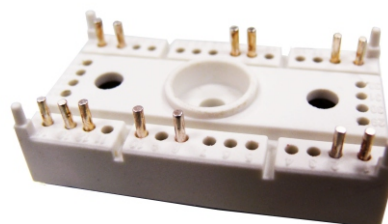


## Three-Phase Bridge + Thyristor, 60A ( Low Profile Package )

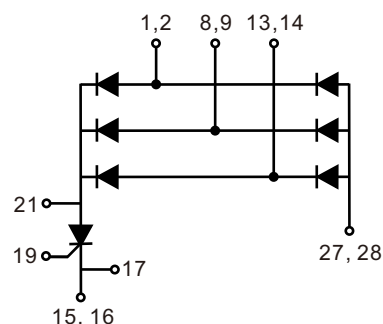
### FEATURES

- Three-phase bridge and a thyristor
- High surge current capability
- Planar thyristor chip
- Heat transfer and isolation through direct copper bonded aluminium oxide ceramic (DBC)
- Low thermal resistance
- Compliant to RoHS
- Isolation voltage up to 2500V
- Compact package, one screw mounting



### Applications

- Inverter for AC or DC motor control
- Soft starters
- Switching power supply
- Light control
- Temperature control



### ADVANTAGE

- International standard package  
Epoxy meets UL 94 V-O flammability rating
- Small volume, light weight
- Small thermal resistance
- Weight: 30g (1.06 oz.)

#### PRIMARY CHARACTERISTICS

|                 |                |
|-----------------|----------------|
| $I_{F(AV)}$     | 60A            |
| $V_{RRM}$       | 1200V to 1600V |
| $I_{FSM}$       | 1000A          |
| $I_R$           | 10 $\mu$ A     |
| $V_{FM}/V_{TM}$ | 1.45V / 1.6V   |
| $T_{J\max.}$    | 150°C          |

### © Maximum Ratings for Diodes

| MAJOR RATINGS AND CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted) |                   |            |      |                      |
|--------------------------------------------------------------------------------------|-------------------|------------|------|----------------------|
| PARAMETER                                                                            | SYMBOL            | NK60TP     |      | UNIT                 |
|                                                                                      |                   | 12         | 16   |                      |
| Maximum repetitive peak reverse voltage                                              | $V_{RRM}/V_{RRM}$ | 1200       | 1600 | V                    |
| Peak reverse non-repetitive voltage                                                  | $V_{RSM}$         | 1300       | 1700 | V                    |
| Output DC current three-phase full wave, $T_C = 80^\circ\text{C}$                    | $I_O$             | 60         |      | A                    |
| Peak forward surge current single sine-wave superimposed on rated load               | $I_{FSM}$         | 1000       |      | A                    |
| Rating (non-repetitive, for t greater than 1 ms and less than 8.3 ms) for fusing     | $I^2t$            | 5000       |      | $\text{A}^2\text{s}$ |
| Operating junction temperature range                                                 | $T_J$             | -40 to 150 |      | $^\circ\text{C}$     |
| Storage temperature range                                                            | $T_{STG}$         | -40 to 125 |      | $^\circ\text{C}$     |

| ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted) |                           |        |        |    |               |
|-------------------------------------------------------------------------------|---------------------------|--------|--------|----|---------------|
| PARAMETER                                                                     | TEST CONDITIONS           | SYMBOL | NK60TP |    | UNIT          |
|                                                                               |                           |        | 12     | 16 |               |
| Maximum instantaneous forward drop per diode                                  | $I_F = 75\text{A}$        | $V_F$  | 1.45   |    | V             |
| Maximum reverse DC current at rated DC blocking voltage per diod              | $T_C = 25^\circ\text{C}$  | $I_R$  | 10     |    | $\mu\text{A}$ |
|                                                                               | $T_C = 150^\circ\text{C}$ |        | 6      |    | mA            |

