



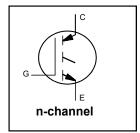
# Insulated Gate Bipolar Transistor

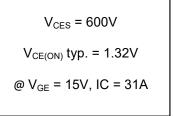
### **Features**

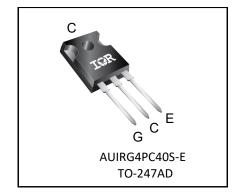
- Standard: Optimized for minimum saturation voltage and low operating frequencies ( < 1kHz)</li>
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3
- Industry standard TO-247AD package
- Lead-Free
- Automotive Qualified\*

### **Benefits**

- Generation 4 IGBT's offer highest efficiency available
- IGBT's optimized for specified application conditions
- Designed to be a "drop-in" replacement for equivalent industry-standard Generation 3 IR IGBT's







| G    | С         | E       |
|------|-----------|---------|
| Gate | Collector | Emitter |

| Base part number | Package Type | Standard Pack |          | Orderable Part Number |
|------------------|--------------|---------------|----------|-----------------------|
|                  |              | Form          | Quantity |                       |
| AUIRG4PC40S-E    | TO-247AD     | Tube          | 25       | AUIRG4PC40S-E         |

# **Absolute Maximum Ratings**

|                                         | Parameter                          | Max.                              | Units |  |
|-----------------------------------------|------------------------------------|-----------------------------------|-------|--|
| V <sub>CES</sub>                        | Collector-to-Emitter Voltage       | 600                               | V     |  |
| I <sub>C</sub> @ T <sub>C</sub> = 25°C  | Continuous Collector Current       | 60                                |       |  |
| I <sub>C</sub> @ T <sub>C</sub> = 100°C | Continuous Collector Current       | 31                                | ۸     |  |
| I <sub>CM</sub>                         | Pulse Collector Current ①          | 120                               | Α     |  |
| I <sub>LM</sub>                         | Clamped Inductive Load Current ②   | 120                               |       |  |
| $V_{\sf GE}$                            | Continuous Gate-to-Emitter Voltage | ±20                               | V     |  |
| E <sub>ARV</sub>                        | Reverse Voltage Avalanche Energy ③ | 15                                |       |  |
| $P_D @ T_C = 25^{\circ}C$               | Maximum Power Dissipation          | 160                               | ۱۸/   |  |
| P <sub>D</sub> @ T <sub>C</sub> = 100°C | Maximum Power Dissipation          | 65                                | W     |  |
| TJ                                      | Operating Junction and             | -55 to +150                       |       |  |
| T <sub>STG</sub>                        | Storage Temperature Range          |                                   |       |  |
|                                         | Soldering Temperature, for 10 sec. | 300 (0.063 in. (1.6mm) from case) | С     |  |
|                                         | Mounting Torque, 6-32 or M3 Screw  | 10 lbf·in (1.1 N·m)               |       |  |

### Thermal Resistance

|                 | Parameter                                                      | Тур.     | Max. | Units  |
|-----------------|----------------------------------------------------------------|----------|------|--------|
| $R_{\theta JC}$ | Thermal Resistance Junction-to-Case                            |          | 0.77 |        |
| $R_{\theta CS}$ | Thermal Resistance, Case-to-Sink (flat, greased surface)       | 0.24     |      | °C/W   |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient (typical socket mount) |          | 40   |        |
| Wt              | Weight                                                         | 6 (0.21) |      | g (oz) |

