RENESAS

Solutions for Automotive Power Management

Advanced Power MOSFETs and Intelligent Power Devices

Renesas Electronics America
www.am.renesas.com

Robust Power-semiconductor Solutions for Automotive Applications

Renesas Electronics offers an outstanding range of power MOSFETs and Intelligent Power Devices (IPDs) for meeting the demanding requirements of various safety, convenience and control-system applications in gasoline, diesel and hybrid cars and trucks. These robust semiconductor devices do some of the toughest jobs in electronics: switching power on and off, controlling the flow of electricity to actuators and valves, etc. And they do so precisely and reliably under many of the worst environmental conditions imaginable — conditions of extreme temperature, vibration, humidity, dust and dirt.

Our automotive-rated products have amassed a long track record of solid, enduring performance in millions of vehicles around the globe. Their reputation for reliability is increasingly important as more vehicle warranties are extended to 100K miles, making long-term quality and device durability among the most critical component-selection and system-design issues.

Renesas' success in serving major automotive-industry manufacturers has enabled us to create one of the industry's largest portfolios of in-vehicle power-management solutions, allowing maximum system design flexibility. Our MOSFETs and IPDs are built with very low on-resistance process technologies for energy efficiency and have compact packages that dissipate heat efficiently.

Advanced Power MOSFETs

AEC-Q101 is the US and European automotive qualification standard aimed at ensuring that semiconductor devices can survive extreme conditions and temperatures. The Renesas NP-series of power MOSFETs are designed for and qualified to this international standard and can operate up to 175°C junction temperature. Optimized for automotive applications, these chips are made exclusively in our own TS16949-certified factories to safeguard quality.

The design characteristics of our latest NP-series MOSFETs are bolstered by two new Renesas-developed 'Super-Junction' process technologies that improve efficiency and save power in high-performance switching applications: Our ANL1 semiconductor technology reduces gate charge significantly, while maintaining the low on-resistance provided by UMOS-4 trench technology. The Renesas ANL2 process technology minimizes gate charge and delivers the lowest on-resistance in our portfolio.

Noteworthy progress in MOSFET packaging is exemplified by the new HSON-8 package. It achieves more compact power packaging to save space, while offering the highest levels of electrical and thermal performance. Similar in size to an SOP-8, the HSON-8 delivers the high current capability of a larger TO-252 (Dpak).

For automotive systems and applications in communications and industrial equipment that have design requirements below the capabilities of NP-series MOSFETs, Renesas recommends the devices in our 2SK, 2SJ and UPA series. These popular design choices are highly regarded for the performance and reliability they have demonstrated in many successful end products.

Typical Automotive MOSFET Applications

- Engine and transmission control
- Reverse-battery protection
- Electric power steering
- Anti–lock brakes
- Electric pump motors
- Power seats, power windows
- DC/DC converters
- Switch-mode power supplies
- Uninterruptible power supplies
- Industrial power tools
- Battery switches

RoHS compliant

Key MOSFET Features

- Ultra-low RDS (on), down to 1.15 mΩ
- Super high current capability, up to 180A
- Operation up to Tch=175°C
- Avalanche operation rated
- Small size: new HSON-8 package (5.4x5.0x1.45mm)
- Popular surface-mount and through-hole packages

Intelligent Power Devices

Automotive-type IPDs combine MOSFETs with logic-based control circuits. They generally serve "body controller" applications, a category encompassing the electronic controls for vehicle lights, keyless entry systems, windshield wipers, power seat adjusters and other interior items. These robust, self-protecting electronic switches are ideal for making cars safer, implementing new convenience features, boosting fuel efficiency and decreasing maintenance requirements. Three new multi-channel IPDs are among the devices highlighted on the last page of this document.

N-channel Power MOSFETs, V_{DSS} = 16V

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} =					I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
		10V	5.0V	4.5V	4.0V	2.5V				
2SK1583-T1/T2	16				1,500	2,000	0.5	2	SC-62/SOT-89	
2SK1585-T1/T2	16				1,000	1,200	1	2	SC-62/SOT-89	
2SK1587-T1/T2	16				500	800	2	2	SC-62/SOT-89	
2SK1959-T1/T2	16				500	600	2	2	SC-62/SOT-89	
2SK1588-T1/T2	16				300	500	3	2	SC-62/SOT-89	
2SK1960-T1/T2	16				200	300	3	2	SC-62/SOT-89	
2SK2053-T1/T2	16				120	150	5	2	SC-84	

N-channel Power MOSFETs, V_{DSS} = 20V

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} =					I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
		10V	5.0V	4.5V	4.0V	2.5V				
2SK3295-S	20	18		27			35	35	TO-262	
2SK3295-ZJ-E1/E2	20	18		27			35	35	TO-263ZJ	
UPA1725G-E1/E2	20			21	22	30	7	2	SOP-8	
UPA1724G-E1/E2	20			11	12	15	10	2	SOP-8	
UPA1726G-E1/E2	20			9.1	10	12.5	12	2	SOP-8	
UPA1723G-E1/E2	20			6.7	7.4	8.7	13	2	SOP-8	

N-channel Power MOSFETs, V_{DSS} = 30V

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} =					I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
		10V	5.0V	4.5V	4.0V	2.5V				
2SK1584-T1/T2	30	1,500			2,000		0.5	2	SC-62/SOT-89	
2SK680A-T1/T2	30	700			1,000		1	2	SC-62/SOT-89	
2SK1586-T1/T2	30	600			1,000		1	2	SC-62/SOT-89	
2SK1483-T1/T2	30	400			800		2	2	SC-62/SOT-89	
2SK2157-T1/T2	30	100			150		5	2	SC-84	
UPA1804GR-9JG-E1/E2	30	23		32			8	2	TSSOP-8	
2SK3366-Z-E1/E2	30	21		33	43		20	30	TO-252Z	
UPA2706GR-E1/E2	30	15		22.5	29		11	2	SOP-8	
2SK3365-Z-E1/E2	30	14		21	29		30	36	TO-252Z	
UPA1803GR-9JG-E1/E2	30	12		16			8	2	TSSOP-8	
2SK3367-Z-E1/E2	30	9		12	14		36	40	TO-252Z	
UPA2701GR-E1/E2	30	7.5		11.6	13.7		14	2	SOP-8	
NP80N03KDE-E1/E2	30	7	9	11			80	120	TO-263ZK	✓
NP80N03KLE-E1/E2	30	7	9	11			80	120	TO-263ZK	✓
NP80N03MLE-S18	30	7	9	11			80	120	TO-220M	✓
NP80N03NLE-S18	30	7	9	11			80	120	TO-262N	✓
NP55N03SUG-E1/E2	30	5					55	77	TO-252ZK	✓
NP60N03KUG-E1/E2	30	4.8					60	88	TO-263ZK	✓
NP60N03SUG-E1/E2	30	3.8					60	105	TO-252ZK	✓
NP90N03VUG-E1/E2	30	3.2					90	105	TO-252ZP	✓
NP82N03PUG-E1/E2	30	2.8					82	143	TO-263ZP	✓
NP88N03KDG-E1/E2	30	2.4		3.9			88	200	TO-263ZK	✓
NP88N03KUG-E1/E2	30	2.4					88	200	TO-263ZK	✓
NP110N03PUG-E1/E2	30	1.5					110	288	TO-263ZP	✓

N-channel Power MOSFETs *continues on next page*

N-channel Power MOSFETs, V_{DSS} = 40V

= New product in development

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} = 10V	5.0V	4.5V	4.0V	2.5V	I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
NP16N04YUG-E1/E2	40	25					13	43	HSON-8	✓
NP35N04YUG-E1/E2	40	10					35	77	HSON-8	✓
NP35N04YLG-E1/E2	40	9.5	14				35	77	HSON-8	✓
NP80N04KHE-E1/E2	40	8					80	120	TO-263ZK	✓
NP80N04MHE-S18	40	8					80	120	TO-220M	✓
NP80N04NHE-S18	40	8					80	120	TO-262N	✓
2SK3430	40	7.3			15		80	84	TO-220	
2SK3430-S	40	7.3			15		80	84	TO-262	
2SK3430-ZK-E1/E2	40	7.3			15		80	84	TO-263ZK	
NP60N04MUG-S18	40	6.7					60	88	TO-220M	✓
NP55N04SUG-E1/E2	40	6.5					55	77	TO-252ZK	✓
2SK3716-Z-E1/E2	40	6.5		9.1			60	84	TO-252Z	
NP60N04KUG-E1/E2	40	6.1					60	88	TO-263ZK	✓
NP74N04YUG-E1/E2	40	6					75	120	HSON-8	✓
2SK3431	40	5.6			8.9		83	100	TO-220	
2SK3431-S	40	5.6			8.9		83	100	TO-262	
2SK3431-ZJ-E1/E2	40	5.6			8.9		83	100	TO-263ZJ	
NP35N04YUK-E1/E2	40	5.5					35	97	HSON-8	✓
2SK3813-Z-E1/E2	40	5.3		7.1			60	84	TO-252Z	
NP84N04KHE-E1/E2	40	5.2					84	200	TO-263ZK	✓
NP84N04MHE-S18	40	5.2					84	200	TO-220M	✓
NP84N04NHE-S18	40	5.2					84	200	TO-262N	✓
NP75N04YUG-E1/E2	40	5.1					75	138	HSON-8	✓
NP70N04MUG-S18	40	5					70	115	TO-220M	✓
NP60N04MUK-S18	40	5					60	105	TO-220M	✓
NP60N04NUK-S18	40	5					60	105	TO-262N	✓
NP80N04MDG-S18	40	4.8		9			80	115	TO-220M	✓
NP80N04MLG-S18	40	4.8		9			80	115	TO-220M	✓
NP80N04NUG-S18	40	4.8					80	115	TO-262N	✓
NP80N04NDG-S18	40	4.8		9			80	115	TO-262N	✓
NP80N04NLG-S18	40	4.8		9			80	115	TO-262N	✓
NP60N04VUK-E1/E1	40	4.6					60	105	TO-252ZP	✓
NP80N04PDG-E1/E2	40	4.5		8.7			80	115	TO-263ZP	✓
NP80N04PUG-E1/E2	40	4.5					80	115	TO-263ZP	✓
NP80N04PLG-E1/E2	40	4.5		8.7			80	115	TO-263ZP	✓
NP86N04KHE-E1/E2	40	4.4					86	230	TO-263ZK	✓
NP86N04MHE-S18	40	4.4					86	230	TO-220M	✓
NP86N04NHE-S18	40	4.4					86	230	TO-262N	✓
NP88N04KHE-E1/E2	40	4.3					88	288	TO-263ZK	✓
NP88N04MHE-S18	40	4.3					88	288	TO-220M	✓
NP88N04NHE-S18	40	4.3					88	288	TO-262N	✓
NP82N04MDG-S18	40	4.2		8.5			82	143	TO-220M	✓
NP82N04MUG-S18	40	4.2					82	143	TO-220M	✓
NP82N04MLG-S18	40	4.2		8.5			82	143	TO-220M	✓
NP82N04NDG-S18	40	4.2		8.5			82	143	TO-262N	✓
NP82N04NUG-S18	40	4.2					82	143	TO-262N	✓
NP82N04NLG-S18	40	4.2		8.5			82	143	TO-262N	✓
2SK3432	40	4			6.9		83	100	TO-220	
2SK3432-S	40	4			6.9		83	100	TO-262	
2SK3432-ZJ-E1/E2	40	4			6.9		83	100	TO-263ZJ	
NP90N04VUG-E1/E2	40	4					90	105	TO-252ZP	✓
NP90N04VDG-E1/E2	40	4		8.6			90	105	TO-252ZP	✓
NP90N04VLG-E1/E2	40	4		8.6			90	105	TO-252ZP	✓
NP82N04PDG-E1/E2	40	3.5		8			82	143	TO-263ZP	✓
2SK3943-ZP-E1/E2	40	3.5		5.6			82	104	TO-263ZK	
NP82N04PUG-E1/E2	40	3.5					82	143	TO-263ZP	✓
NP88N04NUG-S18	40	3.4					88	200	TO-262N	✓
NP75N04YUK-E1/E2	40	3.3					75	138	HSON-8	✓

