Solutions for residential solar systems

Introducing high efficiency and cost-optimized designs for solar power systems

www.infineon.com/solar

Full system solution for residential solar systems

Over the last years, energy consumption and the number of battery-powered applications rapidly increased, and so did the need for electrical power. Customers desire lower energy costs and independence in their energy generation. Also, governmental policies go for cleaner and greener energy in renewables, such as solar. Three distinctive requirements emerge from such context: system efficiency, system costs, and reliability. Efficient and reliable power semiconductors and inverter technologies must convert DC to AC and transmit the generated power with minimal losses. Infineon's broad portfolio for residential solar systems offers perfect-match solutions for different topologies used in, for example, microinverters, multi-string inverters with power optimizer, and string inverters.

Key benefits

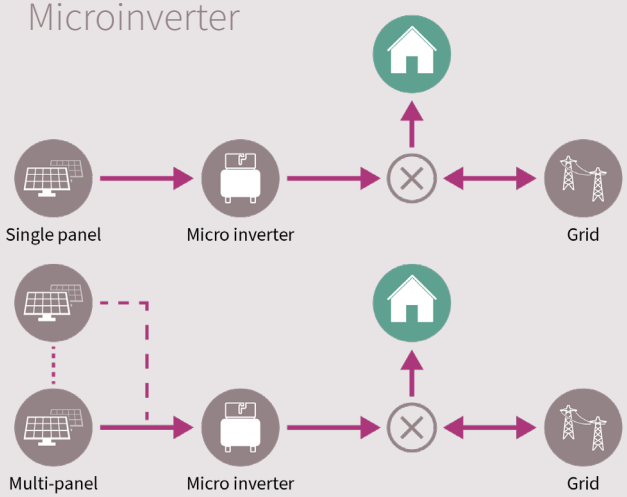
Reliability
Infineon's long industry experience and products with the highest reliability secure long application lifetime.

Lower system costs
Increased switching frequencies enable cost reduction on magnetics, housing, cooling, etc. CoolMOS™ and OptiMOS™ offer increased switching frequencies, lower switching losses and superior price-performance ratio.

High system efficiency
Bigger return on investments with Infineon's CoolMOS™ and OptiMOS™ that offer industry highest efficiency.

Overview of Infineon‘s offerings for residential solar implementation topologies

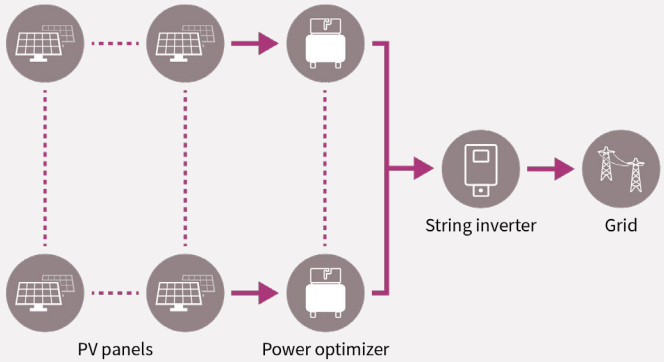
Microinverter



Learn more about three most-common microinverter topologies:

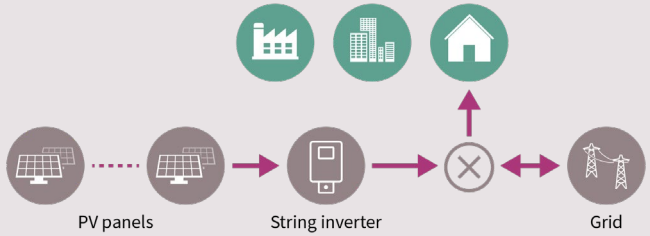
› Flyback (MPPT) + H-bridge VS inverter
› Dual-active bridge (MPPT) + unfolding stage CS inverter
› Full bridge (MPPT) + cycloconverter

Multi-string inverter with power optimizer



Learn more about power optimizer at panel level/multi-panel level

String inverter



Learn more about:

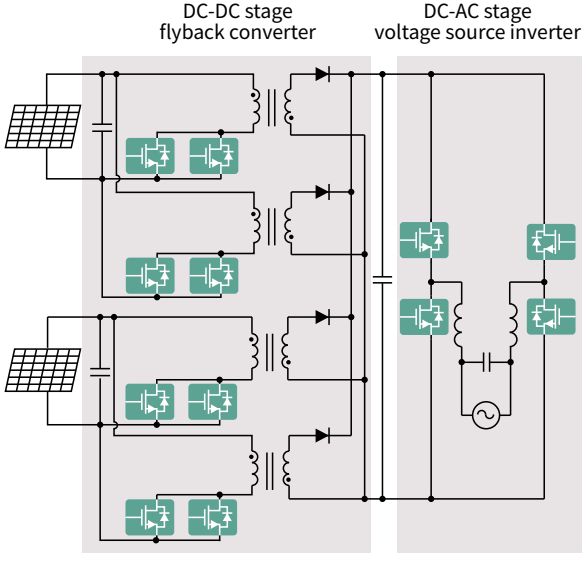
› Single-phase inverter
› Three-phase inverter

