

2000 SHORT FORM CATALOG

ADVANCED POWER TECHNOLOGY

ISO9001 Certified

MIL-PRF-19500

**POWER
DISCRETE SEMICONDUCTORS**



TECHNOLOGY TO THE NEXT POWER.

Advanced Power Technology

Technology Beginning in 1984 with the introduction of Power MOS IV[®], APT has maintained a position at the forefront of power semiconductor technology. Our focus is on the high voltage, high power and high performance segments of this market. Our commitment is to maintain and enhance this position as a technological leader in MOS controlled devices and FREDs and to deliver products which contribute to our customers' success in delivering higher performance power systems.

Service Outstanding technology is only part of the story. A global network of stocking distributors, representatives and applications engineers are in place to support all phases of your product design, evaluation and procurement activities. In a world which demands superior execution, we've won awards as a service leader.

Quality Our commitment is to excellence in all things we do. Whether you are evaluating the quality of our products, our technical assistance, our customer service or the quality of our internal communications systems, excellence is our standard. We understand that ISO9001, MIL-PRF-19500 and 8D are only the beginning.

What's New

- Low Charge/Low Capacitance Power MOS VI[™] MOSFETs and FREDFETs
- Linear MOSFETs
- Expanded Hermetic Product Offering
- Power MOS V[®] MOSFETs and FREDFETs
- Thunderbolt IGBT[™] Capable of replacing MOSFETs up to 150kHz Operation
- Fast IGBT for up to 40kHz Operation
- Center-Tap FREDs 200V - 1000V
- High Frequency FREDs Replacement for GaAs Rectifiers
- New Packages Tape and reel D³ PAK, T-MAX[™] and TO-267
- RF MOSFETs Operation up to 100MHz

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Packaging Information

<u>Package</u>	<u>Quantity Per Tube</u>
TO-247	30 UNITS
T-MAX™	30 UNITS
TO-220	50 UNITS
ISOTOP®	10 UNITS
TO-3	21 UNITS
TO-264	25 UNITS
D ³ PAK	30 UNITS
D ³ PAK Tape and Reel	400/REEL

Visit APT's Website to Download Datasheets
<http://www.advancedpower.com>

NEW LC Series - POWER MOS VI™

WITH ALL THE BENEFITS OF POWER MOS V®.....PLUS

Low Gate Charge Low Capacitances

New advanced designs, thicker gate oxide, and shallower device junctions provide for significant reductions in gate charge and capacitances as shown in the table below. The benefits include reduction in gate driver requirements and improved efficiencies.

Faster Switching / Lower Switching Losses

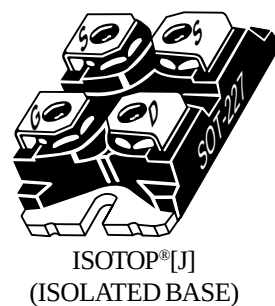
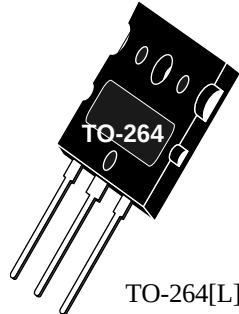
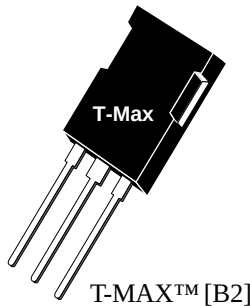
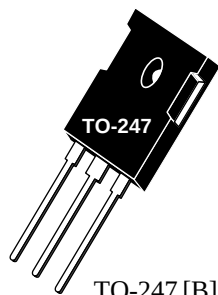
The lower capacitances combined with the low internal gate resistance resulting from new advanced designs and the unique metal gate structure provide for a 50% reduction in total switching time compared to POWER MOS V™. This dramatically improved switching efficiency enables higher frequency operation and smaller power supplies.

Comparison of Key Parameters by Technology
for 500 Volt 370 Watt MOSFET

Parameter		LOW GATE Charge MOS IV® 5020BN	MOS V® 5017BVR	LC Series MOS VI™ 5017BLC	Improvement LC Series vs MOS IV®	Improvement LC Series vs MOS V®
R _{DS} , mW	Max	200	170	170	15%	-
I _D , Amps	Max	28	30	30	7%	-
Q _g , nC	Typ	140	200	85	29%	58%
C _{iss} , pF	Typ	2890	4400	3025	-	31%
C _{rss} , pF	Typ	230	265	120	54%	55%
E _{AS} , mJ	Max	-	1300	1300	-	-

NEW L C Series - POWER MOS VI™ MOSFETs

BV _{DSS} Volts	R _{DS(ON)} Ohms	I _D (cont) Amps	P _D Watts	C _{iss} (pF) Typ	C _{rss} (pF) Typ	Q _g (nC) Typ	E _{AS} mJ	APT Part Number	Samples Available	Package Style
1000	1.000 0.860	11 13	280 370	2330 2835	90 110	80 100	1210 1300	APT1001RBLC APT10086BLC	NOW 1Q00	TO-247
500	0.200 0.170 0.150	26 30 32	300 370 370	2500 3025 3025	100 120 120	70 85 85	1300 1300 1300	APT5020BLC APT5017BLC APT5015BLC	NOW NOW NOW	
200	0.040 0.038	59 67	280 370	3100 3400	100 120	60 70	1300 1300	APT20M40BLC APT20M38BLC	2Q00 2Q00	
1000	1.000 0.860	11 13	280 370	2330 2835	90 110	80 100	1210 1300	APT1001RSLC APT10086SLC	1Q00 1Q00	D ³ PAK
500	0.200 0.170 0.150	26 30 32	300 370 370	2500 3025 3025	100 120 120	70 85 85	1300 1300 1300	APT5020SLC APT5017SLC APT5015SLC	1Q00 1Q00 1Q00	
200	0.040 0.038	59 67	280 370	3100 3400	100 120	60 70	1300 1300	APT20M40SLC APT20M38SLC	2Q00 2Q00	
1000	0.500 0.400	21 25	520 625	5000 5830	190 220	170 190	2500 3000	APT10050B2LC APT10040B2LC	2Q00 2Q00	T-MAX™
500	0.140 0.100 0.080	37 47 58	450 520 625	3650 5200 6200	145 200 240	105 150 180	1600 2500 3000	APT5014B2LC APT5010B2LC APT50M80B2LC	1Q00 NOW 1Q00	
200	0.022 0.018	100 100	520 625	6400 7600	170 200	115 140	2500 3000	APT20M22B2LC APT20M18B2LC	2Q00 2Q00	
1000	0.500 0.400	21 25	520 625	5000 5830	190 220	170 190	2500 3000	APT10050LLC APT10040LLC	2Q00 2Q00	TO-264
500	0.140 0.100 0.080	37 47 58	450 520 625	3650 5200 6200	145 200 240	105 150 180	1600 2500 3000	APT5014LLC APT5010LLC APT50M80LLC	1Q00 NOW 1Q00	
200	0.022 0.018	100 100	520 625	6400 7600	170 200	115 140	2500 3000	APT20M22LLC APT20M18LLC	2Q00 2Q00	
1000	0.500 0.250	25 34	450 700	5000 11250	190 430	170 380	2500 3600	APT10050JLC APT10025JLC	2Q00 1Q00	ISOTOP®
500	0.100 0.080 0.050	44 53 77	450 520 700	5200 6200 11350	200 240 440	150 180 330	2500 3000 3600	APT5010JLC APT50M80JLC APT50M50JLC	1Q00 1Q00 1Q00	