N-channel Power MOSFETs *continues on next page*

N-channel Power MOSFETs, V_{DSS} = 40V (continued)

= New product in development

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} = 10V	5.0V	4.5V	4.0V	2.5V	I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
NP89N04MUK-S18	40	3.25					90	147	TO-220M	✓
NP89N04NUK-S18	40	3.25					90	147	TO-262N	✓
NP90N04MUG-S18	40	3					90	217	TO-220M	✓
NP100N04NUJ-E1/E2	40	3					100	227	TO-262N	✓
NP90N04VUK-E1/E2	40	3					90	147	TO-252ZP	✓
NP90N04MUK-S18	40	2.95					90	176	TO-220M	✓
NP90N04NUK-S18	40	2.95					90	176	TO-262N	✓
NP88N04KUG-E1/E2	40	2.9					88	200	TO-263ZK	✓
NP89N04PUK-E1/E2	40	2.8					90	147	TO-263ZP	✓
NP109N04PUG-E1/E2	40	2.3					110	220	TO-263ZP	✓
NP109N04PUJ-E1/E2	40	2.3					110	220	TO-263ZP	✓
NP100N04PUK-E1/E2	40	2.3					100	176	TO-263ZP	✓
NP160N04TUJ-E1/E2	40	2					160	220	TO-263-7P	✓
NP160N04TDG-E1/E2	40	2		5.4			160	211	TO-263-7P	✓
NP160N04TUG-E1/E2	40	2					160	211	TO-263-7P	✓
2SK3811-ZP-E1/E2	40	1.8					110	213	TO-263ZP	
NP110N04PDG-E1/E2	40	1.8		3.2			110	288	TO-263ZP	✓
NP110N04PUG-E1/E2	40	1.8					110	288	TO-263ZP	✓
NP161N04TUG-E1/E2	40	1.8					160	250	TO-263-7P	✓
NP110N04PUJ-E1/E2	40	1.8					110	288	TO-263ZP	✓
NP109N04PUK-E1/E2	40	1.75					110	250	TO-263ZP	✓
NP180N04TUG-E1/E2	40	1.5					180	288	TO-263-7P	✓
NP180N04TUJ-E1/E2	40	1.5					180	288	TO-263-7P	✓
NP160N04TUK-E1/E2	40	1.5					160	250	TO-263-7P	✓
NP110N04PUK-E1/E2	40	1.4					110	348	TO-263ZP	✓
NP180N04TUK-E1/E2	40	1.05					180	348	TO-263-7P	✓

N-channel Power MOSFETs, V_{DSS} = 55V

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} = 10V	5.0V	4.5V	4.0V	2.5V	I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
NP22N055SHE-E1/E2	55	39					22	45	TO-252ZK	✓
NP22N055SLE-E1/E2	55	37	45	51			22	45	TO-252ZK	✓
NP32N055SHE-E1/E2	55	25					32	66	TO-252ZK	✓
NP32N055SDE-E1/E2	55	24	29	33			32	66	TO-252ZK	✓
NP32N055SLE-E1/E2	55	24	29	33			32	66	TO-252ZK	✓
NP40N055KHE-E1/E2	55	23					40	66	TO-263ZK	✓
NP40N055MHE-S18	55	23					40	66	TO-220M	✓
NP40N055NHE-S18	55	23					40	66	TO-262N	✓
NP40N055KLE-E1/E2	55	23	28	32			40	66	TO-263ZK	✓
NP40N055MLE-S18	55	23	28	32			40	66	TO-220M	✓
NP40N055NLE-S18	55	23	28	32			40	66	TO-262N	✓
NP34N055SHE-E1/E2	55	19					34	88	TO-252ZK	✓
NP34N055SLE-E1/E2	55	18	22	24			34	88	TO-252ZK	✓
NP48N055KHE-E1/E2	55	17					48	85	TO-263ZK	✓
NP48N055MHE-S18	55	17					48	85	TO-220M	✓
NP48N055NHE-S18	55	17					48	85	TO-262N	✓
NP48N055KLE-E1/E2	55	17	21	24			48	85	TO-263ZK	✓
NP48N055MLE-S18	55	17	21	24			48	85	TO-220M	✓
NP48N055NLE-S18	55	17	21	24			48	85	TO-262N	✓
NP36N055SHE-E1/E2	55	14					36	120	TO-252ZK	✓
NP52N055SUG-E1/E2	55	14					52	56	TO-252ZK	✓
NP36N055SLE-E1/E2	55	13	16	18			36	120	TO-252ZK	✓

N-channel Power MOSFETs *continues on next page*

N-channel Power MOSFETs, V_{DSS} = 55V (continued)

