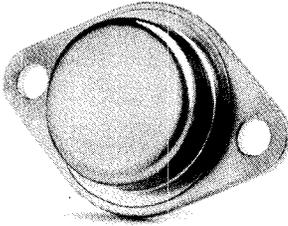# ⚠ LAMBDA SWITCHING POWER DARLINGTONS

# PMD 20K SERIES

## 150 WATT (14 AMP CONTINUOUS, 20 AMP PEAK)



## FEATURES

- Electrical specifications guaranteed for operating junction temperature range of 0 - 150°C
- Guaranteed and 100% tested for $I_{SB}$ (Secondary Breakdown Current) insuring maximum performance at high energy levels
- Built-in speed up diode for fast turn-off with negative base drive
- Low thermal resistance for more useable power and lower operating temperatures
- Hermetically sealed

## DESCRIPTION

The PMD 20K Series of devices are three-terminal NPN Switching Darlington Power Transistors. These devices are monolithic epitaxial base structures with built-in base to emitter shunt resistors. They have been designed to switch at frequencies up to 30kHz. The devices are CVD glass passivated to increase reliability and provide reduced high-temperature reverse leakage current. Internal diode protection (D1) of the Darlington configuration is built into the structure to limit the device power dissipation during negative overshoot. Diode D2 is built-in to reduce device turn-off time when negative base drive is used.

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | MAXIMUM | UNITS |
|---|---|---|---|
| Collector Emitter Voltage | $V_{CEO}$ | | Vdc |
| PMD 20K120 | | 120 | |
| PMD 20K150 | | 150 | |
| PMD 20K200 | | 200 | |
| Collector Base Voltage | $V_{CBO}$ | | Vdc |
| PMD 20K120 | | 120 | |
| PMD 20K150 | | 150 | |
| PMD 20K200 | | 200 | |
| Emitter Base Voltage | $V_{EBO}$ | 2 | Vdc |
| Collector Current | $I_C$ | | Adc |
| Continuous | | 14 | |
| Peak | | 20 | |
| Base Current | $I_B$ | 0.5 | Adc |
| Thermal Resistance | $\theta_{JC}$ | 1.0 | °C/Watt |
| Total Internal Power Dissipation @ $T_C = 0°C^1$ | $P_D$ | 150 | Watts |
| Operating Junction and Storage Temperature | $T_J$ $T_{STG}$ | −65 to +150 −65 to +200 | °C |

(1) For operation above $T_C = 0°C$, derate @ 1 W/°C.

## DEVICE SELECTION GUIDE

| DEVICE | VOLTAGE RATING |
|---|---|
| PMD 20K120 | 120V |
| PMD 20K150 | 150V |
| PMD 20K200 | 200V |

Excellent thermal resistance junction to case ($\theta_{JC}$) provides for more useable power at lower operating temperatures. This, coupled with 100% $I_{SB}$ testing, insures optimum performance and durability in power applications such as switching regulators and inverters. These Darlington devices are hermetically sealed steel TO-3 packages providing high reliability and low thermal resistance.

# PMD 20K SERIES

## ELECTRICAL CHARACTERISTICS

All parameters are guaranteed at $T_J = 0$ to $150°C$, unless otherwise specified.

