

## N-Channel Power MOSFET

40V, 135A, 3.8mΩ

### FEATURES

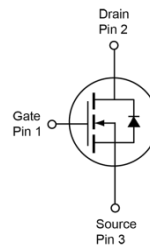
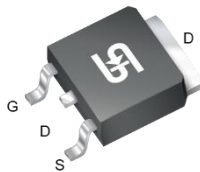
- Low  $R_{DS(on)}$  to minimize conductive losses
- Logic level
- Low gate charge for fast power switching
- 100% UIS and  $R_g$  tested
- Compliant to RoHS directive 2011/65/EU and in accordance to WEEE 2002/96/EC
- Halogen-free according to IEC 61249-2-21

### KEY PERFORMANCE PARAMETERS

| PARAMETER          | VALUE           | UNIT |
|--------------------|-----------------|------|
| $V_{DS}$           | 40              | V    |
| $R_{DS(on)}$ (max) | $V_{GS} = 10V$  | 3.8  |
|                    | $V_{GS} = 4.5V$ | 5    |
| $Q_g$              | 53              | nC   |

### APPLICATIONS

- BLDC Motor Control
- Battery Power Management
- DC-DC converter
- Secondary Synchronous Rectification


**TO-252 (DPAK)**


**Note:** MSL 3 (Moisture Sensitivity Level) per J-STD-020

### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| PARAMETER                                          | SYMBOL         | LIMIT                     | UNIT             |
|----------------------------------------------------|----------------|---------------------------|------------------|
| Drain-Source Voltage                               | $V_{DS}$       | 40                        | V                |
| Gate-Source Voltage                                | $V_{GS}$       | $\pm 20$                  | V                |
| Continuous Drain Current <sup>(Note 1)</sup>       | $I_D$          | $T_C = 25^\circ\text{C}$  | 135              |
|                                                    |                | $T_A = 25^\circ\text{C}$  | 19               |
| Pulsed Drain Current                               | $I_{DM}$       | 540                       | A                |
| Single Pulse Avalanche Current <sup>(Note 2)</sup> | $I_{AS}$       | 38                        | A                |
| Single Pulse Avalanche Energy <sup>(Note 2)</sup>  | $E_{AS}$       | 217                       | mJ               |
| Total Power Dissipation                            | $P_D$          | $T_C = 25^\circ\text{C}$  | 125              |
|                                                    |                | $T_C = 125^\circ\text{C}$ | 25               |
| Total Power Dissipation                            | $P_D$          | $T_A = 25^\circ\text{C}$  | 2.6              |
|                                                    |                | $T_A = 125^\circ\text{C}$ | 0.5              |
| Operating Junction and Storage Temperature Range   | $T_J, T_{STG}$ | - 55 to +150              | $^\circ\text{C}$ |

### THERMAL PERFORMANCE

| PARAMETER                              | SYMBOL          | LIMIT | UNIT               |
|----------------------------------------|-----------------|-------|--------------------|
| Junction to Case Thermal Resistance    | $R_{\theta JC}$ | 1     | $^\circ\text{C/W}$ |
| Junction to Ambient Thermal Resistance | $R_{\theta JA}$ | 49    | $^\circ\text{C/W}$ |

**Thermal Performance Note:**  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistances. The case-thermal reference is defined at the solder mounting surface of the drain pins.  $R_{\theta JA}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.