= New product in development

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} = 10V	5.0V	4.5V	4.0V	2.5V	I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
NP80N055KHE-E1/E2	55	11					80	120	TO-263ZK	✓
NP80N055MHE-S18	55	11					80	120	TO-220M	✓
NP80N055NHE-S18	55	11					80	120	TO-262N	✓
NP80N055KLE-E1/E2	55	11	13	15			80	120	TO-263ZK	✓
NP80N055MLE-S18	55	11	13	15			80	120	TO-220M	✓
NP80N055NLE-S18	55	11	13	15			80	120	TO-262N	✓
NP55N055SUG-E1/E2	55	10					55	77	TO-252ZK	✓
NP55N055SDG-E1/E2	55	9.5		12			55	77	TO-252ZK	✓
NP60N055KUG-E1/E2	55	9.4					60	88	TO-263ZK	✓
NP82N055KHE-E1/E2	55	8.6					82	163	TO-263ZK	✓
NP82N055MHE-S18	55	8.6					82	163	TO-220M	✓
NP82N055NHE-S18	55	8.6					82	163	TO-262N	✓
NP82N055KLE-E1/E2	55	8.4	11	12			82	163	TO-263ZK	✓
NP82N055MLE-S18	55	8.4	11	12			82	163	TO-220M	✓
NP82N055NLE-S18	55	8.4	11	12			82	163	TO-262N	✓
NP80N055MDG-S18	55	7.3		11.2			80	115	TO-220M	✓
NP80N055NDG-S18	55	7.3		11.2			80	115	TO-262N	✓
NP84N055KHE-E1/E2	55	7.3					84	200	TO-263ZK	✓
NP84N055MHE-S18	55	7.3					84	200	TO-220M	✓
NP84N055NHE-S18	55	7.3					84	200	TO-262N	✓
NP80N055PDG-E1/E2	55	7		10.9			80	115	TO-263ZP	✓
NP84N055KLE-E1/E2	55	7	8.7	9.4			84	200	TO-263ZK	✓
NP84N055MLE-S18	55	7	8.7	9.4			84	200	TO-220M	✓
NP84N055NLE-S18	55	7	8.7	9.4			84	200	TO-262N	✓
NP35N055YUK-E1/E2	55	7					35	97	HSON-8	✓
NP60N055MUK-S18	55	6.7					60	105	TO-220M	✓
NP60N055NUK-S18	55	6.7					60	105	TO-262N	✓
NP60N055VUK-E1/E2	55	6.3					60	105	TO-252ZP	✓
NP82N055MUG-S18	55	6					82	143	TO-220M	✓
NP82N055NUG-S18	55	6					82	143	TO-262N	✓
NP90N055VUG-E1/E2	55	6					90	105	TO-252ZP	✓
NP90N055VDG-E1/E2	55	6		10.5			90	105	TO-252ZP	✓
NP88N055KHE-E1/E2	55	5.3					88	288	TO-263ZK	✓
NP88N055MHE-S18	55	5.3					88	288	TO-220M	✓
NP88N055NHE-S18	55	5.3					88	288	TO-262N	✓
NP75N055YUK-E1/E2	55	5.3					75	138	HSON-8	✓
NP82N055PUG-E1/E2	55	5.2					82	143	TO-263ZP	✓
NP88N055KLE-E1/E2	55	5.2	6.3	6.8			88	288	TO-263ZK	✓
NP88N055MLE-S18	55	5.2	6.3	6.8			88	288	TO-220M	✓
NP88N055NLE-S18	55	5.2	6.3	6.8			88	288	TO-262N	✓
NP89N055MUK-S18	55	4.35					90	147	TO-220M	✓
NP89N055NUK-S18	55	4.35					90	147	TO-262N	✓
NP90N055VUK-E1/E2	55	4.1					90	147	TO-252ZP	✓
NP89N055PUK-E1/E2	55	3.95					90	147	TO-263ZP	✓
NP88N055KUG-E1/E2	55	3.9					88	200	TO-263ZK	✓
NP90N055MUK-S18	55	3.85					90	176	TO-220M	✓
NP90N055NUK-S18	55	3.85					90	176	TO-262N	✓
NP109N055PUJ-E1/E2	55	3.2					110	220	TO-263ZP	✓
NP100N055PUK-E1/E2	55	3.2					100	176	TO-263ZP	✓
NP160N055TUJ-E1/E2	55	3					160	220	TO-263-7P	✓
NP110N055PUG-E1/E2	55	2.4					110	288	TO-263ZP	✓
NP110N055PUJ-E1/E2	55	2.4					110	288	TO-263ZP	✓
NP180N055TUJ-E1/E2	55	2.4					180	288	TO-263-7P	✓
NP109N055PUK-E1/E2	55	2.3					110	250	TO-263ZP	✓
NP160N055TUK-E1/E2	55	2.1					160	250	TO-263-7P	✓
NP110N055PUK-E1/E2	55	1.75					110	348	TO-263ZP	✓
NP180N055TUK-E1/E2	55	1.4					180	348	TO-263-7P	✓

N-channel Power MOSFETs *continues on next page*

N-channel Power MOSFETs, V_{DSS} = 60V

= New product in development

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} = 10V	5.0V	4.5V	4.0V	2.5V	I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
2SK1592-T1/T2	60	2,000			2,500		0.5	2	SC-62/SOT-89	
2SK2109-T1/T2	60	800			1,000		0.5	2	SC-62/SOT-89	
2SK1273-T1/T2	60	650			1,000		2	2	SC-62/SOT-89	
2SK2111-T1/T2	60	450			600		1	2	SC-62/SOT-89	
2SK2054-T1/T2	60	200			250		3	2	SC-84	
2SK2857-T1/T2	60	150			220		4	2	SC-62/SOT-89	
2SK2415-Z-E1/E2	60	100			150		8	20	TO-252Z	
2SK2414-Z-E1/E2	60	70			95		10	20	TO-252Z	
2SK3377-Z-E1/E2	60	44			78		20	30	TO-252Z	
2SK3794-Z-E1/E2	60	44			78		20	30	TO-252Z	
2SK3385-Z-E1/E2	60	28			45		30	36	TO-252Z	
2SK3385-Z-E1/E2	60	28			45		30	36	TO-252Z	
NP23N06YDG-E1/E2	60	27	40				23	60	HSON-8	✓
2SK3433	60	26			41		40	47	TO-220	
2SK3433-S	60	26			41		40	47	TO-262	
2SK3433-ZJ-E1/E2	60	26			41		40	47	TO-263ZJ	
UPA1728G-E1/E2	60	26		29	34		9	2	SOP-8	
2SK3386-Z-E1/E2	60	21			36		34	40	TO-252Z	
2SK3902-ZK-E1/E2	60	21		26			60	45	TO-263ZK	
2SK3434	60	20			31		48	56	TO-220	
2SK3434-S	60	20			31		48	56	TO-262	
2SK3434-ZJ-E1/E2	60	20			31		48	56	TO-263ZJ	
UPA1727G-E1/E2	60	19		22	25		10	2	SOP-8	
NP52N06SLG-E1/E2	60	17.5		25			52	56	TO-252ZK	✓
2SK3402-Z-E1/E2	60	15			22		36	40	TO-252Z	
NP33N06YDG-E1/E2	60	14	19				33	97	HSON-8	✓
2SK3435	60	14			22		80	84	TO-220	
2SK3435-S	60	14			22		80	84	TO-262	
2SK3435-ZJ-E1/E2	60	14			22		80	84	TO-263ZJ	
2SK3901-ZK-E1/E2	60	13		16.5			60	64	TO-263ZK	
NP80N06MLG-S18	60	10		13.3			80	115	TO-220M	✓
NP80N06NLG-S18	60	10		13.3			80	115	TO-262N	✓
NP80N06PLG-E1/E2	60	9.7		13			80	115	TO-263ZP	✓
2SK3353	60	9.5			14		82	95	TO-220	
2SK3353-S	60	9.5			14		82	95	TO-262	
2SK3353-ZJ-E1/E2	60	9.5			14		82	95	TO-263ZJ	
2SK3814-Z-E1/E2	60	8.7		10.5			60	84	TO-252Z	
2SK3900-ZP-E1/E2	60	8		10			82	104	TO-263ZP	
2SK3354	60	8			12		83	100	TO-220	
2SK3354-S	60	8			12		83	100	TO-262	
2SK3354-ZJ-E1/E2	60	8			12		83	100	TO-263ZJ	
NP90N06VLG-E1/E2	60	7.8		12.5			90	105	TO-252ZP	✓
NP82N06MLG-S18	60	7.4		9.7			82	143	TO-220M	✓
NP82N06NLG-S18	60	7.4		9.7			82	143	TO-262N	✓
NP82N06PLG-E1/E2	60	6.7		8.5			82	143	TO-263ZP	✓
NP82N06PDG-E1/E2	60	6.7	8.5				80	143	TO-263ZP	✓
2SK3355	60	5.8			8.8		83	100	TO-220	
2SK3355-S	60	5.8			8.8		83	100	TO-262	
2SK3355-ZJ-E1/E2	60	5.8			8.8		83	100	TO-263ZJ	
2SK3899-ZK-E1/E2	60	5.3		6.5			84	146	TO-263ZK	
2SK3812-ZP-E1/E2	60	2.8		3.7			110	213	TO-263ZP	
2SK2159-T1/T2	60				300	500	2	2	SC-62/SOT-89	

N-channel Power MOSFETs *continues on next page*

N-channel Power MOSFETs, V_{DSS} = 75V

= New product in development

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} = 10V	5.0V	4.5V	4.0V	2.5V	I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
NP33N075YDF-E1/E2	75	28		35			33	88	HSON-8	✓
2SK3511	75	12.5					83	100	TO-220	
2SK3511-S	75	12.5					83	100	TO-262	
2SK3511-ZJ-E1/E2	75	12.5					83	100	TO-263ZJ	
NP84N075KUE-E1/E2	75	12.5					84	200	TO-263ZK	✓
NP84N075MUE-S18	75	12.5					84	200	TO-220M	✓
NP84N075NUE-S18	75	12.5					84	200	TO-262N	✓
2SK3510	75	8.5					83	125	TO-220	
2SK3510-S	75	8.5					83	125	TO-262	
2SK3510-ZJ-E1/E2	75	8.5					83	125	TO-263ZJ	
NP88N075KUE-E1/E2	75	8.5					88	288	TO-263ZK	✓
NP88N075MUE-S18	75	8.5					88	288	TO-220M	✓
NP88N075NUE-S18	75	8.5					88	288	TO-262N	✓

N-channel Power MOSFETs, V_{DSS} = 100V

= New product in development

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} = 10V	5.0V	4.5V	4.0V	2.5V	I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
2SK1593-T1/T2	100	5,000			6,000		0.5	2	SC-62/SOT-89	
2SK2110-T1/T2	100	1,200			1,500		0.5	2	SC-62/SOT-89	
2SK1485-T1/T2	100	800			1,200		1	2	SC-62/SOT-89	
2SK2112-T1/T2	100	800			1,200		1	2	SC-62/SOT-89	
2SK2055-T1/T2	100	350			450		2	2	SC-84	
2SK1284-Z-E1/E2	100	320			400		3	20	TO-252Z	
2SK3484-Z-E1/E2	100	125		148			16	30	TO-252Z	
NP28N10SDE-E1/E2	100	52		59			28	88	TO-252ZK	✓
2SK3483-Z-E1/E2	100	52		59			28	40	TO-252Z	
2SK3481	100	50		58			30	56	TO-220	
2SK3481-S	100	50		58			30	56	TO-262	
2SK3481-ZJ-E1/E2	100	50		58			30	56	TO-263ZJ	
NP36N10SDE-E1/E2	100	33		39			36	120	TO-252ZK	✓
2SK3482-Z-E1/E2	100	33		39			36	50	TO-252Z	
2SK3480	100	31		36			50	84	TO-220	
2SK3480-S	100	31		36			50	84	TO-262	
2SK3480-ZJ-E1/E2	100	31		36			50	84	TO-263ZJ	
NP40N10PDF-E1/E2	100	27		38			75	tbd	TO-263ZK	✓
NP40N10VDF-E1/E2	100	26		37			75	tbd	TO-252ZK	✓
NP40N10YDF-E1/E2	100	25		36			75	tbd	HSON-8	✓
NP70N10KUF-E1/E2	100	20	30				70	120	TO-263ZK	✓
NP82N10PUF-E1/E2	100	15					82	150	TO-263ZP	✓
2SK3479	100	11		13			83	125	TO-220	
2SK3479-S	100	11		13			83	125	TO-262	
2SK3479-ZJ-E1/E2	100	11		13			83	125	TO-263ZJ	
2SK3479-ZK-E1/E2	100	11		13			83	125	TO-263ZK	

P-channel Power MOSFETs

= New product in development

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} = 10V	5.0V	4.5V	4.0V	2.5V	1.8V	I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
2SJ462-T1/T2	-12				190	290		-2.5	2	SC-84	
UPA1912TE-T1/T2	-12			50	52	70		-4.5	0.2	SC-95/SOT-6	
UPA1916TE-T1/T2	-12			39		55	98	-4.5	0.2	SC-95/SOT-6	
2SJ205-T1/T2	-16				3,000	5,000		-0.5	2	SC-62/SOT-89	
2SJ207-T1/T2	-16				1,500	4,000		-1	2	SC-62/SOT-89	
2SJ208-T1/T2	-16				1,000	3,000		-2	2	SC-62/SOT-89	
UPA1911ATE-T1/T2	-20			115	120	190		-2.5	0.2	SC-95/SOT-6	
2SJ625-T1B/T2B	-20			113		171	314	-3	0.2	SC-96 (similar SOT-23)	
UPA1919TE-T1/T2	-20			58	60	84		-6	0.2	SC-95/SOT-6	
UPA1913TE-T1/T2	-20			55	58	90		-4.5	0.2	SC-95/SOT-6	
UPA1915TE-T1/T2	-20			55	58	90		-4.5	0.2	SC-95/SOT-6	
UPA1815GR-9JG-E1/E2	-20			15	16	23		-7	2	TSSOP-8	
2SJ687-ZK-E1/E2	-20			7				-20	36	TO-252ZK	
2SJ206-T1/T2	-30	3,000			4,000			-0.5	2	SC-62/SOT-89	
2SJ179-T1/T2	-30	1,000			1,500			-1.5	2	SC-62/SOT-89	
2SJ132-Z-E1/E2	-30	400			600			-2	20	TO-252Z	
2SJ355-T1/T2	-30	350			600			-2	2	SC-62/SOT-89	
2SJ357-T1/T2	-30	200			350			-3	2	SC-84	
2SJ557-T1B/T2B	-30	155		255	290			-2.5	0.2	SC-96 (similar SOT-23)	
2SJ325-Z-E1/E2	-30	110			240			-4	20	TO-252Z	
UPA1914TE-T1/T2	-30	57		86	96			-4.5	0.2	SC-95/SOT-6	
UPA2714GR-E1/E2	-30	20		30	34			-7	2	SOP-8	
UPA2713GR-E1/E2	-30	16		25	30			-8	2	SOP-8	
UPA1814GR-9JG-E1/E2	-30	16		24	27			-7	2	TSSOP-8	
NP50P03YDG-E1/E2	-30	9	15					-50	102	HSON-8	✓
NP75P03YDG-E1/E2	-30	6.2	10.3					-75	138	HSON-8	✓
UPA1931TE-T1/T2*	-40	65		100				-3.5	0.2	SC-95/SOT-6	
NP15P04SLG-E1/E2	-40	42		61				-15	36	TO-252ZK	✓
NP20P04SLG-E1/E2	-40	28		40				-20	45	TO-252ZK	✓
NP36P04SDG-E1/E2	-40	17.5		25				-36	56	TO-252ZK	✓
NP36P04KDG-E1/E2	-40	17		23.5				-36	56	TO-263ZK	✓
NP75P04YLG-E1/E2	-40	10.7	13					-75	138	HSON-8	✓
NP50P04KDG-E1/E2	-40	10		15				-50	100	TO-263ZK	✓
NP50P04SDG-E1/E2	-40	9.6		15				-50	90	TO-252ZK	✓
NP83P04PDG-E1/E2	-40	5.3		8				-83	200	TO-263ZP	✓
NP100P04PLG-E1/E2	-40	3.7		5.1				-100	200	TO-263ZP	✓
NP100P04PDG-E1/E2	-40	3.5		5.1				-100	288	TO-263ZP	✓
2SJ212-T1/T2	-60	3,000			4,000			-0.5	2	SC-62/SOT-89	
2SJ197-T1/T2	-60	1,000			1,500			-1.5	2	SC-62/SOT-89	
2SJ356-T1/T2	-60	500			950			-2	2	SC-62/SOT-89	
2SJ626-T1B/T2B	-60	388		514	556			-1.5	0.2	SC-96 (similar SOT-23)	
2SJ358-T1/T2	-60	300			400			-3	2	SC-84	
UPA1918TE-T1/T2	-60	143		179	190			-3.5	0.2	SC-95/SOT-6	✓
2SJ598-Z-E1/E2	-60	130			190			-12	23	TO-252Z	