NEW L C Series - POWER MOS VI™ FREDFETs

BV _{DSS} Volts	R _{DS(ON)} Ohms	I _D (cont) Amps	P _D Watts	C _{iss} (pF) Typ	C _{rss} (pF) Typ	Q _g (nC) Typ	t _{rr} (nsecs) Max	E _{AS} mJ	APT Part Number	Samples Available	Package Style
1000	1.100 0.860	11 13	280 370	2300 2800	65 80	90 110	200 200	1210 1300	APT1001R1BFLC APT10086BFLC	2Q00 2Q00	TO-247
500	0.200 0.170	26 30	300 370	2800 3000	80 105	80 100	250 250	1300 1300	APT5020BFLC APT5017BFLC	1Q00 1Q00	
200	0.040 0.038	59 67	280 370	3100 3400	100 120	60 70	200 225	1300 1300	APT20M40BFLC APT20M38BFLC	2Q00 2Q00	
1000	0.500	21	520	5000	145	200	250	2500	APT10050B2FLC	2Q00	T-MAX™
500	0.140	37	450	4100	120	115	250	1600	APT5014B2FLC	2Q00	
	0.100	47	520	5600	155	155	250	2500	APT5010B2FLC	2Q00	
	0.080	58	625	6700	185	190	250	3000	APT50M80B2FLC	2Q00	
200	0.022 0.018	100 100	520 625	6400 7600	170 200	115 140	220 220	2500 3000	APT20M22B2FLC APT20M18B2FLC	2Q00 2Q00	TO-264
1000	0.500	21	520	5000	145	200	250	2500	APT10050LFLC	2Q00	
500	0.140	37	450	4100	120	115	250	1600	APT5014LFLC	2Q00	
	0.100	47	520	5600	155	155	250	2500	APT5010LFLC	1Q00	
	0.080	58	625	6700	185	190	250	3000	APT50M80LFLC	2Q00	
200	0.022 0.018	100 100	520 625	6400 7600	170 200	115 140	220 220	2500 3000	APT20M22LFLC APT20M18LFLC	2Q00 2Q00	ISOTOP®
1000	0.500	25	450	5000	145	200	250	2500	APT10050JFLC	2Q00	
	0.250	34	700	11300	355	400	250	3600	APT10025JFLC	2Q00	
500	0.100	44	450	5600	155	155	250	2500	APT5010JFLC	1Q00	
	0.080	53	520	6700	185	190	250	3000	APT50M80JFLC	2Q00	
	0.050	77	700	12600	340	345	250	3600	APT50M50JFLC	2Q00	

MOS VI™ AVAILABLE IN HERMETIC PACKAGES

NEW

LINEAR MOSFETs

What is a Linear MOSFET?

A MOSFET specifically designed to be more robust than a standard MOSFET when operated with concurrent high voltage and high current near DC conditions (>100msecs).

APT Technology Innovation

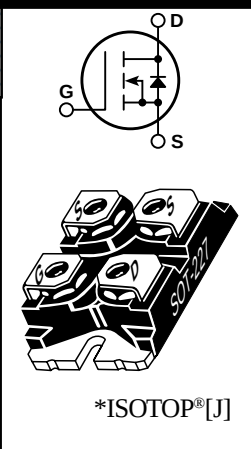
A low gain (low packing density) device provides the best SOA performance at high voltage. APT has modified its proprietary interdigitated MOSFET technology to develop a lower gain device with enhanced performance in high voltage, linear

applications. This new Linear MOSFET provides 1.5-2.0 times the DC SOA capability at high voltage compared to previous APT technologies.

Typical Applications:

- Active load above 200 volts such as DC dynamic loads for testing power supplies, batteries, fuel cells, etc.
- High voltage, high current constant current sources.

LINEAR MOSFETs

							
BV _{DSS} Volts	R _{DS(ON)} Ohms	I _D (Cont.) Amps	P _D Watts	SOA1 Watts	APT Part No.	Package Style	
1000	0.60	18.0	520	325	APL1001J	ISOTOP®	
500	0.12	43.0	520	325	APL501J		

Power MOS V[®] MOSFETs

A new generation of high power, high voltage Power MOSFETs Based on a patented self aligned interdigitated open cell structure, this new generation of MOSFETs offers many advantages over our previous MOS IV[®] generation and over industry standard, closed cell devices.

Lower $R_{DS(ON)}$ A 25% reduction in on-resistance is gained by employing shallower junctions and “overactive area” bonding to increase the channel packing density per unit of silicon. The packing density has been optimized to minimize the JFET resistance and capacitances.

Faster Switching Power MOS V[®] utilizes a low resistance aluminum metal gate structure. This allows for faster gate signal propagation than is possible with conventional polysilicon gate structures. Power MOS V[®] employs shorter gate fingers and a more efficient gate bus structure than our previous generation to further reduce the series gate resistance. Multiple bond pads and wires for both source and gate contacts have also reduced impedances. The result is decreased on, rise, delay and fall times. Total switching time has been reduced by up to 60% over our previous generation.

Avalanche Energy Rated All Power MOS V[®] devices are 100% tested and guaranteed for avalanche energy.

Low Leakage Current Process improvements have made possible a substantial decrease over our previous generation. Maximum values for most products are now specified at 25μA at 25°C and 250μA at 125°C.

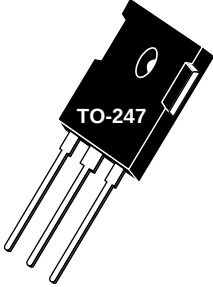
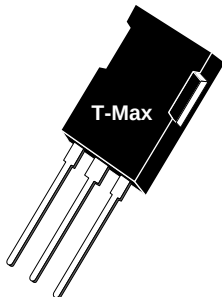
Rugged Gate Improvements in gate oxide processing allow for specification of a high gate rupture voltage. All Power MOS V[®] MOSFETs are specified for ± 30V continuous operation and ± 40V transient operation.

Lower Cost A less complex fabrication process, improved manufacturing yields and reduced cycle times have all contributed to a more cost-effective device.

Comparison of Lowest $R_{DS(ON)}$ in TO-247 Package Between New Generation Power MOS V[®] and Previous Generation Power MOS IV[®]

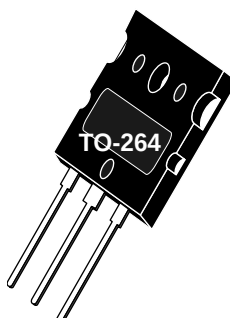
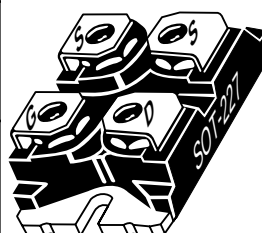
Breakdown Voltage (V)	New Generation Power MOS V [®] $R_{DS(ON)}$ (mW)	Previous Generation Power MOS IV [®] $R_{DS(ON)}$ (mW)	Improvement
1200	1500	---	New
1000	860	1000	14%
800	560	750	25%
600	250	300	17%
500	150	200	25%
400	120	160	25%
300	70	85	18%
200	38	45	16%
100	19	25	24%