Microinverter solutions

Microinverters perform power conversion at each photo-voltaic panel or multi-panel. They are rated from 200 watts up to 1500 watts and typically rely on two or three-stage power conversions. The three most-common microinverter topologies are:

› Flyback (MPPT) + H-bridge VS inverter
› Dual-active bridge (MPPT) + unfolding stage CS inverter
› Full-bridge (MPPT) + cycloconverter

Flyback (MPPT) + H-bridge VS inverter

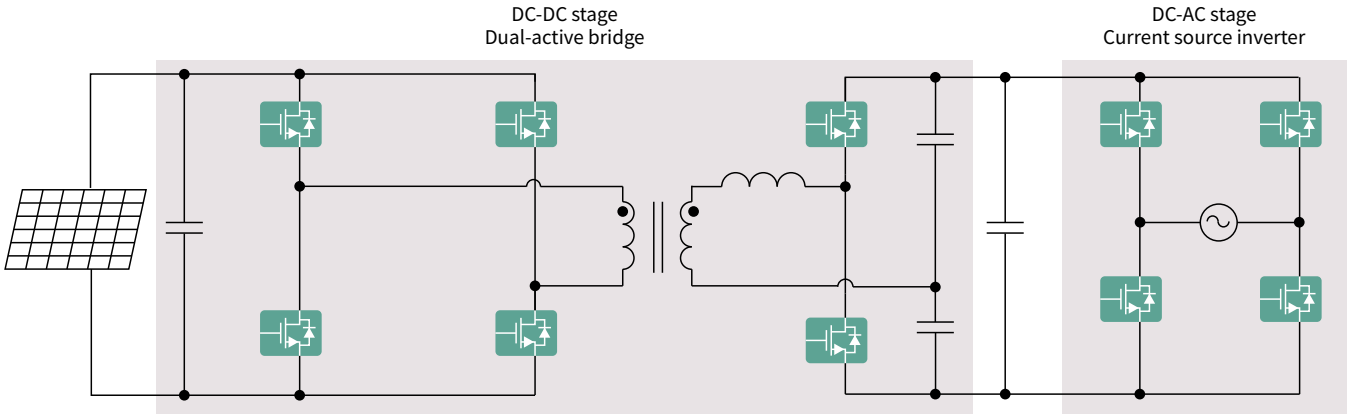


› Based on a traditional flyback topology
› Moderate efficiency (~96.5%)
› Increased cooling requirement and bigger housing
› Easy to scale for multi-PV microinverter
› Ease of design

Recommended products

Stage	Product type	Product family	Part number	Package	Technical specification
DC-DC stage – flyback convertor	MOSFET	OptiMOS™	BSC190N15S3	SuperSO8	150 V (V_{BRDSS} max.), 19 mΩ ($R_{DS(on)}$max.)
			BSC093N15NS5		150 V (V_{BRDSS} max.), 9.3 mΩ ($R_{DS(on)}$max.)
			BSC074N15NS5		150 V (V_{BRDSS} max.), 7.4 mΩ ($R_{DS(on)}$max.)
			IPB060N15N5	D²PAK 7-pin	150 V (V_{BRDSS} max.), 6 mΩ ($R_{DS(on)}$max.)
			IPB044N15N5		150 V (V_{BRDSS} max.), 4.4 mΩ ($R_{DS(on)}$max.)
			IPB048N15N5	D²PAK 3-pin	150 V (V_{BRDSS} max.), 4.8 mΩ ($R_{DS(on)}$max.)
	Diode	CoolSiC™	IDM02G120C5	DPAK	1200 V (V_{DC}), 2 A (IF), 1.4 A (V_F), 14 nc (Q_C)
			IDM05G120C5		1200 V (V_{DC}), 5 A (IF), 1.5 A (V_F), 24 nc (Q_C)
	Gate driver IC	EiceDRIVER™	2EDN7424F	PG-DSO-8	Low-side dual channel, 4 V UVLO, 4 A/4 A source/ sink current
			2EDN7424R	PG-TSSOP-8	Low-side dual channel, 4 V UVLO, 4 A/4 A source/ sink current
DC-AC stage – voltage source inverter	MOSFET	CoolMOS™	IPB60R125CFD7	D²PAK	600 V (V_{DS} max.), 125 mΩ ($R_{DS(on)}$max.)
			IPB60R145CFD7		600 V (V_{DS} max.), 145 mΩ ($R_{DS(on)}$max.)
			IPB60R105CFD7		600 V (V_{DS} max.), 105 mΩ ($R_{DS(on)}$max.)
			IPB65R125CFD7		650 V (V_{DS} max.), 125 mΩ ($R_{DS(on)}$max.)
			IPB65R155CFD7		650 V (V_{DS} max.), 155 mΩ ($R_{DS(on)}$max.)
	Gate driver IC	EiceDRIVER™	2EDS8265H	WB-DSO-16	Dual channel/ isolated/reinforced, 8 V UVLO, 4 A/8 A source/ sink current

