2000 SHORT FORM CATALOG

ADVANCED POWER TECHNOLOGY

ISO9001 Certified

MIL-PRF-19500

POWER DISCRETE SEMICONDUCTORS

APT®

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 D^3 PAK, T-MAX™ and TO-267
- RF MOSFETs .... Operation up to 100MHz

Table of Contents

Packaging Information

Package	Quantity Per Tube
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 .....

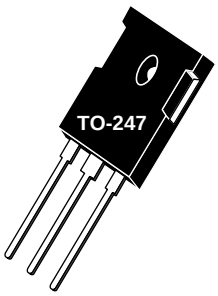
The lower capacitances combined with the low internal gate resistance resulting from new advanced designs and the unique metal gate structure provide for a 50% reduction in total switching time compared to POWER MOS V®. This dramatically improved switching efficiency enables higher frequency operation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

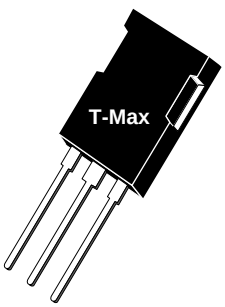
NEW LC Series - POWER MOS VI™ MOSFETs

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	11	280	2330	90	80	1210	APT1001RBLC	*NOW*	TO-247
	0.860	13	370	2835	110	100	1300	APT10086BLC	*NOW*	
500	0.200	26	300	2500	100	70	1300	APT5020BLC	*NOW*	
	0.170	30	370	3025	120	85	1300	APT5017BLC	*NOW*	
	0.150	32	370	3025	120	85	1300	APT5015BLC	*NOW*	
1000	1.000	11	280	2330	90	80	1210	APT1001RSLC	*NOW*	D^3 PAK
	0.860	13	370	2835	110	100	1300	APT10086SLC	*NOW*	
500	0.200	26	300	2500	100	70	1300	APT5020SLC	*NOW*	
	0.170	30	370	3025	120	85	1300	APT5017SLC	*NOW*	
1000	0.500	21	520	5000	190	170	2500	APT10050B2LC	*NOW*	T-MAX™
	0.400	25	625	5830	220	190	3000	APT10040B2LC	*NOW*	
500	0.140	37	450	3650	145	105	1600	APT5014B2LC	*NOW*	
	0.100	47	520	5200	200	150	2500	APT5010B2LC	*NOW*	
	0.080	58	625	6200	240	180	3000	APT50M80B2LC	*NOW*	
200	0.022	100	520	6400	170	115	2500	APT20M22B2LC	*NOW*	
1000	0.500	21	520	5000	190	170	2500	APT10050LLC	*NOW*	TO-264
	0.400	25	625	5830	220	190	3000	APT10040LLC	*NOW*	
500	0.140	37	450	3650	145	105	1600	APT5014LLC	*NOW*	
	0.100	47	520	5200	200	150	2500	APT5010LLC	*NOW*	
	0.080	58	625	6200	240	180	3000	APT50M80LLC	*NOW*	
200	0.022	100	520	6400	170	115	2500	APT20M22LLC	*NOW*	
1000	0.500	25	450	5000	190	170	2500	APT10050JLC	*NOW*	ISOTOP®
	0.250	34	700	11250	430	380	3600	APT10025JLC	*NOW*	
500	0.100	44	450	5200	200	150	2500	APT5010JLC	*NOW*	
	0.080	53	520	6200	240	180	3000	APT50M80JLC	*NOW*	
	0.050	77	700	11350	440	330	3600	APT50M50JLC	*NOW*	

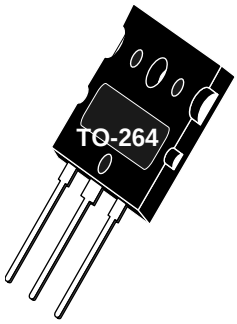


TO-247 [B]

D^3 PAK[S]



T-MAX™ [B2]



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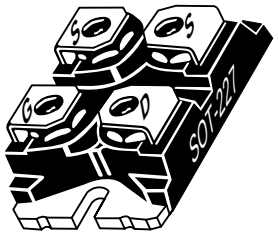


ISOTOP®[J]
(ISOLATED BASE)

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

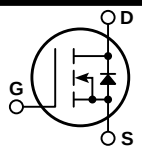
A low gain (low packing density) device provides the best SOA performance at high voltage. APT has modified its proprietary interdigitated MOSFET technology to develop a lower gain device with enhanced performance in high voltage, linear applications. This new Linear MOSFET provides 1.5-2.0 times the DC SOA capability at high voltage compared to previous APT technologies.