### Maximum Ratings fo Thyristor

| FORWARD CONDUCTION                                            |                    |                                                                |                                |                                                                 |        |                    |
|---------------------------------------------------------------|--------------------|----------------------------------------------------------------|--------------------------------|-----------------------------------------------------------------|--------|--------------------|
| PARAMETER                                                     | SYMBOL             | TEST CONDITIONS                                                |                                |                                                                 | VALUES | UNIT               |
| Maximum average on-state current at case temperature          | I <sub>T(AV)</sub> | 180° conduction, half sine wave, 50Hz                          |                                |                                                                 | 60     | A                  |
|                                                               |                    |                                                                |                                |                                                                 | 80     | °C                 |
| Maximum peak, one-cycle, on-state non-reptitive surge current | I <sub>TSM</sub>   | t = 10ms                                                       | No voltage reapplied           | Sine half wave, initial T <sub>J</sub> = T <sub>J</sub> maximum | 1500   | A                  |
|                                                               |                    | t = 8.3ms                                                      |                                |                                                                 | 1570   |                    |
| Maximum I <sup>2</sup> t for fusing                           | I <sup>2</sup> t   | t = 10ms                                                       | No voltage reapplied           | Sine half wave, initial T <sub>J</sub> = T <sub>J</sub> maximum | 11250  | A <sup>2</sup> s   |
|                                                               |                    | t = 8.3ms                                                      |                                |                                                                 | 10230  |                    |
|                                                               |                    | t = 10ms                                                       | 100%V <sub>RRM</sub> reapplied |                                                                 | 7870   |                    |
|                                                               |                    | t = 8.3ms                                                      |                                |                                                                 | 7160   |                    |
|                                                               |                    |                                                                |                                |                                                                 |        |                    |
| Maximum I <sup>2</sup> √t for fusing                          | I <sup>2</sup> √t  | t = 0.1 to 10 ms, no voltage reapplied                         |                                |                                                                 | 112.5  | kA <sup>2</sup> √s |
| Maximum on-state voltage drop                                 | V <sub>TM</sub>    | I <sub>TM</sub> = 200A, T <sub>J</sub> = 25°C, 180° conduction |                                |                                                                 | 1.8    | V                  |
| Maximum holding current                                       | I <sub>H</sub>     | Anode supply = 6V, resistive load, T <sub>J</sub> = 25°C       |                                |                                                                 | 150    | mA                 |
| Maximum latching current                                      | I <sub>L</sub>     |                                                                |                                |                                                                 | 250    |                    |

| SWITCHING             |        |                                                                                                                                                                  |           |               |
|-----------------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------|
| PARAMETER             | SYMBOL | TEST CONDITIONS                                                                                                                                                  | VALUES    | UNIT          |
| Typical turn-off time | $t_q$  | $I_{TM} = 300\text{A}$ , $dI/dt = 15\text{A}/\mu\text{s}$ , $T_J = T_J$ maximum<br>$V_R = 50\text{V}$ , $dV/dt = 20\text{V}/\mu\text{s}$ , gate 0V, 100 $\Omega$ | 50 to 120 | $\mu\text{s}$ |

| BLOCKING                                           |                        |                                                                         |        |                  |
|----------------------------------------------------|------------------------|-------------------------------------------------------------------------|--------|------------------|
| PARAMETER                                          | SYMBOL                 | TEST CONDITIONS                                                         | VALUES | UNIT             |
| Maximum peak reverse and off-state leakage current | $I_{RRM}$<br>$I_{DRM}$ | $T_J = 125^\circ\text{C}$                                               | 20     | mA               |
| RMS isolation Voltage                              | $V_{ISO}$              | 60 Hz, circuit to base, all terminals shorted, $25^\circ\text{C}$ , 60s | 2500   | V                |
| Critical rate of rise of off-state voltage         | $dV/dt$                | $T_J = T_J$ maximum, exponential to 67% $V_{DRM}$                       | 1000   | V/ $\mu\text{s}$ |

