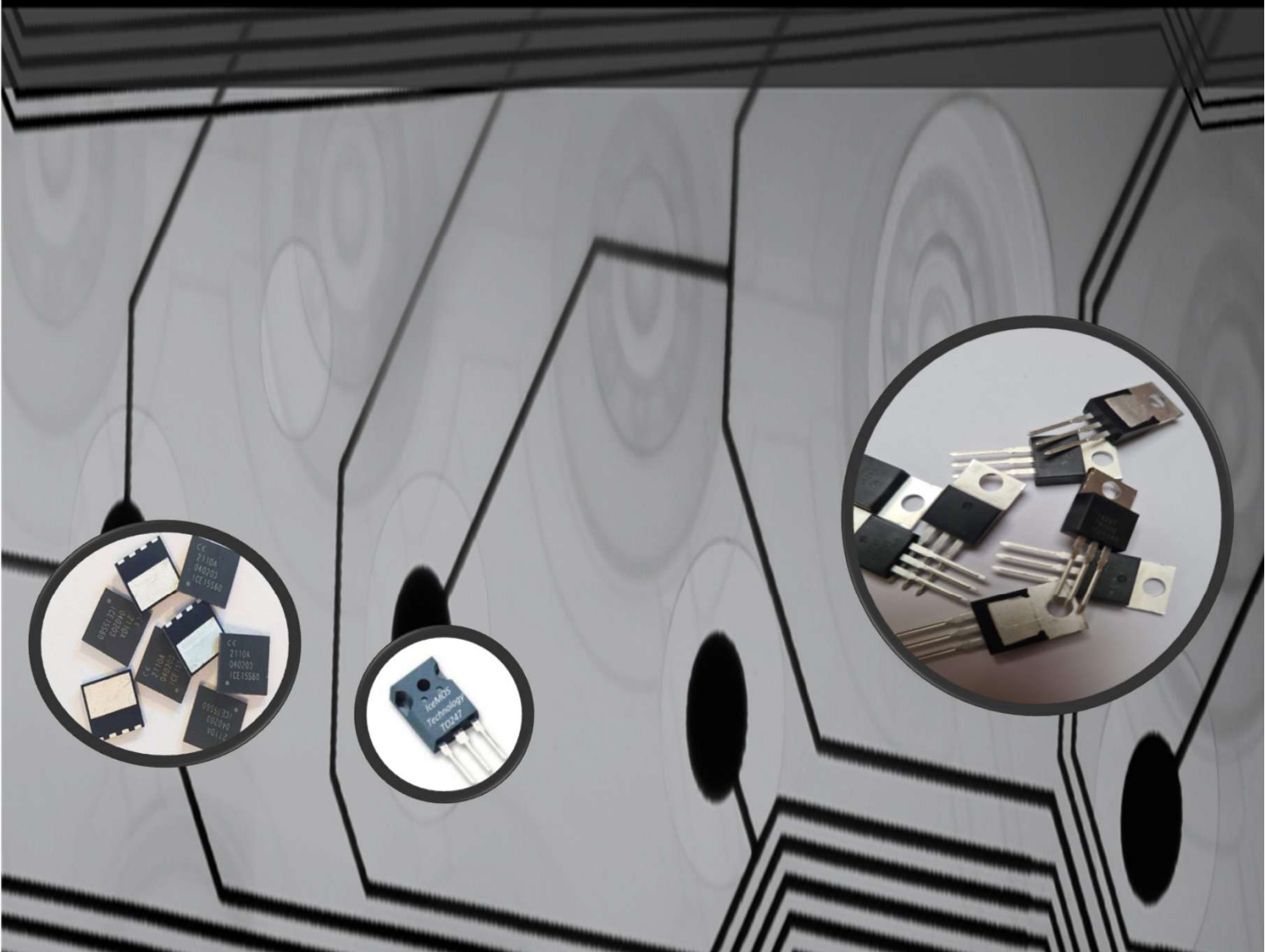
IceMOS Technology

Application Example・Design WIN
High Voltage
Super Junction MOSFET

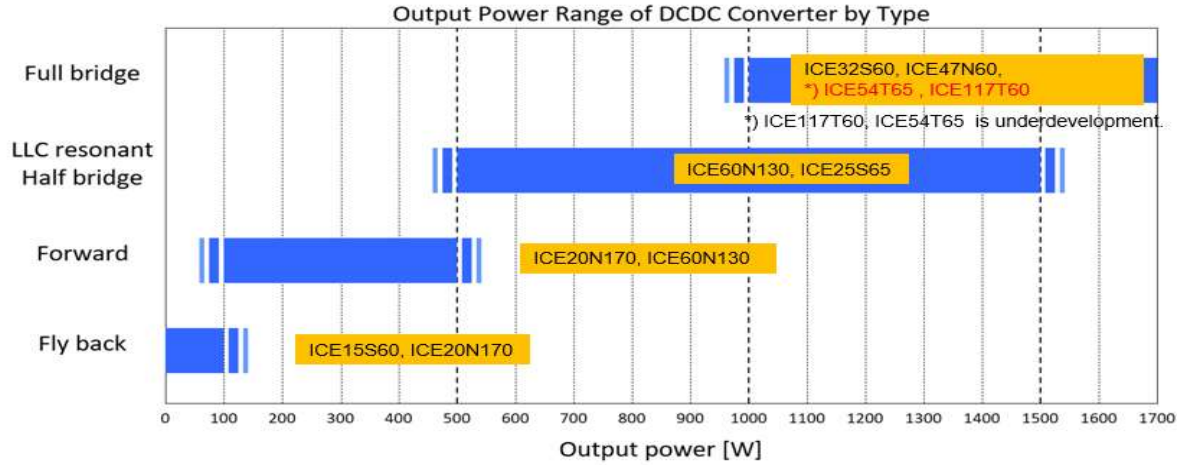
https://icemostech.com/
2025 ver.



