



POWER MOSFETs

SMM Medical Devices

Medical Approved Process Flow and Devices for Implantable Applications



Vishay offers a growing range of approved MOSFETs that can be used for the implantable medical market.

KEY BENEFITS

- Strict manufacturing process controls result in high quality and reliability
 - Enhanced quality control gates for every lot
 - SBL (Statistical Bin Limit) / SYL (Statistical Yield Limit) and Statistical PAT (Part Average Testing) controls for wafer and component package testing
 - AQL (Average Quality Level) = 0.065 %
 - Homogenous reliability testing for all wafer lots
- Upscreen from a broad power MOSFET portfolio

APPLICATIONS

- Medical implantable applications including:
 - Drug delivery systems
 - Defibrillators
 - Pacemakers
 - Hearing aids

RESOURCES

- Datasheet: Power MOSFETs - <http://www.vishay.com/medical-mosfets/>
- For technical questions contact pmstechsupport@vishay.com

A **WORLD OF**
SOLUTIONS



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THE BROAD PORTFOLIO INCLUDES:

- N-channel and P-channel configurations including:
 - Singles
 - Duals
 - N and P pairs
- Packaging sizes down to 1.6 mm x 1.6 mm: [PowerPAK® SC-75](#), [PowerPAK SC-70](#), [SC-70](#), [SOT-23](#), [TSOP-6](#), [PowerPAK 1212-8](#), [SO-8](#), [PowerPAK SO-8L](#), [DPAK](#), [D2PAK](#), [D2PAK \(7-lead\)](#) and [TO-220](#)
- Ultra-low on-resistance, lowering conduction losses and saving power
- On-resistance ratings down to $V_{GS} = 1.2$ V, allowing use with small input voltages

HOW TO SELECT A DEVICE

A selection guide starts on page 4.

Each product has been given a category letter of A or B.

- “A” devices have been qualified using a special optimized process design for medical excellence. You can view the full medical MOSFET “SMM” product selection at <http://www.vishay.com/mosfets/medical-mosfets/>.
- “B” devices have been qualified to AEC-Q101 standards making those parts the next quickest path to medical (SMM) qualification. You can view the full AEC-Q101 MOSFET “SQ” product selection at <http://www.vishay.com/mosfets/automotive-mosfets/>.