POWER MOS V[®] MOSFETs

BV _{DSS} Volts	R _{DS(ON)} Ohms	I _D (Cont.) Amps	P _D Watts	C _{iss} (pF) Typ	E _{AS} mJ	APT Part No.	Package Style
1200	1.600 1.500	8 10	280 370	3050 3700	1210 1300	APT1201R6BVR APT1201R5BVR	 *TO-247[B]
1000	1.000 0.860	11 13	280 370	3050 3700	1210 1300	APT1001RBVR APT10086BVR	
800	0.750 0.650 0.560	12 13 16	260 280 370	2700 3050 3700	960 1210 1300	APT8075BVR APT8065BVR APT8056BVR	
600	0.450 0.350 0.300 0.250	15 18 21 25	250 280 300 370	2600 3450 3750 4300	960 1210 1300 1300	APT6045BVR APT6035BVR APT6030BVR APT6025BVR	
500	0.280 0.240 0.200 0.170 0.150	20 22 26 30 32	250 280 300 370 370	2650 3600 3700 4400 4400	960 1210 1300 1300 1300	APT5028BVR APT5024BVR APT5020BVR APT5017BVR APT5015BVR	
400	0.200 0.160 0.140 0.120	23 27 28 37	250 280 300 370	2650 3350 3600 4500	960 1210 1300 1300	APT4020BVR APT4016BVR APT4014BVR APT4012BVR	
300	0.085 0.070	40 48	300 370	4100 4890	1300 1300	APT30M85BVR APT30M70BVR	
200	0.045 0.040 0.038	56 59 67	300 300 370	4050 4050 5100	1300 1300 1300	APT20M45BVR APT20M40BVR APT20M38BVR	
100	0.025 0.019	75** 75	300 370	4300 5100	1500 1500	APT10M25BVR APT10M19BVR	
Any devices offered in the TO-264 package can be made available in the T-MAX™. See page 23 for details.							 *T-MAX™ [B2]
1200	0.600	20	625	7700	3000	APT12060B2VR NEW	
1000	0.500 0.400	21 25	520 625	6600 7800	2500 3000	APT10050B2VR APT10040B2VR NEW	
800	0.300 0.240	27 33	520 625	6600 7800	2500 3000	APT8030B2VR APT8024B2VR NEW	
600	0.150 0.110	38 49	520 625	7500 8800	2500 3000	APT6015B2VR APT6011B2VR NEW	
500	0.140 0.100 0.085 0.080	37 47 56 58	450 520 625 625	5600 7400 8700 8700	1600 2500 3000 3000	APT5014B2VR APT5010B2VR APT50M85B2VR NEW APT50M80B2VR NEW	
200	0.022 0.018	100** 100**	520 625	8500 10,000	2500 3000	APT20M22B2VR APT20M18B2VR NEW	
100	0.011 0.009	100** 100**	520 625	8600 10,000	2500 3000	APT10M11B2VR APT10M09B2VR NEW	

** I_{Dmax} limited by package

POWER MOS V[®] MOSFETs

BV _{DSS} Volts	R _{DS(ON)} Ohms	I _D (Cont.) Amps	P _D Watts	C _{iss} (pF) Typ	E _{AS} mJ	APT Part No.	Package Style
1200	0.800 <i>0.600</i>	16 <i>20</i>	520 <i>625</i>	6500 <i>7700</i>	2500 <i>3000</i>	APT12080LVR <i>APT12060LVR NEW</i>	 *TO-264[L]
1000	0.500 <i>0.400</i>	21 <i>26</i>	520 <i>625</i>	6600 <i>7800</i>	2500 <i>3000</i>	APT10050LVR <i>APT10040LVR NEW</i>	
800	0.300 <i>0.240</i>	27 <i>33</i>	520 <i>625</i>	6600 <i>8800</i>	2500 <i>3000</i>	APT8030LVR <i>APT8024LVR NEW</i>	
600	0.200 0.150 <i>0.110</i>	30 38 <i>49</i>	450 520 <i>625</i>	5600 7500 <i>8800</i>	1600 2500 <i>3000</i>	APT6020LVR APT6015LVR <i>APT6011LVR NEW</i>	
500	0.140 0.100 <i>0.085</i> <i>0.080</i>	37 47 <i>56</i> <i>58</i>	450 520 <i>625</i> <i>625</i>	5600 7400 <i>8700</i> <i>8700</i>	1600 2500 <i>3000</i> <i>3000</i>	APT5014LVR APT5010LVR <i>APT50M85LVR NEW</i> <i>APT50M80LVR NEW</i>	
400	0.070	57	520	7410	2500	APT40M70LVR	
300	0.040	76	520	8500	2500	APT30M40LVR	
200	0.022 <i>0.018</i>	100 <i>100**</i>	520 <i>625</i>	8500 <i>10,000</i>	2500 <i>3000</i>	APT20M22LVR <i>APT20M18LVR NEW</i>	
100	0.011 <i>0.009</i>	100 <i>100**</i>	520 <i>625</i>	8600 <i>10,000</i>	2500 <i>3000</i>	APT10M11LVR <i>APT10M09LVR NEW</i>	
1200	0.800 0.400	15 26	450 700	6500 15000	2500 3600	APT12080JVR APT12040JVR	 *ISOTOP [®] [J] (ISOLATED BASE)
1000	0.500 0.430 0.250	19 22 34	450 500 700	6600 7500 15000	2500 1300 3600	APT10050JVR APT10043JVR APT10025JVR	
800	0.300 0.280 0.150	25 28 44	450 500 700	6600 7700 14715	2500 1300 3600	APT8030JVR APT8028JVR APT8015JVR	
600	0.150 0.130 0.075	35 40 62	450 500 700	7500 8800 16500	2500 1300 3600	APT6015JVR APT6013JVR APT60M75JVR	
500	0.100 0.085 0.050	44 50 77	450 500 700	7400 9000 16800	2500 1300 3600	APT5010JVR APT50M85JVR APT50M50JVR	
400	0.070 0.035	53 93	450 700	7410 16000	2500 3600	APT40M70JVR APT40M35JVR	
300	0.040 0.019	70 130	450 700	8500 18000	2500 3600	APT30M40JVR APT30M19JVR	
200	0.022 0.019 0.011	97 112 175	450 500 700	8500 9700 18000	2500 1300 3600	APT20M22JVR APT20M19JVR APT20M11JVR	
100	0.011 0.007	144 225	450 700	8600 18000	2500 3600	APT10M11JVR APT10M07JVR	

POWER MOS V[®] MOSFETs

BV _{DSS} Volts	R _{DS(ON)} Ohms	I _D (Cont.) Amps	P _D Watts	C _{iss} (pF) Typ	E _{AS} mJ	APT Part No.	Package Style
Any devices offered in the TO-247 package can be made available in D ³ PAK. <i>See page 23 for details.</i>							 *D ³ PAK[S]
1000	1.000	11	280	3050	1210	APT1001RSVR	
	0.860	13	370	3700	1300	APT10086SVR	
800	0.650	13	280	3050	1210	APT8065SVR	
600	0.450	15	250	2600	960	APT6045SVR	
	0.350	18	280	3450	1210	APT6035SVR	
500	0.280	20	250	2650	960	APT5028SVR	
	0.200	26	300	3700	1300	APT5020SVR	
	0.170	30	370	4400	1300	APT5017SVR	
200	0.045	56	300	4050	1300	APT20M45SVR	
	0.038	67	370	5100	1300	APT20M38SVR	
100	0.025	75 **	300	4150	1500	APT10M25SVR	
	0.019	75 **	370	5100	1500	APT10M19SVR	

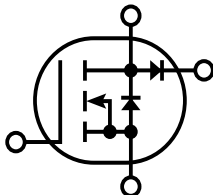
POWER MOS V[®] MOSFET/FRED "COMBI" PRODUCTS

POWER FACTOR CORRECTION "BOOST" CONFIGURATION

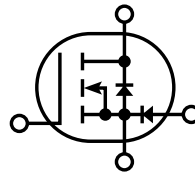
500 0.100 44 450 7410 2500 APT5010JVRU2

MOTOR DRIVE "BUCK" CONFIGURATION

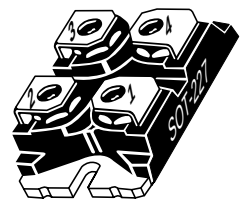
500 0.100 44 450 7410 2500 APT5010JVRU3



"BOOST" CONFIGURATION



"BUCK" CONFIGURATION



*ISOTOP[®][J]
(ISOLATED BASE)

- Reduced parts count vs discretes.
- Improved circuit performance due to reduced inductance.