Application Matrix Table

★:Showing type frequently use of Circuit.

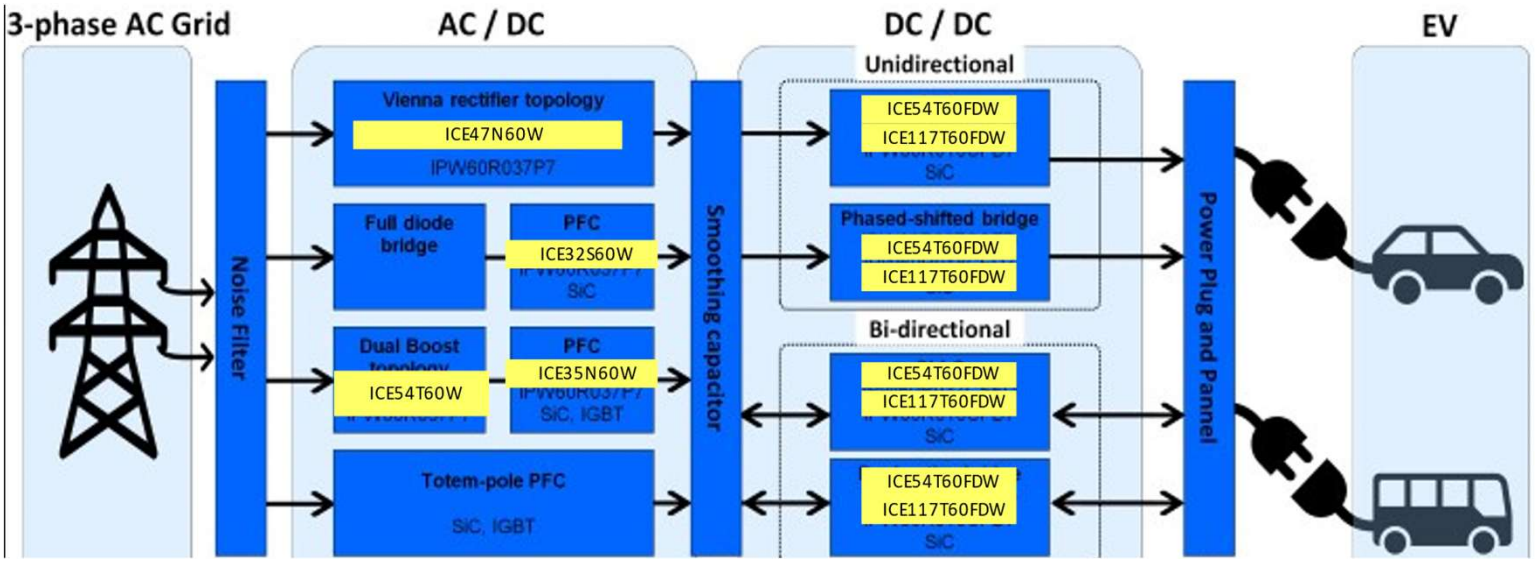
#	Application	Output Power (W)		Circuit								ICEMOS
				AC-DC			DC-DC				DC-AC	
		Min	Max	Half wave	Full Wave1	Full Wave2	Fly back	For ward	LLC Half Bridge	Full Bridge	Inverter	Product
1	SMPS Power Factor Correction	500							★	★		ICE25S65 ICE60N130
2	LLC Half Bridge	1000								★		ICE47N60 ICE32S60
3	Low power SMPS Quasi- Resonant Flyback		100				★					ICE8S65,ICE8N60, ICE10N60,ICE15S60
4	High Power SMPS LLC Half- Bridge	500	1500						★			ICE47N60 ICE32S60
5	ATXPower Supplies	200	1600	★	★	★	★	★	★			ICE47N60 ICE32S60
6	LED TV	5k-140inch				★				★		ICE32S60 ICE47N60
7	LED Lighting	20	500	★	★	★	★	★				ICE25S65 ICE60N130
8	Data center AC/DC(Severs and Telecom)	500k-1k node				★				★		ICE32S60 ICE47N60
9	Fast Chargers	3k	400k			★				★		ICE47N60
10	Chargers PC Adapters	36	90	★	★		★					ICE8S65,ICE8N60, ICE10N60,ICE15S60
11	TV Power application	24	410		★	★	★	★				ICE25S65 ICE60N130
12	UPS	500	10k			★			★	★	★	ICE32S60 ICE47N60
13	Solar inverters	300	6k					★	★	★	★	ICE32S60 ICE47N60
14	HID Street lights	22	500			★		★	★			ICE25S65 ICE60N130
15	Gaming consoles	100	200		★	★		★				ICE60N130 ICE20N170
16	LED signage	10	250	★	★			★				ICE60N130 ICE20N170
17	E bikes E-Mobility	600	40k			★			★	★		ICE32S60 ICE47N60
18	Printers	10	1500	★	★	★	★	★	★	★		ICE32S60 ICE47N60
19	White good Fridge	200	300			★			★	★	★	ICE60N130 ICE20N170
20	Washing machine	800	1500			★			★	★	★	ICE32S60 ICE47N60
21	Audio Amp	200 x n	5k x n			★			★	★		ICE32S60 ICE47N60
22	Projector	300	2k			★		★	★	★		ICE32S60 ICE47N60
23	Car audio	10 x n	100xn				★	★				ICE47N60 ICE32S60
24	Navigation	10	20				★					ICE8S65,ICE8N60, ICE10N60,ICE15S60
25	3D printer	180	1500	★	★	★	★	★	★	★		ICE32S60 ICE47N60
26	Smart phone adaptors	20	90	★	★		★					ICE15S60 ICE20N170
27	Factorized power	320	1300			★			★	★		ICE47N60
28	Tablet computers	200	1500	★	★		★					ICE15S60 ICE20N170
29	Micro Inverters	200	1500						★	★	★	ICE47N60