| Parameter | Symbol | Test Conditions | Minimum | Maximum | Units |
|---|---|---|---|---|---|
| **ON CHARACTERISTICS** | | | | | |
| Collector Emitter Saturation Voltage[1] | $V_{CE(sat)}$ | $I_C = 10$ Adc; $I_B = 50$ mAdc | | $1.7^2$ <br> 1.8 | Vdc |
| Base Emitter Turn-on Voltage[1] | $V_{BE(on)}$ | $I_C = 10$ Adc; $V_{CE} = 3$ Vdc | | $2.6^2$ <br> 2.8 | Vdc |
| Base Emitter Saturation[1] | $V_{BE(sat)}$ | $I_C = 10$ Adc; $I_B = 50$ mAdc | | $2.6^2$ <br> 2.8 | Vdc |
| DC Current Gain[1] | $h_{FE}$ | $I_C = 10$ Adc; $V_{CE} = 3$ Vdc | 300 | | |
| Forward Bias Secondary Breakdown Current | $I_{s/b}$ | $V_{CE} = 26$ Vdc; $T_A = 25°C$ <br> 1 sec non-repetitive pulse | 5.8 | | Adc |
| Secondary Breakdown Energy | $E_{s/b}$ | $I_C = 8.43$ Adc; $L = 45\mu H$ <br> $T_A = 25°C$ | 1.6 | | mJoules |
| **OFF CHARACTERISTICS** | | | | | |
| Collector Emitter Breakdown Voltage[1] (Base Open) <br> PMD 20K120 <br> PMD 20K150 <br> PMD 20K200 | $V_{(BR)CEO}$ | $I_{CE} = 100$ mAdc; $I_B = 0$ <br> $T_J = 25°C$ | 120 <br> 150 <br> 200 | | Vdc |
| Collector Emitter Sustaining Voltage[1] <br> PMD 20K120 <br> PMD 20K150 <br> PMD 20K200 | $V_{(SUS)CER}$ | $I_{CE} = 100$ mAdc; $R_{BE} = 2.2k\Omega$ | 120 <br> 150 <br> 200 | | Vdc |
| Emitter Base Leakage Current | $I_{EBO}$ | $V_{EB} = 0.9$ Vdc; $I_C = 0A$ | | 70 | mAdc |
| Collector Emitter Leakage Current <br> PMD 20K120 <br> PMD 20K150 <br> PMD 20K200 | $I_{CER}$ | <br> $V_{CE} = 80$ Vdc; $R_{BE} = 2.2k\Omega$ <br> $V_{CE} = 100$ Vdc; $R_{BE} = 2.2k\Omega$ <br> $V_{CE} = 150$ Vdc; $R_{BE} = 2.2k\Omega$ | | <br> 5.0 <br> 5.0 <br> 5.0 | mAdc |
| Collector Emitter Leakage Current (Base Open)[2] <br> PMD 20K120 <br> PMD 20K150 <br> PMD 20K200 | $I_{CEO}$ | <br> $V_{CE} = 80$ Vdc <br> $V_{CE} = 100$ Vdc <br> $V_{CE} = 150$ Vdc | | <br> 0.5 <br> 0.5 <br> 0.5 | mAdc |
| **DYNAMIC CHARACTERISTICS[2,3]** | | | | | |
| Rise Time | $t_r$ | $I_C = 10$ Adc; $V_{CC} = 30V$ | | 0.3 | $\mu S$ |
| Turn-On Time | $t_{on}$ | $I_C = 10$ Adc; $V_{CC} = 30V$ | | 0.5 | $\mu S$ |
| Fall Time | $t_f$ | $I_C = 10$ Adc; $V_{CC} = 30V$ | | 0.8 | $\mu S$ |
| Turn-Off Time | $t_{off}$ | $I_C = 10$ Adc; $V_{CC} = 30V$ | | 1.0 | $\mu S$ |

(1) Pulse tested with pulse width $\leq 300\ \mu S$ and duty cycle $\leq 2.0\%$.
(2) $T_J = 25°C$.
(3) See AC test circuit.

# PMD 20K SERIES

## OPERATIONAL DATA

### AC TEST CIRCUIT

$V_{cc} = 30V$

FAST RECOVERY
1N4435
RECTIFIER

$R_c$

DC CURRENT PROBE

TEST POINT
100 mHz
(SCOPE)