Consult Factory for other voltages.

POWER MOS V® FREDFETs

FREDFET Technology Using a proprietary platinum lifetime control process, the performance of the intrinsic body drain diode of the Power MOS V® MOSFET is improved.

Faster Intrinsic Diode Recovery The reverse recovery time has been reduced to 250ns maximum, eliminating the external FRED and Schottky rectifiers in certain circuit configurations.

Improved Ruggedness The ruggedness of the intrinsic diode has also been improved, allowing for a commutative dv/dt rating of 5V/ns.

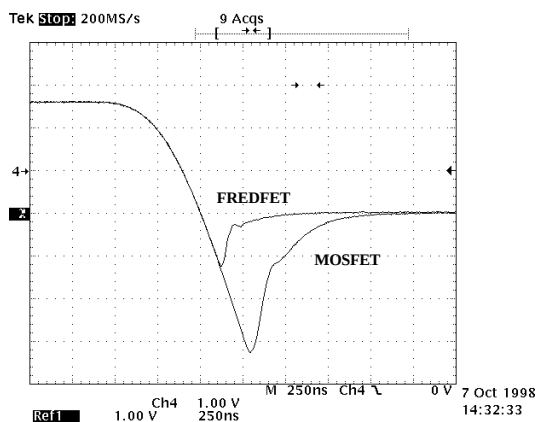
Other Benefits The platinum process provides the added advantages of soft recovery, lower leakage current, lower recovery charge and more temperature independent performance than alternative processes used to improve intrinsic diode performance.

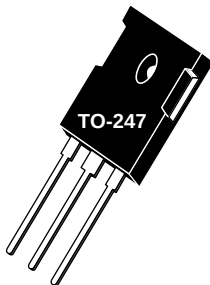
Any devices offered in standard MOSFETs can be made available as FREDFETs. See page 23 for details.

Applications for FREDFETs Power MOS V® FREDFETs should be specified under the following conditions:

- Whenever the intrinsic body drain diode of the MOSFET is expected to carry forward current. Examples are Half Bridge, H-Bridge and 3-Phase Bridge circuit topologies.
- In soft switched circuits, where the body diode carries current. Examples are Phase Shift Controlled H-Bridge or Resonant circuit topologies.

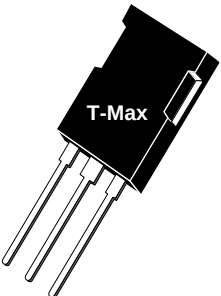
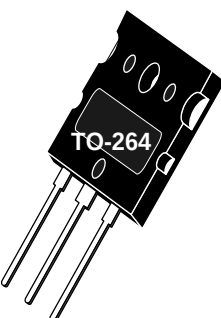
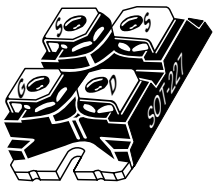
MOSFET vs FREDFET Intrinsic Diode t_{rr}



BV _{DSS} Volts	R _{DS(ON)} Ohms	I _D (Cont.) Amps	P _D Watts	C _{iss} (pF) Typ	E _{AS} mJ	t _{rr} (nsecs) Max	APT Part No.	Package Style
1000	1.100 0.860	11 13	280 370	3050 3700	1210 1300	200 200	APT1001R1BVFR APT10086BVFR	 *TO-247[B]
800	0.750 0.650 0.560	12 13 16	260 280 370	2700 3050 3700	960 1210 1300	250 200 200	APT8075BVFR NEW APT8065BVFR APT8056BVFR	
600	0.250	25	370	4300	1300	250	APT6025BVFR NEW	
500	0.240 0.200 0.170	22 26 30	280 300 370	3600 3700 4400	1210 1300 1300	250 250 250	APT5024BVFR APT5020BVFR APT5017BVFR	
300	0.085 0.070	40 48	300 370	4100 4890	1300 1300	200 225	APT30M85BVFR APT30M70BVFR	
200	0.045 0.038	56 67	300 370	4050 5100	1300 1300	200 240	APT20M45BVFR APT20M38BVFR	
100	0.025 0.019	75 75	300 370	4300 5100	1500 1500	200 200	APT10M25BVFR APT10M19BVFR	
Any devices offered in the TO-247 package can also be made available in D ³ PAK See page 23 for details.								
500	0.200	26	300	3700	300	250	APT5020SVFR	
200	0.045	56	300	4050	1300	200	APT20M45SVFR	

** I_{Dmax} limited by package

POWER MOS V[®] FREDFETs

BV _{DSS} Volts	R _{DS(ON)} Ohms	I _D (Cont.) Amps	P _D Watts	C _{iss} (pF) Typ	E _{AS} mJ	t _{rr} (nsecs) Max	APT Part No.	Package Style
Any devices offered in the TO-264 package can also be made available in T-Max™. See page 23 for details.								 *T-MAX™[B2]
1000	0.400	25	625	7800	3000	250	APT10040B2VFR NEW	
800	0.300 0.240	27 33	520 625	6600 7800	2500 3000	300 250	APT8030B2VFR APT8024B2VFR NEW	
600	0.110	49	625	8800	3000	250	APT6011B2VFR NEW	
500	0.100 0.085 0.080	47 56 58	520 625 625	7400 8700 8700	2500 3000 3000	250 250 250	APT5010B2VFR APT50M85B2VFR NEW APT50M80B2VFR NEW	
200	0.022 0.018	100** 100**	520 625	8500 10,000	2500 3000	220 220	APT20M22B2VFR APT20M18B2VFR NEW	
100	0.009	100**	625	10,000	3000	220	APT10M09B2VFR NEW	
1000	0.500 0.400	21 25	520 625	6600 7800	2500 3000	300 250	APT10050LVFR APT10040LVFR NEW	 *TO-264[L]
800	0.300 0.240	27 33	520 625	6600 7800	2500 3000	300 250	APT8030LVFR APT8024LVFR NEW	
600	0.110	49	625	8800	3000	250	APT6011LVFR NEW	
500	0.100 0.085	47 56	520 625	7400 8700	2500 3000	250 250	APT5010LVFR NEW APT50M85LVFR NEW	
300	0.040	76	520	8500	2500	240	APT30M40LVFR	
200	0.022 0.018	100** 100**	520 625	8500 10,000	2500 3000	220 220	APT20M22LVFR APT20M18LVFR NEW	
100	0.009	100**	625	10,000	3000	220	APT10M09LVFR NEW	
1000	0.500 0.250	19 34	450 700	6600 15000	2500 3600	300 300	APT10050JVFR APT10025JVFR	 *ISOTOP®[J] (ISOLATED BASE)
800	0.300 0.150	25 44	450 700	6600 14715	2500 3600	300 280	APT8030JVFR APT8015JVFR	
500	0.100 0.085 0.050	44 50 77	450 500 700	7400 9000 16300	2500 1300 3600	250 300 300	APT5010JVFR APT50M85JVFR APT50M50JVFR	
300	0.040 0.019	70 130	450 700	8500 18000	2500 3600	240 300	APT30M40JVFR APT30M19JVFR	
200	0.022 0.011	97 175	450 700	8500 18000	2500 3600	220 250	APT20M22JVFR APT20M11JVFR	

