crandell would be eligible for severance benefits of 12 months of then-current base pay, 100% of her or his target bonus or, if greater, her or his most recent annual bonus, and \$3,000 per month for 12 months in lieu of employee benefits upon a qualifying termination.

[Table of Contents](#)

In addition, upon a qualifying termination of Ms. Richardson or Mr. Crandell, the shares underlying all unvested equity awards held by such officer will become vested and exercisable in full immediately prior to such termination. The severance payments under the change of control severance agreements with each of our executive officers are contingent upon such executive officer's execution, delivery and non-revocation of a release and waiver of claims satisfactory to us within 45 days of such executive officer's separation from service.

Employee benefit plans

2010 equity incentive plan

Our board of directors approved, and our stockholders adopted, our 2010 Plan in August 2010. Our 2010 Plan provides for the grant of incentive stock options, within the meaning of Section 422 of the Code, to our employees or any parent or subsidiary's employees, and for the grant of nonstatutory stock options, stock appreciation rights, restricted stock and RSUs to our employees, directors and consultants and any parent or subsidiary's employees and consultants. Stock appreciation rights, restricted stock and RSUs may also be granted under the 2010 Plan. As of December 31, 2013, an aggregate of 32,420,000 shares of our Class B common stock are reserved for issuance under our 2010 Plan. Upon the signing of the underwriting agreement relating to this offering, no further equity grants will be made under our 2010 Plan. We intend to grant all future equity awards under the 2014 Plan and the ESPP. However, all stock options and RSUs granted under our 2010 Plan will continue to be governed by the terms of our 2010 Plan. The purposes of the 2010 Plan are to attract, retain and motivate eligible persons whose present and potential contributions are important to our growth by offering such eligible persons an opportunity to participate in our future performance through the grant of awards.

Administration. Subject to the terms of the 2010 Plan, our board of directors or an authorized committee, referred to as the compensation committee, has the discretion to make all decisions implementing the 2010 Plan including the power to determine recipients, dates of grant, the numbers and types of stock awards to be granted and the terms and conditions of the stock awards, including the period of their exercisability and vesting. Subject to the limitations set forth below, the compensation committee will also determine the exercise price of options granted, and the consideration (if any) to be paid for restricted stock awards.

Stock options. Incentive and nonstatutory stock options are granted pursuant to stock option agreements adopted by the compensation committee. Generally, the exercise price for an incentive stock option or a nonstatutory stock option cannot be less than 100% of the fair market value of the Class B common stock subject to the option on the date of grant. No incentive stock option may be granted to any person who, at the time of the grant, owns or is deemed to own stock comprising more than 10% of our total combined voting power or that of any of our affiliates unless (a) the option exercise price is at least 110% of the fair market value of the stock subject to the option on the date of grant and (b) the term of the incentive stock option does not exceed five years from the date of grant. Options granted under the 2010 Plan generally vest over a four-year period. A stock option agreement may provide for early exercise prior to vesting and rights of repurchase.

The term of stock options granted under the 2010 Plan may not exceed 10 years. Unless the terms of an optionholder's stock option agreement provides for earlier or later termination, if an optionholder's service relationship with us, or any affiliate of ours, ceases due to disability or death, the optionholder, or his or her beneficiary, may exercise any vested options up to the

[Table of Contents](#)

12 months after the date the service relationship ends. Unless the terms of an optionholders' stock option agreement provides for earlier or later termination, if an optionholder's service relationship with us, or any affiliate of ours, ceases without cause for any reason other than disability or death, the optionholder may exercise any vested options for up to three months. In no event may an option be exercised after its expiration date.

The forms of consideration for the purchase of our Class B common stock under the 2010 Plan that the compensation committee may approve include cash, check, full recourse promissory note, cancellation of indebtedness, waiver of accrued compensation, shares of stock already owned, consideration paid through a formal cashless exercise program or same day sale program, any other form of consideration approved by the compensation committee or any combination of such consideration.

Limitations. The aggregate fair market value, determined at the time of grant, of shares of our Class B common stock with respect to incentive stock options that are exercisable for the first time by an optionholder during any calendar year under all of our stock plans may not exceed \$100,000. The options or portions of options that exceed this limit are treated as nonstatutory stock options.

Stock appreciation rights. Our 2010 Plan also permits the issuance of stock appreciation rights that provide for a payment, or payments, in cash or shares of our Class B common stock, to the holder based upon the increase in the fair market value of our Class B common stock on the date of exercise from the stated exercise price (subject to any maximum number of shares as may be specified in the applicable award agreement). Stock appreciation rights expire under the same rules that apply to stock options.

Restricted stock. Our 2010 Plan also permits the issuance of restricted stock. Restricted stock represents the purchase of our Class B common stock that is subject to our right of repurchase in the event of a termination of the stockholder's service relationship with us.