**ELECTRICAL SPECIFICATIONS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

| PARAMETER                         | CONDITIONS                                                                                  | SYMBOL              | MIN                                         | TYP                 | MAX  | UNIT |
|-----------------------------------|---------------------------------------------------------------------------------------------|---------------------|---------------------------------------------|---------------------|------|------|
| Static                            |                                                                                             |                     |                                             |                     |      |      |
| Drain-Source Breakdown Voltage    | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                                                | BV <sub>DSS</sub>   | 40                                          | --                  | --   | V    |
| Gate Threshold Voltage            | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250μA                                  | V <sub>GS(TH)</sub> | 1.2                                         | 1.5                 | 2.5  | V    |
| Gate-Source Leakage Current       | V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V                                                | I <sub>GSS</sub>    | --                                          | --                  | ±100 | nA   |
| Drain-Source Leakage Current      | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 40V                                                 | I <sub>DSS</sub>    | --                                          | --                  | 1    | μA   |
|                                   | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 40V<br>T <sub>J</sub> = 125°C                       |                     | --                                          | --                  | 100  |      |
|                                   | Drain-Source On-State Resistance<br>(Note 3)                                                |                     | V <sub>GS</sub> = 10V, I <sub>D</sub> = 19A | R <sub>DS(on)</sub> | --   |      |
|                                   | V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 17A                                                | --                  | 3.4                                         |                     | 5    |      |
| Forward Transconductance (Note 3) | V <sub>DS</sub> = 5V, I <sub>D</sub> = 19A                                                  | g <sub>fs</sub>     | --                                          | 55                  | --   | S    |
| Dynamic (Note 4)                  |                                                                                             |                     |                                             |                     |      |      |
| Total Gate Charge                 | V <sub>GS</sub> = 10V, V <sub>DS</sub> = 20V,<br>I <sub>D</sub> = 19A                       | Q <sub>g</sub>      | --                                          | 104                 | --   | nC   |
| Total Gate Charge                 | V <sub>GS</sub> = 4.5V, V <sub>DS</sub> = 20V,<br>I <sub>D</sub> = 17A                      | Q <sub>g</sub>      | --                                          | 53                  | --   |      |
| Gate-Source Charge                |                                                                                             | Q <sub>gs</sub>     | --                                          | 14                  | --   |      |
| Gate-Drain Charge                 |                                                                                             | Q <sub>gd</sub>     | --                                          | 23                  | --   |      |
| Input Capacitance                 | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 20V<br>f = 1.0MHz                                   | C <sub>iss</sub>    | --                                          | 5509                | --   | pF   |
| Output Capacitance                |                                                                                             | C <sub>oss</sub>    | --                                          | 548                 | --   |      |
| Reverse Transfer Capacitance      |                                                                                             | C <sub>rss</sub>    | --                                          | 332                 | --   |      |
| Gate Resistance                   | f = 1.0MHz                                                                                  | R <sub>g</sub>      | 0.4                                         | 1.3                 | 2.6  | Ω    |
| Switching (Note 4)                |                                                                                             |                     |                                             |                     |      |      |
| Turn-On Delay Time                | V <sub>GS</sub> = 10V, V <sub>DS</sub> = 20V,<br>I <sub>D</sub> = 19A, R <sub>G</sub> = 2Ω, | t <sub>d(on)</sub>  | --                                          | 8                   | --   | ns   |
| Turn-On Rise Time                 |                                                                                             | t <sub>r</sub>      | --                                          | 21                  | --   |      |
| Turn-Off Delay Time               |                                                                                             | t <sub>d(off)</sub> | --                                          | 57                  | --   |      |
| Turn-Off Fall Time                |                                                                                             | t <sub>f</sub>      | --                                          | 35                  | --   |      |
| Source-Drain Diode                |                                                                                             |                     |                                             |                     |      |      |
| Forward Voltage (Note 3)          | V <sub>GS</sub> = 0V, I <sub>S</sub> = 19A                                                  | V <sub>SD</sub>     | --                                          | --                  | 1    | V    |
| Reverse Recovery Time             | I <sub>S</sub> = 19A ,<br>dI/dt = 100A/μs                                                   | t <sub>rr</sub>     | --                                          | 37                  | --   | ns   |
| Reverse Recovery Charge           |                                                                                             | Q <sub>rr</sub>     | --                                          | 27                  | --   | nC   |

**Notes:**

1. Silicon limited current only.
2.  $L = 0.3\text{mH}, V_{GS} = 10V, V_{DD} = 25V, R_G = 25\Omega, I_{AS} = 38A$ , Starting  $T_J = 25^\circ\text{C}$
3. Pulse test: Pulse Width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$ .
4. Switching time is essentially independent of operating temperature.