** I_{Dmax} limited by package

IGBT Technology

NPT Technology Non-Punch-Through IGBTs are manufactured by fabricating the MOSFET structure on the surface of a lightly doped, n-substrate. No epi layer needs to be grown on the substrate. The wafer is thinned to 100 μ m after all high temperature processes are completed to reduce the n-drift region. The pn junction required on the back of the wafer is formed using a p+ implant and a light diffusion. Making the p+ region only a few μ m thick keeps the voltage drop low in this region and controllable within very tight tolerances throughout the wafer. This construction provides an optimal tradeoff between $V_{CE(SAT)}$, switching speed and ruggedness. At full rated current, the $V_{CE(SAT)}$ may be higher than PT technologies, but under normal operating currents the difference is negligible.

Faster Switching Faster turn-off speeds and lower tail currents are key advantages of NPT technology. This is primarily due to the generation of fewer minority carriers during operation in NPT devices.

Improved High Temperature Operation The turn-off speed and tail current of an NPT IGBT is not as temperature dependent as PT devices. These parameters remain relatively constant over the entire operating temperature range, resulting in approximately 50% less dynamic losses at high temperatures.

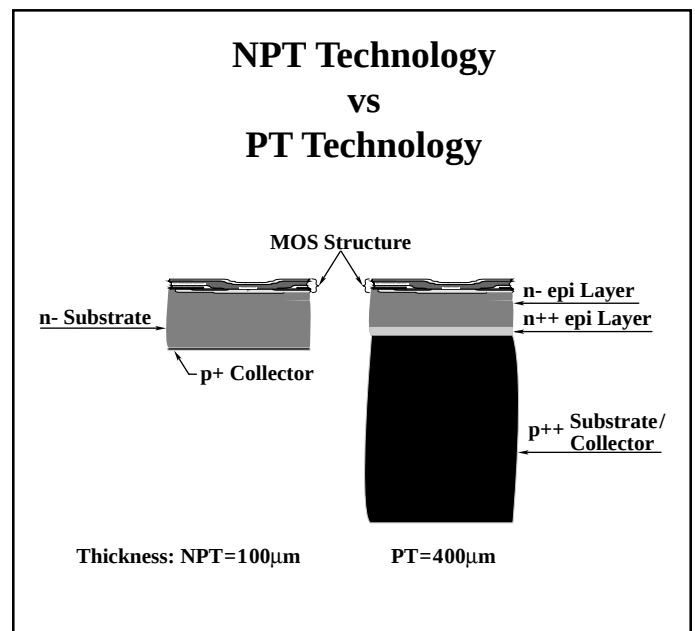
Improved Ruggedness NPT technology IGBTs are avalanche energy, SCSOA and RBSOA rated.

Fast IGBT Family Designated by the “GF” in the part number, these devices are designed for operation up to 40kHz in hard switching applications.

Easy Paralleling A positive temperature coefficient of $V_{CE(SAT)}$ makes paralleling of NPT IGBTs as easy as with MOSFETs.

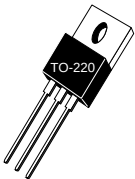
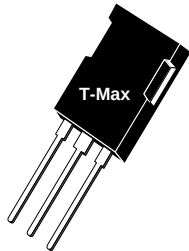
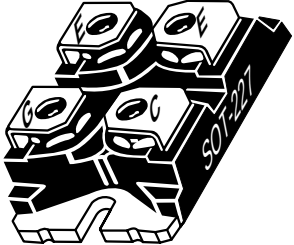
Tighter Electrical Parameters Distribution.... NPT technology has fewer and more easily controlled processing steps than with PT technologies. The end user can expect less lot-to-lot variation of electrical parameters than is possible with PT devices.

Low Leakage Current No lifetime control is used in producing NPT IGBTs, eliminating the major cause of leakage current in alternative technologies.



Thunderbolt IGBT™ Family Designated by the “GT” in the part number, these devices are designed for operation up to 150kHz hard switching and 300kHz in resonant applications.

NPT IGBT

	BV _{CES} Volts	Max V _{CE(ON)} Volts	I _{C1} (25°C) Amps	I _{C2} Amps	P _D Watts	Part Number	Package	
DISCRETE (IGBT ONLY)								
Fast	1200	3.0 3.2	22 32	11 20	125 200	APT11GF120KR APT20GF120KR	TO-220	 *TO-220[K]
Thunderbolt	600	2.5 2.5 2.5 2.5 2.5	17 25 31 40 58	8 12 15 20 30	70 125 135 175 250	APT8GT60KR APT12GT60KR APT15GT60KR APT20GT60KR APT30GT60KR		
	1700	3.5	25	15	310	APT15GF170BR NEW		
	1200	3.2 3.2	32 52	20 33	200 300	APT20GF120BR APT33GF120BR		
	Thunderbolt	600	2.5 2.5 2.5 2.5 2.5 2.5	25 31 40 58 80 116	12 15 20 30 40 60	125 135 175 250 350 500		APT12GT60BR APT15GT60BR APT20GT60BR APT30GT60BR APT40GT60BR APT60GT60BR
		600	2.7	75**	50	300	APT50GF60BR	
600		2.5	90	60	375	APT60GT60JR	ISOTOP®	
Fast		1200 600	3.4 2.7	80 100**	50 100	390 390	APT50GF120B2R APT100GF60B2R	T-MAX™
		1200 600	3.4 2.7	80 100**	50 100	390 390	APT50GF120LR APT100GF60LR	TO-264
	COMBI (IGBT + FRED)							
Fast	1200	3.0 3.2	22 32	11 20	125 200	APT11GF120BRD APT20GF120BRD	TO-247	 *T-MAX™[B2]
Thunderbolt	600	2.5 2.5	30 55	15 30	125 200	APT15GT60BRD APT30GT60BRD		
Fast	1200 600 1200 600	3.2 2.7 3.2 2.7	52 80 52 80	33 50 33 50	300 300 300 300	APT33GF120B2RD APT50GF60B2RD APT33GF120LRD APT50GF60LRD	T-MAX™ TO-264	
	1200 600	3.4 2.7	60 140	40 100	390 390	APT40GF120JRD APT50GF120JRD APT60GF120JRD APT100GF60JRD	ISOTOP®	
	600	2.5	90	60	375	APT60GT60JRD		
								 *ISOTOP®[J]

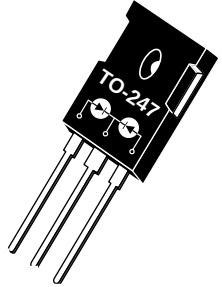
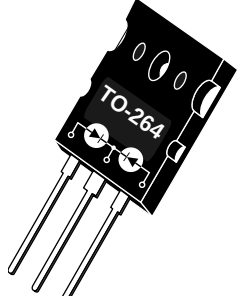
** I_{C1} limited by package

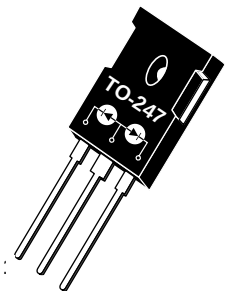
FRED Technology

FRED Technology Our proprietary platinum lifetime control process results in performance advantages vs FREDs built with alternative processes for lifetime control. Use of platinum produces a “softer” and faster recovery with an optimal trade-off between V_F and t_{rr} .