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MEDICAL SMM FLOW

Receiving Inspection (Q.A.), DieSort, Wafer Mount, Sawing, Clean

Visual I Gate 0A/1R

Epoxy Die Attach, Epoxy Cure

Wire Bond

AQL – 0.065 % 0A/1R

Molding, Post Mold Cure, Deflash, Marking

100 % Solder Reflow

100 % Visual

Trim / Form

AQL – 0.15 % 0A/1R

Electrical Test / Tape and Reel

AQL Mech and Elec – 0.065 % 0A/1R

Pack

Post Pack Inspection, LTPD = 5 per Reel, 4 Reel/Lot, A=0, R=1

Ship



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					V _{GS} = 10 V	V _{GS} = 4.5 V	V _{GS} = 2.5 V	V _{GS} = 1.8 V	V _{GS} = 1.5 V	V _{GS} = 10 V	V _{GS} = 4.5 V		
SINGLE N-CHANNEL													
B	20	8		6		0.03	0.034		0.042		4.5	SOT-23	SQ2310ES
B	20	8		7.8		0.028	0.034	0.038		5		PowerPAK SC-70	SQA410EJ
B	20	8		8		0.028	0.032	0.038		9		PowerPAK 1212-8	SQS420EN
B	20	8		8		0.03	0.034	0.038		9.3		TSOP-6	SQ3460EV
B	20	20		120	0.001	0.002				192		D ² PAK (TO-263)	SQM120N02-1m3L
A	30	20			0.002	0.003				77		KGD** - 3.696 mm x 2.936 mm	SMM50N03-4M0LKGD
B	30	20		7.8	0.035	0.052				6		TSOP-6	SQ3456BEV
B	30	20		8	0.018	0.021				14		TSOP-6	SQ3410EV
B	30	20		8	0.024	0.032				7.95		SOT-23	SQ2348ES
A	30	20		8	0.024	0.032				7.95		SOT-23	SMM2348ES
B	30	20		15	0.012	0.02				35		SO-8	SQ4410EY
B	30	20		16	0.009	0.01				26		PowerPAK 1212-8	SQS482EN
B	30	20		30	0.009	0.014				25.3		PowerPAK SO-8L	SQJ840EP
B	30	20		32	0.004	0.004				73.5		PowerPAK SO-8L	SQJ410EP
B	30	20		32	0.004	0.005				72		SO-8	SQ4182EY
B	30	20		100	0.003					82.7		DPAK (TO-252)	SQD100N03-3m4
B	30	20		100	0.003	0.004				77		DPAK (TO-252)	SQD100N03-3m2L
B	30	20		120	0.002	0.002				179		D ² PAK (TO-263)	SQM120N03-1m5L
B	40	20			0.002					219		KGD** - 3.604 mm x 7.144 mm	SQC200N04-1m7KGD
B	40	20			0.002	0.002				220		KGD** - 7.074 mm x 4.794 mm	SQC200N04-1m5LKGD
B	40	20		8	0.031	0.036				8.7		SOT-23	SQ2318AES
B	40	20		12	0.0166	0.0219				15		PowerPAK 1212-8	SQS840EN
B	40	20		16	0.009	0.01				25.5		PowerPAK 1212-8	SQS484EN
B	40	20		20.7	0.009	0.012				41		SO-8	SQ4840EY
B	40	20		29	0.005	0.006				72		SO-8	SQ4184EY
B	40	20		32	0.004	0.0052*				80		PowerPAK SO-8L	SQJ412EP
B	40	20		50	0.004					70		D ² PAK (TO-263)	SQM50N04-4m1
B	40	20		50	0.006					55		DPAK (TO-252)	SQD50N04-5m6
B	40	20		50	0.004					70		Reverse DPAK	SQR50N04-3m8
B	40	20		50	0.004	0.006				85		D ² PAK (TO-263)	SQM50N04-4m0L
B	40	20		58	0.006	0.008				36		PowerPAK SO-8L	SQJ858AEP
B	40	20		60	0.005	0.006				43		PowerPAK SO-8L	SQJ886EP
B	40	20		75	0.003	0.004				67		PowerPAK SO-8L	SQJ422EP

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SINGLE N-CHANNEL (continued)													
B	40	20		100	0.003					95.5		D ² PAK (TO-263)	SQM100N04-2m7
B	40	20		100	0.004					70		DPAK (TO-252)	SQD100N04-3m6
B	40	20		100	0.004	0.004				85		DPAK (TO-252)	SQD100N04-3m6L
B	40	20		120	0.002					206		D ² PAK (TO-263)	SQM120N04-1m7
B	40	20		120	0.002					180		D ² PAK (TO-263)	SQM120N04-1m9
B	40	20		120	0.002	0.002				190		D ² PAK (TO-263)	SQM120N04-1m7L
B	40	20		200	0.002					206		D ² PAK (TO-263-7L)	SQM200N04-1m8
B	40	20		200	0.001	0.001				275		D ² PAK (TO-263-7L)	SQM200N04-1m1L
B	40	20		200	0.002	0.002				194		D ² PAK (TO-263-7L)	SQM200N04-1m7L
B	50	20		50	0.011	0.015				34.6		DPAK (TO-252)	SQD50N05-11L
B	55	20		30	0.02	0.026					12	DPAK (TO-252)	SQD30N05-20L
B	55	20		110	0.006	0.01				73		D ² PAK (TO-263)	SQM110N05-06L
B	60	20			0.071	0.115				8		KGD** - 1.384 mm x 1.394 mm	SQC462BKGD
A	60	20			0.029	0.043				16		KGD** - 2.364 mm x 1.564 mm	SMM23N06-31LKGD
B	60	20		2.3	0.15	0.164				3.5		SOT-23	SQ2308CES
B	60	20		8	0.036	0.048				13		PowerPAK 1212-8	SQS460EN
B	60	20		8	0.063	0.082				8		PowerPAK 1212-8	SQS462EN
B	60	20		12	0.022	0.026				27.4		PowerPAK 1212-8	SQS850EN
B	60	20		12	0.022	0.031				20		SO-8	SQ4850EY
B	60	20		15	0.042	0.06				9.5		DPAK (TO-252)	SQD15N06-42L
B	60	20		16	0.012	0.014				45		SO-8	SQ4470EY
B	60	20		16	0.026	0.036				16		PowerPAK 1212-8	SQ7414AEN
B	60	20		23	0.031	0.045				16		DPAK (TO-252)	SQD23N06-31L
B	60	20		24	0.023	0.032				20		PowerPAK SO-8L	SQJ850EP
B	60	20		25	0.022	0.033				33		DPAK (TO-252)	SQD25N06-22L
B	60	20		40	0.014	0.02				34		DPAK (TO-252)	SQD40N06-14L
B	60	20		50	0.009	0.013				48		TO-220	SQP50N06-09L
B	60	20		50	0.009	0.013				48		DPAK (TO-252)	SQD50N06-09L
B	60	20		56	0.015					33		TO-220	SQP60N06-15
B	60	20		56	0.015					33		D ² PAK (TO-263)	SQM60N06-15
B	60	20		97	0.006	0.007				82		DPAK (TO-252)	SQD97N06-6m3L
B	60	20		120	0.004	0.004				220		D ² PAK (TO-263)	SQM120N06-3m5L
B	75	20		30	0.026	0.032				22		PowerPAK SO-8L	SQJ486EP