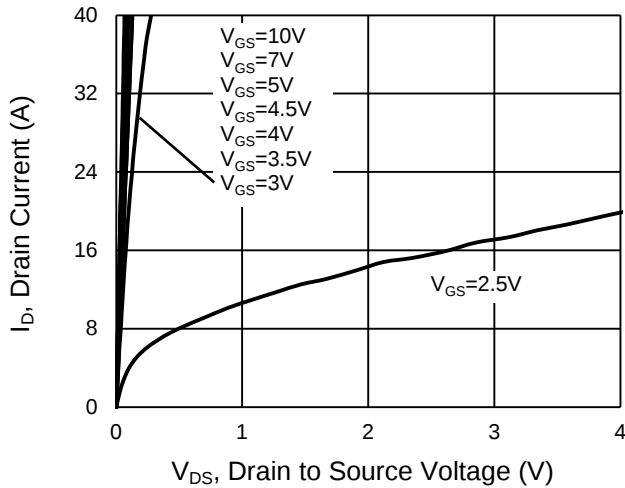
**ORDERING INFORMATION**

| PART NO.         | PACKAGE       | PACKING             |
|------------------|---------------|---------------------|
| TSM038N04LCP ROG | TO-252 (DPAK) | 2,500pcs / 13" Reel |

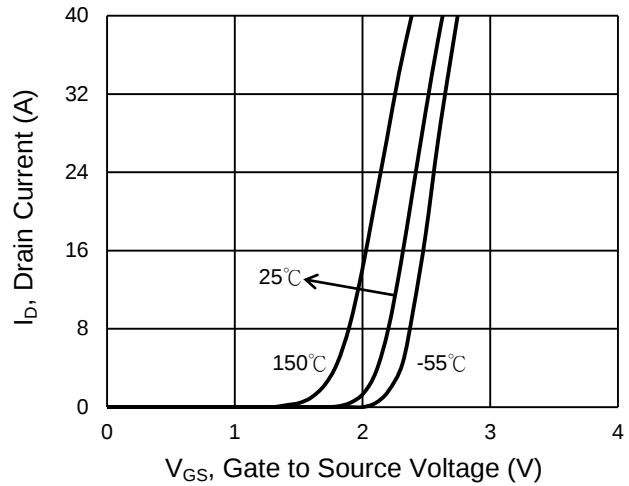
## CHARACTERISTICS CURVES

( $T_A = 25^\circ\text{C}$  unless otherwise noted)