P-channel Power MOSFETs *continues on next page*

P-channel Power MOSFETs (continued)

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} =						I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
		10V	5.0V	4.5V	4.0V	2.5V	1.8V				
2SJ302	-60	100			240			-16	75	TO-220	
2SJ302-S	-60	100			240			-16	75	TO-262	
2SJ302-ZJ-E1/E2	-60	100			240			-16	75	TO-263ZJ	
NP15P06SLG-E1/E2	-60	75		98				-15	30	TO-252ZK	✓
2SJ599-Z-E1/E2	-60	75			111			-20	35	TO-252Z	
2SJ602	-60	73			107			-20	40	TO-220	
2SJ602-S	-60	73			107			-20	40	TO-262	
2SJ602-ZJ-E1/E2	-60	73			107			-20	40	TO-263ZJ	
2SJ328	-60	60			110			-20	75	TO-220	
2SJ328-S	-60	60			110			-20	75	TO-262	
2SJ328-ZJ-E1/E2	-60	60			110			-20	75	TO-263ZJ	
NP20P06SLG-E1/E2	-60	50		64				-20	45	TO-252ZK	✓
2SJ600-Z-E1/E2	-60	50			79			-25	45	TO-252Z	
2SJ603	-60	48			75			-25	50	TO-220	
2SJ603-S	-60	48			75			-25	50	TO-262	
2SJ603-ZJ-E1/E2	-60	48			75			-25	50	TO-263ZJ	
2SJ601-Z-E1/E2	-60	31			46			-36	65	TO-252Z	
2SJ604	-60	30			43			-45	70	TO-220	
2SJ604-S	-60	30			43			-45	70	TO-262	
2SJ604-ZJ-E1/E2	-60	30			43			-45	70	TO-263ZJ	
NP36P06SLG-E1/E2	-60	30		40				-36	56	TO-252ZK	✓
NP36P06KDG-E1/E2	-60	29.5		37.5				-36	56	TO-263ZK	✓
2SJ605	-60	20			31			-65	100	TO-220	
2SJ605-S	-60	20			31			-65	100	TO-262	
2SJ605-ZJ-E1/E2	-60	20			31			-65	100	TO-263ZJ	
NP50P06KDG-E1/E2	-60	17		23				-50	100	TO-263ZK	✓
NP50P06SDG-E1/E2	-60	16.5		23.5				-50	90	TO-252ZK	✓
2SJ606	-60	15			23			-83	120	TO-220	
2SJ606-S	-60	15			23			-83	120	TO-262	
2SJ606-ZJ-E1/E2	-60	15			23			-83	120	TO-263ZJ	
2SJ607	-60	11			16			-83	160	TO-220	
2SJ607-S	-60	11			16			-83	160	TO-262	
2SJ607-ZJ-E1/E2	-60	11			16			-83	160	TO-263ZJ	
NP83P06PDG-E1/E2	-60	8.8		12				-83	200	TO-263ZP	✓
NP100P06PLG-E1/E2	-60	6		7.8				-100	200	TO-263ZP	✓
NP100P06PDG-E1/E2	-60	6		7.8				-100	288	TO-263ZP	✓

Dual P-channel Power MOSFETs

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} =						I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
		10V	5.0V	4.5V	4.0V	2.5V	1.8V				
UPA1950TE-T1/T2	-12			130		205	375	-3	1.2	SC-95/SOT-6	
UPA1750G-E1/E2	-20	90			180			-4	2.0	SOP-8	
UPA1856GR-9JG-E1/E2	-20			45	48	77		-5	2.0	TSSOP-8	
UPA1770G-E1/E2	-20			37	39	59		-6	0.8	SOP-8	
UPA1772G-E1/E2	-30	20		30	34			-8	2.0	SOP-8	
UPA2770GR-E1/E2	-40	26		35				-7	2.0	SOP-8	
UPA1774G-E1/E2	-60	250		300	330			-3	0.8	SOP-8	