1.High Voltage EV Charging Infrastructure

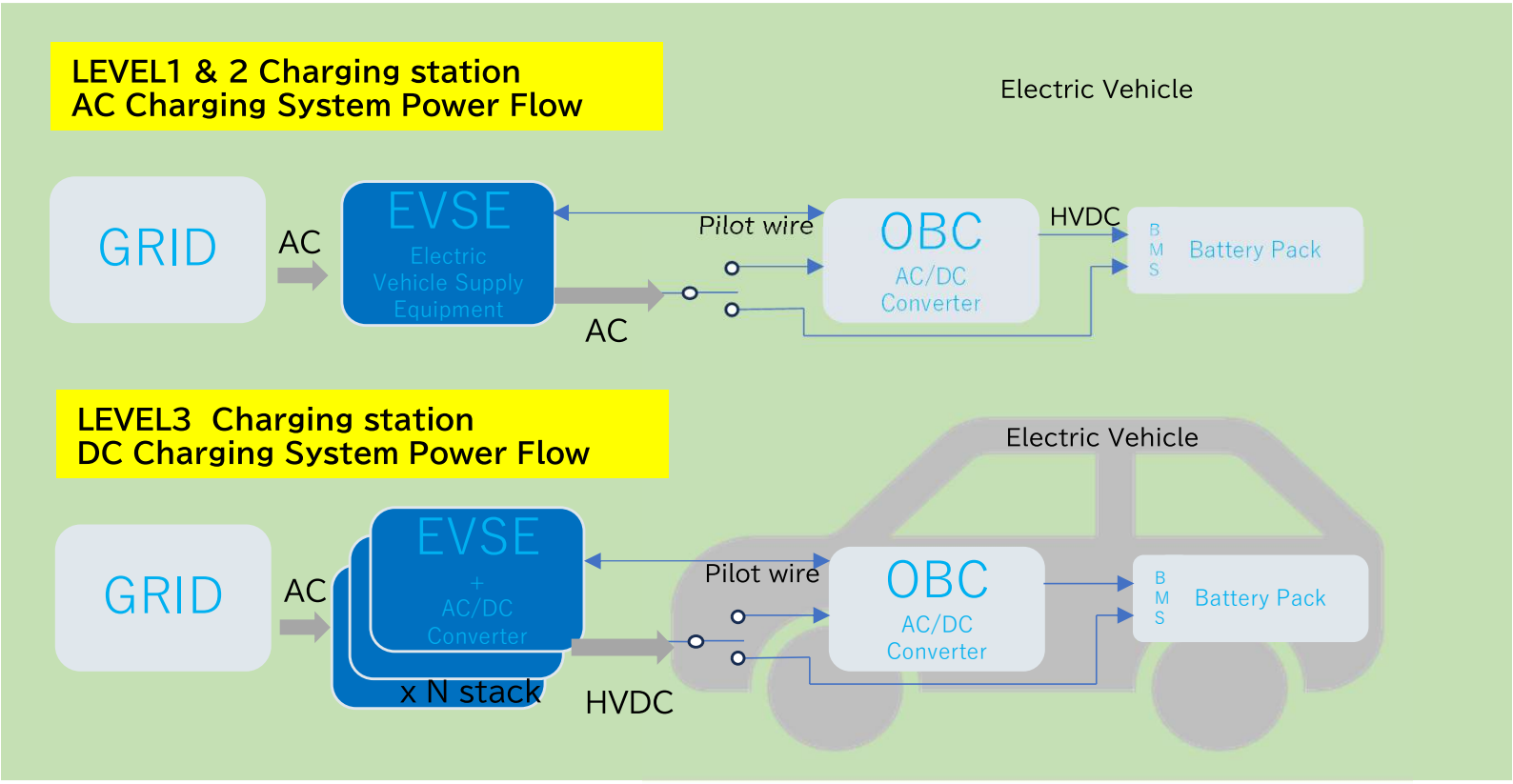
The strategies to achieve zero emissions latest by 2050 in most major cities worldwide relies in part on greater EV usage and therefore better fast charging infrastructure. Due to space limitations in urban area, future charging needs cannot be satisfied by private installations. Therefore, public charger will gain more and more importance to increase usability of urban e-Mobility.