| TRIGGERING                                  |                    |                                                                        |                                                        |        |      |
|---------------------------------------------|--------------------|------------------------------------------------------------------------|--------------------------------------------------------|--------|------|
| PARAMETER                                   | SYMBOL             | TEST CONDITIONS                                                        |                                                        | VALUES | UNIT |
| Maximum peak gate power                     | P <sub>GM</sub>    | t <sub>p</sub> ≤ 5ms, T <sub>J</sub> = T <sub>J</sub> maximum          |                                                        | 10     | W    |
| Maximum average gate power                  | P <sub>G(AV)</sub> | f = 50Hz, T <sub>J</sub> = T <sub>J</sub> maximum                      |                                                        | 5      |      |
| Maximum peak positive gate current          | I <sub>GM</sub>    | t <sub>p</sub> ≤ 5ms, T <sub>J</sub> = T <sub>J</sub> maximum          |                                                        | 3      | A    |
| Maximum peak negative gate voltage          | -V <sub>GT</sub>   |                                                                        |                                                        | 10     | V    |
| Maximum required DC gate voltage to trigger | V <sub>GT</sub>    | T <sub>J</sub> = 25°C                                                  | Anode supply = 6V, resistive load; R <sub>a</sub> = 1Ω | 2      |      |
| Maximum required DC gate current to trigger | I <sub>GT</sub>    |                                                                        |                                                        | 100    |      |
| Maximum gate voltage that will not trigger  | V <sub>GD</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum, 67% V <sub>DRM</sub> applied  |                                                        | 0.25   | V    |
| Maximum gate current that will not trigger  | I <sub>GD</sub>    |                                                                        |                                                        | 5      | mA   |
| Maximum rate of rise of turned-on current   | dI/dt              | T <sub>J</sub> = 25°C, I <sub>GM</sub> = 1.5A, t <sub>r</sub> ≤ 0.5 μs |                                                        | 150    | A/μs |

| THERMAL AND MECHANICAL SPECIFICATIONS                     |                      |                                                                                                                                          |            |       |
|-----------------------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------|-------|
| PARAMETER                                                 | SYMBOL               | TEST CONDITIONS                                                                                                                          | VALUES     | UNITS |
| Operating junction temperature range                      | T <sub>J</sub>       |                                                                                                                                          | -40 to 150 | °C    |
| Storage temperature range                                 | T <sub>stg</sub>     |                                                                                                                                          | -40 to 125 |       |
| Maximum thermal resistance, junction to case per junction | R <sub>th(j-c)</sub> | DC operation                                                                                                                             | 1.0        | °C/W  |
| Typical thermal resistance, case to heatsink per module   | R <sub>thCS</sub>    | Mounting surface, smooth, flat and greased                                                                                               | 0.30       |       |
| Mounting torque, ±10% module to heatsink, M4              |                      | A mounting compound is recommended and the torque should be rechecked after a period of 3 hours to allow for the spread of the compound. | 2          | N·m   |
| Approximate weight                                        |                      |                                                                                                                                          | 30         | g     |
|                                                           |                      |                                                                                                                                          | 1.06       | oz.   |

### Ordering Information Table

Device code

|    |    |    |    |
|----|----|----|----|
| NK | 60 | TP | 12 |
| ①  | ②  | ③  | ④  |

- ① - Nell's Low Profile Module
- ② - Current rating :  $I_{(TAV)}$  /  $I_O$
- ③ - Circuit configuration type : "TP" for 3-phase bridge + thyristor
- ④ - Voltage code : code x 100 =  $V_{RRM}$