Dual-active bridge (MPPT) + unfolding stage CS inverter



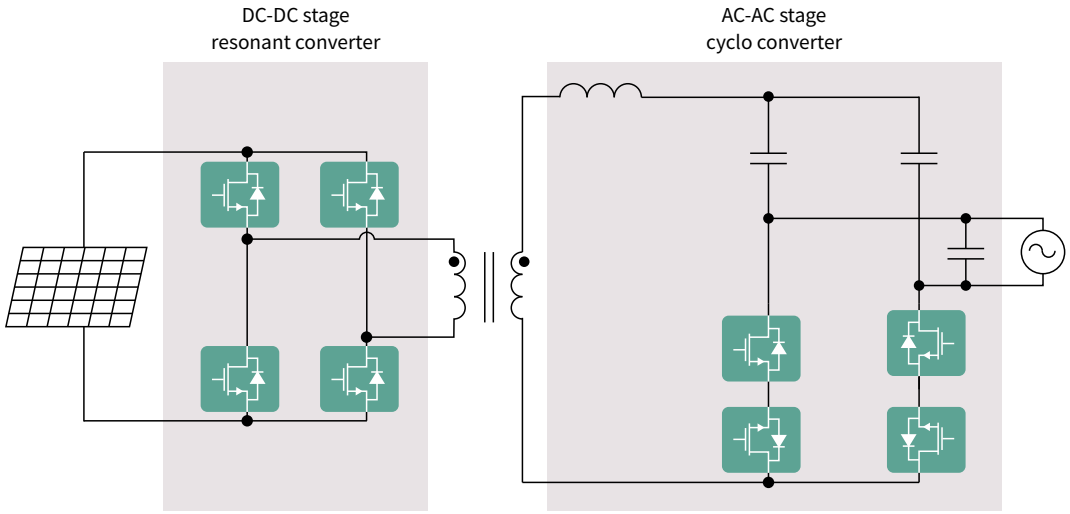
- Relatively high efficiency (~97%)
- Easier thermal design and less cooling
- Less output filter requirement
- Current source inverter; output voltage surge requirement more critical

Recommended products

Stage	Product type	Product family	Part number	Package	Technical specification
DC-DC stage – dual-active bridge	MOSFET	OptiMOS™	BSC026N08NS5	SuperSO8	80 V (V_{BRDSS} max.), 2.6 mΩ ($R_{DS(on)}$max.)
			BSC050N10NS5		100 V (V_{BRDSS} max.), 5 mΩ ($R_{DS(on)}$max.)
			BSC037N08NS5		80 V (V_{BRDSS} max.), 3.7 mΩ ($R_{DS(on)}$max.)
			BSC070N10LS5		100 V (V_{BRDSS} max.), 7 mΩ ($R_{DS(on)}$max.)
	Gate driver IC	EiceDRIVER™	2EDS8265H	WB-DSO-16	Dual channel/isolated/reinforced, 8 V UVLO, 4 A/8 A source/sink current
			2EDF7275F	DSO 16-pin 150 mil	Dual-channel galvanically isolated, 4 V UVLO, 4 A/8 A source/sink current
DC-AC stage – Current source inverter	MOSFET	CoolMOS™	IPB65R125C7	D^2PAK	650 V (V_{DS} max.), 125 mΩ ($R_{DS(on)}$max.)
			IPB60R120C7		600 V (V_{DS} max.), 120 mΩ ($R_{DS(on)}$max.)
			IPB60R099C7		600 V (V_{DS} max.), 99 mΩ ($R_{DS(on)}$max.)
			IPB60R120P7		600 V (V_{DS} max.), 120 mΩ ($R_{DS(on)}$max.)
			IPB60R099P7		600 V (V_{DS} max.), 99 mΩ ($R_{DS(on)}$max.)
	Gate driver IC	EiceDRIVER™	2EDL05N06PF	PG-DSO-8	Half-bridge, level-shift, 8 V UVLO, 0.36 A/0.7 A source/ sink current