Restricted stock units. Our 2010 Plan also permits the issuance of restricted stock units, or RSUs, to our service providers. RSUs granted under our 2010 Plan represent the right to receive shares of our Class B common stock or cash payment at a specified future date and may be subject to vesting requirements.

Transferability. Unless the compensation committee permits otherwise, stock may not be transferred, except by will or by the laws of descent or distribution. However, nonstatutory stock options may be transferred to immediate family members or certain trusts.

Changes to capitalization. In the event that there is a specified type of change in our capital structure not involving the receipt of consideration by us, such as a stock split, stock dividend or other recapitalization, the 2010 Plan provides for the proportional adjustment of the number of shares reserved under the 2010 Plan and the number of shares and exercise or purchase price, if applicable, of all outstanding stock awards.

Corporate transactions. Unless otherwise provided in the award agreement, in the event of certain corporate transactions, any or all outstanding stock awards under the 2010 Plan may be assumed or substituted for by any surviving entity. If the surviving entity elects not to assume or substitute for such awards, such stock awards will terminate without vesting acceleration. In the event of our dissolution or liquidation, all outstanding options and stock appreciation rights under the 2010 Plan will terminate immediately prior to such event without accelerating vesting.

[Table of Contents](#)

Additional provisions. Our board of directors has the authority to amend, alter, suspend or terminate the 2010 Plan. However, no amendment or termination of the plan may adversely affect any rights under awards already granted to a participant without the affected participant's consent. No equity awards will be made under the 2010 Plan after the effective date of this offering and our 2014 Plan.

2014 equity incentive plan

We expect our board of directors to adopt our 2014 Plan, subject to stockholder approval, to become effective the day before the effective date of this prospectus. The 2014 Plan will terminate in 2024, unless sooner terminated by our board of directors. The purpose of the 2014 Plan is to attract, retain and motivate selected employees, consultants and directors through the granting of stock-based compensation awards and cash-based performance bonus awards. The 2014 Plan is also designed to permit us to make cash-based awards and equity-based awards intended to qualify as "performance-based compensation" under Section 162(m) of the Code.

Stock awards. The 2014 Plan provides for the grant of incentive stock options, nonstatutory stock options, stock appreciation rights, restricted stock awards, RSUs, performance-based stock awards and other forms of equity compensation, or collectively, stock awards. In addition, the 2014 Plan provides for the grant of performance cash awards. Incentive stock options may be granted only to employees, subject to certain limitation described below. All other awards may be granted to employees, including officers, as well as directors and consultants.

The principal features of the 2014 Plan are summarized below. This summary is qualified in its entirety by reference to the text of the 2014 Plan, which is filed as an exhibit to the registration statement of which this prospectus is a part.

Share reserve. We reserved _____ shares of our Class A common stock to be issued under our 2014 Plan. The number of shares reserved for issuance under our 2014 Plan will increase automatically on January 1 of each of our fiscal years beginning January 1, 2015 through the termination of the plan by the number of shares equal to 3% of the total outstanding shares of our Class A common stock as of the immediately preceding December 31. However, our board of directors or compensation committee may reduce the amount of the increase in any particular year. In addition, shares reserved but not issued or subject to outstanding grants under our 2010 Plan on the date of this prospectus will be available for grant and issuance under our 2014 Plan as Class A common stock and the following shares will again be available for grant and issuance under our 2014 Plan as Class A common stock:

- shares subject to options or stock appreciation rights granted under our 2014 Plan that cease to be subject to the option or stock appreciation right for any reason other than exercise of the option or stock appreciation right;
- shares subject to awards granted under our 2014 Plan that are subsequently forfeited or repurchased by us at the original issue price;
- shares subject to awards granted under our 2014 Plan that otherwise terminate without shares being issued;
- shares surrendered, cancelled, or exchanged for cash or a different award (or combination thereof);
- shares issuable upon the exercise of options or subject to other awards under our 2010 Plan prior to the date of this prospectus that cease to be subject to such options or other awards by forfeiture or otherwise after the date of this prospectus;

[Table of Contents](#)

• shares issued under our 2010 Plan that are forfeited or repurchased by us after the date of this prospectus; and

• shares subject to awards under our 2010 Plan that are used to pay the exercise price of an option or withheld to satisfy the tax withholding obligations related to any award.

As of the date hereof, no shares of our Class A common stock have been issued under the 2014 Plan. No person may be granted stock awards covering more than 500,000 shares of our Class A common stock under the 2014 Plan during any calendar year pursuant to stock options or stock appreciation rights other than a new employee of ours, who will be eligible to receive no more than 1,000,000 shares of our Class A common stock under the 2014 Plan in the calendar year in which the employee commences employment. Such limitations are designed to help assure that any deductions to which we would otherwise be entitled with respect to such stock awards will not be subject to the \$1,000,000 limitation on the income tax deductibility of compensation paid per covered executive officer imposed by Section 162(m) of the Code.