**Fig.1 Power dissipation per module vs. bridge output current**

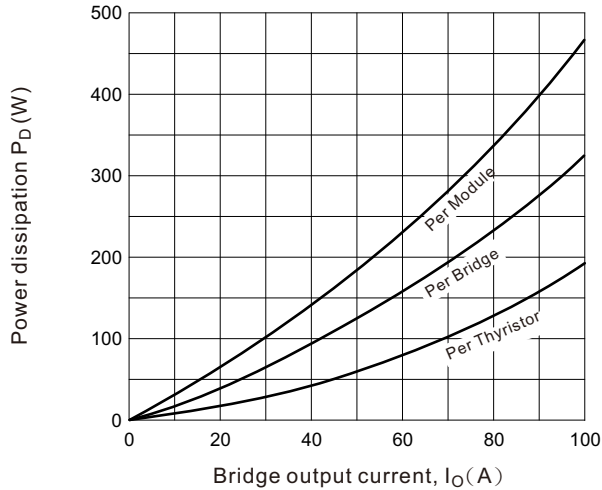


**Fig.2 Forward current derating curve**

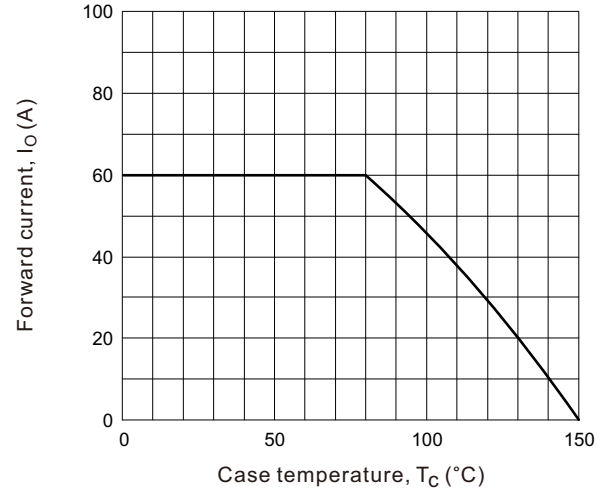


**Fig.3 Transient thermal impedance**

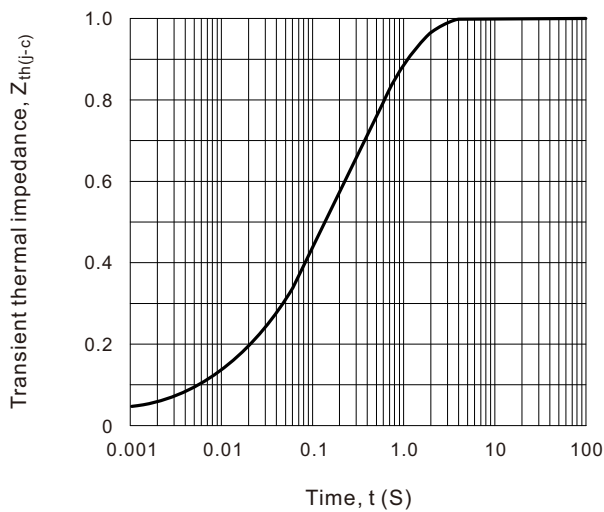