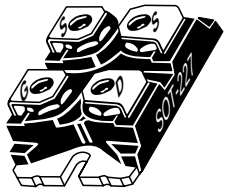
Typical Applications:

-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	300	APL1001J	ISOTOP®
500	0.12	43.0	520	300	APL501J	





*ISOTOP®[J]

*Not to Scale

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.

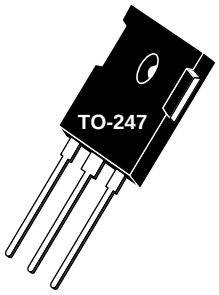
Lower Cost .... A less complex fabrication process, improved manufacturing yields and reduced cycle times have all contributed to a more cost-effective device.

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® $R_{DS(ON)}$ (mΩ)	Previous Generation Power MOS IV® $R_{DS(ON)}$ (mΩ)	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

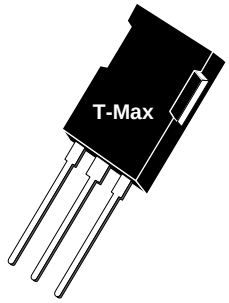
BV_{DSS} Volts	$R_{DS(ON)}$ Ohms	I_D(Cont.) Amps	P_D Watts	C_{iss}(pF) Typ	E_{AS} mJ	APT Part No.	Package Style
1200	1.600	8	280	3050	1210	APT1201R6BVR	
	1.500	10	370	3700	1300	APT1201R5BVR	
1000	1.000	11	280	3050	1210	APT1001RBVR	
	0.860	13	370	3700	1300	APT10086BVR	
800	0.750	12	260	2700	960	APT8075BVR	
	0.650	13	280	3050	1210	APT8065BVR	
	0.560	16	370	3700	1300	APT8056BVR	
600	0.450	15	250	2600	960	APT6045BVR	
	0.350	18	280	3450	1210	APT6035BVR	
	0.300	21	300	3750	1300	APT6030BVR	
	0.250	25	370	4300	1300	APT6025BVR	
500	0.280	20	250	2650	960	APT5028BVR	
	0.240	22	280	3600	1210	APT5024BVR	
	0.200	26	300	3700	1300	APT5020BVR	
	0.170	30	370	4400	1300	APT5017BVR	
	0.150	32	370	4400	1300	APT5015BVR	
400	0.200	23	250	2650	960	APT4020BVR	
	0.160	27	280	3350	1210	APT4016BVR	
	0.140	28	300	3600	1300	APT4014BVR	
	0.120	37	370	4500	1300	APT4012BVR	
300	0.085	40	300	4100	1300	APT30M85BVR	
	0.070	48	370	4890	1300	APT30M70BVR	
200	0.045	56	300	4050	1300	APT20M45BVR	
	0.040	59	300	4050	1300	APT20M40BVR	
	0.038	67	370	5100	1300	APT20M38BVR	
100	0.025	75**	300	4300	1500	APT10M25BVR	
	0.019	75	370	5100	1500	APT10M19BVR	



*TO-247[B]

Any devices offered in the TO-264 package can be made available in the T-MAX™.
See page 23 for details.

1200	0.600	20	625	7700	3000	APT12060B2VR	
1000	0.500	21	520	6600	2500	APT10050B2VR	
	0.400	25	625	7800	3000	APT10040B2VR	
800	0.300	27	520	6600	2500	APT8030B2VR	
	0.240	33	625	7800	3000	APT8024B2VR	
600	0.150	38	520	7500	2500	APT6015B2VR	
	0.110	49	625	8800	3000	APT6011B2VR	
500	0.140	37	450	5600	1600	APT5014B2VR	
	0.100	47	520	7400	2500	APT5010B2VR	
	0.085	56	625	8700	3000	APT50M85B2VR	
	0.080	58	625	8700	3000	APT50M80B2VR	
200	0.022	100**	520	8500	2500	APT20M22B2VR	
	0.018	100**	625	10,000	3000	APT20M18B2VR	
100	0.011	100**	520	8600	2500	APT10M11B2VR	
	0.009	100**	625	10,000	3000	APT10M09B2VR	