<sup>\*</sup> Qualification standard can be found at www.infineon.com/



# Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

|                                   | Parameter                                | Min. | Тур. | Max. | Units | Conditions                                         |
|-----------------------------------|------------------------------------------|------|------|------|-------|----------------------------------------------------|
| V <sub>(BR)CES</sub>              | Collector-to-Emitter Breakdown Voltage   |      |      | _    |       | $V_{GE} = 0V, I_{C} = 250\mu A$                    |
| $V_{(BR)ECS}$                     | Emitter-to-Collector Breakdown Voltage @ | 18   | _    |      | V     | $V_{GE} = 0V, I_{C} = 1.0A$                        |
| $\Delta V_{(BR)CES}/\Delta T_{J}$ | Temperature Coeff. of Breakdown Voltage  |      | 0.75 | _    | V/°C  | $V_{GE} = 0V$ , $I_C = 1mA$                        |
|                                   |                                          | _    | 1.32 | 1.5  |       | $I_{C} = 31A, V_{GE} = 15V, T_{J} = 25^{\circ}C$   |
| $V_{CE(on)}$                      | Collector-to-Emitter Saturation Voltage  | _    | 1.68 | _    | V     | $I_C$ = 60A, $V_{GE}$ = 15V, See Fig. 2,5          |
|                                   | _                                        | _    | 1.32 | _    |       | $I_C = 31A$ , $V_{GE} = 15V$ , $T_J = 150$ °C      |
| $V_{GE(th)}$                      | Gate Threshold Voltage                   | 3.0  | _    | 6.0  | V     | $V_{CE} = V_{GE}$ , $I_C = 250\mu A$               |
| $\Delta V_{GE(th)}/\Delta T_{J}$  | Threshold Voltage Temperature Coeff.     | _    | -9.3 |      | mV/°C | $V_{CE} = V_{GE}$ , $I_C = 250\mu A$               |
| gfe                               | Forward Transconductance®                | 12   | 21   | _    | S     | $V_{CE} = 100V, I_{C} = 31A$                       |
|                                   |                                          | _    |      | 250  |       | $V_{GE} = 0V, V_{CE} = 600V$                       |
| I <sub>CES</sub>                  | Collector-to-Emitter Leakage Current     | _    |      | 2.0  |       | $V_{GE} = 0V, V_{CE} = 10V, T_{J} = 25^{\circ}C$   |
|                                   |                                          |      |      | 1000 |       | $V_{GE} = 0V, V_{CE} = 600V, T_{J} = 150^{\circ}C$ |
| I <sub>GES</sub>                  | Gate-to-Emitter Leakage Current          |      |      | ±100 | nA    | $V_{GE}$ = ±20V                                    |

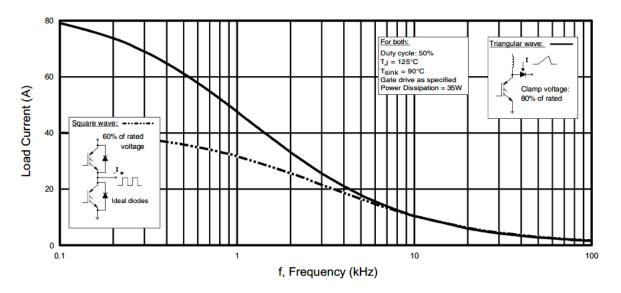
# Switching Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

|                    | Parameter                          | Min. | Тур. | Max | Units | Conditions                                     |  |
|--------------------|------------------------------------|------|------|-----|-------|------------------------------------------------|--|
| $Q_g$              | Total Gate Charge (turn-on)        | _    | 100  | 150 |       | I <sub>C</sub> = 31A                           |  |
| $Q_{ge}$           | Gate-to-Emitter Charge (turn-on)   | _    | 14   | 21  | nC    | V <sub>GE</sub> = 15V See Fig.8                |  |
| $Q_{gc}$           | Gate-to-Collector Charge (turn-on) | _    | 34   | 51  |       | V <sub>CC</sub> = 400V                         |  |
| t <sub>d(on)</sub> | Turn-On delay time                 |      | 22   | _   |       |                                                |  |
| t <sub>r</sub>     | Rise time                          | _    | 18   |     |       | $I_C = 31A$ , $V_{CC} = 480V$ , $V_{GE} = 15V$ |  |
| $t_{d(off)}$       | Turn-Off delay time                |      | 650  | 980 | ns    | $R_G = 10\Omega, T_J = 25^{\circ}C$            |  |
| t <sub>f</sub>     | Fall time                          |      | 380  | 570 |       | F                                              |  |
| Eon                | Turn-On Switching Loss             | _    | 0.45 | _   |       | Energy losses include "tail"                   |  |
| E <sub>off</sub>   | Turn-Off Switching Loss            | _    | 6.5  |     | mJ    | See Fig. 10, 11, 13, 14                        |  |
| E <sub>ts</sub>    | Total Switching Loss               | _    | 6.95 | 9.9 |       | -                                              |  |
| t <sub>d(on)</sub> | Turn-On delay time                 |      | 23   | _   |       | $I_C = 31A$ , $V_{CC} = 480V$ , $V_{GE} = 15V$ |  |
| t <sub>r</sub>     | Rise time                          | _    | 21   | _   |       | $R_G = 10\Omega, T_J = 150^{\circ}C$           |  |
| $t_{d(off)}$       | Turn-Off delay time                | _    | 1000 |     | ns    | Energy lesses include "tail"                   |  |
| t <sub>f</sub>     | Fall time                          | _    | 940  |     | 1     | Energy losses include "tail"                   |  |
| E <sub>ts</sub>    | Total Switching Loss               |      | 12   | _   | mJ    | See Fig. 13, 14                                |  |
| L <sub>E</sub>     | Internal Emitter Inductance        | T —  | 13   | _   | nΗ    | Measured 5mm from package                      |  |
| C <sub>ies</sub>   | Input Capacitance                  | _    | 2200 | _   |       | V <sub>GE</sub> = 0V                           |  |
| Coes               | Output Capacitance                 |      | 140  | _   | pF    | V <sub>CC</sub> = 30V See Fig. 7               |  |
| C <sub>res</sub>   | Reverse Transfer Capacitance       | _    | 26   | _   |       | f = 1.0Mhz                                     |  |