$R_{BB1}$

DC CURRENT PROBE

1N914
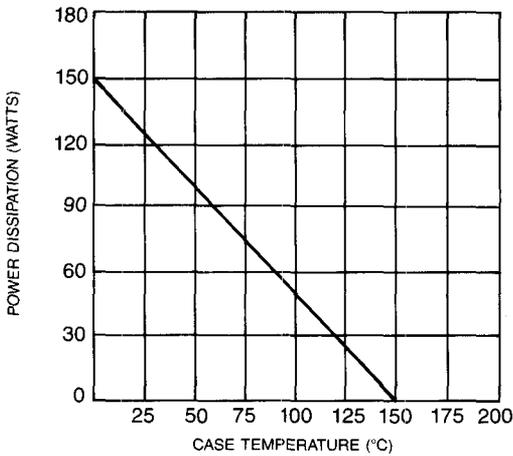
51Ω

DARLINGTON UNDER TEST
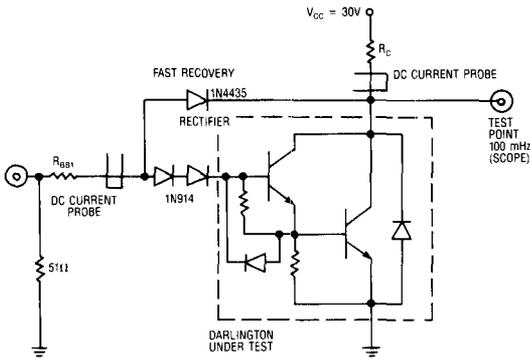
Adjust $R_c$ to obtain desired $I_C$.
Adjust $V_{IN}$, $R_{BB1}$ to obtain $I_{B1} = I_C/100$.
Adjust $V_{IN}$ to 1% duty cycle with pulse rise and fall times less than 10nS.

### SWITCHING WAVEFORMS

$V_{IN}$

90%

0    10%

$V_{OUT}$    $t_d$         $t_s$

90%

0    10%

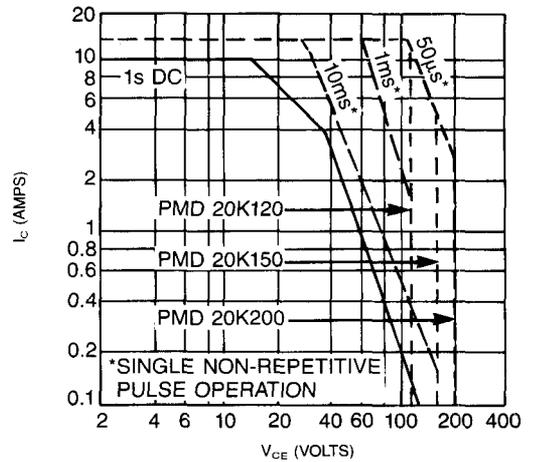$t_r$    $t_f$

$t_{on} = t_d + t_r$
$t_{off} = t_s + t_f$
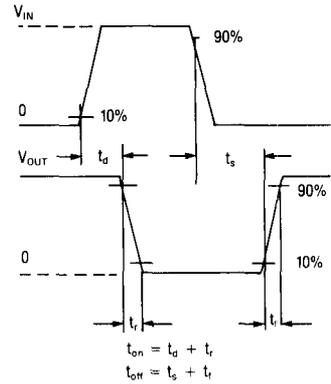
Switching times are specified only under the condition that the device under test is not allowed to enter classical saturation. A Baker Clamp is used to insure that the base-collector junction of the DUT is never forward biased under worst case temperature and drive conditions.
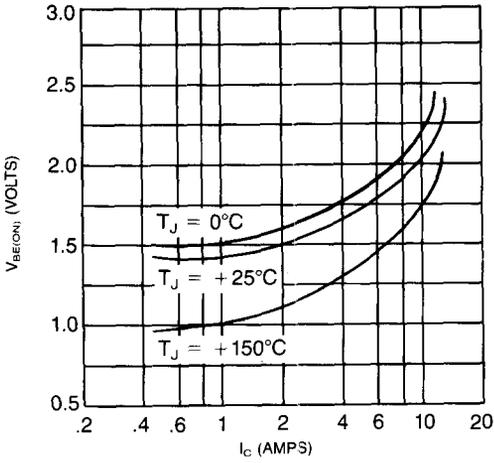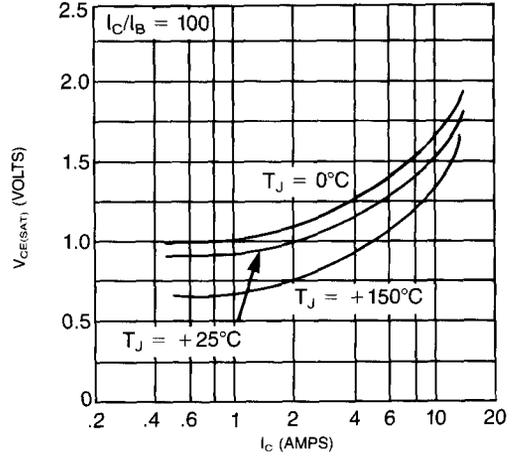
### POWER DERATING

POWER DISSIPATION (WATTS)

180
150
120
90
60
30
0

25   50   75   100   125   150   175   200

CASE TEMPERATURE (°C)

### SAFE OPERATING AREA

$I_C$ (AMPS)

20
10
8
6
4

2

1
0.8
0.6
0.4

0.2

0.1

50μs*
1ms*
10ms*

1s DC

PMD 20K120
PMD 20K150
PMD 20K200

*SINGLE NON-REPETITIVE
PULSE OPERATION

2   4  6   10    20    40 60 100   200  400

$V_{CE}$ (VOLTS)

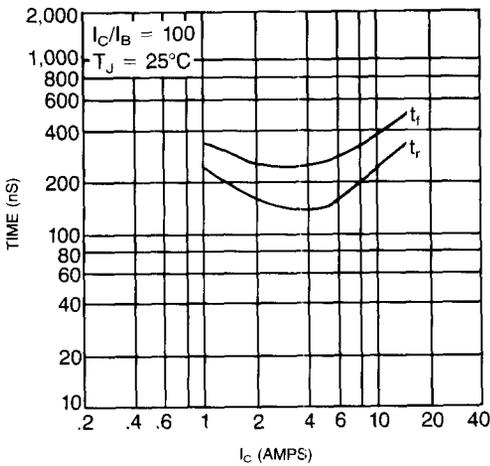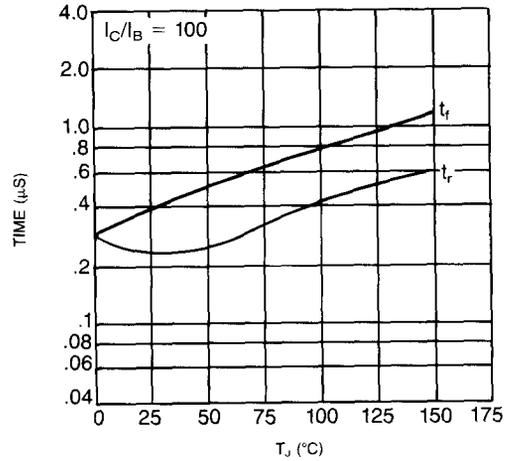## OPERATIONAL DATA