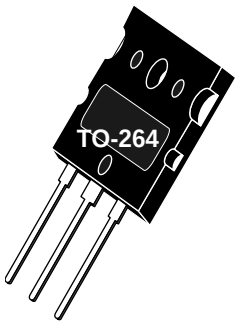
*T-MAX™ [B2]

** I_{Dmax} limited by package

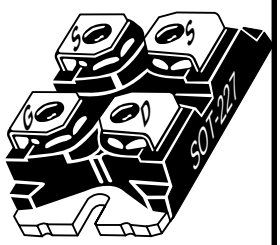
*Not to Scale

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	16	520	6500	2500	APT12080LVR	
	0.600	20	625	7700	3000	APT12060LVR	
1000	0.500	21	520	6600	2500	APT10050LVR	
	0.400	26	625	7800	3000	APT10040LVR	
800	0.300	27	520	6600	2500	APT8030LVR	
	0.240	33	625	8800	3000	APT8024LVR	
600	0.200	30	450	5600	1600	APT6020LVR	
	0.150	38	520	7500	2500	APT6015LVR	
	0.110	49	625	8800	3000	APT6011LVR	
500	0.140	37	450	5600	1600	APT5014LVR	
	0.100	47	520	7400	2500	APT5010LVR	
	0.085	56	625	8700	3000	APT50M85LVR	
	0.080	58	625	8700	3000	APT50M80LVR	
400	0.070	57	520	7410	2500	APT40M70LVR	
300	0.040	76	520	8500	2500	APT30M40LVR	
200	0.022	100	520	8500	2500	APT20M22LVR	
	0.018	100**	625	10,000	3000	APT20M18LVR	
100	0.011	100	520	8600	2500	APT10M11LVR	
	0.009	100**	625	10,000	3000	APT10M09LVR	
1200	0.800	15	450	6500	2500	APT12080JVR	
	0.400	26	700	15000	3600	APT12040JVR	
1000	0.500	19	450	6600	2500	APT10050JVR	
	0.430	22	500	7500	1300	APT10043JVR	
	0.250	34	700	15000	3600	APT10025JVR	
800	0.300	25	450	6600	2500	APT8030JVR	
	0.280	28	500	7700	1300	APT8028JVR	
	0.150	44	700	14715	3600	APT8015JVR	
600	0.150	35	450	7500	2500	APT6015JVR	
	0.130	40	500	8800	1300	APT6013JVR	
	0.075	62	700	16500	3600	APT60M75JVR	
500	0.100	44	450	7400	2500	APT5010JVR	
	0.085	50	500	9000	1300	APT50M85JVR	
	0.050	77	700	16800	3600	APT50M50JVR	
400	0.070	53	450	7410	2500	APT40M70JVR	
	0.035	93	700	16000	3600	APT40M35JVR	
300	0.040	70	450	8500	2500	APT30M40JVR	
	0.019	130	700	18000	3600	APT30M19JVR	
200	0.022	97	450	8500	2500	APT20M22JVR	
	0.019	112	500	9700	1300	APT20M19JVR	
	0.011	175	700	18000	3600	APT20M11JVR	
100	0.011	144	450	8600	2500	APT10M11JVR	
	0.007	225	700	18000	3600	APT10M07JVR	



*TO-264[L]



*ISOTOP®[J]
(ISOLATED BASE)

*Not to Scale

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. ***See page 23 for details.***							
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	

*D^3 PAK[S]

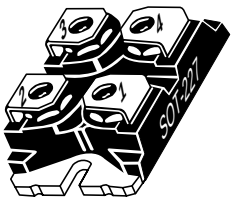
POWER MOS V® MOSFET/FRED "COMBI" PRODUCTS

POWER FACTOR CORRECTION "BOOST" CONFIGURATION

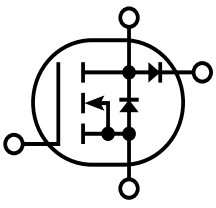
500	0.100	44	450	7410	2500	APT5010JVRU2

MOTOR DRIVE "BUCK" CONFIGURATION

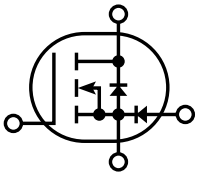
500	0.100	44	450	7410	2500	APT5010JVRU3



*ISOTOP®[J]
(ISOLATED BASE)



"BOOST" CONFIGURATION



"BUCK" CONFIGURATION

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

Consult Factory for other voltages.