*Coming soon

Full-bridge (MPPT) + cycloconverter



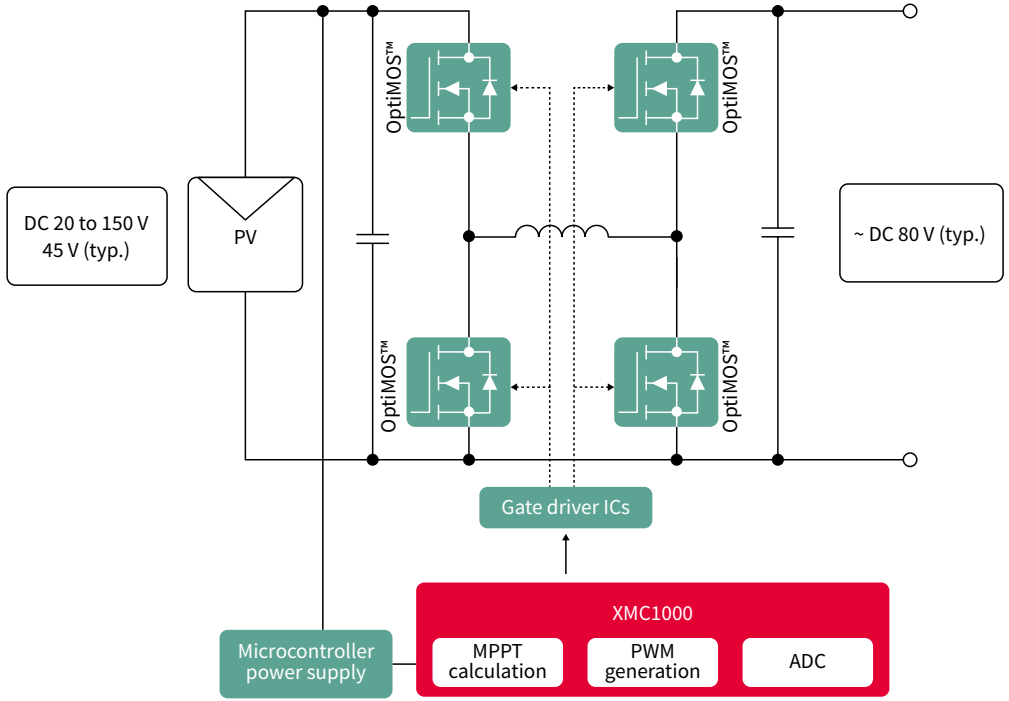
- Superior efficiency (~97.5%)
- High switching frequency 100 kHz <F_{sw}<200 kHz
- Less cooling and smaller housing
- Reduced BOM cost
- Higher design complexity

Recommended products

Stage	Product type	Product family	Part number	Package	Technical specification
DC-AC stage – resonant converter	MOSFET	OptiMOS™	BSC028N06NS	SuperSO8	60 V (V_{BRDSS} max.), 2.8 mΩ ($R_{DS(on)}$max.)
			BSC026N08NS5		80 V (V_{BRDSS} max.), 2.6 mΩ ($R_{DS(on)}$max.)
			BSC050N10NS5		100 V (V_{BRDSS} max.), 5 mΩ ($R_{DS(on)}$max.)
			BSC037N08NS5		80 V (V_{BRDSS} max.), 3.7 mΩ ($R_{DS(on)}$max.)
			BSC070N10LS5		100 V (V_{BRDSS} max.), 7 mΩ ($R_{DS(on)}$max.)
			BSC039N06NS		60 V (V_{BRDSS} max.), 3.9 mΩ ($R_{DS(on)}$max.)
	Gate driver IC	EiceDRIVER™	2EDS8265H	WB-DSO-16	Dual channel/ isolated/reinforced, 8 V UVLO, 4 A/8 A source/sink current
			2EDF7275F	DSO 16-pin 150 mil	Dual-channel galvanically isolated, 4 V UVLO, 4 A/8 A source/sink current
AC-AC stage – Cycloconverter	MOSFET	CoolMOS™	IPB60R060C7	D^2PAK	600 V (V_{DS} max.), 60 mΩ ($R_{DS(on)}$max.)
			IPB60R099C7		600 V (V_{DS} max.), 99 mΩ ($R_{DS(on)}$max.)
			IPT60R050G7	TOLL	600 V (V_{DS} max.), 50 mΩ ($R_{DS(on)}$max.)
			IPT60R102G7		600 V (V_{DS} max.), 102 mΩ ($R_{DS(on)}$max.)
			IPDD60R050G7	DDPAK	600 V (V_{DS} max.), 50 mΩ ($R_{DS(on)}$max.)
			IPDD60R080G7		600 V (V_{DS} max.), 80 mΩ ($R_{DS(on)}$max.)
			IPDD60R102G7		600 V (V_{DS} max.), 102 mΩ ($R_{DS(on)}$max.)
			IPDD60R125G7		600 V (V_{DS} max.), 125 mΩ ($R_{DS(on)}$max.)
	Gate driver IC	EiceDRIVER™	2EDS8265H	WB-DSO-16	Dual channel/ isolated/reinforced, 8 V UVLO, 4 A/8 A source/ sink current

Power optimizer solutions

A string inverter is connected with several power optimizers at panel level or string level in a multi-string inverter. Multi-string inverters are rated up to 30 kW. Power optimizers offer similar benefits as microinverters but are less expensive.