Power Management System from AC to DC for EV Rapid chargers and charging stations



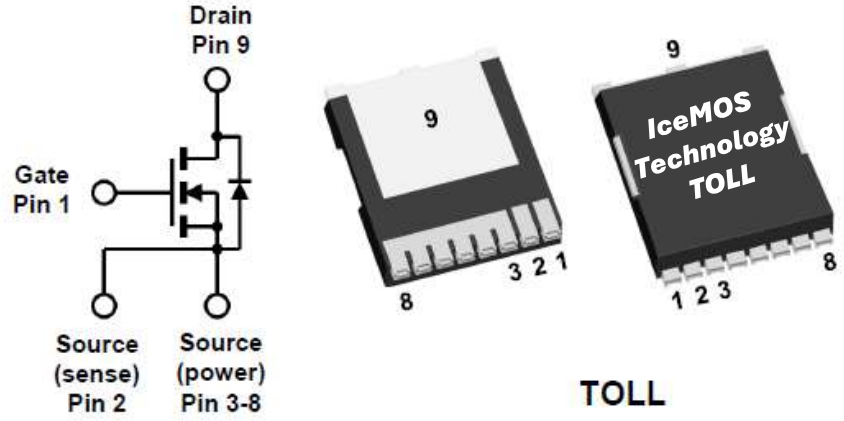
Device	Rthjc [°C/W]	Pd [W]	ID max_100% [A]	Ron_max [mΩ]	Qg_typ [nC]	trr_typ [nsec]	description
IPW60R037P7	0.49	255	54.8	37	121	300	Id Max at duty 50% on data sheet
IPW60R037CSFD	0.51	245	54	38	136	168	fast recovery
IPW60R018CFD7	0.3	417	101	19	251	223	fast recovery
ICE54T60W	0.49	255	54.8	37	121	300	
ICE54T65W	0.49	320	54	38	136	440	
ICE54T60FDW	0.51	245	54	38	136	168	fast recovery
ICE117T60FDW	0.3	417	117	18	251	223	fast recovery

RAPID CHARGING FROM SMART GRID to ON BOARD CHARGERS USING IceMOS mSJMOS™



NEW PRODUCT ICE54T65T

TOLL PACKAGE ON BOARD CHARGER IPOWER DEVICE



TOLL

1=Gate, 2=Source(sense),

3-8 =Source (power), 9=Drain

Gen 3 third generation mSJMOS™ technology, provides the lowest on-state resistances for higher efficiency and power dense solutions. End users benefit from lower cost of technology with industry-leading reliability.

IceMOS' s new 600-650V silicon MOSFETs offer a 50 percent decrease in conduction losses which results in a substantial increase in power density.

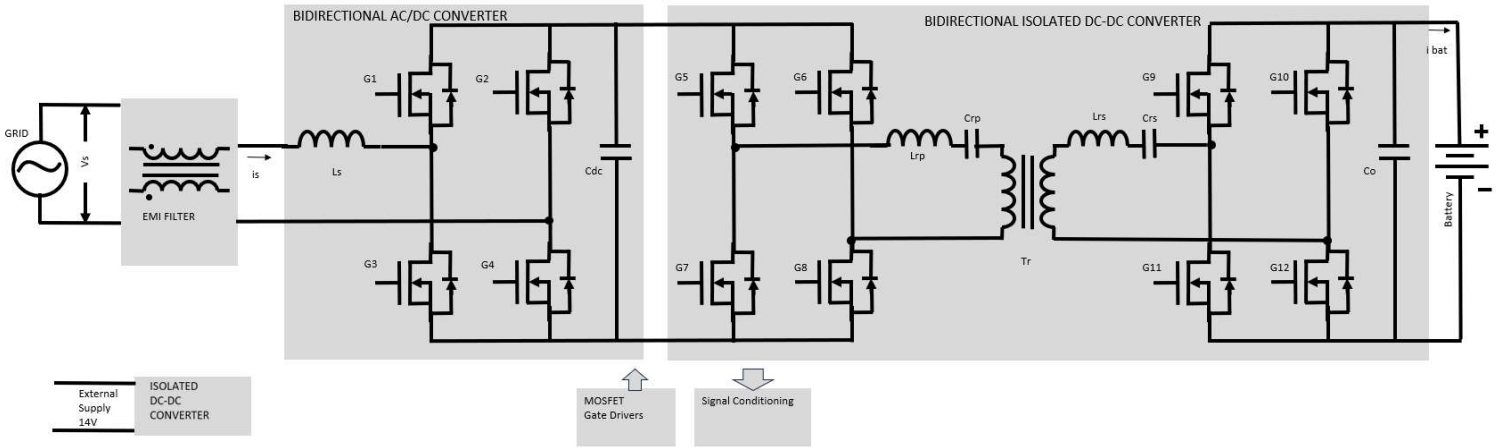
Design engineers can now meet and exceed the industry' s most ambitious efficiency standards, including 80 Plus Titanium requirements."

BIDIRECTIONAL ON-BOARD CHARGING FOR 800Volt BATERRIES

As the automotive world moves toward replacing gasoline with cleaner fuel alternatives, the EV transportation segment is experiencing rapid growth. As EVs operating purely on electric power continue to increase market share, the installed battery capacity per vehicle is also increasing.
Consumers are also demanding faster charging times for larger-capacity batteries. This demand is also spurring an increase in battery operating voltage from 400 V to 800 V, beginning with high-performance vehicles.

An EV equipped with sufficient battery capacity is potentially capable of acting as an energy-storage system, enabling a variety of vehicle-to-everything charging use cases: vehicle-to-home power generation, vehicle-to-grid opportunities, or vehicle-to-vehicle charging.
As a result, the OBC is migrating from a unidirectional to a bidirectional topology. There is a general trend toward the employment of bidirectional OBCs for their higher system efficiency.