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SINGLE N-CHANNEL (continued)													
B	100	20			0.025	0.029				46		KGD** - 3.724 mm x 2.964 mm	SQC40N10-25KGD
B	100	20		2	0.3					3.6		SOT-23	SQ2328ES
B	100	20		32	0.026	0.03*				42		PowerPAK SO-8L	SQJ456EP
B	100	20		32	0.011	0.014				37		PowerPAK SO-8L	SQJ402EP
B	100	20		40	0.03	0.034*				41		D ² PAK (TO-263)	SQM40N10-30
B	100	20		40	0.025	0.029				46		DPAK (TO-252)	SQD40N10-25
B	100	20		40	0.025	0.029				46		Reverse DPAK	SQR40N10-25
B	100	20		42	0.021	0.026				18		PowerPAK SO-8L	SQJ488EP
B	100	20		47	0.024	0.027				48		D ² PAK (TO-263)	SQM47N10-24L
B	100	20		50	0.009	0.011				46		DPAK (TO-252)	SQD50N10-8m9L
B	100	20		100	0.011	0.012				122		D ² PAK (TO-263)	SQM100N10-10
B	100	20		120	0.004					125		TO-220	SQP120N10-3m8
B	100	20		120	0.010					120		TO-220	SQP120N10-09
B	100	20		120	0.004					125		TO-262	SQV120N10-3m8
B	100	20		120	0.004					125		D ² PAK (TO-263)	SQM120N10-3m8
B	100	20		120	0.010					120		D ² PAK (TO-263)	SQM120N10-09
B	150	20		25	0.052					34		D ² PAK (TO-263)	SQM25N15-52
B	150	20		25	0.052					34		DPAK (TO-252)	SQD25N15-52
B	150	20		40	0.038	0.04*				46		D ² PAK (TO-263)	SQM40N15-38
B	150	20		85	0.019					80		D ² PAK (TO-263)	SQM85N15-19
B	200	20		60	0.035					90		D ² PAK (TO-263)	SQM60N20-35
B	250	30		7	0.35					19		DPAK (TO-252)	SQD07N25-350H
B	300	30		10	0.33					31		DPAK (TO-252)	SQD10N30-330H
B	300	20		35	0.097					86		D ² PAK (TO-263)	SQM35N30-97
SINGLE P-CHANNEL													
B	-12	8		5		0.05	0.068	0.092			8.4	SOT-23	SQ2315ES
B	-12	8		17.5		0.02	0.026				49.8	PowerPAK 1212-8	SQS405EN
B	-12	8		32		0.006	0.008				109	PowerPAK SO-8L	SQJ401EP
B	-20	12		3.2		0.115	0.205				3.4	SOT-23	SQ2351ES
B	-20	8		3.9		0.12	0.18				5	SOT-23	SQ2301ES
B	-20	20		8	0.036	0.064				17.7		TSOP-6	SQ3469EV
B	-30	20			0.065					14		KGD** - 1.714 mm x 0.994 mm	SQ3457KGD

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SINGLE P-CHANNEL (continued)													
B	-30	20			0.015	0.028				38.3		KGD** - 1.764 mm x 1.894 mm	SQ4435CKGD
B	-30	20			0.010	0.026				55.3		KGD** - 2.594 mm x 2.504 mm	SQC45P03-12AKGD
B	-30	20		2.5	0.17	0.37				4.5		SOT-23	SQ2303ES
B	-30	20		3	0.175	0.3					4.2	SC-70	SQ1431EH
B	-30	20		6.8	0.065	0.1				14		TSOP-6	SQ3457EV
B	-30	20		7.5	0.043	0.07				15.4		TSOP-6	SQ3481EV
B	-30	20		10.8	0.03	0.052				25		SO-8	SQ4431EY
B	-30	20		15	0.018	0.031				39		SO-8	SQ4435EY
B	-30	20		16	0.021	0.06					17	PowerPAK 1212-8	SQS423EN
B	-30	20		18	0.012	0.019					33.6	SO-8	SQ4425EY
B	-30	20		22	0.009	0.02				75		SO-8	SQ4483BEEY
B	-30	20		30	0.009	0.02				75		PowerPAK SO-8L	SQJ403EEP
B	-30	20		50	0.007	0.011				103.5		TO-220	SQP50P03-07
B	-30	20		50	0.007	0.011				103.5		D ² PAK (TO-263)	SQM50P03-07
B	-30	20		50	0.007	0.011				97		DPAK (TO-252)	SQD50P03-07
B	-30	20		50	0.012	0.029				55.3		DPAK (TO-252)	SQD45P03-12
B	-40	12		7.4	0.05	0.078					10	TSOP-6	SQ3419EEV
B	-40	20		16	0.029	0.047					17.7	PowerPAK 1212-8	SQS401EN
B	-40	20		17.3	0.014	0.023				74		SO-8	SQ4401EY
B	-40	20		30	0.01	0.015				98		PowerPAK SO-8L	SQJ463EP
B	-40	20		40	0.029	0.047				38		PowerPAK SO-8L	SQJ443EP
B	-40	20		50	0.009	0.017				96.5		D ² PAK (TO-263)	SQM50P04-09L
B	-40	20		50	0.013	0.022				60		DPAK (TO-252)	SQD50P04-13L
B	-40	20		90	0.009	0.016				103		DPAK (TO-252)	SQD90P04-9m4L
B	-40	20		120	0.004	0.006				220		D ² PAK (TO-263)	SQM120P04-04L
B	-60	20			0.282	0.378				6		KGD** - 0.964 mm x 0.964 mm	SQ2309BKGD
B	-60	20		1.6	0.29	0.395					3.6	SC70-6	SQ1421EEH
B	-60	20		1.7	0.335	0.5				5.5		SOT-23	SQ2309ES
B	-60	20		2.5	0.15	0.2				11.2		SOT-23	SQ2361EES
B	-60	20		4.6	0.085	0.115				26.5		SO-8	SQ9407EY
B	-60	20		5.5	0.082	0.115				20.8		TSOP-6	SQ3427EEV
B	-60	20		8	0.085	0.115				26.5		PowerPAK SO-8L	SQJ465EP