** I_{Dmax} limited by package

*Not to Scale

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.

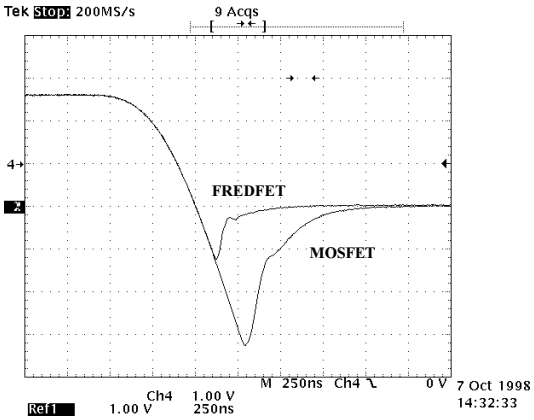
Other Benefits .... The platinum process provides the added advantages of soft recovery, lower leakage current, lower recovery charge and more temperature independent performance than alternative processes used to improve intrinsic diode performance.

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

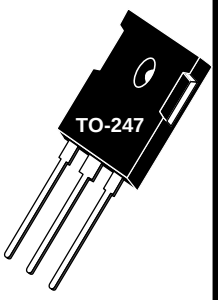
Applications for FREDFETs .... Power MOS V® FREDFETs should be specified under the following conditions:

- 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	11	280	3050	1210	200	APT1001R1BVFR	
	0.860	13	370	3700	1300	200	APT10086BVFR	
800	0.750	12	260	2700	960	250	APT8075BVFR	
	0.650	13	280	3050	1210	200	APT8065BVFR	
	0.560	16	370	3700	1300	200	APT8056BVFR	
600	***0.300***	***21***	***300***	***3750***	***1300***	***250***	***APT6030BVFR NEW***	
	0.250	25	370	4300	1300	250	APT6025BVFR	
500	0.240	22	280	3600	1210	250	APT5024BVFR	
	0.200	26	300	3700	1300	250	APT5020BVFR	
	0.170	30	370	4400	1300	250	APT5017BVFR	
300	0.085	40	300	4100	1300	200	APT30M85BVFR	
	0.070	48	370	4890	1300	225	APT30M70BVFR	
200	0.045	56	300	4050	1300	200	APT20M45BVFR	
	0.038	67	370	5100	1300	240	APT20M38BVFR	
100	0.025	75	300	4300	1500	200	APT10M25BVFR	
	0.019	75	370	5100	1500	200	APT10M19BVFR	



*TO-247[B]

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	

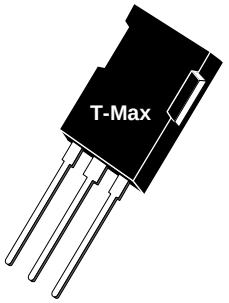
*D^3 PAK[S]

** I_{Dmax} limited by package

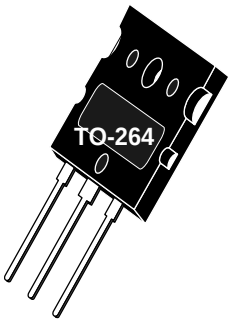
*Not to Scale

POWER MOS V® FREDFETs

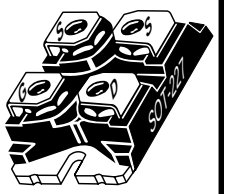
BV_{DSS} Volts	$R_{DS(ON)}$ Ohms	I_D(Cont.) Amps	P_D Watts	C_{iss}(pF) Typ	E_{AS} mJ	t_{rr}(nsecs) Max	APT Part No.	Package Style
Any devices offered in the TO-264 package can also be made available in T-Max™. ***See page 23 for details.***								
1000	0.400	25	625	7800	3000	250	APT10040B2VFR	
800	0.300 0.240	27 33	520 625	6600 7800	2500 3000	300 250	APT8030B2VFR APT8024B2VFR	
600	0.110	49	625	8800	3000	250	APT6011B2VFR	
500	0.100 0.085 0.080	47 56 58	520 625 625	7400 8700 8700	2500 3000 3000	250 250 250	APT5010B2VFR APT50M85B2VFR APT50M80B2VFR	
200	0.022 0.018	100** 100**	520 625	8500 10,000	2500 3000	220 220	APT20M22B2VFR APT20M18B2VFR	
100	0.009	100**	625	10,000	3000	220	APT10M09B2VFR	
1000	0.500 0.400	21 25	520 625	6600 7800	2500 3000	300 250	APT10050LVFR APT10040LVFR	
800	0.300 0.240	27 33	520 625	6600 7800	2500 3000	300 250	APT8030LVFR APT8024LVFR	
600	***0.150***	***38***	***520***	***7500***	***2500***	***250***	***APT6015LVFR NEW***	
0.110		49	625	8800	3000	250	APT6011LVFR	
500	0.100 0.085	47 56	520 625	7400 8700	2500 3000	250 250	APT5010LVFR APT50M85LVFR	
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	
100	0.009	100**	625	10,000	3000	220	APT10M09LVFR	
1000	0.500 0.250	19 34	450 700	6600 15000	2500 3600	300 300	APT10050JVFR APT10025JVFR	
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	



*T-MAX™[B2]



*TO-264[L]



*ISOTOP®[J]
(ISOLATED BASE)

** I_{Dmax} limited by package

*Not to Scale

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 100µm 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 µm 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.

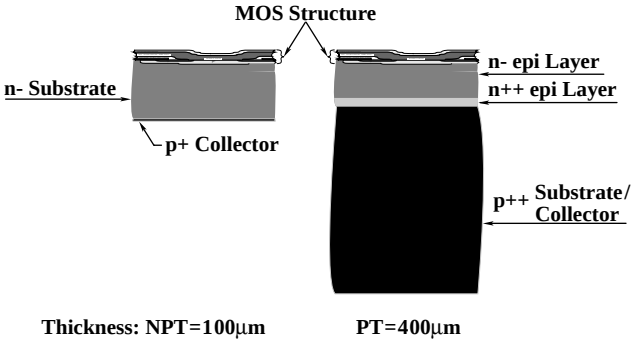
Improved Ruggedness .... NPT technology IGBTs are avalanche energy, SCSOA and RBSOA rated.

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.

NPT Technology
vs
PT Technology

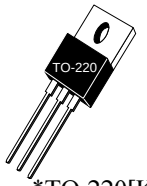


Fast IGBT Family .... Designated by the "GF" in the part number, these devices are designed for operation up to 40kHz in hard switching applications.

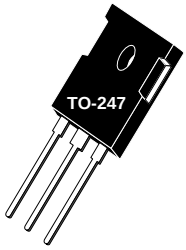
Thunderbolt IGBT® Family .... Designated by the "GT" in the part number, these devices are designed for operation up to 150kHz hard switching and 300kHz in resonant applications.