**Fig.4 Max non-repetitive forward surge current**

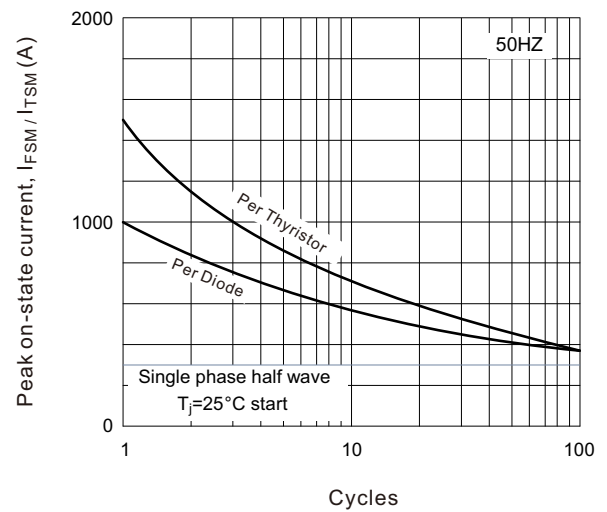


**Fig.5 On-state characteristics**

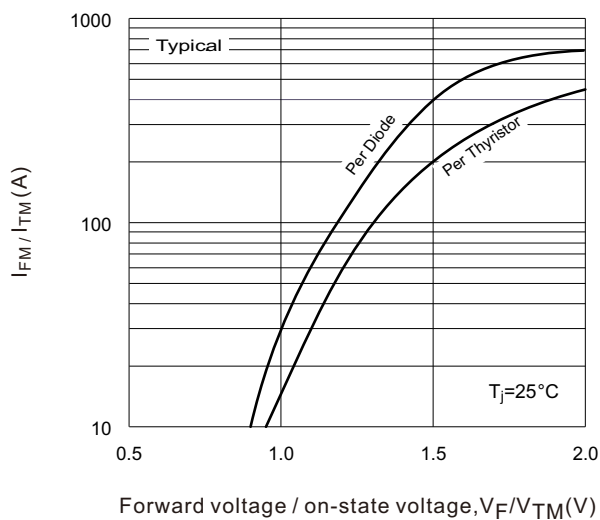
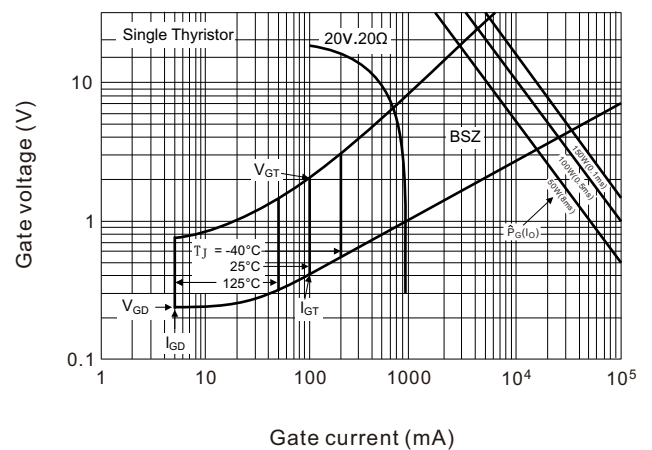
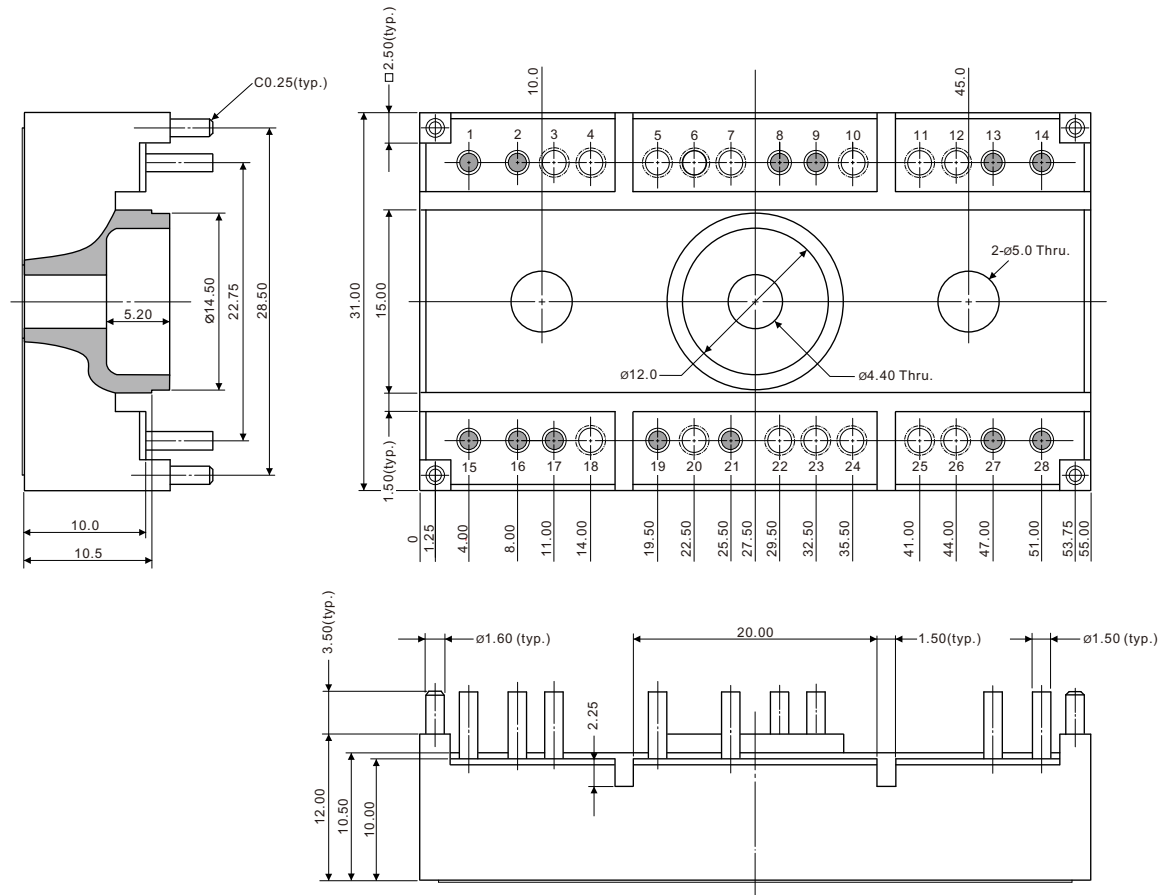


**Fig.6 Gate trigger characteristics**





Dimension Unit : mm

### "TP" Circuit Configuration:

