

# Medium Power Film Capacitors



## FPG - General Description

### PROTECTION



Metallized polypropylene dielectric capacitor with controlled self-healing.

Reinforced metallization on margins developed for high impulse currents.

Axial connections specially developed to reduce series inductance and to provide rigid mechanical mounting.

### APPLICATIONS

Protection of gate turn-off thyristor (G.T.O.).

Medium frequency tuning.

### PACKAGING

Cylindrical in either plastic case (preferred packaging) or a resin molding.

Outputs: threaded inserts either M6 or M8.

Filled with thermosetting resin.

### ELECTRICAL CHARACTERISTICS

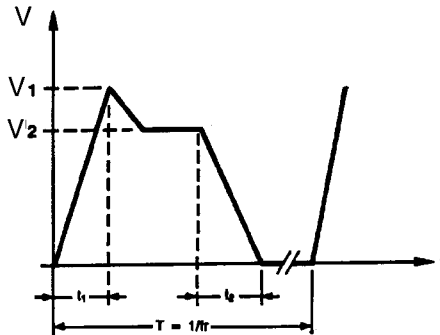
|                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Capacitance range $C_n$                                                                                                                                                                                                   | 0.12 $\mu$ F to 6 $\mu$ F                                                                                                                                                                                                                                                                                                                                                      |
| Tolerance on $C_n$                                                                                                                                                                                                        | $\pm 5\%$                                                                                                                                                                                                                                                                                                                                                                      |
| Rated DC voltage $V_{n,dc}$                                                                                                                                                                                               | 800 to 3000 V                                                                                                                                                                                                                                                                                                                                                                  |
| Peak voltage $V_{peak}$                                                                                                                                                                                                   | 1200 to 4000 V                                                                                                                                                                                                                                                                                                                                                                 |
| Allowable overvoltage $V_s$ (for 10 s/day)                                                                                                                                                                                | 1500 to 4600 V                                                                                                                                                                                                                                                                                                                                                                 |
| Nominal RMS voltage $V_{n,dc}$                                                                                                                                                                                            | 500 to 1400 V                                                                                                                                                                                                                                                                                                                                                                  |
| Stray inductance                                                                                                                                                                                                          | $\approx 10$ nH                                                                                                                                                                                                                                                                                                                                                                |
| RMS current                                                                                                                                                                                                               | $I_{rms}$ max. = up to 80 A<br>The currents shown in the tables are maximum.<br>It is necessary to respect the thermal limits of the dielectric 85°C<br>see "Hot spot temperature calculation"                                                                                                                                                                                 |
| Insulation resistance                                                                                                                                                                                                     | $R_i \times C \geq 30,000$ s                                                                                                                                                                                                                                                                                                                                                   |
| Impulse current                                                                                                                                                                                                           | $I^2.t$ max. given in the tables<br>Spikes or peak currents in the capacitors may cause a deterioration of the bonding between the metallization and the connections. These bonds are capable of withstanding only a limited amount of energy for each spike. The table shows the maximum energy permitted in the form ( $I^2.t$ ), where I is in Ampere, and t is in seconds. |
| <b>Note:</b> The formula ( $I^2.t$ ) replaces $dV/dt$ which is less easy to use as it is not an expression of energy ( $I = C.dV/dt$ ).<br>This type of capacitor has been designed to withstand high ( $I^2.t$ ) values. |                                                                                                                                                                                                                                                                                                                                                                                |
| Variation of capacitance with temperature                                                                                                                                                                                 | $\frac{\Delta C}{C} \leq \pm 2\%$ between -40 and 85°C                                                                                                                                                                                                                                                                                                                         |
| Climatic category                                                                                                                                                                                                         | 40/085/56 (IEC 68)                                                                                                                                                                                                                                                                                                                                                             |
| Test voltage between terminals @ 25°C                                                                                                                                                                                     | $V_s$ during 10s                                                                                                                                                                                                                                                                                                                                                               |
| Test voltage between terminals and case @ 25°C                                                                                                                                                                            | @ 4 kVrms @ 50 Hz during 1 min.                                                                                                                                                                                                                                                                                                                                                |

For higher power protection devices and further information please see PPX Series in Capacitor for High Power Electronics available on AVX website: [www.avxcorp.com](http://www.avxcorp.com)

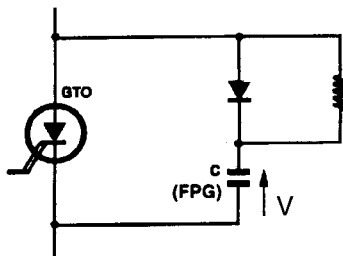
### PROTECTION

### APPLICATION NOTES

### G.T.O. PROTECTION



Choice of voltage:  $V_1 \leq V_{peak}$   
 $V_2 \leq V_{ndc}$   
 Maximum overvoltage  $\leq V_s$  (10 s/day)



FPG: Snubber capacitor

Nominal DC voltage ( $V_{ndc}$ ) and peak voltage ( $V_{peak}$ ) are given in the table of values.

### HOT SPOT TEMPERATURE CALCULATION

$$\theta_{hot\ spot} = \theta_{terminals} + (P_d + P_t) \times R_{th}$$

with

$$P_d \text{ (Dielectric losses)} = Q \times \tan \delta_0$$

$$\Rightarrow \left[ \frac{1}{2} \times C_n \times (V_{peak\ to\ peak})^2 \times f \right] \times (2 \times 10^{-4})$$

$$P_t \text{ (Thermal losses)} = R_s \times (I_{rms})^2$$

where

- $C_n$  in Farads
- $V$  in Volts
- $I_{rms}$  in Amperes
- $R_s$  in Ohms
- $f$  in Hertz
- $\theta$  in  $^{\circ}C$
- $R_{th}$  in  $^{\circ}C/W$

### MARKING

Logo

Withstanding surge voltage

Capacitance and tolerance in clear

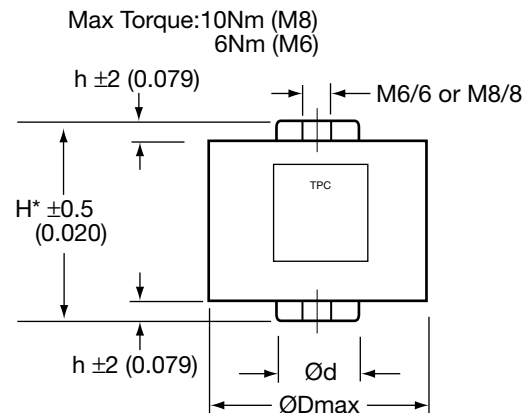
Nominal DC voltage in clear

RMS current in clear

Date of manufacture (IEC coding)

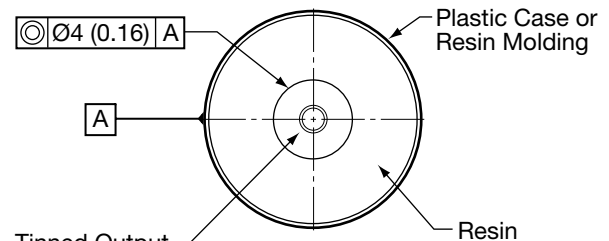
### DESIGN

Dimensions: millimeters (inches)



\*H = 52 for 2000 or 2500v M6/6 M8/8

\*H = 62 for 3500 or 4500v M8/8



Dimensions: millimeters (inches)  
 General tolerance:  $\pm 2$

Due to the design of the capacitor and its technology, the thermal impedance between the terminations and the core of the capacitor is low, it is necessary to take care that the capacitor is never overheated by use of incorrect sized connections.

In the case where the series diodes are screwed to the capacitor, cooling of the diodes must be taken in account.

Do not use the capacitor as a heat sink.

Due to the complexity of the diode/capacitor thermal exchanges, we recommend that thermal measurements shall be made on the different components. We would be pleased to advise you on specific problems.