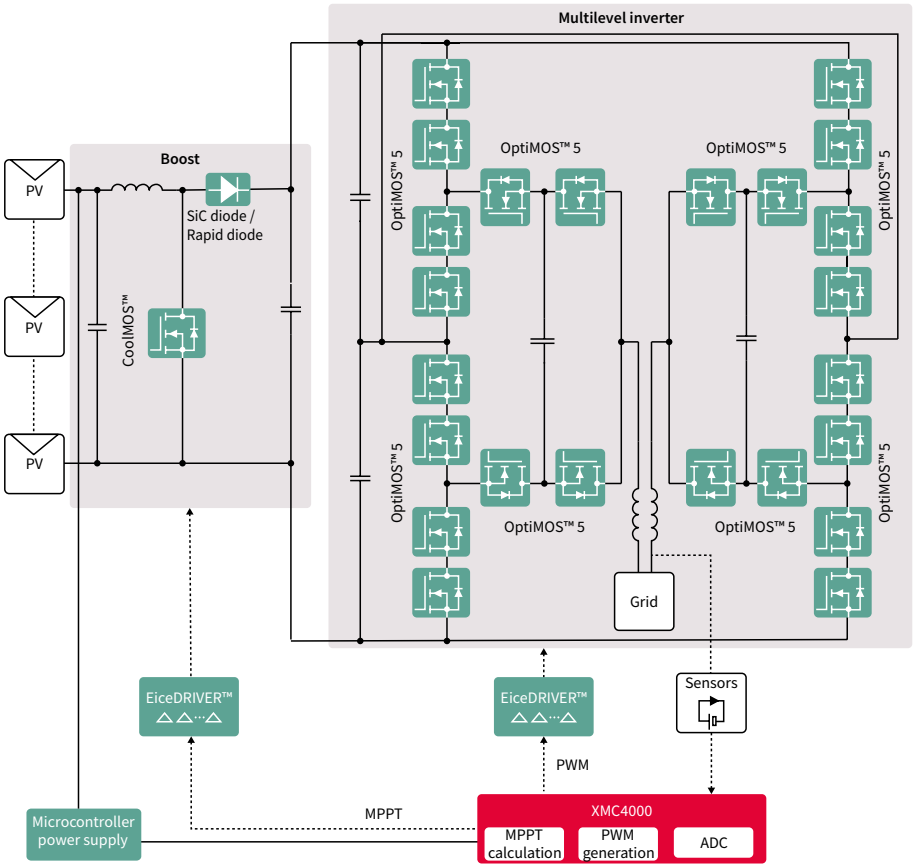
Recommended products

Topology	Product family	Part number	Package	Input voltage	Voltage class [V_{DS} max.]	$R_{DS(on)}$
Buck-boost	OptiMOS™	BSC012N06NS	SuperSO8	Up to 48 V	60 V	1.2 mΩ
		BSB028N06NN3 G	DirectFET™			2.8 mΩ
		BSC021N08NS5	SuperSO8	Up to 64 V	80 V	2.1 mΩ
		BSB044N08NN3 G	DirectFET™			4.4 mΩ
		BSC027N10NS5	SuperSO8	Up to 80 V	100 V	2.7 mΩ
		BSB056N10NN3 G	DirectFET™			5.6 mΩ
		BSC220N20NSFD	SuperSO8	Up to 125 V	200 V	22.0 mΩ
Gate driver ICs	EiceDRIVER™	1ED Compact, 2EDN Family				
		1EDB7275F, 1EDN7550B				
Microcontroller	XMC™	XMC1200, XMC4400, XMC4500				

String inverter solutions

String inverters perform power conversion on series-connected photovoltaic panels. Usually, these inverters are rated around a few kilowatts up to 200 kilowatts.
String inverters typically come with a maximum powerpoint tracker (MPPT).

Single-phase string inverter – multilevel topology



Benefits of flying capacitor multilevel inverter

In a multilevel inverter, four high voltage MOSFETs/IGBTs in H-bridge topology are replaced with a higher number of lower voltage MOSFETs. Compared to a conventional H-bridge inverter, a multilevel inverter, composed of lower voltage MOSFETs, offers several advantages:

- Lower $R_{DS(on)}$ and switching loss parameters considerably reduce conduction and switching losses
- Lower switching losses enable higher effective output frequency (smaller magnetics)
- Improved EMC due to reduced switching voltages
- Significant reduction in cooling system, size and weight

Product family	Topology	Part number	Package	Part number	Voltage class [V_{DS} max.]
OptiMOS™	Flying-capacitor-based active neutral-point-clamp (NPC)	BSC093N15NS5	SuperSO8	9.3 mΩ	150 V
		BSC110N15NS5		11 mΩ	
		IRF150DM115*	DirectFET™	11.3 mΩ	
		IPB044N15N5	D2PAK	4.4 mΩ	
		IPB048N15N5		4.8 mΩ	
		IPP051N15N5	TO-220	5.1 mΩ	
CoolMOS™	Boost	IPW60R017C7	TO-247	17 mΩ	600 V
		IPW60R024P7		24 mΩ	
		IPB60R045P7	D2PAK	45 mΩ	
CoolSiC™ Schottky diode	Boost	IDW20G65C5	TO-247		650 V
EiceDRIVER™ gate driver ICs		1ED Compact, 2EDN Family			
		1EDB7275F, 1EDN7550B			
XMC™ microcontroller		XMC4000			