NPT IGBT

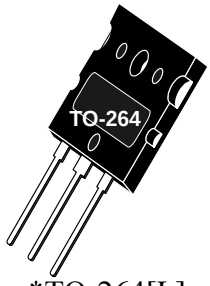
	BV_{CES} Volts	Max $V_{CE(ON)}$ Volts	I_{C1} (25°C) Amps	I_{C2} Amps	P_D Watts	Part Number	Package
	DISCRETE (IGBT ONLY)						
Fast	1200	3.0	22	11	125	APT11GF120KR	
		3.2	32	20	200	APT20GF120KR	
Thunderbolt	600	2.5	17	8	70	APT8GT60KR	
		2.5	25	12	125	APT12GT60KR	TO-220
		2.5	31	15	135	APT15GT60KR	
		2.5	40	20	175	APT20GT60KR	
		2.5	58	30	250	APT30GT60KR	
Fast	1700	3.5	25	15	310	APT15GF170BR	
	1200	3.2	32	20	200	APT20GF120BR	
		3.2	52	33	300	APT33GF120BR	
Thunderbolt	600	2.5	25	12	125	APT12GT60BR	TO-247
		2.5	31	15	135	APT15GT60BR	
		2.5	40	20	175	APT20GT60BR	
		2.5	58	30	250	APT30GT60BR	
		2.5	80	40	350	APT40GT60BR	
		2.5	116	60	500	APT60GT60BR	
	600	2.7	75**	50	300	APT50GF60BR	
	600	2.5	90	60	375	APT60GT60JR	ISOTOP®
Fast	1200	3.4	80	50	390	APT50GF120B2R	T-MAX™
	600	2.7	100**	100	390	APT100GF60B2R	
	1200	3.4	80	50	390	APT50GF120LR	TO-264
	600	2.7	100**	100	390	APT100GF60LR	
	COMBI (IGBT + FRED)						
Fast	1200	3.0	22	11	125	APT11GF120BRD	
		3.2	32	20	200	APT20GF120BRD	
Thunderbolt	600	2.5	30	15	125	APT15GT60BRD	TO-247
		2.5	55	30	200	APT30GT60BRD	
Fast	1200	3.2	52	33	300	APT33GF120B2RD	T-MAX™
	600	2.7	80	50	300	APT50GF60B2RD	
	1200	3.2	52	33	300	APT33GF120LRD	TO-264
	600	2.7	80	50	300	APT50GF60LRD	
	1200	3.4	60	40	390	APT40GF120JRD	
		3.4	75	50	460	APT50GF120JRD	ISOTOP®
		3.4	100	60	520	APT60GF120JRD	
	600	2.7	140	100	390	APT100GF60JRD	
	600	2.5	90	60	375	APT60GT60JRD	



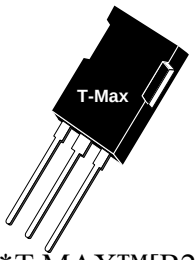
*TO-220[K]



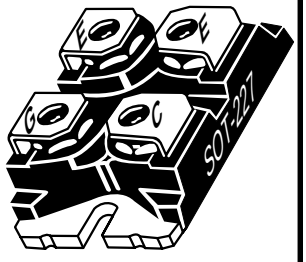
*TO-247[B]



*TO-264[L]



*T-MAX™[B2]



*ISOTOP®[J]

** I_{C1} limited by package

*Not to Scale

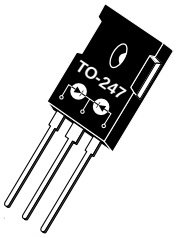
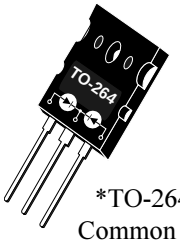
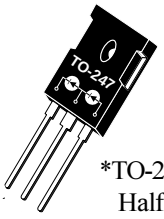
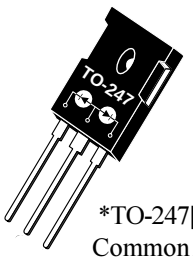
FRED Technology

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}.

CONSULT FACTORY FOR OTHER CONFIGURATIONS

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°C, maximum rated current and dI/dt and 80% rated voltage.

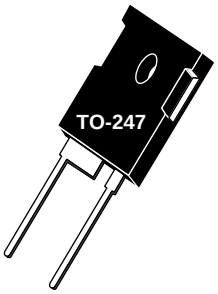
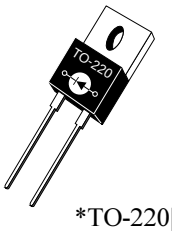
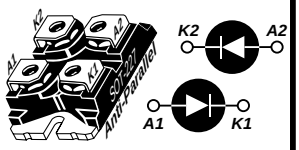
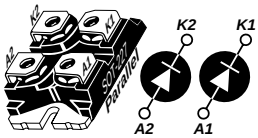
DUAL FREDS

V_{RMM} Volts	$I_F(AV)$ Amps**	t_{rr2}(25°C) nsec Typ	t_{rr3}(100°C) nsec Typ	V_F(25°C) Volts	I_{RM}(25°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	
1000	15 30	60 60	120 120	2.3 2.3	250 250	APT15D100BHB APT30D100BHB	 *TO-247[BHB] Half Bridge
600	30	50	80	1.8	250	APT30D60BHB	
1000	30	60	120	2.3	250	APT30D100BCA	 *TO-247[BCA] Common Anode
600	15 30	40 50	80 80	1.8 1.8	150 250	APT15D60BCA APT30D60BCA	
200	30	40	60	1.15	250	APT30D20BCA	