### WORKING TEMPERATURE

(according to the power to be dissipated)  $-40^{\circ}C$  to  $+85^{\circ}C$

For higher power protection devices and further information please see PPX Series in Capacitor for High Power Electronics available on AVX website: [www.avxcorp.com](http://www.avxcorp.com)

# Medium Power Film Capacitors



## FPG Table of Values

### PROTECTION

Dimensions: millimeters (inches)

| Cn<br>(μF) | Dimensions            |                            |                     |               |                            | I <sup>2</sup> t<br>max.<br>(A <sup>2</sup> .s) | I <sub>rms</sub><br>max.<br>(A) | R <sub>s</sub><br>(mΩ) | R <sub>th</sub><br>(°C/W) | Part Number   |
|------------|-----------------------|----------------------------|---------------------|---------------|----------------------------|-------------------------------------------------|---------------------------------|------------------------|---------------------------|---------------|
|            | Case<br>Type          | H*<br>±0.5<br>(±0.020)     | h<br>±2<br>(±0.079) | D<br>max.     | d<br>±0.5<br>(±0.020)      |                                                 |                                 |                        |                           |               |
| FPG 1500 V |                       | V <sub>n</sub> dc = 800 V  |                     |               | V <sub>peak</sub> = 1200 V |                                                 | V <sub>rms</sub> = 500 V        |                        | V <sub>s</sub> = 1500 V   |               |
| 1          | Resin Molding<br>M6/6 | 49<br>(1.929)              | 4.2<br>(0.165)      | 40<br>(1.575) | 19<br>(0.748)              | 2                                               | 15                              | 2.4                    | 14                        | FPG66R0105J-- |
| 1.5        | Resin Molding<br>M6/6 | 49<br>(1.929)              | 4.2<br>(0.165)      | 55<br>(2.165) | 19<br>(0.748)              | 4.6                                             | 20                              | 1.6                    | 10.5                      | FPG66R0155J-- |
| 2          | Plastic Case<br>M8/8  | 52<br>(2.047)              | 5<br>(0.197)        | 60<br>(2.362) | 22<br>(0.866)              | 8                                               | 30                              | 1.2                    | 6.1                       | FPG86R0205J-- |
| 3          | Plastic Case<br>M8/8  | 52<br>(2.047)              | 5<br>(0.197)        | 72<br>(2.835) | 22<br>(0.866)              | 18                                              | 45                              | 0.9                    | 4.5                       | FPG86R0305J-- |
| 3.5        | Plastic Case<br>M8/8  | 52<br>(2.047)              | 5<br>(0.197)        | 72<br>(2.835) | 22<br>(0.866)              | 25                                              | 50                              | 0.85                   | 4.5                       | FPG86R0355J-- |
| 4          | Plastic Case<br>M8/8  | 52<br>(2.047)              | 5<br>(0.197)        | 82<br>(1.575) | 22<br>(0.866)              | 32                                              | 60                              | 0.75                   | 3.5                       | FPG86R0405J-- |
| 5          | Plastic Case<br>M8/8  | 52<br>(2.047)              | 5<br>(0.197)        | 82<br>(3.622) | 22<br>(0.866)              | 50                                              | 70                              | 0.65                   | 2.5                       | FPG86R0505J-- |
| 6          | Resin Molding<br>M8/8 | 52<br>(2.047)              | 5.7<br>(0.224)      | 92<br>(3.622) | 28<br>(1.102)              | 73                                              | 75                              | 0.6                    | 2.5                       | FPG86R0605J-- |
| FPG 2000 V |                       | V <sub>n</sub> dc = 1000 V |                     |               | V <sub>peak</sub> = 1600 V |                                                 | V <sub>rms</sub> = 600 V        |                        | V <sub>s</sub> = 2000 V   |               |
| 0.5        | Plastic Case<br>M6/6  | 52<br>(2.047)              | 5<br>(0.197)        | 40<br>(1.575) | 18<br>(0.709)              | 1                                               | 15                              | 3                      | 14                        | FPG66N0504J-- |