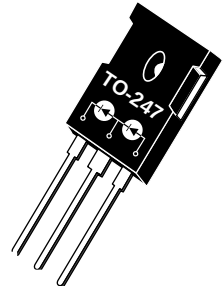
Improved High Temperature Operation The reverse recovery of silicon diodes degrades as operating temperatures increase. The advantage of using platinum for lifetime control is less degradation of performance at high temperatures. To assist the designer, t_{rr} is specified on all datasheets under operating conditions; i.e., at $T_j = 125^\circ\text{C}$, maximum rated current and dI/dt and 80% rated voltage.

CENTER-TAP DUAL FREDS

V_{RMM} Volts	$I_F(AV)$ Amps**	$t_{rr2}(25^\circ\text{C})$ nsec Typ	$t_{rr3}(100^\circ\text{C})$ nsec Typ	$V_F(25^\circ\text{C})$ Volts	$I_{RM}(25^\circ\text{C})$ μA	APT Part No.	Package Style
1000	15 30	60 60	120 120	2.3 2.3	250 250	APT15D100BCT APT30D100BCT	 *TO-247[BCT] Common Cathode
600	15 30	40 50	80 80	1.8 1.8	150 250	APT15D60BCT APT30D60BCT	
400	15 30	40 45	70 70	1.5 1.5	150 250	APT15D40BCT APT30D40BCT	
200	30	40	60	1.15	250	APT30D20BCT	
1000	60	70	130	2.5	250	APT60D100LCT	 *TO-264[LCT] Common Cathode
600	60	70	90	1.8	250	APT60D60LCT	
400	60	70	90	1.5	250	APT60D40LCT	
200	60	36	71	1.15	250	APT60D20LCT	

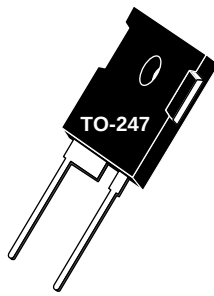
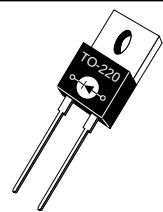


CONSULT FACTORY FOR THESE OR OTHER
PACKAGE CONFIGURATIONS



Half Bridge or Phase Leg

DISCRETE FREDs

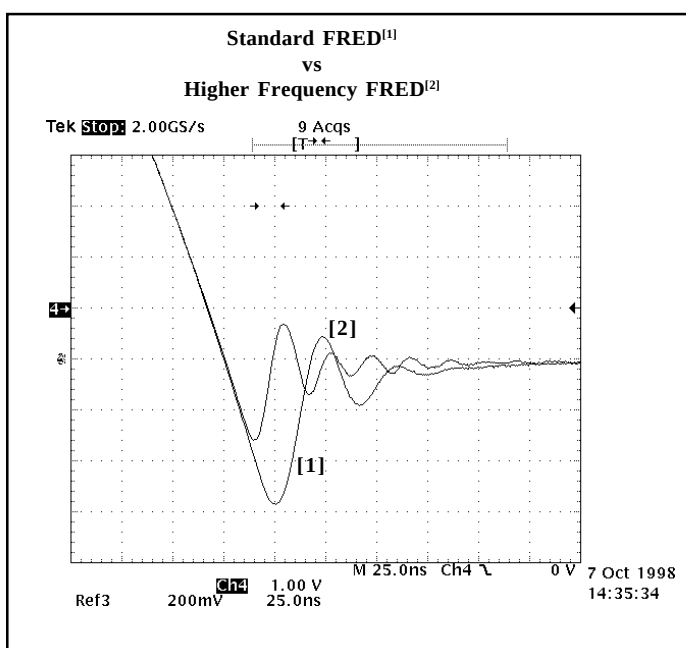
V_{RMM} Volts	$I_F(AV)$ Amps	$t_{rr2}(25^{\circ}C)$ nsec Typ	$t_{rr3}(100^{\circ}C)$ nsec Typ	$V_F(25^{\circ}C)$ Volts	$I_{RM}(25^{\circ}C)$ μA	APT Part No.	Package Style
1200	30 60	70 70	160 130	2.5 2.5	250 250	APT30D120B APT60D120B	 *TO-247[B]
1000	30 60	60 70	120 130	2.3 2.5	250 250	APT30D100B APT60D100B	
600	15 30 60	40 50 70	80 80 90	1.8 1.8 1.8	150 250 250	APT15D60B APT30D60B APT60D60B	
400	30 60	45 40	70 65	1.5 1.5	250 250	APT30D40B APT60D40B	
200	30 60	40 36	60 71	1.15 1.15	250 250	APT30D20B APT60D20B	
1000	15	60	120	2.3	250	APT15D100K	 *TO-220[K]
600	15	40	80	1.8	150	APT15D60K	
400	15	40	70	1.5	150	APT15D40K	
300	15	35	60	1.4	150	APT15D30K	
1200	30 60 100	70 70 130	160 130 215	2.5 2.5 2.5	250 250 250	APT2X30D120J APT2X60D120J APT2X100D120J	 *ISOTOP®[J] Antiparallel Configuration (ISOLATED BASE)
1000	30 60 100	60 70 80	120 130 160	2.3 2.5 2.5	250 250 250	APT2X30D100J APT2X60D100J APT2X100D100J	
600	30 60 100	50 70 60	80 90 92	1.8 1.8 2.0	250 250 250	APT2X30D60J APT2X60D60J APT2X100D60J	
400	30 60 100	45 70 60	70 90 140	1.5 1.5 1.5	250 250 500	APT2X30D40J APT2X60D40J APT2X100D40J	
200	60 100	36 70	71 150	1.15 1.1	250 500	APT2X60D20J APT2X100D20J	
1200	30 60 100	70 70 130	160 130 215	2.5 2.5 2.5	250 250 250	APT2X31D120J APT2X61D120J APT2X101D120J	 *ISOTOP®[J] Parallel Configuration (ISOLATED BASE)
1000	30 60 100	60 70 80	120 130 160	2.3 2.5 2.5	250 250 250	APT2X31D100J APT2X61D100J APT2X101D100J	
600	30 60 100	50 70 60	80 90 92	1.8 1.8 2.0	250 250 250	APT2X31D60J APT2X61D60J APT2X101D60J	
400	30 60 100	45 70 60	70 90 140	1.5 1.5 1.5	250 250 500	APT2X31D40J APT2X61D40J APT2X101D40J	
200	60 100	36 70	71 150	1.15 1.1	250 500	APT2X61D20J APT2X101D20J	

DISCRETE SURFACE MOUNT FREDs

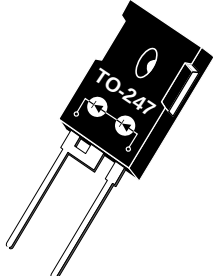
V_{RMM} Volts	$I_F(AV)$ Amps	$t_{rr2}(25^{\circ}C)$ nsec Typ	$t_{rr3}(100^{\circ}C)$ nsec Typ	$V_F(25^{\circ}C)$ Volts	$I_{RM}(25^{\circ}C)$ μA	APT Part No.	Package Style
600	30	50	80	1.8	250	APT30D60S	 *D ³ PAK[S]
400	30	45	70	1.5	250	APT30D40S	
200	30	40	60	1.15	250	APT30D20S	

Higher Frequency FREDs

Extremely Fast Recovery These FREDs are capable of replacing GaAs rectifiers in high frequency applications up to 2 MHz, at a fraction of the cost. By using two (2), much heavier platinum doped 300V FREDs in series, a considerable decrease in the reverse recovery time is achieved vs standard 600V FREDs. This heavier concentration of platinum produces a FRED that is specifically designed for higher frequency applications where reduction of switching losses is most important and a higher V_F specification can be tolerated.



HIGHER FREQUENCY FREDs

V_{RMM} Volts	$I_F(AV)$ Amps	$t_{rr2}(25^{\circ}C)$ nsec Typ	$t_{rr3}(100^{\circ}C)$ nsec Typ	$V_F(25^{\circ}C)$ Volts	$I_{RM}(25^{\circ}C)$ μA	APT Part No.	Package Style
600	30	20	35	4.0	250	APT30DS60B	 *TO-247[B]
	15	12.5	25	4.0	150	APT15DS60B	
300	30	20	35	2.0	250	APT30DS30B NEW	
	15	12.5	25	2.0	150	APT15DS30B NEW	

RF MOSFETs

RF Technology.... APT RF MOSFETs are optimized for high power Class C, D and E operation from 1-100 MHz. The die geometry has been designed for RF high power efficiency and low gate loss. The RF MOSFETs are mounted on an isolation substrate to create a TO-247 common source configuration. The source is directly connected to the center pin and heatsink tab; no external insulator is necessary. This provides maximum thermal efficiency without the added expense and assembly problems of drain isolation. Internally, symmetric wire bonding schemes insure that both pinout versions of each device are perfect mirror image pairs. This configuration allows for easy layout of push-pull and parallel pairs for circuit board symmetry and separation of input and output sections.

High Voltage Operation Historically, all RF MOSFETs operated at a maximum of 50V. By combining high voltage MOSFET technology with specific RF die geometries, this limitation has been removed. RF operation at up to 300V is now possible.

Why Higher Voltage Higher operating voltage means higher load impedances. For 300W of RF output at 50V, the load is less than 4 ohms. At 125V, the load impedance is 25 ohms. The higher impedance allows for fewer transformers and combiners. Parallel devices can still operate into a reasonable and convenient load impedance. Increasing the operating voltage also lowers the current required for any given power output, reducing the size and weight of other components.

Lower Cost

- No insulators required
- Maximum thermal efficiency. The internal BeO insulator is more efficient than external insulators.
- Simplified board layout due to symmetric pairs configuration

Note: The ARF446 through ARF450 devices are based on the latest MOS V[®] RF technology and are the preferred devices for all new designs. The ARF440 through ARF445 are based on Power MOS IV[®] technology and are not recommended for new designs.

RF MOSFETs

V _{DD} Volts	P _{OUT} Watts	G _{PS} dB(typ)	R _{θJC} °C/W	Pin Out	APT Part No.
50	125	21 @ 13.56 MHz	0.75	Figure 1	ARF440
	125	21 @ 13.56 MHz	0.75	Figure 2	ARF441
100	200	22 @ 13.56 MHz	0.75	Figure 1	ARF442
	200	22 @ 13.56 MHz	0.75	Figure 2	ARF443
300	300	18.7 @ 13.56 MHz	0.60	Figure 1	ARF444
	300	18.7 @ 13.56 MHz	0.60	Figure 2	ARF445
250	250	15 @ 40.68 MHz	0.55	Figure 1	ARF446
	250	15 @ 40.68 MHz	0.55	Figure 2	ARF447
150	250	15 @ 40.68 MHz	0.55	Figure 1	ARF448A
	250	15 @ 40.68 MHz	0.55	Figure 2	ARF448B
150	150	13 @ 81.36 MHz	0.76	Figure 1	ARF449A
	150	13 @ 81.36 MHz	0.76	Figure 2	ARF449B
150	500	13 @ 81.36 MHz	0.26	Figure 3	ARF450 NEW

Figure 1

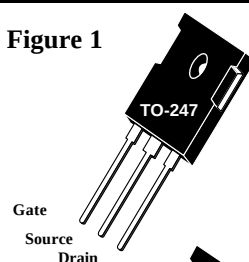


Figure 2

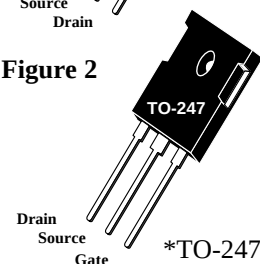
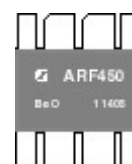
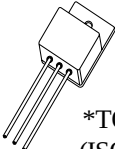
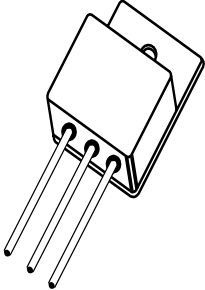
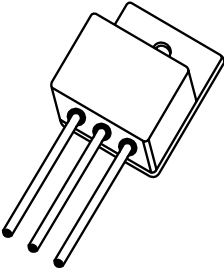


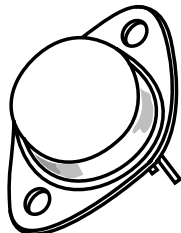
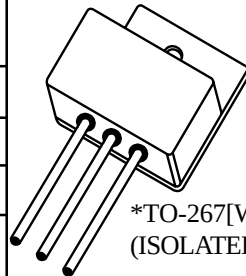
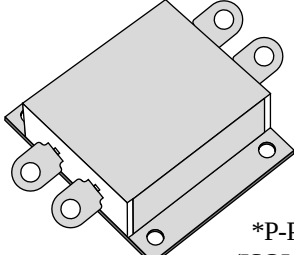
Figure 3



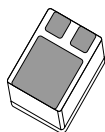
HERMETIC MOSFET PRODUCTS

BV_{DS} Volts	$R_{DS(ON)}$ Ohms	$I_D(Cont.)$ Amps	P_D Watts	$C_{iss}(pF)$ Typ	$Q_g(nC)$ Typ	APT Part No.	Optional Surface Mount Pkg.	Package Style
1000	4.000	3.3	100	805	35	APT1004RGN	CoolPack1	 *TO-257[G] (ISOLATED)
1000	2.000	5.5	150	1530	66	APT1002RCN	CoolPack1	 *TO-254[C] (ISOLATED)
	4.000	3.6	125	805	35	APT1004RCN	CoolPack1	
600	0.450	11.8	150	2600	115	APT6045CVR	CoolPack1	
500	0.320	14.0	150	2650	110	APT5032CVR	CoolPack1	
	0.400	13.0	150	1430	71	APT5040CNR	CoolPack1	
	0.415	12.0	150	2410	103	2N7228/JX/JV	CoolPack1	
400	0.300	15.0	150	1500	71	APT4030CNR	CoolPack1	CoolPack1
	0.315	14.0	150	2400	100	2N7227/JX/JV	CoolPack1	
1000	0.88	11.0	250	3700	185	APT10088HVR	CoolPack2	 *TO-258[H] (ISOLATED)
	1.10	9.0	200	3050	150	APT1001R1HVR	CoolPack1	
800	0.58	13.5	250	3700	185	APT8058HVR	CoolPack2	
	0.67	11.5	200	3050	150	APT8067HVR	CoolPack1	
600	0.27	20.0	250	4300	185	APT6027HVR	CoolPack2	
	0.37	15.5	200	3450	140	APT6037HVR	CoolPack2	
500	0.19	24.0	250	4400	200	APT5019HVR	CoolPack2	
	0.26	18.5	200	3600	140	APT5026HVR	CoolPack2	
400	0.14	28.0	250	4500	195	APT4014HVR	CoolPack2	
	0.18	22.0	200	3350	135	APT4018HVR	CoolPack2	
200	0.040	45.0	250	5100	148	APT20M40HVR	CoolPack2	