**All Ratings Are Per Leg

*Not to Scale

DISCRETE FREDS

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

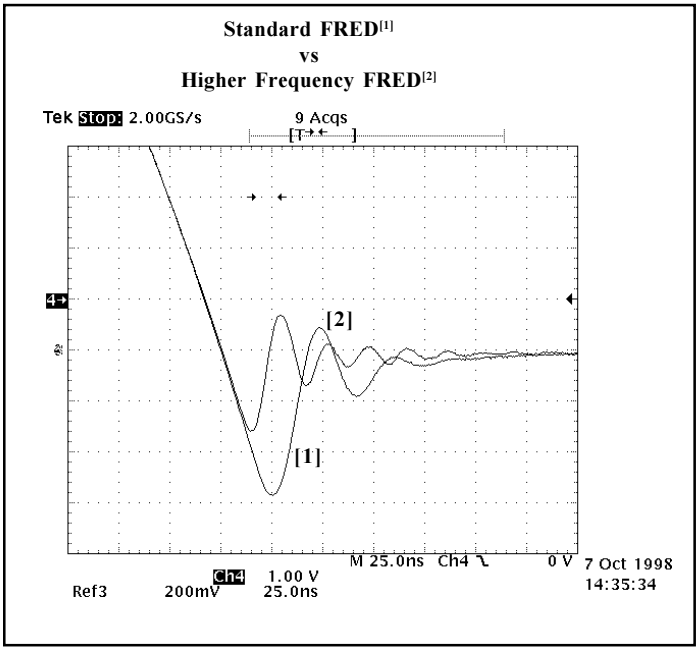
*Not to Scale

DISCRETE SURFACE MOUNT FREDS

V_{RMM} Volts	I_F(AV) Amps	t_{rr2}(25°C) nsec Typ	t_{rr3}(100°C) nsec Typ	V_F(25°C) Volts	I_{RM}(25°C) µA	APT Part No.	Package Style
600	30	50	80	1.8	250	APT30D60S	
400	30	45	70	1.5	250	APT30D40S	
200	30	40	60	1.15	250	APT30D20S	*D³ PAK[S]

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°C) nsec Typ	t_{rr3}(100°C) nsec Typ	V_F(25°C) Volts	I_{RM}(25°C) µA	APT Part No.	Package Style
600	30	20	35	4.0	250	APT30DS60B	Figure 1
	15	12.5	25	4.0	150	APT15DS60B	Figure 1
300	30	20	35	2.0	250	APT30DS30B	Figure 2
	15	12.5	25	2.0	150	APT15DS30B	Figure 2

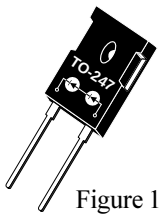


Figure 1

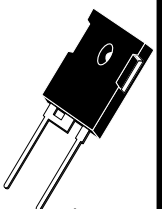


Figure 2

*TO-247[B]

*Not to Scale

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	F_{MAX}* MHZ	P_d W	$R_{\theta JC}$ °C/W	Pin Out	APT Part No.
50V	25	167	0.75	Figure 1	ARF440
	25	167	0.75	Figure 2	ARF441
100V	25	167	0.75	Figure 1	ARF442
	25	167	0.75	Figure 2	ARF443
250V	25	208	0.60	Figure 1	ARF444
	25	208	0.60	Figure 2	ARF445
250V	65	230	0.55	Figure 1	ARF446
	65	230	0.55	Figure 2	ARF447
125V	65	230	0.55	Figure 1	ARF448A
	65	230	0.55	Figure 2	ARF448B
125V	100	165	0.76	Figure 1	ARF449A
	100	165	0.76	Figure 2	ARF449B
125V	120	650	0.26	Figure 3	ARF450

Figure 1

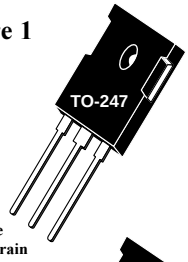
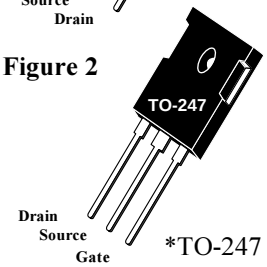
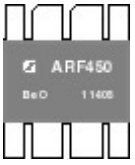