Administration. Our 2014 Plan will be administered by our compensation committee, all of the members of which are outside directors as defined under applicable federal tax laws, or by our board of directors acting in place of our compensation committee. The compensation committee will have the authority to construe and interpret our 2014 Plan, grant awards and make all other determinations necessary or advisable for the administration of the plan.

The compensation committee has the authority to reprice any outstanding stock award (by reducing the exercise price of any outstanding option, canceling an option in exchange for cash or another equity award or any other action that may be deemed a repricing under generally accepted accounting provisions) under the 2014 Plan without the approval of our stockholders.

Stock options. Incentive and nonstatutory stock options are granted pursuant to incentive and nonstatutory stock option agreements adopted by the compensation committee. The compensation committee determines the exercise price for a stock option, within the terms and conditions of the 2014 Plan, provided that the exercise price of a stock option cannot be less than 100% of the fair market value of our Class A common stock on the date of grant, except where a higher exercise price is required in the case of certain incentive stock options, as described below.

We anticipate that in general, options will vest over a four-year period. Options may vest based on time or achievement of performance conditions. Our compensation committee may provide for options to be exercised only as they vest or to be immediately exercisable with any shares issued on exercise being subject to our right of repurchase that lapses as the shares vest. The maximum term of options granted under our 2014 Plan is 10 years. The compensation committee determines the term of stock options granted under the 2014 Plan, up to a maximum of 10 years, except in the case of certain incentive stock options, as described below. Unless the terms of an optionholder's stock option agreement provide otherwise, if an optionholder's relationship with us, or any of our affiliates, ceases for any reason other than for cause, disability or death, the optionholder may exercise any vested options for a period of three months following the cessation of service. If an optionholder's service relationship with us is terminated for cause, then the option terminates immediately. If an optionholder's service relationship with us or any of our affiliates ceases due to disability or death, or an optionholder dies within the period (if any) specified in the award agreement following cessation of service, the optionholder or a beneficiary may exercise any vested options for a period of at least six months in the event of disability or death. The option term may be extended in the event that exercise of the option

[Table of Contents](#)

following termination of service is prohibited by applicable securities laws. In no event, however, may an option be exercised beyond the expiration of its maximum term.

Acceptable consideration for the purchase of Class A common stock issued upon the exercise of a stock option will be determined by the compensation committee and may include (a) cash, check, bank draft or money order, (b) a broker-assisted cashless exercise, (c) the tender of Class A common stock or Class B common stock previously owned by the optionholder, (d) cancellation of our indebtedness to the optionholder, (e) waiver of compensation due to the optionholder for services rendered and (f) other legal consideration approved by the compensation committee.

Unless the compensation committee provides otherwise, options generally are not transferable except by will, the laws of descent and distribution, or pursuant to a domestic relations order. An optionholder may, however, designate a beneficiary who may exercise the option following the optionholder's death.

Limitations on incentive stock options. Incentive stock options may be granted only to our employees. The aggregate fair market value, determined at the time of grant, of shares of our Class A common stock with respect to incentive stock options that are exercisable for the first time by an optionholder during any calendar year under all of our stock plans may not exceed \$100,000. No incentive stock option may be granted to any person who, at the time of the grant, owns or is deemed to own stock comprising more than 10% of our total combined voting power or that of any of our affiliates unless (a) the option exercise price is at least 110% of the fair market value of the stock subject to the option on the date of grant and (b) the term of the incentive stock option does not exceed five years from the date of grant.

Restricted stock awards. Restricted stock awards are granted pursuant to restricted stock award agreements adopted by our compensation committee. A restricted stock award is an offer by us to sell shares of our Class A common stock subject to restrictions. The price, if any, of a restricted stock award will be determined by our compensation committee. Restricted stock awards may be granted in consideration for (a) cash, check, bank draft or money order, (b) past or future services rendered to us or our affiliates, or (c) any other form of legal consideration determined by the compensation committee. Shares of Class A common stock acquired under a restricted stock award may, but need not, be subject to a share repurchase option or forfeiture restriction in our favor in accordance with a vesting schedule to be determined by the compensation committee. Rights to acquire shares under a restricted stock award may be transferred only upon such terms and conditions as set by the compensation committee. Except as otherwise provided in the applicable award agreement, restricted stock awards that have not vested will be forfeited or subject to repurchase upon the participant's cessation of continuous service for any reason.

Restricted stock unit awards. RSU awards are granted pursuant to restricted stock unit award agreements adopted by our compensation committee. RSUs represent the right to receive shares of our Class A common stock at a specified date in the future, subject to forfeiture of that right because of termination of the holder's services to us or the holder's failure to achieve certain performance conditions. If a RSU has not been forfeited, then on the date specified in the RSU agreement, we may deliver to the holder of the RSU whole shares of our Class A common stock, which may be subject to additional restrictions, cash or a combination of our Class A common stock and cash. Our compensation committee may also permit the holders of the RSUs to defer payment to a date or dates after the RSU is earned, provided that the terms of the RSU and any deferral satisfy the requirements of Section 409A of the Code.

[Table of Contents](#)

Stock appreciation rights. Stock appreciation rights are granted pursuant to stock appreciation rights agreements adopted by the compensation committee. Stock appreciation rights provide for a payment, or payments, in cash or shares of our Class A common stock, to the holder based upon the increase in the fair market value of our Class A common stock on the date of exercise from the stated exercise price (subject to any maximum number of shares as may be specified in the applicable award agreement). The payment may occur upon the exercise of a stock appreciation right or deferred with such interest or dividend equivalent, if any, as our compensation committee determines, provided that the terms of the stock appreciation right and any deferral satisfy the requirements of Section 409A of the Code. The compensation committee determines the exercise price for a stock appreciation right which generally cannot be less than 100% of the fair market value of our Class A common stock on the date of grant. Stock appreciation rights may vest based on time or achievement of performance conditions. Stock appreciation rights expire under the same rules that apply to stock options.

Performance awards. The 2014 Plan permits the grant of performance stock awards and performance cash awards that may qualify as performance-based compensation that is not subject to the \$1,000,000 limitation on the income tax deductibility of compensation paid per covered executive officer imposed by Section 162(m) of the Code. To assure that the compensation attributable to performance-based awards will so qualify, our committee can structure such awards so that stock will be issued or paid pursuant to such award only upon the achievement of certain pre-established performance goals during a designated performance period. The maximum benefit that may be granted to a participant in any calendar year may not exceed \$1,000,000.

Other stock awards. Our compensation committee may grant other awards based in whole or in part by reference to our Class A common stock. The compensation committee will set the number of shares under the award and all other terms and conditions of such awards.

Changes to capital structure. In the event that there is a specified type of change in our capital structure, such as a stock split, appropriate adjustments will be made to (a) the class and maximum number of shares reserved under the 2014 Plan, (b) the class and maximum number of shares subject to options, stock appreciation rights and performance stock awards that can be granted in a calendar year, (c) the class and maximum number of shares that may be issued upon exercise of incentive stock options, (d) the maximum number of shares that may be awarded to a member of our board of directors, and (e) the number of shares and exercise price, if applicable, of all outstanding stock awards.

Corporate transactions. The 2014 Plan provides that, in the event of a sale, lease or other disposition of all or substantially all of the assets of us or specified types of mergers or consolidations (each, a "corporate transaction"), outstanding awards under our 2014 Plan may be assumed or replaced by any surviving or acquiring corporation; the surviving or acquiring corporation may substitute similar awards for those outstanding under the 2014 Plan; outstanding awards may be settled for the full value of such outstanding award (whether or not then vested or exercisable) in cash or securities of the successor entity with payment deferred until the date or dates the award would have become exercisable or vested; or outstanding awards may be terminated for no consideration. Our board of directors has the discretion to provide that a stock award under the 2014 Plan will immediately vest as to all or any portion of the shares subject to the stock award at the time of a corporate transaction or in the event a participant's service with us or a successor entity is terminated actually or constructively within a designated period following the occurrence of the transaction. Stock awards held by participants

[Table of Contents](#)

under the 2014 Plan will not vest automatically on such an accelerated basis unless specifically provided in the participant's applicable award agreement.

Plan suspension or termination. Our board of directors has the authority to suspend or terminate the 2014 Plan at any time provided that such action does not impair the existing rights of any participant.

Securities laws and federal income taxes. The 2014 Plan is designed to comply with various securities and federal tax laws as follows:

- *Securities laws.* The 2014 Plan is intended to conform to all provisions of the Securities Act of 1933, as amended, and the Exchange Act and any and all regulations and rules promulgated by the SEC thereunder, including, without limitation, Rule 16b-3. The 2014 Plan will be administered, and options will be granted and may be exercised, only in such a manner as to conform to such laws, rules and regulations.
 - *Section 409A of the Code.* Certain awards under the 2014 Plan may be considered "nonqualified deferred compensation" for purposes of Section 409A of the Code, which imposes certain additional requirements regarding the payment of deferred compensation. Generally, if at any time during a taxable year a nonqualified deferred compensation plan fails to meet the requirements of Section 409A, or is not operated in accordance with those requirements, all amounts deferred under the 2014 Plan and all other equity incentive plans for the taxable year and all preceding taxable years, by any participant with respect to whom the failure relates, are includible in gross income for the taxable year to the extent not subject to a substantial risk of forfeiture and not previously included in gross income. If a deferred amount is required to be included in income under Section 409A, the amount also is subject to interest and an additional income tax. The interest imposed is equal to the interest at the underpayment rate plus one percentage point, imposed on the underpayments that would have occurred had the compensation been includible in income for the taxable year when first deferred, or if later, when not subject to a substantial risk of forfeiture. The additional federal income tax is equal to 20% of the compensation required to be included in gross income. In addition, certain states, including California, have laws similar to Section 409A, which impose additional state penalty taxes on such compensation.
 - *Section 162(m) of the Code.* In general, under Section 162(m) of the Code, income tax deductions of publicly held corporations may be limited to the extent total compensation (including, but not limited to, base salary, annual bonus, and income attributable to stock option exercises and other non-qualified benefits) for certain executive officers exceeds \$1,000,000 (less the amount of any "excess parachute payments" as defined in Section 280G of the Code) in any taxable year of the corporation. However, under Section 162(m), the deduction limit does not apply to certain "performance-based compensation" established by an independent compensation committee that is adequately disclosed to, and approved by, stockholders. In particular, stock options and stock appreciation rights will satisfy the "performance-based compensation" exception if the awards are made by a qualifying compensation committee, the 2014 Plan sets the maximum number of shares that can be granted to any person within a specified period and the compensation is based solely on an increase in the stock price after the grant date. Specifically, the option exercise price must be equal to or greater than the fair market value of the stock subject to the award on the grant date.
- We have attempted to structure the 2014 Plan in such a manner that the compensation attributable to stock options, stock appreciation rights and other performance-based awards which meet the

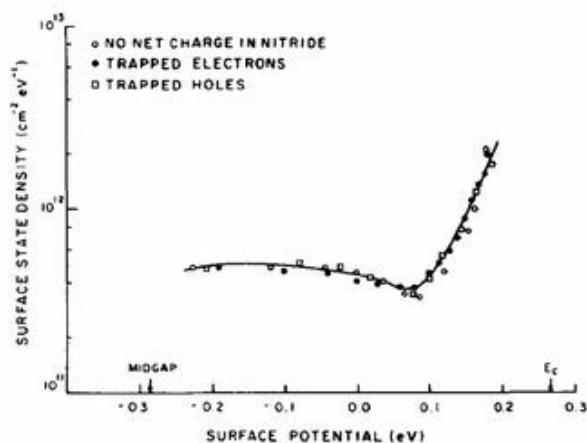


FIG. 3. Interface-state density N_{ss} versus surface potential, with and without trapped nitride charge.

voltage plot on an X - Y recorder. At regular intervals during the slow ramp the sample is biased to accumulation for a time interval τ_a in order to fill the interface states in the upper half of the energy gap and then swept to depletion by a fast (100 μ s) linear voltage ramp. The C - V curves produced by the fast ramp are displayed on a storage oscilloscope. From these, a plot of V_{fb} versus V_g is obtained, as shown in Fig. 2, and the slope dV_{fb}/dV_g is used in Eq. (4) to calculate N_{ss} . The time interval τ_a is chosen to be sufficiently long (1 ms) so that the contribution to dV_{fb}/dV_g of the interface states with time constants $>\tau_a$ is negligible, while still assuring that no measurable disturbance of the nitride charge occurs. The experimental procedure assures that the interface-state occupancy remains essentially the same each time the sample is swept through the flat-band point by the fast ramp, whether or not all states remain in equilibrium during the

fast-ramp sweep. The charge centroid is determined in a separate experiment.^{3,4}

Figure 3 shows the interface-state density obtained with different amounts of trapped nitride charge. The density-of-states spectrum shows the same general characteristics as are exhibited by the Si-SiO₂ interface: a nearly constant density of states near the midgap, increasing steeply toward the band edge.^{1,5} The nitride charge is seen to have no effect on the interface-state density. This may be contrasted with the correlation between the fixed oxide charge and interface-state density frequently observed in the MOS system.^{1,6} The lack of correlation in this case may be due to the larger distance between the nitride charge and the silicon space charge. It is also possible that, when such correlation exists, it is caused by a common chemical origin of the oxide charge and interface states rather than by Coulombic interaction between the charges in the insulator and in the semiconductor space-charge region.

The authors are indebted to P. Müräu and B. Singer for useful discussions and for providing the experimental samples.

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Charge retention of MNOS devices limited by Frenkel-Poole detrapping^{a)}

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(Received 26 September 1977; accepted for publication 20 December 1977)

A simple analytical expression is derived for charge retention in MNOS memory devices assuming that retention loss is limited by Frenkel-Poole release from monoenergetic traps. This model shows that charge retention becomes eventually independent of the initial charge distribution. Experimental data obtained at elevated temperatures confirm this model and provide a trap depth of 1.5 eV, Frenkel-Poole coefficient of about $6 \times 10^{-4} \text{ cm}^{1/2} \text{ V}^{-1/2} \text{ eV}$, and effective escape attempt rate factor of $1.2 \times 10^8 \text{ sec}^{-1}$.

PACS numbers: 73.40.Qv, 73.60.Hy, 85.30.Tv, 72.20.Jv

Charge retention loss in thin oxide MNOS memory devices ($t_{ox} \lesssim 30 \text{ Å}$) is dominated in its early stages by

charge tunneling through the oxide from traps located at or near the oxide-nitride interface,¹⁻³ and in latter phases by Frenkel-Poole emission of charge trapped in the nitride and charge transport through the nitride.^{3,4} In this paper we derive a simple analytic expression for the decay of retained charge based on Frenkel-Poole

^{a)}Supported by the Army Research Office, Grant DAAG29-77-G-0123.

emission from monoenergetic traps. Following our procedure, an analytic expression can be derived for any other detrapping mechanism which depends solely on the local electric field intensity. The effect of re-trapping can be accounted for by modifying the effective escape attempt factor.

After a charging pulse, the trapped nitride charge induces a charge of opposite polarity in the silicon and at the gate electrode (Fig. 1). This charge is not necessarily located at the silicon surface, as has been indicated, and there can be a potential drop, not shown in Fig. 1, across the silicon space-charge region. Ramifications of the charge distribution in the silicon and of the corresponding potential drop are discussed later in this paper. The potential distribution in the nitride has a minimum at a distance x_m from the oxide.^{4,5} This minimum is located closer to the oxide than to the gate, i. e., $x_m < \frac{1}{2}t_N$, since the concentration of trapped charge decreases with increasing distance from the oxide.^{4,6-8} Consequently, the maximum nitride field during retention is located at the oxide interface. Thus detrapping occurs mostly near the oxide interface and the detrapped nitride charge shifts primarily toward the silicon. Therefore, the time dependence of the initial Frenkel-Poole-type detrapping in the region $0 \leq x \leq x_m$ provides a lower limit for charge retention.

The escape rate from traps will be assumed to obey the Frenkel-Poole law

$$\frac{\partial n_t}{\partial t} = -n_t \nu \exp[-\phi + \beta(E)^{1/2}], \quad (1)$$

where $n_t(x, t)$ is the local trapped charge density and $E(x, t)$ is the local field, both functions of time. The notation here is the same as that used in Refs. 4, 7, and 8. Trapped charge density and field are related by Poisson's law

$$\frac{\partial E}{\partial x} = \frac{n_t q}{\epsilon_N}. \quad (2)$$

Thus

$$q \frac{d}{dt} \int_0^{x_m} n_t dx = -\nu \exp(-\phi) \epsilon_N \int_0^{E_0} \exp[\beta(E)^{1/2}] dE + n_t(x_m) q \frac{dx_m}{dt} \quad (3)$$

with

$$E_0(t) = (q/\epsilon_N) \int_0^{x_m} n_t dx \quad (4)$$

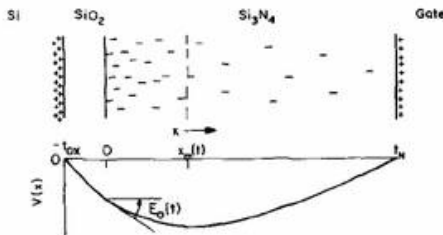


FIG. 1. A typical charge and potential distribution during retention. The potential drop across the silicon space-charge layer is not shown, but is considered later in the text.

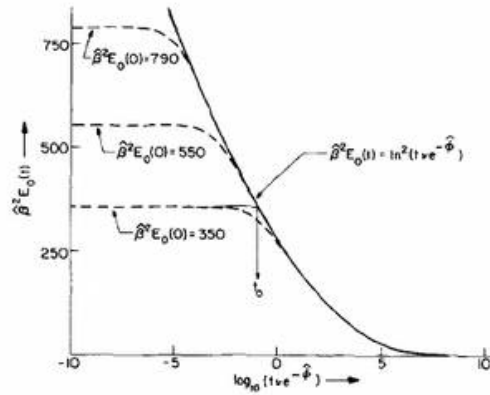


FIG. 2. The function $\beta^2 E_0(t)$ of $\nu t \exp(-\phi)$ according to Eq. (5) for different values of $\beta^2 E_0(0)$. In the range $\beta^2 E_0(t)^{1/2} \lesssim 1$, terms neglected in deriving Eq. (5) have been included in Fig. 2. to obtain $E_0(t) \rightarrow 0$ for $t \rightarrow \infty$.

the field in the nitride at the nitride/oxide interface, $x = 0$.