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SINGLE P-CHANNEL (continued)													
B	-60	20		16	0.065	0.09				25.5		PowerPAK 1212-8	SQJ415AEN
B	-60	20		20	0.055	0.1				27		DPAK (TO-252)	SQD19P06-60L
B	-60	20		30	0.016	0.021				90		PowerPAK SO-8L	SQJ461EP
B	-60	20		50	0.016	0.02				98		DPAK (TO-252)	SQD50P06-15L
B	-60	20		50	0.015	0.022				103		D ² PAK (TO-263)	SQM50P06-15L
B	-60	20		110	0.009	0.013				130		D ² PAK (TO-263)	SQM110P06-8m9L
B	-60	20		120	0.0067	0.0088				180		TO-220	SQP90P06-07L
B	-60	20		120	0.007	0.009				180		D ² PAK (TO-263)	SQM120P06-07L
B	-80	20			0.025	0.031				91		KGD** - 3.724 mm x 2.964 mm	SQC50P08-25LKGD
B	-80	20		2.2	0.29	0.314*				11.5		SOT-23	SQ2337ES
B	-80	20		32	0.025	0.029				101		PowerPAK SO-8L	SQJ469EP
B	-80	20		48	0.028					95		DPAK (TO-252)	SQD50P08-28
B	-80	20		50	0.025	0.031				91		D ² PAK (TO-263)	SQM50P08-25L
B	-80	20		50	0.025	0.031				91		DPAK (TO-252)	SQD50P08-25L
B	-100	20		38	0.04	0.048				96		DPAK (TO-252)	SQD40P10-40L
B	-100	20		40	0.04	0.048*				89		D ² PAK (TO-263)	SQM40P10-40L
B	-200	20		12	0.213	0.221*				71		PowerPAK SO-8L	SQJ431EP
DUAL N-CHANNEL													
A	20	8		1.5		0.216	0.268	0.375			1.2	PowerPAK SC-75	SMMB912DK
B	30	20		30	0.007	0.0086				25.8		PowerPAK SO-8L	SQJ910AEP
B	30	20		8	0.012	0.014				31.5		SO-8	SQ4282EY
B	30	20		8	0.015	0.018				19.7		SO-8	SQ4920EY
B	30	20		8	0.017	0.028				17		PowerPAK SO-8L	SQJ844AEP
B	30	20		30	0.007	0.009				25.8		PowerPAK SO-8L	SQJ910AEP
B	40	20		8	0.014	0.015				30		SO-8	SQ4284EY
B	40	20		8	0.024	0.029				28.4		SO-8	SQ4940AEY
B	40	20	1	15	0.016	0.019				13.5		PowerPAK SO-8L	SQJ940EP
	40	20	2	18	0.006	0.008				31.8			
B	40	20		30	0.009	0.011				25.6		PowerPAK SO-8L	SQJ912AEP
B	40	20	1	15	0.022	0.026				13.1		PowerPAK SO-8L	SQJ942EP
	40	20	2	45	0.011	0.013				22.5			
B	60	20		5.4	0.064	0.082				8		SO-8	SQ9945BEY
B	60	20		7	0.04	0.055				11.7		SO-8	SQ4946AEY

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POWER MOSFETs

SMM Medical Devices

Category	V _{DS} (V)	V _{GS} (V)	CH #	I _D (A)	R _{DS(ON)} (Ω)					Q _g (nC)		Package	Part Number
					V _{GS} = 10 V	V _{GS} = 4.5 V	V _{GS} = 2.5 V	V _{GS} = 1.8 V	V _{GS} = 1.5 V	V _{GS} = 10 V	V _{GS} = 4.5 V		
DUAL N-CHANNEL (continued)													
B	60	20		8	0.036	0.046				13		PowerPAK SO-8L	SQJ960EP
B	60	20		8	0.06	0.08				8.5		PowerPAK SO-8L	SQJ962EP
B	60	20		15	0.056	0.075				8.1		PowerPAK SO-8L	SQJ992EP
B	60	20		18	0.034	0.044				12.3		PowerPAK SO-8L	SQJ968EP
B	75	20		17	0.05	0.066				14		PowerPAK SO-8L	SQJ980AEP
DUAL P-CHANNEL													
B	-30	20		5	0.075	0.145				9.5		SO-8	SQ4937EY
B	-30	20		7.5	0.035	0.065				19.5		SO-8	SQ4949EY
B	-30	20		8	0.024	0.039				35		PowerPAK SO-8L	SQJ941EP
B	-30	20		30	0.017	0.036				33		PowerPAK SO-8L	SQJ951EP
B	-60	20		4.4	0.085	0.115				26.5		SO-8	SQ4961EY
B	-60	20		8	0.085	0.115*				26.5		PowerPAK SO-8L	SQJ963EP
B	-60	20		8	0.048	0.061				43.4		SO-8	SQ4917EY
N&P PAIR													
B	40	20		30	0.0092	0.0112				25.5		PowerPAK SO-8L	SQJ500AEP
	-40	20		30	0.027	0.0435				30.2			