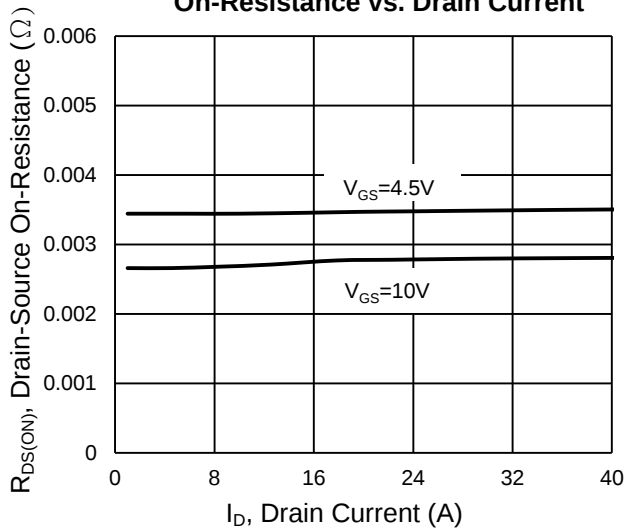
**Output Characteristics**



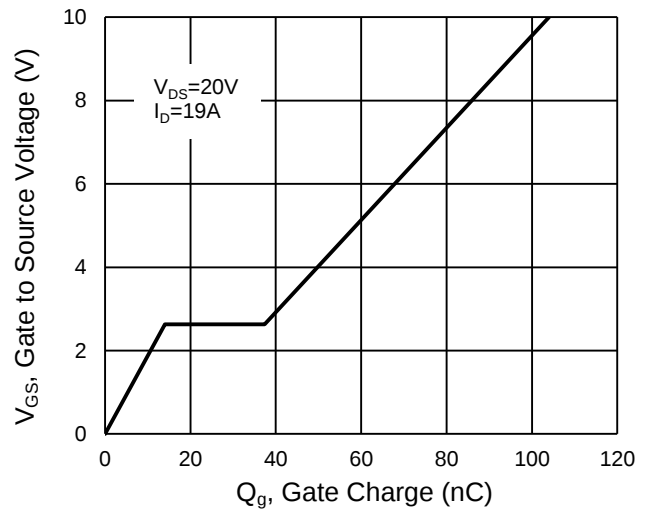
**Transfer Characteristics**



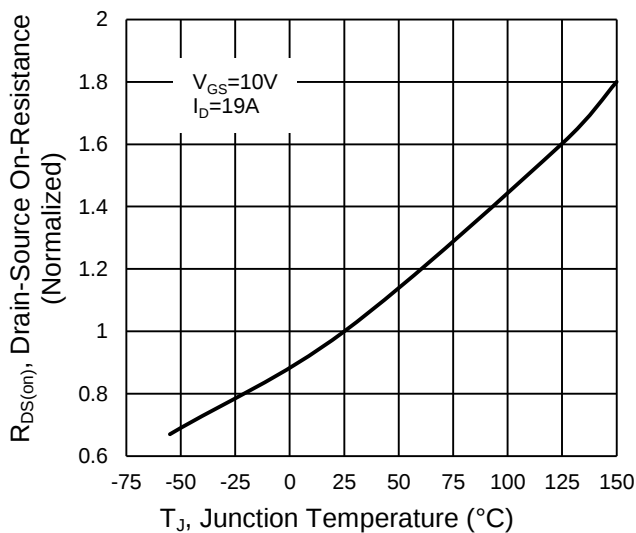
**On-Resistance vs. Drain Current**



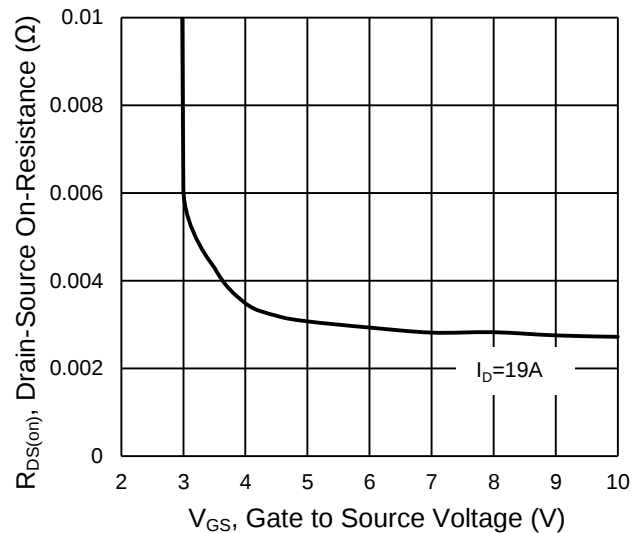
**Gate-Source Voltage vs. Gate Charge**



**On-Resistance vs. Junction Temperature**



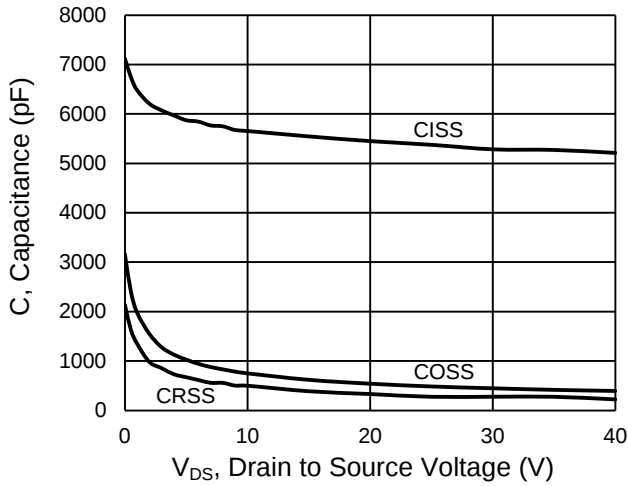
**On-Resistance vs. Gate-Source Voltage**