| 1          | Plastic Case<br>M8/8  | 52<br>(2.047)              | 5<br>(0.197)        | 60<br>(2.362) | 22<br>(0.866)              | 3                                               | 20                              | 2.3                    | 10.5                      | FPG86N0105J-- |
| 1.5        | Plastic Case<br>M8/8  | 52<br>(2.047)              | 5<br>(0.197)        | 60<br>(2.362) | 22<br>(0.866)              | 7                                               | 30                              | 1.5                    | 6.1                       | FPG86N0155J-- |
| 2          | Plastic Case<br>M8/8  | 52<br>(2.047)              | 5<br>(0.197)        | 72<br>(2.835) | 22<br>(0.866)              | 12.7                                            | 40                              | 1.1                    | 4.5                       | FPG86N0205J-- |
| 2.5        | Plastic Case<br>M8/8  | 52<br>(2.047)              | 5<br>(0.197)        | 72<br>(2.835) | 22<br>(0.866)              | 20                                              | 60                              | 0.89                   | 3.7                       | FPG86N0255J-- |
| 3          | Plastic Case<br>M8/8  | 52<br>(2.047)              | 5<br>(0.197)        | 82<br>(3.228) | 22<br>(0.866)              | 28                                              | 60                              | 0.85                   | 3.2                       | FPG86N0305J-- |
| 3.5        | Plastic Case<br>M8/8  | 52<br>(2.047)              | 5<br>(0.197)        | 82<br>(3.228) | 22<br>(0.866)              | 39                                              | 65                              | 0.78                   | 2.9                       | FPG86N0355J-- |
| 4          | Resin Molding<br>M8/8 | 52<br>(2.047)              | 5.7<br>(0.224)      | 92<br>(3.622) | 28<br>(1.102)              | 50                                              | 70                              | 0.7                    | 2.5                       | FPG86N0405J-- |
| FPG 2500 V |                       | V <sub>n</sub> dc = 1300 V |                     |               | V <sub>peak</sub> = 2000 V |                                                 | V <sub>rms</sub> = 700 V        |                        | V <sub>s</sub> = 2500 V   |               |
| 0.47       | Resin Molding<br>M6/6 | 59<br>(2.323)              | 4.2<br>(0.165)      | 40<br>(1.575) | 19<br>(0.748)              | 0.7                                             | 15                              | 6                      | 25                        | FPG66P0474J-- |
| 1          | Resin Molding<br>M6/6 | 59<br>(2.323)              | 4.2<br>(0.165)      | 55<br>(2.165) | 19<br>(0.748)              | 2                                               | 18                              | 3                      | 13                        | FPG66P0105J-- |
| 1.5        | Resin Molding<br>M8/8 | 59<br>(2.323)              | 4.2<br>(0.165)      | 60<br>(2.362) | 19<br>(0.748)              | 4.5                                             | 25                              | 2                      | 10                        | FPG66P0155J-- |
| 2          | Plastic Case<br>M8/8  | 62<br>(2.441)              | 5<br>(0.197)        | 72<br>(2.835) | 22<br>(0.866)              | 8                                               | 35                              | 1.5                    | 6.5                       | FPG86P0205J-- |
| 2.5        | Plastic Case<br>M8/8  | 62<br>(2.441)              | 5<br>(0.197)        | 72<br>(2.835) | 22<br>(0.866)              | 12.5                                            | 40                              | 1.3                    | 4.8                       | FPG86P0255J-- |
| 3          | Resin Molding<br>M8/8 | 62<br>(2.441)              | 5.7<br>(0.224)      | 82<br>(3.228) | 28<br>(1.102)              | 18                                              | 50                              | 1.15                   | 4.4                       | FPG86P0305J-- |
| 4          | Plastic Case<br>M8/8  | 62<br>(2.441)              | 5<br>(0.197)        | 92<br>(3.622) | 22<br>(0.866)              | 32                                              | 65                              | 0.95                   | 3.4                       | FPG86P0405J-- |

**= Preferred standard values**

PROTECTION

For higher power protection devices and further information  
please see PPX Series in Capacitor for High Power Electronics  
available on AVX website: [www.avxcorp.com](http://www.avxcorp.com)