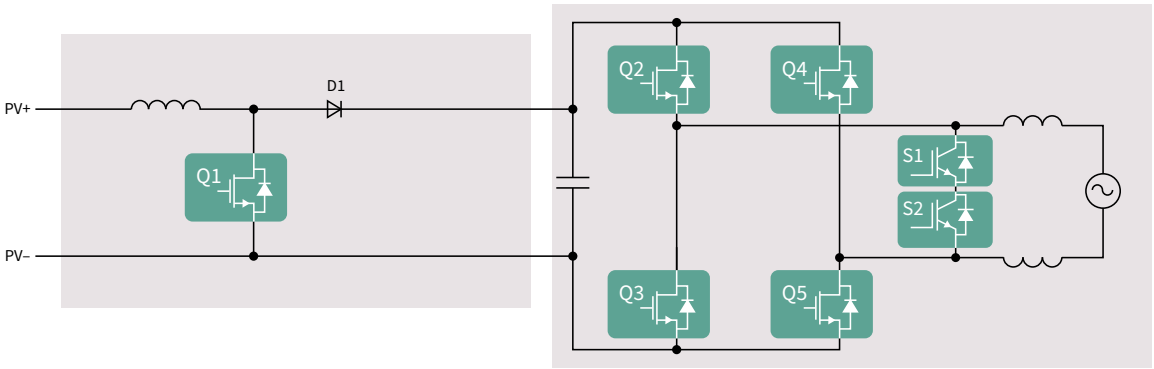
* For more information on the product, contact our product support.

String inverter solutions

Single-phase string inverters – HERIC Topology

Boost DC-DC converter
Q1: 650 V CoolMOS™ G7 / C7, CoolSiC™ 650 V
D1: CoolSiC™ 650 V

DC-AC HERIC inverter
Q2, Q3, Q4, Q5: 650 V CoolMOS™ CFD7, CoolSiC™ 650 V
S1, S2: IGBT TRENCHSTOP™ 5



HERIC topology is characterized by compactness and low weight. It is being widely used as it offers higher efficiency at low system cost. Its power density and efficiency will be even more improved if 650 V CoolMOS™ CFD7 or 650 V CoolSiC™ MOSFET is used instead of IGBT solutions.