The second term on the right-hand side arises from the exchange of differentiation with respect to time, and of integration with respect to position, when proceeding from Eq. (1) to Eq. (3). For a constant potential applied between gate and silicon, the charge shift $qn_t(x_m) dx_m/dt$ can be related to the term on the left-hand side of Eq. (3), and to factors which involve the centroids of $q \int_0^{x_m} \partial n_t / \partial t dx$ and of the induced charge in the silicon. The latter is ϵ_s/C_{sp} , where C_{sp} is the low-frequency silicon space-charge capacitance. It can be shown that the right-hand side of Eq. (3) can be replaced by omitting the second term and multiplying the first term on that side by a factor η . This factor is significantly less than unity only in the depletion regime without inversion, and then only if $\epsilon_s/t_N C_{sp} \gtrsim 1$. The overall effect of this "η dip" is always small, however, since at high dopant concentrations the dip is shallow, while at low dopant concentrations the dip is narrow because the E_0 -field range pertaining to depletion without inversion becomes very small. We shall, therefore, neglect the last term of Eq. (3) in what follows.

Integration of the thus simplified Eq. (3), considering Eq. (4), provides

$$\beta[E_0(t)]^{1/2} = \beta[E_0(0)]^{1/2} - \ln[1 + \nu t \exp(-\phi) \times \exp[\beta(E_0)^{1/2}]], \quad (5)$$

where certain terms have been neglected for convenience, assuming that $\beta[E_0(t)]^{1/2} \gg 1$. The function $\beta^2 E_0(t)$ versus $\log[\nu t \exp(-\phi)]$ is shown in Fig. 2 for various values of $\beta^2 E_0(0)$ chosen to provide $t_0 = \nu^{-1} \exp[\phi - \beta^2 E_0(0)^{1/2}]$ of 10^{-1} , 10^{-3} , and 10^{-5} sec, respectively. All curves merge into the same unique function

$$\beta^2 E_0(t) = \ln^2[\nu t \exp(-\phi)] \quad (6)$$

for

$$t_0 \ll t \ll \nu^{-1} \exp(+\phi). \quad (7)$$

The field intensity $E_0(t)$ in the nitride at the boundary of the oxide can be related to the threshold voltage by the following considerations. The threshold voltage with nitride charge differs from that without nitride charge

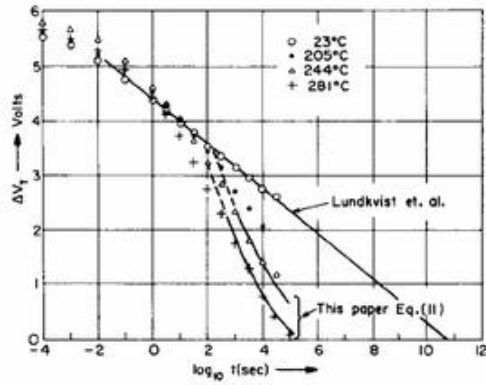


FIG. 3. Experimental charge retention loss fitted by Eq. (11).

(so-called "intrinsic state") by

$$\begin{aligned} V_T(t) - V_T(\infty) &= \left(\frac{q}{\epsilon_N}\right) \int_0^{t_N} n_t(t_N - x) dx \\ &= \left(\frac{qt_N}{\epsilon_N}\right) \int_0^{x_m} n_t dx - \frac{q}{\epsilon_N} \int_0^{x_m} n_t x dx \\ &\quad + \left(\frac{q}{\epsilon_N}\right) \int_{x_m}^{t_N} n_t(t_N - x) dx. \end{aligned} \quad (8)$$

The first of the last three terms is $E_0(t)t_N$; the second term is the potential drop between $x=0$ and x_m ; and the third term is the potential drop between x_m and t_N . In a typical retention experiment a constant bias voltage V_A is applied between gate electrode and silicon substrate. Since

$$\begin{aligned} V_A + V_B &= V_{sp} - \left(\frac{\epsilon_N}{\epsilon_0}\right) t_{ox} E_0 - \left(\frac{q}{\epsilon_N}\right) \int_0^{x_m} n_t x dx \\ &\quad + \left(\frac{q}{\epsilon_N}\right) \int_{x_m}^{t_N} n_t(t_N - x) dx, \end{aligned} \quad (9)$$

where V_{sp} is the potential across the space-charge layer in the silicon and V_B is the built-in potential between gate and substrate, Eq. (8) can be transformed into

$$V_T(t) - V_T(\infty) = E_0(t)[t_N + \epsilon_N t_{ox} / \epsilon_{ox}] + V_A + V_B - V_{sp}. \quad (10)$$

The built-in potential compensates closely the space-charge layer potential in case of a p^+ -polysilicon gate and an n -type substrate if the nitride charge induces an inversion layer in the silicon. Under this condition, one obtains from Eqs. (10) and (6) for retention at zero gate to substrate bias voltage

$$V_T(t) - V_T(\infty) \approx t_N \hat{\beta}^{-2} \ln^2[\nu t \exp(-\hat{\phi})]. \quad (11)$$

This equation is valid for $t \gg t_0$.