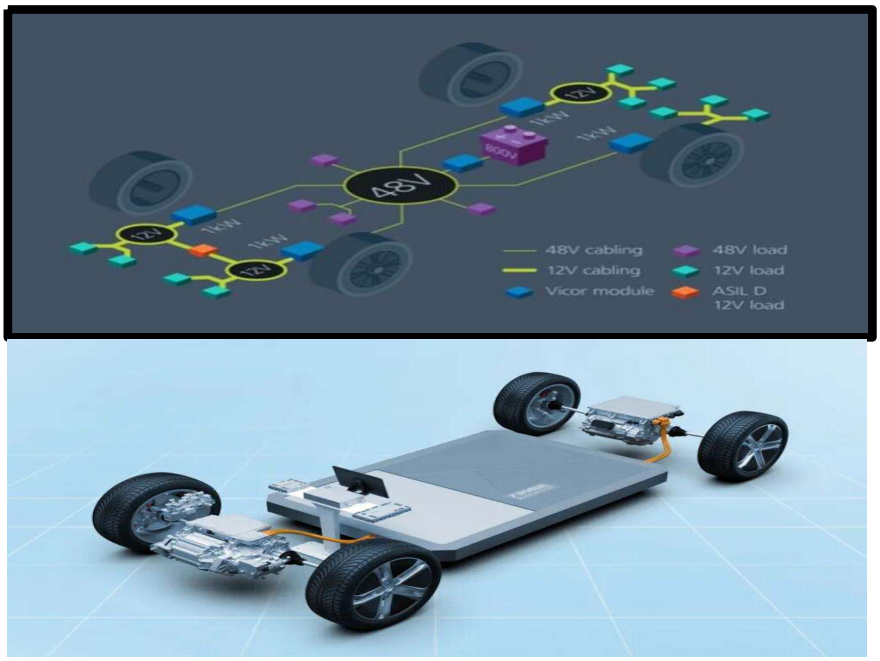
Totem Pole PFC DC link:385V-425V Bi-Directional DC/DC Battery 250V-450V



NEXT GENERATION EV BATTERY TECHNOLOGY MOVING FROM 400V to 800V DEMANDS mTSOI ISOLATION.

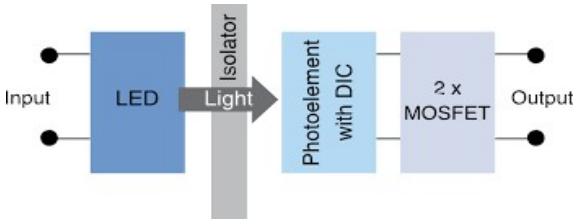
With the next generation of electric vehicles moving from 400V to 800V battery systems isolation is needed to allow sensitive electronic components to communicate safely with high-voltage fast transient components such as motors.

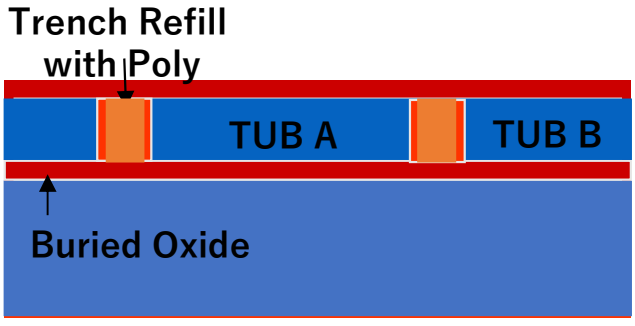
The use of PHOTOMOS relays based on IceMOS TSOI engineered substrates in both active and passive battery balancing circuits is a promising solution for EV manufacturers.



As EV system designers plan their transition from 400 V to 800 V batteries, new technologies are required the IceMOS TSOI enables High Voltage Battery Isolation.

Physical isolation: Sometimes referred to as galvanic separation, physical isolation between the relay's input and output or between different output channels enhances precision by minimizing noise. Optically-isolated relays offer a true physical separation of the input and output, and the best of these products exhibit isolation voltages as high as 5,000 volts AC.





mTSOI™

An EV is basically the biggest example of a human-machine interface (HMI). In other words, the biggest kind of equipment that a human will touch, operate, and work with every day is an EV. On one side you have the average very fragile human—not well trained, not well equipped—and then on the other side you have an 800 V battery.

With all that in mind, power isolation is becoming extremely important in EVs, a Physical isolation: Sometimes referred to as galvanic separation, physical isolation between the relay's input and output or between different output channels enhances precision by minimizing noise. Optically-isolated relays offer a true physical separation of the input and output, and the best of these products exhibit isolation voltages as high as 5,000 volts AC.

Trench Isolation substrates TSOI ensure efficient isolation between the control side (light input) and the switched side (electrical output). The isolation provided by the TSOI nd even more so as the EV industry transitions from 400 V batteries to 800 V batteries.

To address these challenges, enter solid-state relay MOSFETs and TSOI for Photo Relays from IceMOS.