### Notes

- $\odot$  Repetitive rating;  $V_{GE}$  = 20V, pulse width limited by max. junction temperature. ( See fig. 13b )
- $@~V_{CC}$  = 80%(V\_{CES}), V\_{GE} = 20V, L = 10 $\mu H,~R_G$  = 10 $\Omega,$  (See fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width  $\leq 80\mu s$ ; duty factor  $\leq 0.1\%$ .
- S Pulse width 5.0µs, single shot.





 $\label{eq:Fig.1} \textbf{Fig. 1} \mbox{ - Typical Load Current vs. Frequency} \\ \mbox{(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)} \\$ 

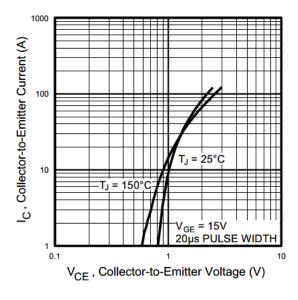


Fig. 2 - Typical Output Characteristics

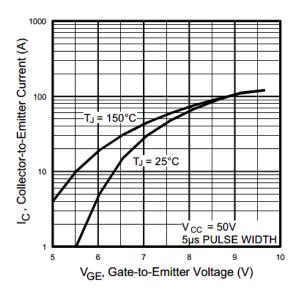
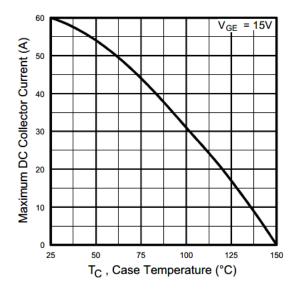
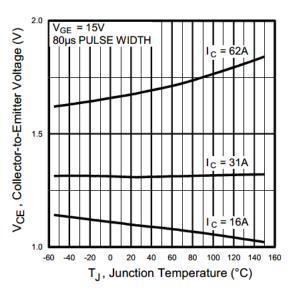


Fig. 3 - Typical Transfer Characteristics



**Fig. 4** - Maximum Collector Current vs. Case Temperature



**Fig. 5** - Collector-to-Emitter Voltage vs. Junction Temperature

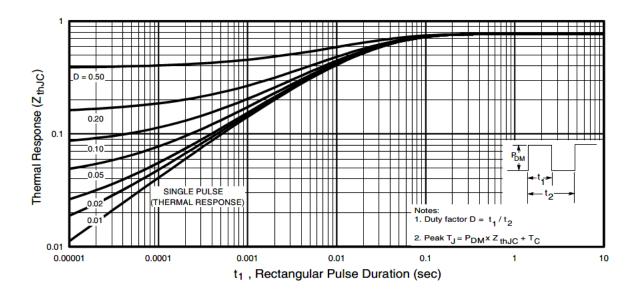
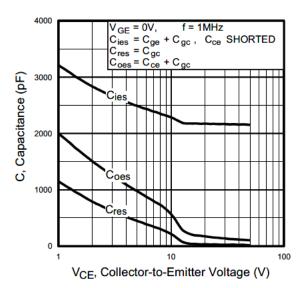
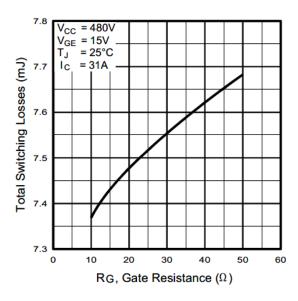


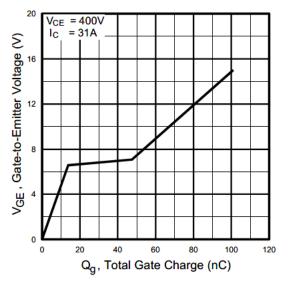
Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



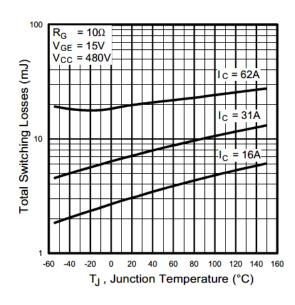
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



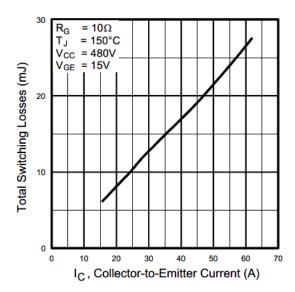
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage



**Fig. 10** - Typical Switching Losses vs. Junction Temperature



**Fig. 11 -** Typical Switching Losses vs. Collector-to-Emitter Current

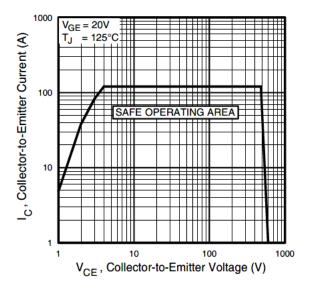
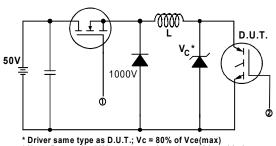


Fig. 12 - Turn-Off SOA





- \* Driver same type as D.U.T.; Vc = 80% of Vce(max)

  \* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated ld.
  - Fig. 13a Clamped Inductive Load Test Circuit

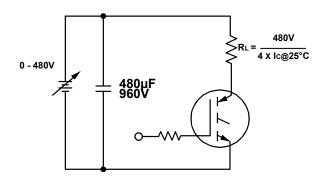
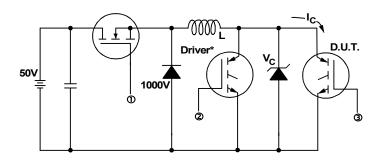


Fig. 13b - Pulsed Collector Current Test Circuit



\* Driver same type as D.U.T., VC = 480V

Fig. 14a - Switching Loss Test Circuit

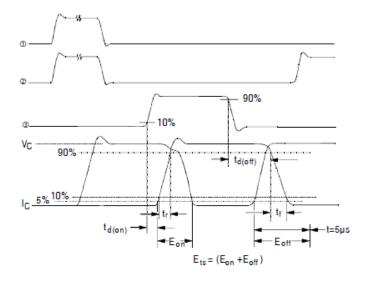
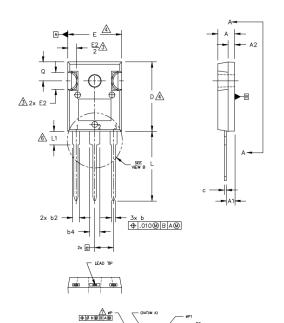
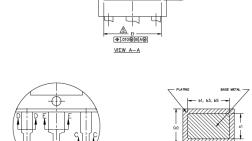


Fig. 14b - Switching Loss Waveforms



# TO-247AD Package Outline Dimensions are shown in millimeters (inches)





### NOTES:

DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.

DIMENSIONS ARE SHOWN IN INCHES.

CONTOUR OF SLOT OPTIONAL.

DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.

THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.

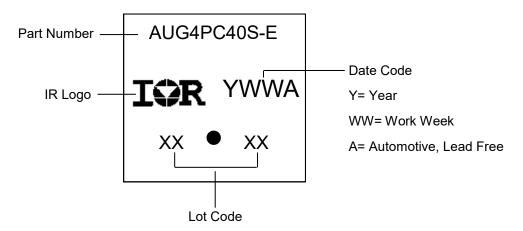
LEAD FINISH UNCONTROLLED IN L1.

ØP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 'TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.