Figure 3 shows experimental data supplied by Dr. M. Beguwala of Rockwell International. The nitride was charged by applying positive voltage pulse to the gate of an MNOS capacitor on n -type silicon substrate at various temperatures indicated in Fig. 3. The device was at its intrinsic threshold voltage prior to pulsing. The lack of a significant temperature dependence for

$t \lesssim 100$ msec suggests that retention loss is initially governed by tunneling. The straight line in Fig. 2 is the tunnel relation of Ref. 1. After about 1 sec detrapping appears to become the dominant factor for retention loss at the elevated temperatures. The retention period when initial charge distribution has an effect on the detrapping rate is masked by tunnel escape. The drop-off of the data points at 281 °C was fitted by Eq. (11) with $\beta = \hat{\beta} kT/q = 5.2 \times 10^{-4} \text{ cm}^{1/2} \text{ V}^{-1/2} \text{ eV}$, $\phi = 1.5 \text{ eV}$, and $\nu = 1.2 \times 10^8 \text{ sec}^{-1}$ determined as follows: A plot of $\ln V_T$ versus $\log_{10} t$ of the experimental values was matched to a plot of $\ln E_0$ versus $\log_{10} [\nu \exp(-\hat{\phi})t]$ according to Eq. (11); the displacement along the ordinate is $\ln(t_N \hat{\beta}^{-2})$ and the displacement along the x axis is $\log_{10}[\nu \exp(-\hat{\phi})]$. The parameters ν and ϕ have been separated by applying the same procedure to the data at 244 °C and assuming that ν is independent of temperature. The β value pertaining to 244 °C was $6.4 \times 10^{-4} \text{ cm}^{1/2} \text{ V}^{-1/2} \text{ eV}$. The slight temperature dependence of β should be confirmed by additional experimental data before attempting an interpretation. The β values are about twice the accepted value for the Frenkel-Poole coefficient.^{7,9-12} The comparatively small value of ν may be indicative of a positive temperature coefficient of the trap depths, $d\phi/dT > 0$, and of retrapping. The time t used in the theoretical expression (11) is the initial detrapping time, $t_{th} = \tau_i$. On the other hand, the time of the experimental points is the time when trapped electrons are removed from the nitride, i. e., $t_{exp} = \tau_i + \theta$. These times differ by the delay θ due to retrapping.

Since, by curve fitting, $\nu_{th} t_{th} = \nu_{exp} t_{exp}$ we have

$$\nu_{exp} = \frac{\nu_{th}}{1 + \theta/\tau_i} = \nu^* \exp \left[- \left(\frac{d\phi}{k dT} \right) \left(1 + \frac{\theta}{\tau_i} \right) \right]^{-1}, \quad (12)$$

where ν^* is the intrinsic escape attempt frequency, usually assumed to be of the order of the vibrational lattice frequency. The delay time θ is expected to be a weak function of time, and this implicit time dependence should not affect Eq. (11) strongly.

The observed temperature dependence in the temperature range 154–205 °C was less than that expected by our theory, with ϕ and ν as derived from the data obtained at 244 and 281 °C. This discrepancy is attributed to a second, more shallow, trap level which becomes dominant (filled) at the lower temperatures and which is insignificant (empty) at the more elevated temperatures. Unfortunately, Eq. (3) written for the case of multiple trap levels cannot be integrated to provide a concise form such as Eq. (5) for the retention loss arising from the detrapping of electrons from a single trap level.

Our model provides a concise analytical expression for the charge retention loss if all traps have the same activation energy. During the latter periods of retention loss, this expression becomes independent of the initial charge distribution, and depends then only on trap depth, Frenkel-Poole coefficient, and an effective escape attempt rate factor which takes into account retrapping.

We thank Dr. M. Beguwala and Dr. Ross Williams of Rockwell International for supplying the experimental data and for helpful discussions.

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L01, AO1-A, MENARA 1, KL ECO CITY, NO 1 JALAN BANGSAR, 50200 KUALA LUMPUR, MALAYSIA

Salary Slip

Employee Name:	Goh Zhe Guan	Pay Period Begin Date:	1/2/2022
Employee IC:	021031-07-7479	Pay Period End Date:	28/2/2022
Employee No:	B009	Occupation:	AI/Machine Learning Engineer
Earnings (MYR)		Deductions (MYR)	
Basic Salary	7,500.00	Employee EPF	825.00
		Employee SOCSO	19.75
Bonus (MYR)		Employee EIS	7.90
		Tax	489.2
Total Earnings	7,500.00	Total Deduction	1,341.85
Current NETT Salary (MYR)		6,158.15	
Employer Statutory (MYR)		Year-to-Date (MYR)	
Employer EPF	900.00	Basic Salary	14,516.13
Employer SOCSO	69.05	Gross Salary	14,516.13
Employer EIS	7.90		
Employee EPF Number:	29700633	Employee Bank Account:	Malayan Banking Berhad 135201001697
Employee SOCSO Number:	021031077479	Employee DuitNow Account:	-
Employee Income Tax Number:	SG34041838051		