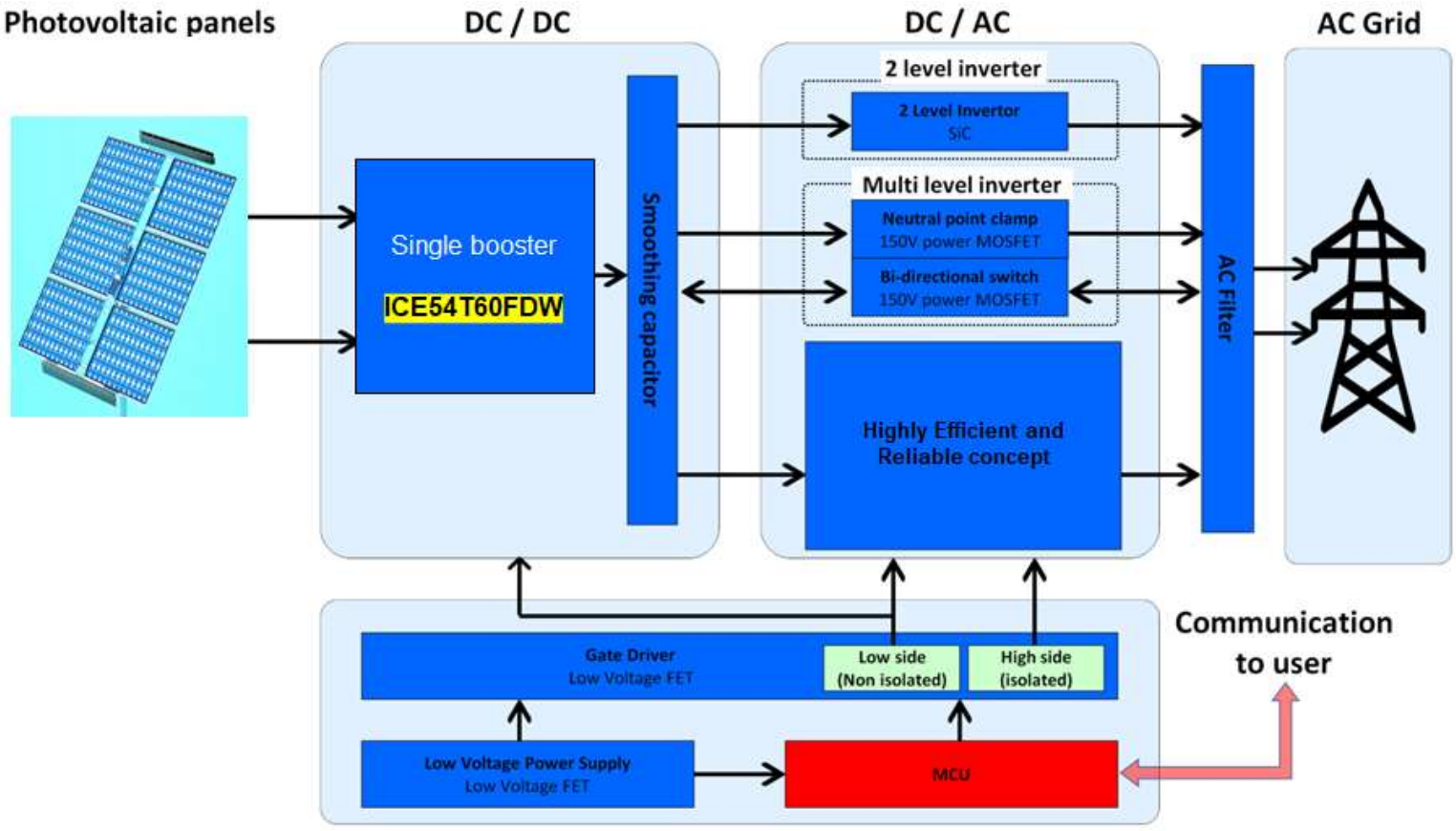
Smart Grid Connected Photovoltaic Renewable Solar Energy

The use of photovoltaic (PV) systems as the energy source of electrical distributed generators (DG) is gaining popularity, due to the progress of power electronics devices and technologies.

Large-scale solar PV power plants are becoming the preferable solution to meet the fast growth of electrical energy demand, as they can be installed in less than one year, as compared to around four years in the case of conventional power plants.

Photovoltaic installations are growing throughout the world, nearly according to Moore's law, duplicating the cumulative installed PV capacity roughly every two years. About 2 GWp were installed in 2000, 40 GWp were available in 2010 and more than 480 GWp operated all over the world in 2020.

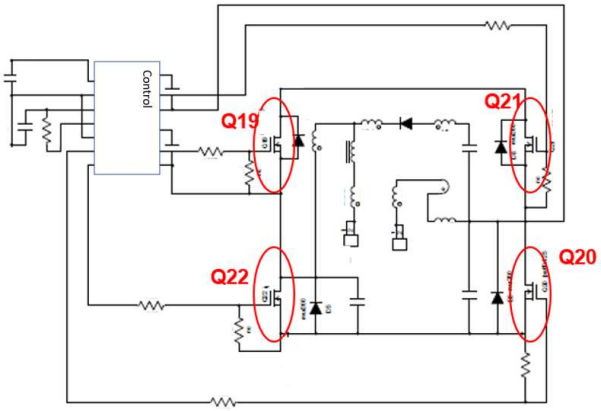
Efficiency and performance are the most important features of power converters used to manage PV energy. Grid-connected PV systems usually consist of a series of PV panels or strings, they are frequently configured by a couple of serially connected power converters, first a DC–DC converter that gets the maximum energy from the panels and then a DC–AC inverter that transfers all the available power to the grid