# Medium Power Film Capacitors



## FPG Table of Values

### PROTECTION

Dimensions: millimeters (inches)

| Cn<br>(μF) | Case<br>Type          | Dimensions                 |                     |               |                       | I².t<br>max.<br>(A².s)     | I <sub>rms</sub><br>max.<br>(A) | Rs<br>(mΩ)                | Rth<br>(°C/W) | References              |
|------------|-----------------------|----------------------------|---------------------|---------------|-----------------------|----------------------------|---------------------------------|---------------------------|---------------|-------------------------|
|            |                       | H*<br>±0.5<br>(±0.020)     | h<br>±2<br>(±0.079) | D<br>max.     | d<br>±0.5<br>(±0.020) |                            |                                 |                           |               |                         |
| FPG 2600 V |                       | V <sub>n</sub> dc = 1750 V |                     |               |                       | V <sub>peak</sub> = 2000 V |                                 | V <sub>rms</sub> = 800 V  |               | V <sub>s</sub> = 2600 V |
| 0.47       | Resin Molding<br>M6/6 | 59<br>(2.323)              | 4.2<br>(0.165)      | 40<br>(1.575) | 19<br>(0.748)         | 1.4                        | 12                              | 4.04                      | 28            | FPG66W0474J--           |
| 1          | Resin Molding<br>M6/6 | 59<br>(2.323)              | 4.2<br>(0.165)      | 55<br>(2.165) | 19<br>(0.748)         | 5.7                        | 21                              | 2.17                      | 10.9          | FPG66W0105J--           |
| 1.5        | Resin Molding<br>M6/6 | 59<br>(2.323)              | 4.2<br>(0.165)      | 60<br>(2.362) | 19<br>(0.748)         | 12.9                       | 31                              | 1.55                      | 7.7           | FPG66W0155J--           |
| 2          | Plastic Case<br>M8/8  | 62<br>(2.441)              | 5<br>(0.197)        | 72<br>(2.835) | 22<br>(0.866)         | 23                         | 41                              | 1.24                      | 6.1           | FPG86W0205J--           |
| 2.5        | Resin Molding<br>M8/8 | 62<br>(2.441)              | 5.7<br>(0.224)      | 82<br>(3.228) | 28<br>(1.102)         | 36                         | 51                              | 1.05                      | 4.5           | FPG86W0255J--           |
| 3          | Plastic Case<br>M8/8  | 62<br>(2.441)              | 5<br>(0.197)        | 92<br>(3.622) | 22<br>(0.866)         | 50                         | 62                              | 0.92                      | 3.9           | FPG86W0305J--           |
| 3.5        | Plastic Case<br>M8/8  | 62<br>(2.441)              | 5<br>(0.197)        | 92<br>(3.622) | 22<br>(0.866)         | 70                         | 72                              | 0.83                      | 3.4           | FPG86W0355J--           |
| 3.9        | Plastic Case<br>M8/8  | 62<br>(2.441)              | 5<br>(0.197)        | 92<br>(3.622) | 22<br>(0.866)         | 85                         | 80                              | 0.78                      | 3.1           | FPG86W0395J--           |
| FPG 3500 V |                       | V <sub>n</sub> dc = 2000 V |                     |               |                       | V <sub>peak</sub> = 2400 V |                                 | V <sub>rms</sub> = 1000 V |               | V <sub>s</sub> = 3500 V |
| 0.33       | Resin Molding<br>M6/6 | 59<br>(2.323)              | 4.2<br>(0.165)      | 40<br>(1.575) | 19<br>(0.748)         | 2                          | 15                              | 2.5                       | 28            | FPG66X0334J--           |
| 0.5        | Resin Molding<br>M6/6 | 59<br>(2.323)              | 4.2<br>(0.165)      | 55<br>(2.165) | 19<br>(0.748)         | 5                          | 19                              | 2.5                       | 11.2          | FPG66X0504J--           |
| 1          | Plastic Case<br>M8/8  | 62<br>(2.441)              | 5<br>(0.197)        | 72<br>(2.835) | 22<br>(0.866)         | 15                         | 38                              | 1.4                       | 6.2           | FPG86X0105J--           |
| 1.5        | Resin Molding<br>M8/8 | 62<br>(2.441)              | 5.7<br>(0.224)      | 82<br>(3.228) | 28<br>(1.102)         | 40                         | 56                              | 1.03                      | 3.9           | FPG86X0155J--           |
| 2          | Plastic Case<br>M8/8  | 62<br>(2.441)              | 5<br>(0.197)        | 92<br>(3.622) | 22<br>(0.866)         | 70                         | 75                              | 0.85                      | 3.1           | FPG86X0205J--           |
| FPG 4500 V |                       | V <sub>n</sub> dc = 2500 V |                     |               |                       | V <sub>peak</sub> = 3200 V |                                 | V <sub>rms</sub> = 1200 V |               | V <sub>s</sub> = 4500 V |
| 0.22       | Resin Molding<br>M6/6 | 59<br>(2.323)              | 4.2<br>(0.165)      | 40<br>(1.575) | 19<br>(0.748)         | 1.5                        | 15                              | 3.8                       | 25            | FPG66Z0224J--           |
| 0.47       | Resin Molding<br>M6/6 | 59<br>(2.323)              | 4.2<br>(0.165)      | 60<br>(2.362) | 19<br>(0.748)         | 7                          | 24                              | 2.16                      | 8.5           | FPG66Z0474J--           |
| 0.68       | Plastic Case<br>M8/8  | 62<br>(2.441)              | 5<br>(0.197)        | 72<br>(2.835) | 22<br>(0.866)         | 14                         | 35                              | 1.59                      | 6.2           | FPG86Z0684J--           |
| 1          | Resin Molding<br>M8/8 | 62<br>(2.441)              | 5.7<br>(0.224)      | 82<br>(3.228) | 28<br>(1.102)         | 30                         | 52                              | 1.18                      | 4             | FPG86Z0105J--           |
| 1.25       | Plastic Case<br>M8/8  | 62<br>(2.441)              | 5<br>(0.197)        | 92<br>(3.622) | 22<br>(0.866)         | 50                         | 65                              | 1                         | 3.3           | FPG86Z1254J--           |
| FPG 4600 V |                       | V <sub>n</sub> dc = 3000 V |                     |               |                       | V <sub>peak</sub> = 4000 V |                                 | V <sub>rms</sub> = 1400 V |               | V <sub>s</sub> = 4600 V |
| 0.12       | Resin Molding<br>M6/6 | 59<br>(2.323)              | 4.2<br>(0.165)      | 40<br>(1.575) | 19<br>(0.748)         | 0.8                        | 15                              | 6                         | 28            | FPG66Y0124J--           |
| 0.22       | Resin Molding<br>M6/6 | 59<br>(2.323)              | 4.2<br>(0.165)      | 60<br>(2.362) | 19<br>(0.748)         | 3                          | 20                              | 3.48                      | 11            | FPG66Y0224J--           |
| 0.33       | Plastic Case<br>M8/8  | 62<br>(2.441)              | 5<br>(0.197)        | 72<br>(2.835) | 22<br>(0.866)         | 6.8                        | 25                              | 2.42                      | 7.7           | FPG86Y0334J--           |
| 0.47       | Resin Molding<br>M8/8 | 62<br>(2.441)              | 5.7<br>(0.224)      | 82<br>(3.228) | 28<br>(1.102)         | 13.8                       | 35                              | 1.79                      | 5.2           | FPG86Y0474J--           |
| 0.60       | Plastic Case<br>M8/8  | 62<br>(2.441)              | 5<br>(0.197)        | 92<br>(3.622) | 22<br>(0.866)         | 22                         | 45                              | 1.47                      | 4.2           | FPG86Y0604J--           |

  = Preferred standard values

For higher power protection devices and further information  
please see PPX Series in Capacitor for High Power Electronics  
available on AVX website: [www.avxcorp.com](http://www.avxcorp.com)