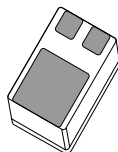
HERMETIC MOSFET PRODUCTS

BV_{DSS} Volts	$R_{DS(ON)}$ Ohms	$I_D(Cont.)$ Amps	P_D Watts	$C_{iss}(pF)$ Typ	$Q_g(mC)$ Typ	APT Part No.	Surface Mount Pkg.	Package Style
1000	1.10	9.0	200	3050	150	APT1001R1AVR	CoolPack1	 *TO-3[A] (NON-ISOLATED)
800	0.65	11.5	200	3050	150	APT8065AVR	CoolPack1	
600	0.32	17.5	235	3750	160	APT6032AVR	CoolPack2	
	0.35	16.0	200	3450	140	APT6035AVR	CoolPack2	
500	0.22	21.0	235	3700	150	APT5022AVR	CoolPack2	
	0.24	18.5	200	3600	140	APT5024AVR	CoolPack2	
	0.30	14.7	155	2650	110	APT5030AVR	CoolPack1	
400	0.15	25.5	235	3600	160	APT4015AVR	CoolPack2	
300	0.090	33.0	235	4100	130	APT30M90AVR	CoolPack2	
100	0.030	65.0**	235	4300	150	APT10M30AVR	CoolPack2	
1000	0.57	17.3	450	6600	335	APT10057WVR	CoolPack3	 *TO-267[W] (ISOLATED)
600	0.17	31.5	450	7500	315	APT6017WVR	CoolPack3	
500	0.12	40.0	450	7400	312	APT5012WVR	CoolPack3	
400	0.082	44.0	450	7410	330	APT40M82WVR	CoolPack3	
200	0.026	65.0	450	8500	290	APT20M26WVR	CoolPack3	
1000	0.250	33.0	625	15000	660	APT10025PVR	 *P-PACK (ISOLATED)	
600	0.075	60.5	625	16500	700	APT60M75PVR		
500	0.05	74.5	625	16300	690	APT50M50PVR		
400	0.035	89.0	625	16000	700	APT40M35PVR		
200	0.013	146.0	625	18000	630	APT20M13PVR		

CONSULT FACTORY FOR INFORMATION ON FRED, FREDFET AND IGBTs IN ANY HERMETIC PACKAGE.



*CoolPack™ 1
.450X.625X.130 inches



*CoolPack™ 2
.550X.800X.145 inches



*CoolPack™ 3
.980X1.23X.145 inches

CONSULT FACTORY FOR INFORMATION ON SURFACE MOUNT PRODUCTS

CoolPack™ is a trademark of Microsemi Corporation

NEW

HERMETIC NPT IGBT

BV _{CES} Volts	Max V _{ce(on)} Volts	I _{C1} 25C Amps	I _{C2} Amps	P _D Watts	APT Part No.	Package
600	2.5 2.5 2.7	40 58 65**	20 30 50	175 250 300	APT20GT60AR APT30GT60AR APT50GF60AR	TO-3 [A]
600	2.5 2.5	35** 35**	20 30	175 250	APT20GT60CR APT30GT60CR	TO-254 [C]
600	2.7	65**	50	300	APT50GF60HR	TO-258 [H]
1200	3.2 3.4	52 65**	33 50	300 300	APT33GF120HR APT50GF120HR	

SEE PAGE 14 FOR TECHNOLOGY FEATURES AND BENEFITS

NEW

HERMETIC FREDs

V _{RMM} Volts	I _{F(AV)} Amps	t _{rr2} (25C) nsec TYP	t _{rr3} (100C) nsec TYP	V _F (25C) Volts	I _{RM} (25C) mA	APT Part No.	Configuration***	Package
600	15	40	80	2.0	150	APT15D60C	Discrete	TO-254[C]
400	15	40	70	1.7	150	APT15D40C	Discrete	
300	15	35	60	1.6	150	APT15D30C	Discrete	
600	30 60	50 70	80 90	2.0 2.0	250 250	APT30D60H APT60D60H	Discrete Discrete	TO-258[H]
400	30 60	45 40	70 65	1.7 1.7	250 250	APT30D40H APT60D40H	Discrete Discrete	
200	30 60	40 36	60 71	1.4 1.5	250 250	APT30D20H APT60D20H	Discrete Discrete	
600	30	50	80	2.0	250	APT30D60HCT	Center Tap	
400	30	45	70	1.7	250	APT30D40HCT	Center Tap	
200	30	40	60	1.4	250	APT30D20HCT	Center Tap	

SEE PAGE 16 FOR TECHNOLOGY FEATURES AND BENEFITS

***Contact factory for other current, voltages, package availability and Half Bridge or Common Anode Configuration

NEW

HERMETIC HIGHER FREQUENCY FREDs

V _{RMM} Volts	I _{F(AV)} Amps	t _{rr2} (25C) nsec TYP	t _{rr3} (100C) nsec TYP	V _F (25C) Volts	I _{RM} (25C) mA	Part Number	Package
600	30 15	20 12.5	35 25	4.0 4.0	250 150	APT30DS60H APT15DS60H	TO-258 [H]
300	30 15	20 12.5	35 25	2.0 2.0	250 150	APT30DS30C APT15DS30C	TO-254 [C]

SEE PAGE 18 FOR TECHNOLOGY FEATURES AND BENEFITS

**NEW Hermetic
Products Brochure
Available**

Hermetic Products

APT is a MIL-PRF-19500 certified supplier and can provide TX, TXV and space level processing. In addition to the MOSFETs shown in this catalog, other MOSFETs, FREDFETs, IGBTs, FREDs, or combinations of these products can be provided in hermetic packages. If you do not see the product you need, or if you have questions concerning processing capabilities or certification levels, please contact your local representative or APT directly.

Custom, Value-Added Solutions To Meet Your Specific Power Application Requirements

In addition to the broad line of leading edge products in this catalog, APT is dedicated to providing innovative solutions for our customers. This means working with our customers to solve their procurement, manufacturing or application problems. We are known as the supplier that provides solutions that others cannot, or will not, provide. These include, but are not limited to:

- Custom products including special designs, processes, and packaging.
- Supply chain management requirements.
- Strategic inventories to allow for unexpected changes in demand.
- Special testing.
- Thermal and power management.
- Hi-Rel Testing/Screening
- Application Specific Power Modules (ASPM) where power semiconductors are combined with driver and protection circuits to meet your specific application requirements.

***For additional information contact your local APT Representative
or APT directly.***

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