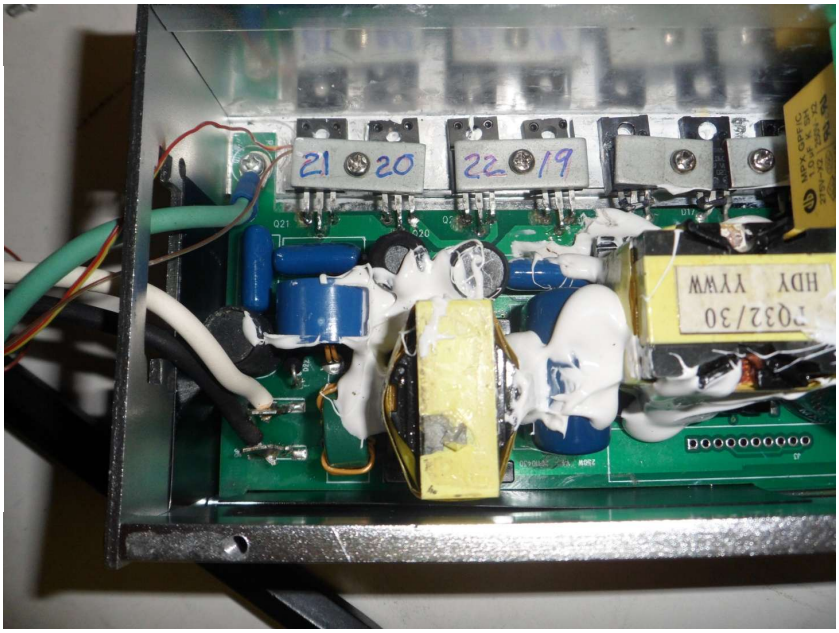


2.General Application

1)HID light ballast application ~500W

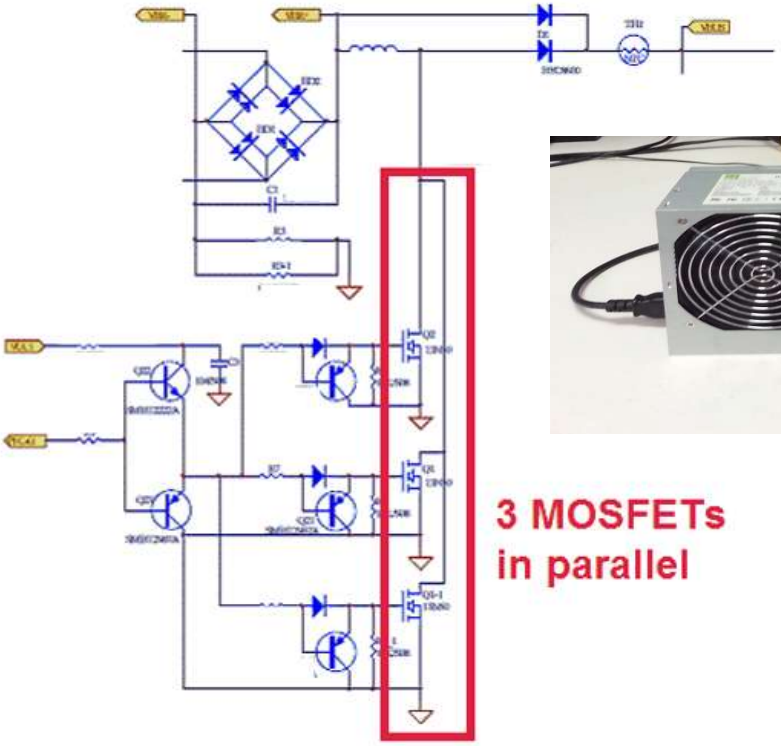
ICE15N60-15A/600V (4 MOSFETs are used for Bridge section)





2)ATX 600W Model

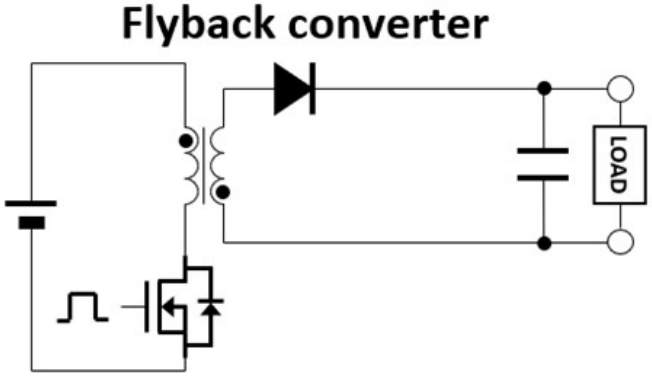
ICE20N170 -20A/600V /TO220
(3つの MOSFET をPFC(boost Converter)に使用。
SPEC:AC 100/240V DC 0~400W, 12V output



3) Switched-Mode Power Supply for Multifunction Peripheral/Printer/Product_FC Stage

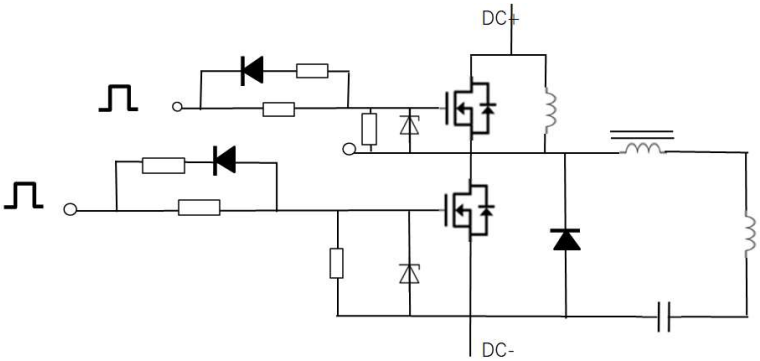
ICE10N60FP -10A600V
Alternative:
ICE15N60FP -15A600V
ICE20N170FP- 20A/ 600V