OUTLINE CONFORMS TO JEDEC OUTLINE TO-247AD.

|        | DIMENSIONS |      |        |             |       |                          |
|--------|------------|------|--------|-------------|-------|--------------------------|
| SYMBOL | INC        | HES  | MILLIM | MILLIMETERS |       |                          |
|        | MIN.       | MAX. | MIN.   | MAX.        | NOTES |                          |
| Α      | .190       | .203 | 4.83   | 5.13        |       |                          |
| A1     | .087       | .102 | 2.21   | 2.59        |       |                          |
| A2     | .072       | .084 | 1.83   | 2.13        |       | LEAD ASSIGNMENTS         |
| b      | .041       | .051 | 1.04   | 1.30        |       | ELTIS TIOSISTIMENTO      |
| b1     | .041       | .050 | 1.04   | 1.28        |       | <u>HEXFET</u>            |
| b2     | .065       | .094 | 1.65   | 2.39        |       | 1 GATE                   |
| b3     | .065       | .092 | 1.65   | 2.34        |       | 2 DRAIN                  |
| b4     | .102       | .135 | 2.59   | 3.43        |       | 3 SOURCE<br>4 DRAIN      |
| b5     | .102       | .133 | 2.59   | 3.38        |       |                          |
| С      | .017       | .035 | 0.44   | 0.88        |       | IGBTs, CoPACK            |
| c1     | .017       | .034 | 0.44   | 0.84        |       | 1.— GATE                 |
| D      | .776       | .795 | 19.71  | 20.20       | 4     | 2 COLLECTOR              |
| D1     | .515       | _    | 13.08  | _           | 5     | 3 EMITTER                |
| D2     | .020       | .053 | 0.51   | 1.35        |       | 4 COLLECTOR              |
| E      | .604       | .625 | 15.35  | 15.87       | 4     |                          |
| E1     | .530       | _    | 13.46  | _           |       | DIODES                   |
| E2     | .178       | .216 | 4.52   | 5.49        |       | 1 ANODE/OPEN             |
| е      | .215       | BSC  | 5.46   | BSC         |       | 2.— CATHODE<br>3.— ANODE |
| øk     | .0         | 10   | 0.:    | 25          |       |                          |
| L      | .791       | .823 | 20.10  | 20.90       |       |                          |
| L1     | .146       | .169 | 3.71   | 4.29        |       |                          |
| øΡ     | .140       | .144 | 3.56   | 3.66        |       |                          |
| øP1    | _          | .291 | _      | 7.39        |       |                          |
| Q      | .209       | .224 | 5.31   | 5.69        | ]     |                          |
| S      | .217       | BSC  | 5.51   | BSC         |       |                          |
|        |            |      | 1      |             | I     | l .                      |

# **TO-247AD Part Marking Information**



TO-247AD package is not recommended for Surface Mount Application.



# Qualification Information<sup>†</sup>

|                |                      | Automotive                                                                                                                                                              |            |  |  |  |  |
|----------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--|--|--|--|
|                |                      | (per AEC-Q101) <sup>††</sup>                                                                                                                                            |            |  |  |  |  |
|                |                      | Comments: This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level. |            |  |  |  |  |
| Moisture       | e Sensitivity Level  | TO-247AD                                                                                                                                                                | -247AD N/A |  |  |  |  |
|                |                      | Class H1C (+/- 2000V)                                                                                                                                                   |            |  |  |  |  |
|                | Human Body Model     | AEC-Q101-001                                                                                                                                                            |            |  |  |  |  |
| ESD            |                      | Class C5 (+/- 2000V)                                                                                                                                                    |            |  |  |  |  |
|                | Charged Device Model | AEC-Q101-005                                                                                                                                                            |            |  |  |  |  |
| RoHS Compliant |                      | Yes                                                                                                                                                                     |            |  |  |  |  |

- † Qualification standards can be found at International Rectifier's web site: <a href="www.infineon.com">www.infineon.com</a>
- †† Exceptions to AEC-Q101 requirements are noted in the qualification report.

## **Revision History**

| Date       | Comments                                                          |  |  |  |
|------------|-------------------------------------------------------------------|--|--|--|
| 08/12/2020 | Updated datasheet with corporate template.                        |  |  |  |
| 00/12/2020 | Update the Dimensions table and package outline drawing on page 8 |  |  |  |

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