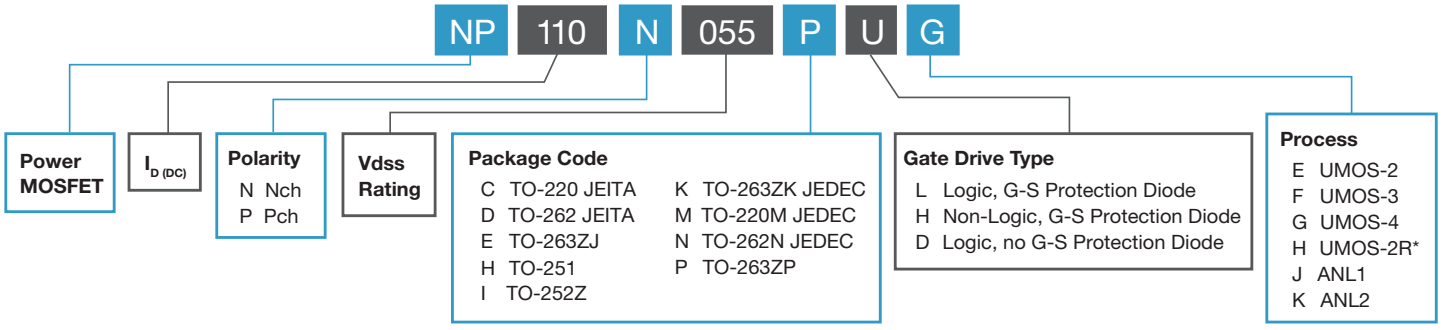
Dual N-channel Power MOSFETs

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} =						I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
		10V	5.0V	4.5V	4.0V	2.5V	1.8V				
UPA2750GR-E1/E2	30	15.5		21	23.9			9	2	SOP-8	
UPA2751GR-E1/E2	30	15.5		21	23.9			9	2	SOP-8	
UPA1871GR-9JG-E1/E2	30			26	27	38		6	2	TSSOP-8	
UPA2754GR-E1/E2	30			14.5	15	18.6		11	2	SOP-8	
UPA2756GR-E1/E2	60	105			150			4	2	SOP-8	
UPA1857GR-9JG-E1/E2	60	67		86	95			3.8	1.7	TSSOP-8	
UPA1763G-E1/E2	60	47		57	66			4.5	2	SOP-8	
UPA1764G-E1/E2	60	35		42	46			7	2	SOP-8	

Complementary N/P-channel Power MOSFETs

Device	V_{DSS} [V]	$R_{DS(ON)}$ max (mOhm) @ V_{GS} =						I_D [A]	P_D [W] @TC = 25°C	Package	AEC-Q101 Qualified
		10V	5.0V	4.5V	4.0V	2.5V	1.8V				
UPA1890GR-9JG-E1/E2	30/-30	0.73		.66	.73			6/-6	2	TSSOP-8	
UPA2792GR-E1/E2	30/-30	12.5/18		.81				10/-10	2	SOP-8	
UPA2793GR-E1/E2	40/-40	0.58		.64				7/-7	2	SOP-8	✓
UPA1790G-E1/E2	60/-60	0.43			.31			1/-0,7	2	SOP-8	
UPA2794GR-E1/E2	60/-60	0.58		.61				5,5/-5,5	2	SOP-8	

N/P Series MOSFET Part Numbering System



Intelligent Power Devices for Control, Protection and Monitoring

For automotive systems that require the utmost load protection and monitoring, Renesas offers high-side IPDs that combine switching elements and control circuits for protection and self-diagnostic functions. Our UPD-series multi-chip ASSP devices are ideal space- and weight-saving solutions for automotive light-bulb controls (55W, max.), relay or fuse replacements, and 14V switches for inductive, resistive or capacitive loads. They reliably protect their loads against current and temperature overloads and short-circuit fault conditions. Additionally, these IPDs provide diagnostic signals and analog proportional current-sensing outputs that are useful for fault detection, alarms and trend analysis.

Three new multi-channel IPDs have been introduced, joining our previously available single-channel TO-252 packaged IPDs. The UPD166011, 166013 and 166014 are intended for use in automotive lighting applications such as turn signals, brake lights, cornering lamps, and fog lights. They provide either two or four controlled outputs in a single package and are offered in three different product versions with two levels of on-resistance (25 or 60 mΩ). Their 12- or 24-pin power HSSOP packages are about the same size as a TO-252.

The intelligence built into all of our highly robust UPD-series IPDs recognizes when an abnormal condition has occurred due to a short circuit. As a result, these devices have been certified 'Class A', the highest ranking, under the AEC-Q100 short-circuit reliability testing guidelines (AEC-Q100-012). Moreover, Renesas is now developing additional IPD products offering even more protection functions.

Typical Automotive IPD Applications

- Airbag control systems
- Controls for exterior and interior lights
- Fuse and relay replacements
- 14V switching for L, C and R loads

Key IPD Features

- Short-circuit, overload and thermal protection
- Under-voltage shutdown
- Active reverse-battery protection
- Diagnostic function
  - — Proportional load-current sensing
  - — Defined fault signal in the event of shutdown
- AEC-Q100 qualified, including AEC-Q100-12

Intelligent Power Devices

= New product in development

Device	Channel Type and Config.	Package	$R_{DS(ON)}$ max (mOhm) @ 25°C	Op. Voltage	Load Dump Voltage	Over-current	Over Temp.	Analog Feed-back	Diag-nostic	Active Reverse Battery Protection	AEC-Q100 Qualified
UPD166007T1F-E1/E2	N Single	TO-252-5	10	28V	36	Yes	Yes	Yes	Yes	No	✓
UPD166009T1F-E1/E2	N Single	TO-252-5	10	28V	40	Yes	Yes	Yes	Yes	Yes	✓
UPD166010T1F-E1/E2	N Single	TO-252-5	10	28V	40	Yes	Yes	Yes	Yes	Yes	✓
UPD166011T1J-E1/E2	N Dual	HSSOP12	25	28V	40	Yes	Yes	Yes	Yes	No	✓
UPD166013T1J-E1/E2	N Dual	HSSOP12	60	28V	40	Yes	Yes	Yes	Yes	No	✓
UPD166014T1J-E1/E2	N Quad	HSSOP24	60	28V	40	Yes	Yes	Yes	Yes	No	✓
UPD166017T1F-E1/E2	N Single	TO-252-5	6.3	28V	40	Yes	Yes	Yes	Yes	Yes	✓
UPD166019T1F-E1/E2	P Single	TO-252-5	11.3	28V	40	Yes	Yes	No	Yes	No	✓
UPD166020T1F-E1/E2	N Single	TO-252-5	10	28V	42	Yes	Yes	Yes	Yes	Yes	✓
UPD166021T1F-E1/E2	N Single	TO-252-5	10	28V	42	Yes	Yes	Yes	Yes	Yes	✓

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Printed on Recycled Paper. 0411/2K/CPRN/PF/SP Document No.: R07PF0004EU0100