› Fast switches: Q1, Q2, Q3, Q4
› Slow switches (50, 60 Hz): S1, S2

Recommended products

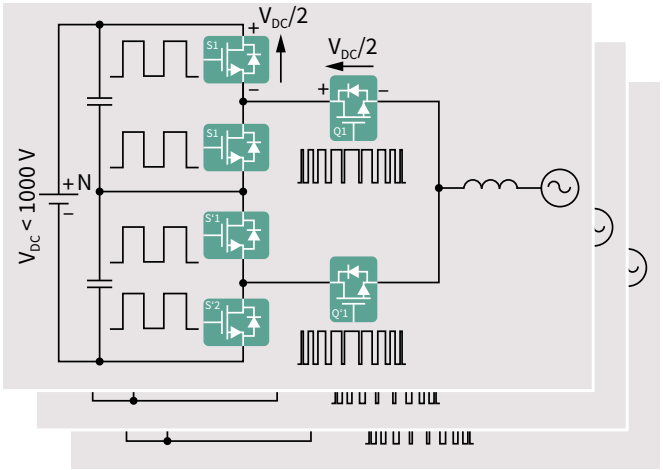
Topology	Product type	Product family	Part number	Package	Technical specification
DC-AC stage	IGBT	TRENCHSTOP™ 5 S5	IKW40N65ES5	TO247 3-pin	650 V (V_{CE}), 40 A (I_C), 1.35 V ($V_{CE(sat)}$,T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 H5	IKW40N65H5	TO247 3-pin	650 V (V_{CE}), 40 A (I_C), 1.65 V ($V_{CE(sat)}$,T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 H5	IKZ50N65EH5	TO247 4-pin	650 V (V_{CE}), 50 A (I_C), 1.65 V ($V_{CE(sat)}$,T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 H5	IKW50N65EH5	TO247 3-pin	650 V (V_{CE}), 50 A (I_C), 1.65 V ($V_{CE(sat)}$,T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 S5	IKZ50N65ES5	TO247 4-pin	650 V (V_{CE}), 50 A (I_C), 1.35 V ($V_{CE(sat)}$,T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 S5	IKW50N65ES5	TO247 3-pin	650 V (V_{CE}), 50 A (I_C), 1.35 V ($V_{CE(sat)}$,T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 L5	IKW30N65EL5	TO247 3-pin	650 V (V_{CE}), 30 A (I_C), 1.05 V ($V_{CE(sat)}$,T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 L5	IKZ75N65EL5	TO247 4-pin	650 V (V_{CE}), 75 A (I_C), 1.1 V ($V_{CE(sat)}$,T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 S5	IKW50N65SS5	TO247 3-pin	650 V (V_{CE}), 50 A (I_C), 1.35 V ($V_{CE(sat)}$,T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 S5	IKZA50N65SS5	TO247 4-pin	650 V (V_{CE}), 50 A (I_C), 1.35 V ($V_{CE(sat)}$,T_{VJ}=25°C), 175°C (T_{VJmax})
	Si Superjunction MOSFETs	CoolMOS™ CFD7	IPW65R029CFD7	TO247 3-pin	650 V (V_{DS} max.), 29 mΩ ($R_{DS(on)}$max.)
		CoolMOS™ CFD7	IPZA65R018CFD7	TO247 4-pin	650 V (V_{DS} max.), 18 mΩ ($R_{DS(on)}$max.)
		CoolMOS™ CFD7	IPW65R018CFD7*	TO247 3-pin	650 V (V_{DS} max.), 18 mΩ ($R_{DS(on)}$max.)
		CoolMOS™ CFD7	IPW65R041CFD7	TO247 3-pin	650 V (V_{DS} max.), 41 mΩ ($R_{DS(on)}$max.)
		CoolMOS™ CFD7	IPZA65R029CFD7	TO247 4-pin	650 V (V_{DS} max.), 29 mΩ ($R_{DS(on)}$max.)
		CoolSiC™ MOSFET	IMZA65R027M1H	TO247 4-pin	650 V (V_{DS} max.), 27 mΩ ($R_{DS(on)}$max.)
		CoolSiC™ MOSFET	IMW65R027M1H	TO247 3-pin	650 V (V_{DS} max.), 27 mΩ ($R_{DS(on)}$max.)
		CoolSiC™ MOSFET	IMZA65R048M1H	TO247 4-pin	650 V (V_{DS} max.), 48 mΩ ($R_{DS(on)}$max.)
		CoolSiC™ MOSFET	IMW65R048M1H	TO247 3-pin	650 V (V_{DS} max.), 48 mΩ ($R_{DS(on)}$max.)
	SiC MOSFETs	CoolSiC™ MOSFET	IMBG65R027M1H*	D2PAK 7-pin	650 V (V_{DS} max.), 27 mΩ ($R_{DS(on)}$max.)
		CoolSiC™ MOSFET	IMBG65R048M1H*	D2PAK 7-pin	650 V (V_{DS} max.), 48 mΩ ($R_{DS(on)}$max.)
	Gate driver ICs for SiC MOSFETs	1EDB9275F, 2EDF9275F, 2EDS9265H			

*Coming soon

String inverter solutions

Three-phase string inverters with active neutral point clamp (ANPC) topology

S1, S2, S‘1, S‘2: 600 V CoolMOS™ CFD7 MOSFETs
Q1, Q‘1: CoolSiC™ MOSFETs 650 V



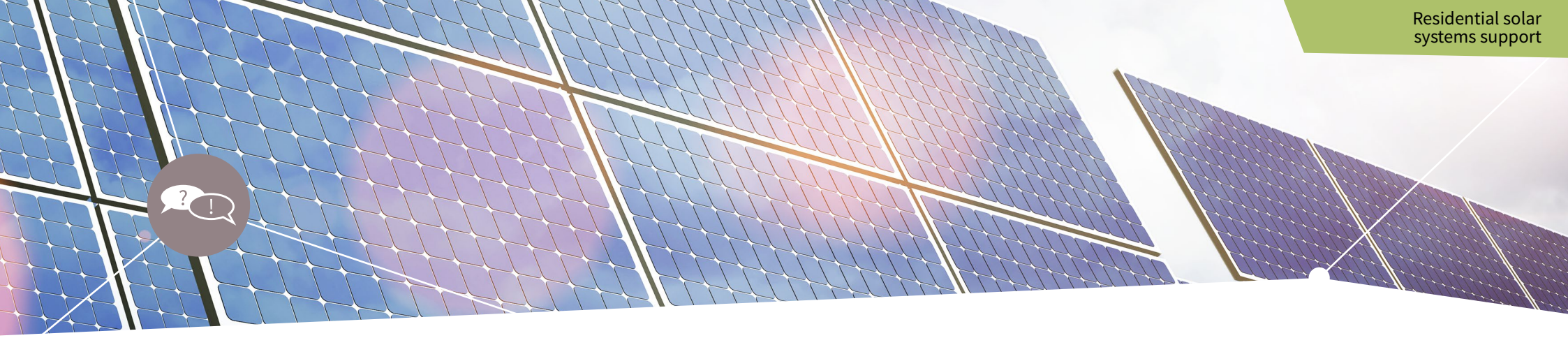
The (ANPC) topology is considered to be one of the dominant solutions in solar applications. It is an attractive alternative to conventional B6 and three-level T-type inverter. It offers increased flexibility in terms of modulation strategies.