Figure 2



*TO-247

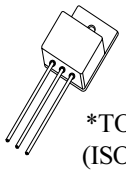
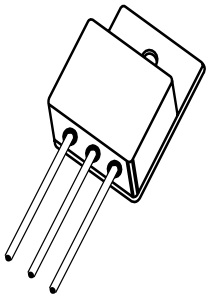
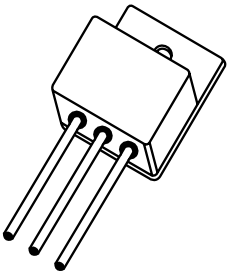
Figure 3



*Not to Scale

*F_{MAX} = f @ Gp > 10dB in Class C.

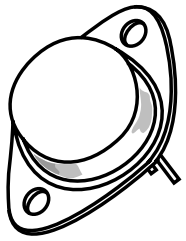
HERMETIC MOSFET PRODUCTS

BV_{DSS} 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	
	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	

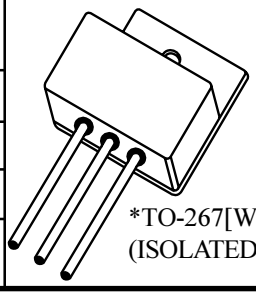
*Not to Scale

HERMETIC MOSFET PRODUCTS

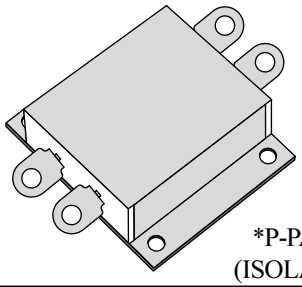
BV_{DSS} Volts	$R_{DS(ON)}$ Ohms	I_D(Cont.) Amps	P_D Watts	C_{iss}(pF) Typ	Q_g(nC) Typ	APT Part No.	Surface Mount Pkg.	Package Style
1000	1.10	9.0	200	3050	150	APT1001R1AVR	CoolPack1	
800	0.65	11.5	200	3050	150	APT8065AVR	CoolPack1	
600	0.32	17.5	235	3750	160	APT6032AVR	CoolPack2	
	0.35	16.0	200	3450	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	
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		
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		



*TO-3[A]
(NON-ISOLATED)

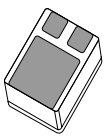


*TO-267[W]
(ISOLATED)

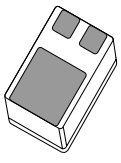


*P-PACK
(ISOLATED)

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

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CoolPack™ is a trademark of Microsemi Corporation

** I_{Dmax} limited by package

*Not to Scale

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	40	20	175	APT20GT60AR	
	2.5	58	30	250	APT30GT60AR	TO-3 [A]
	2.7	65**	50	300	APT50GF60AR	
600	2.5	35**	20	175	APT20GT60CR	TO-254 [C]
	2.5	35**	30	250	APT30GT60CR	
600	2.7	65**	50	300	APT50GF60HR	
1200	3.2	52	33	300	APT33GF120HR	TO-258 [H]
	3.4	65**	50	300	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	
400	15	40	70	1.7	150	APT15D40C	Discrete	TO-254[C]
300	15	35	60	1.6	150	APT15D30C	Discrete	
600	30	50	80	2.0	250	APT30D60H	Discrete	
	60	70	90	2.0	250	APT60D60H	Discrete	
400	30	45	70	1.7	250	APT30D40H	Discrete	
	60	40	65	1.7	250	APT60D40H	Discrete	
200	30	40	60	1.4	250	APT30D20H	Discrete	TO-258[H]
	60	36	71	1.5	250	APT60D20H	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	20	35	4.0	250	APT30DS60H	TO-258 [H]
	15	12.5	25	4.0	150	APT15DS60H	
300	30	20	35	2.0	250	APT30DS30C	TO-254 [C]
	15	12.5	25	2.0	150	APT15DS30C	

SEE PAGE 18 FOR TECHNOLOGY FEATURES AND BENEFITS

** I_{Dmax} limited by package

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.

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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:

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- 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.

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