### V_BE(ON) VS COLLECTOR CURRENT



### V_CE(SAT) VS COLLECTOR CURRENT
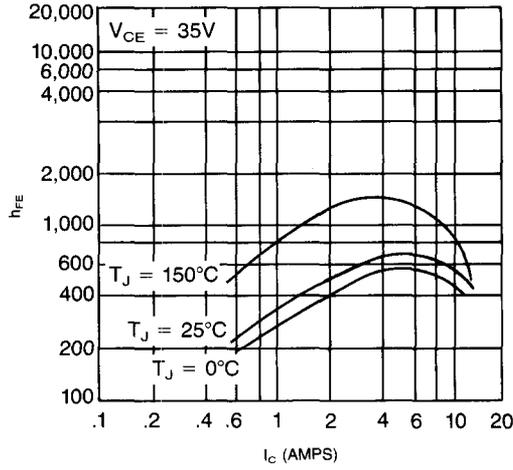


### DYNAMIC CHARACTERISTICS VS COLLECTOR CURRENT



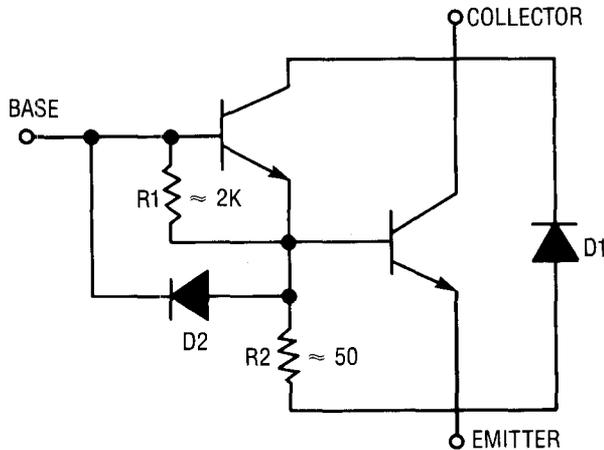### DYNAMIC CHARACTERISTICS VS JUNCTION TEMPERATURE

# OPERATIONAL DATA

## DC COLLECTOR CURRENT GAIN
## VS COLLECTOR CURRENT

$V_{CE} = 35V$

$T_J = 150°C$

$T_J = 25°C$

$T_J = 0°C$

$h_{FE}$

20,000
10,000
6,000
4,000
2,000
1,000
600
400
200
100

.1  .2  .4 .6  1  2  4  6  10  20

$I_C$ (AMPS)
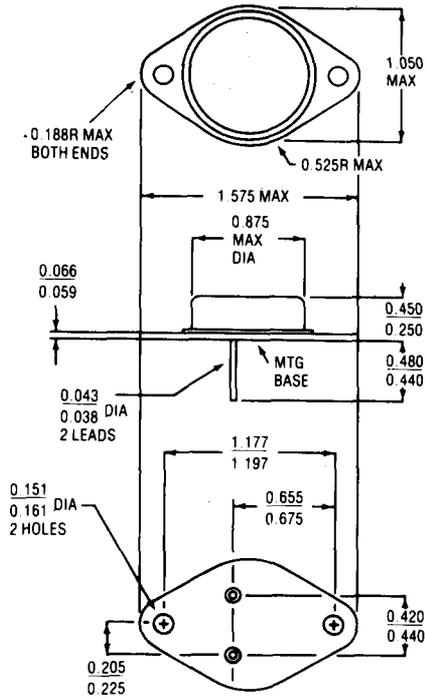
# BLOCK DIAGRAM

COLLECTOR

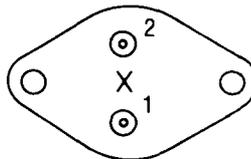BASE

R1 ≈ 2K

D1

D2

R2 ≈ 50

EMITTER

(An external fast recovery diode connected in parallel
to D1 will increase efficiency in DC-DC switching converters.)

# PMD 20K SERIES

## DEVICE OUTLINE



1.050 MAX

-0.188R MAX BOTH ENDS

0.525R MAX

1.575 MAX

0.875 MAX DIA

$\frac{0.066}{0.059}$

$\frac{0.450}{0.250}$

$\frac{0.480}{0.440}$

MTG BASE

$\frac{0.043}{0.038}$ DIA 2 LEADS

$\frac{0.151}{0.161}$ DIA 2 HOLES

$\frac{1.177}{1.197}$

$\frac{0.655}{0.675}$

$\frac{0.420}{0.440}$

$\frac{0.205}{0.225}$

**Bottom View**

2

X

1

1 – Base
2 – Emitter
Case is Collector

NOTE: Case temperature measured at point X.
All dimensions are in inches.