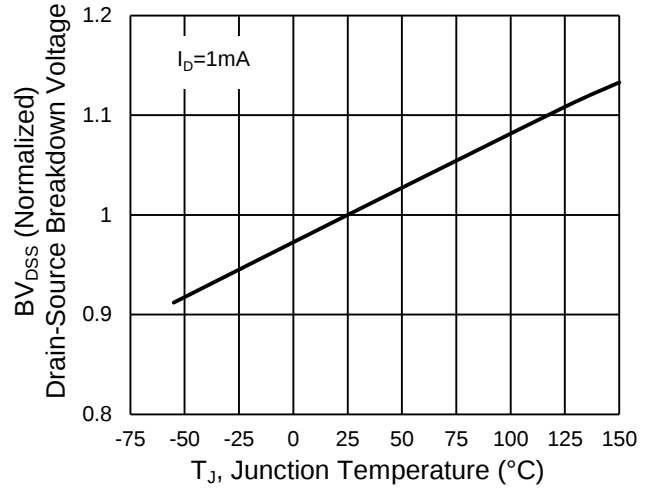
## CHARACTERISTICS CURVES

( $T_A = 25^\circ\text{C}$  unless otherwise noted)

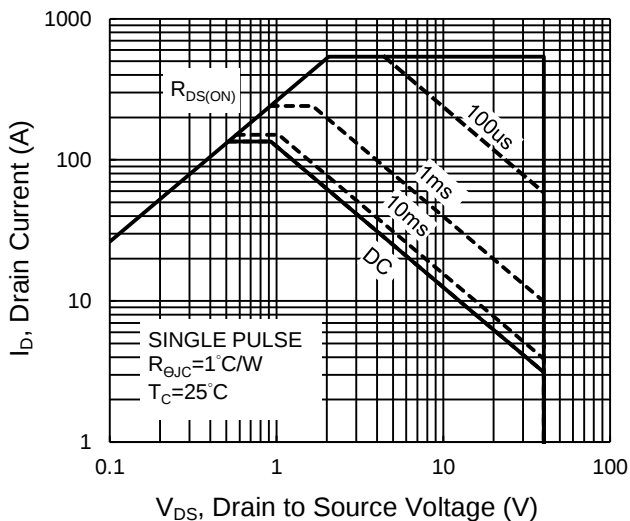
**Capacitance vs. Drain-Source Voltage**



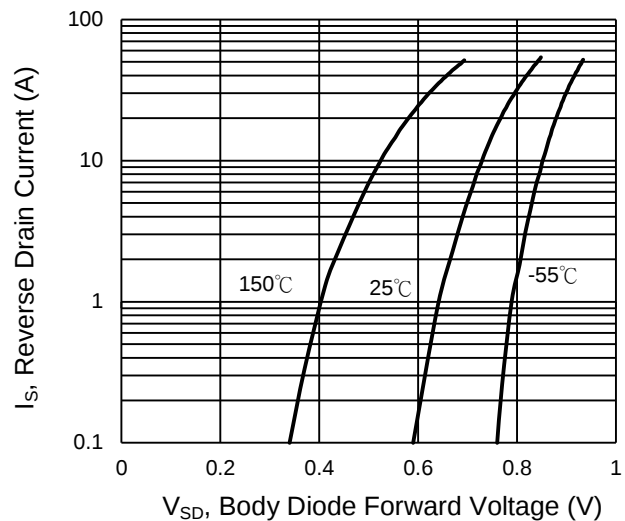
**$BV_{DSS}$  vs. Junction Temperature**



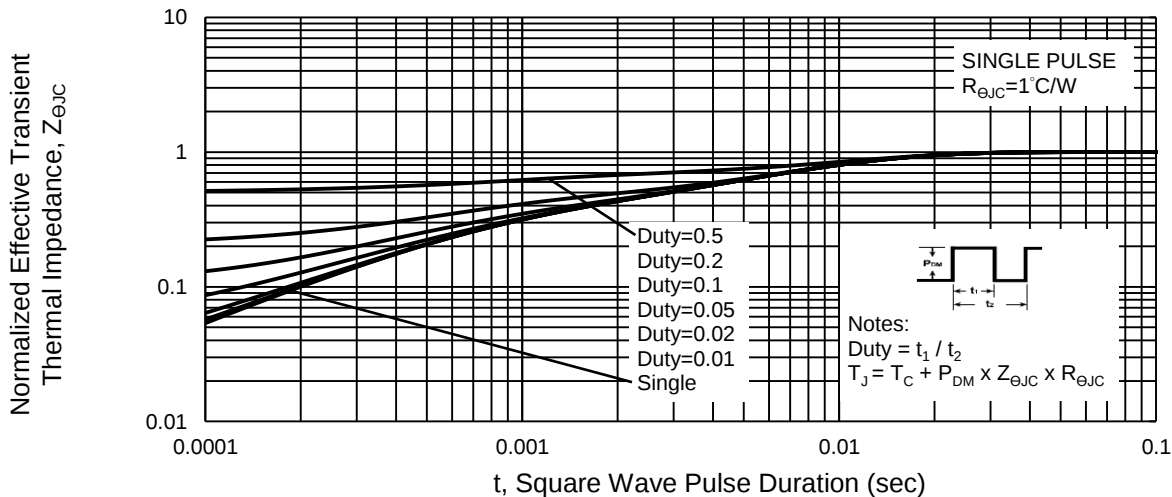
**Maximum Safe Operating Area, Junction-to-Case**



**Source-Drain Diode Forward Current vs. Voltage**

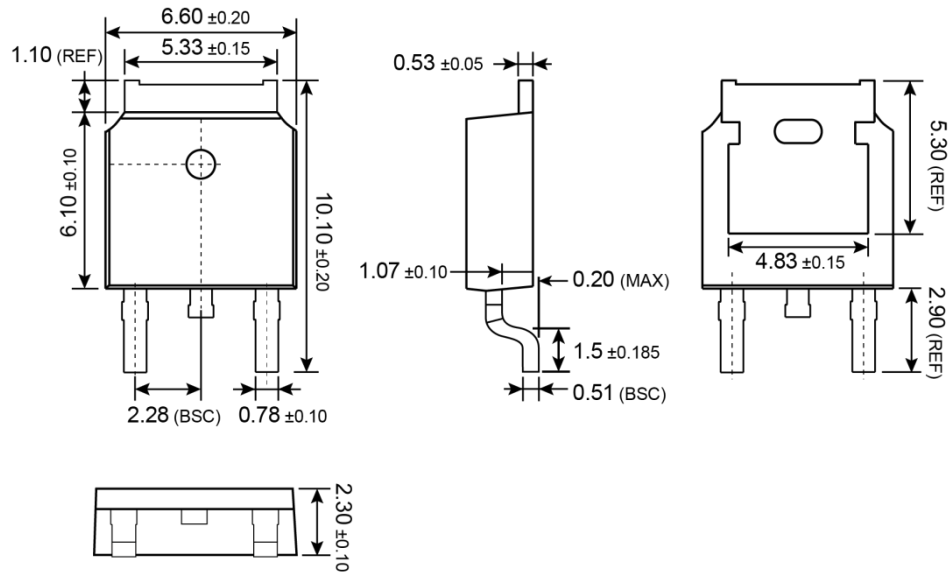


**Normalized Thermal Transient Impedance, Junction-to-Case**

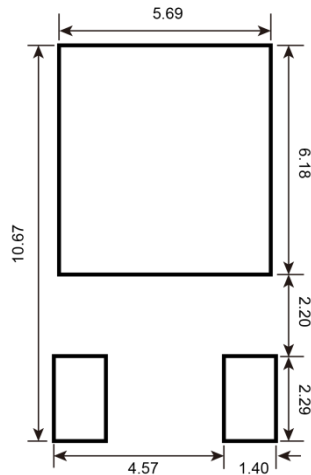


**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)

**TO-252 (DPAK)**



**SUGGESTED PAD LAYOUT** (Unit: Millimeters)



**MARKING DIAGRAM**



**Y** = Year Code

**M** = Month Code

**O** = Jan

**P** = Feb

**Q** = Mar

**R** = Apr

**S** = May

**T** = Jun

**U** = Jul

**V** = Aug

**W** = Sep

**X** = Oct

**Y** = Nov

**Z** = Dec

**L** = Lot Code (1~9, A~Z)

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