› Fast switches: Q1, Q2
› Slow switches (50, 60 Hz): S1, S2, S’1, S’2

Recommended products

Topology	Product type	Product family	Part number	Package	Technical specification
DC-AC stage	IGBT	TRENCHSTOP™ 5 S5	IKW40N65ES5	TO247 3-pin	650 V (V_{CE}), 40 A (ICV), 1.35 V ($V_{CE(sat)}$, T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 H5	IKW40N65H5	TO247 3-pin	650 V (V_{CE}), 40 A (IC), 1.65 V ($V_{CE(sat)}$, T_{VJ}=25°C), 175°C (T_{VJmax})V
		TRENCHSTOP™ 5 H5	IKZ50N65EH5	TO247 4-pin	650 V (V_{CE}), 50 A (IC), 1.65 V ($V_{CE(sat)}$, T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 H5	IKW50N65EH5	TO247 3-pin	650 V (V_{CE}), 50 A (IC), 1.65 V ($V_{CE(sat)}$, T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 S5	IKZ50N65ES5	TO247 4-pin	650 V (V_{CE}), 50 A (IC), 1.35 V ($V_{CE(sat)}$, T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 S5	IKW50N65ES5	TO247 3-pin	650 V (V_{CE}), 50 A (IC), 1.35 V ($V_{CE(sat)}$, T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 L5	IKW30N65EL5	TO247 3-pin	650 V (V_{CE}), 30 A (IC), 1.05 V ($V_{CE(sat)}$, T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 L5	IKZ75N65EL5	TO247 4-pin	650 V (V_{CE}), 75 A (IC), 1.1 V ($V_{CE(sat)}$, T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 S5	IKW50N65SS5	TO247 3-pin	650 V (V_{CE}), 50 A (IC), 1.35 V ($V_{CE(sat)}$, T_{VJ}=25°C), 175°C (T_{VJmax})
		TRENCHSTOP™ 5 S5	IKZA50N65SS5	TO247 4-pin	650 V (V_{CE}), 50 A (IC), 1.35 V ($V_{CE(sat)}$, T_{VJ}=25°C), 175°C (T_{VJmax})
	Si Superjunction MOSFETs	CoolMOS™ CFD7	IPW65R029CFD7	TO247 3-pin	650 V (V_{DS} max.), 29 mΩ ($R_{DS(on)}$max.)
		CoolMOS™ CFD7	IPZA65R018CFD7	TO247 4-pin	650 V (V_{DS} max.), 18 mΩ ($R_{DS(on)}$max.)
		CoolMOS™ CFD7	IPW65R018CFD7*	TO247 3-pin	650 V (V_{DS} max.), 18 mΩ ($R_{DS(on)}$max.)
		CoolMOS™ CFD7	IPW65R041CFD7	TO247 3-pin	650 V (V_{DS} max.), 41 mΩ ($R_{DS(on)}$max.)
		CoolMOS™ CFD7	IPZA65R029CFD7	TO247 4-pin	650 V (V_{DS} max.), 29 mΩ ($R_{DS(on)}$max.)
		CoolSiC™ MOSFET	IMZA65R027M1H	TO247 4-pin	650 V (V_{DS} max.), 27 mΩ ($R_{DS(on)}$max.)
		CoolSiC™ MOSFET	IMW65R027M1H	TO247 3-pin	650 V (V_{DS} max.), 27 mΩ ($R_{DS(on)}$max.)
		CoolSiC™ MOSFET	IMZA65R048M1H	TO247 4-pin	650 V (V_{DS} max.), 48 mΩ ($R_{DS(on)}$max.)
		CoolSiC™ MOSFET	IMW65R048M1H	TO247 3-pin	650 V (V_{DS} max.), 48 mΩ ($R_{DS(on)}$max.)
	Gate driver ICs for SJ MOSFETS	1EDB8275F, 2EDF7275F, 2EDS8265H			
	SiC MOSFETs	CoolSiC™ MOSFET	IMBG65R027M1H*	D2PAK 7-pin	650 V (V_{DS} max.), 27 mΩ ($R_{DS(on)}$max.)
		CoolSiC™ MOSFET	IMBG65R048M1H*	D2PAK 7-pin	650 V (V_{DS} max.), 48 mΩ ($R_{DS(on)}$max.)
	Gate driver ICs for SiC MOSFETs	1EDB9275F, 2EDF9275F, 2EDS9265H			

*Coming soon



Solar support

Support by Infineon

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Published by
Infineon Technologies Austria AG
9500 Villach, Austria

Order Number: B131-I0786-V2-7600-EU-EC
Date: 05 / 2021