* V_{GS} = 6 V

** Datasheet not available on the web, please contact sales for a copy

** Needs a minimum of 8 x 8 mil square gate pad

** Requires a wider passivation than the standard "SQ" device

** Does not use polyimide as a coating

** The design review process is required for all packaged devices that have KGD interest



POWER MOSFETs

SMM Medical Devices

PRODUCT LIST

SEMICONDUCTORS

MOSFETs Segment

MOSFETs

- Low-Voltage TrenchFET® Power MOSFETs
- Medium-Voltage Power MOSFETs
- High-Voltage Planar MOSFETs
- High-Voltage Super Junction MOSFETs
- Automotive-Grade MOSFETs

ICs

- Power Management and Power Control ICs
- Smart Load Switches
- Analog Switches and Multiplexers

Diodes Segment

Rectifiers

- Schottky Rectifiers
- Ultrafast Recovery Rectifiers
- Standard and Fast Recovery Rectifiers
- High-Power Rectifiers/Diodes
- Bridge Rectifiers

Small-Signal Diodes

- Schottky and Switching Diodes
- Zener Diodes
- Tuner/Capacitance Diodes
- Bandswitching Diodes
- RF PIN Diodes

Protection Diodes

- TVS Diodes or TRANSZORB®
(unidirectional, bidirectional)
- ESD Protection Diodes (including arrays)

Thyristors/SCRs

- Phase-Control Thyristors
- Fast Thyristors

IGBTs

Power Modules

- Input Modules (diodes and thyristors)
- Output and Switching Modules (contain MOSFETs, IGBTs, and diodes)
- Custom Modules

Optoelectronic Components Segment

Infrared Emitters and Detectors

Optical Sensors

Infrared Remote Control Receivers

Optocouplers

- Phototransistor, Photodarlington
- Linear
- Phototriac
- High-Speed
- IGBT and MOSFET Driver

Solid-State Relays

LEDs and 7-Segment Displays

Infrared Data Transceiver Modules

Custom Products

PASSIVE COMPONENTS

Resistors and Inductors Segment

Film Resistors

- Metal Film Resistors
- Thin Film Resistors
- Thick Film Resistors
- Power Thick Film Resistors
- Metal Oxide Film Resistors
- Carbon Film Resistors

Wirewound Resistors

- Vitreous, Cemented, and Housed Resistors
- Braking and Neutral Grounding Resistors
- Custom Load Banks

Power Metal Strip® Resistors

Battery Management Shunts

Crowbar and Steel Blade Resistors

Thermo Fuses

Chip Fuses

Pyrotechnic Initiators/Igniters

Variable Resistors

- Cermet Variable Resistors
- Wirewound Variable Resistors
- Conductive Plastic Variable Resistors
- Contactless Potentiometers
- Hall Effect Position Sensors
- Precision Magnetic Encoders

Networks/Arrays

Non-Linear Resistors

- NTC Thermistors
- PTC Thermistors
- Varistors

Magnetics

- Inductors
- Wireless Charging Coils
- Transformers

Connectors

Capacitors Segment

Tantalum Capacitors

- Molded Chip Tantalum Capacitors
- Molded Chip Polymer Tantalum Capacitors
- Coated Chip Tantalum Capacitors
- Solid Through-Hole Tantalum Capacitors
- Wet Tantalum Capacitors

Ceramic Capacitors

- Multilayer Chip Capacitors
- Multilayer Chip RF Capacitors
- Disc Capacitors

Film Capacitors

Power Capacitors

Heavy-Current Capacitors

Aluminum Capacitors

ENYCAP™ Energy Storage Capacitors