LED Driver
ICE20N170 20A/600V Robust UIS —
ICE15S60 15A/600V Lower FOM



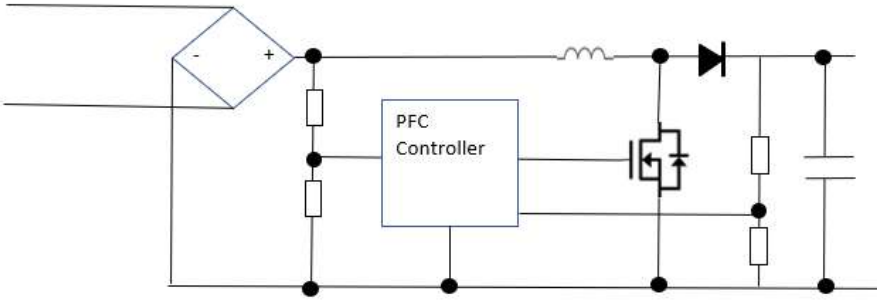
4) ATE 420W products

ICE60N130 25A/ 600V 2pcs
ICE15N60 15A/600V 2pcs



5) AC/DC 100kHz PFC Boost Converter

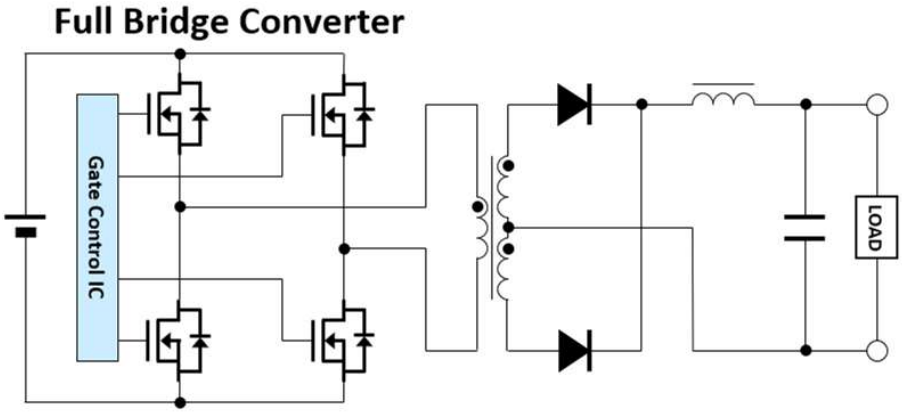
ICE8S65-8A/650V
ICE7N60 7A/ 600V
200V DC Input Output 385V DC



6) Full Bridge Converter

ICE47N60W -47A/600V

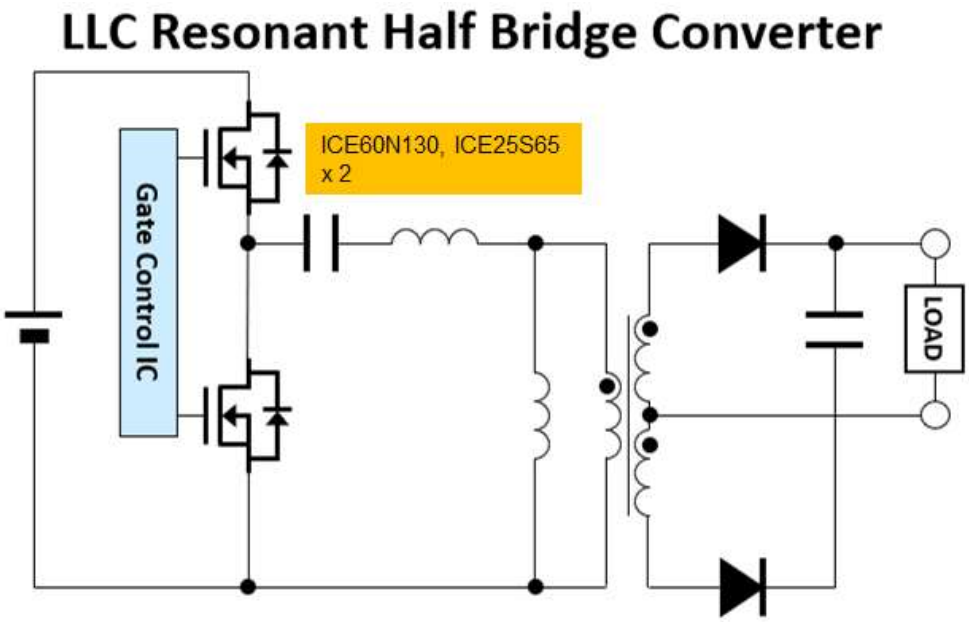
Audio Power



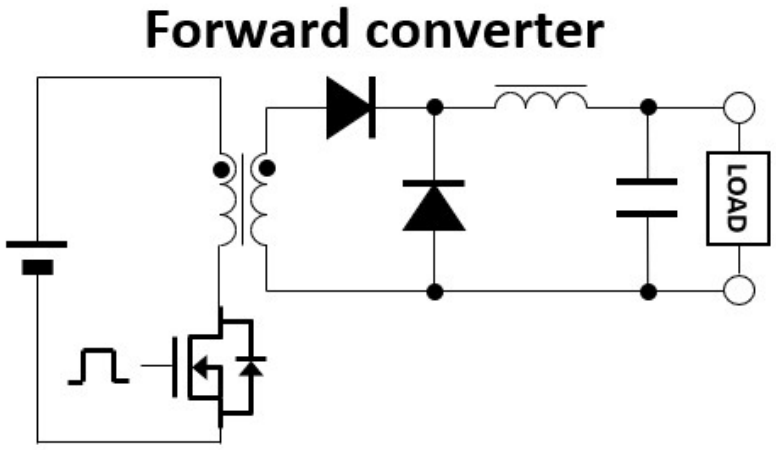
7) LLC Resonant Half Bridge Converter

Printer Power supply
ICE60N130 25A/600V -Robust UIS
ICE25S65 25A/650V – Lower FOM

Audio Power supply（声学电源）
22N60B 22A/600V/D2PAK



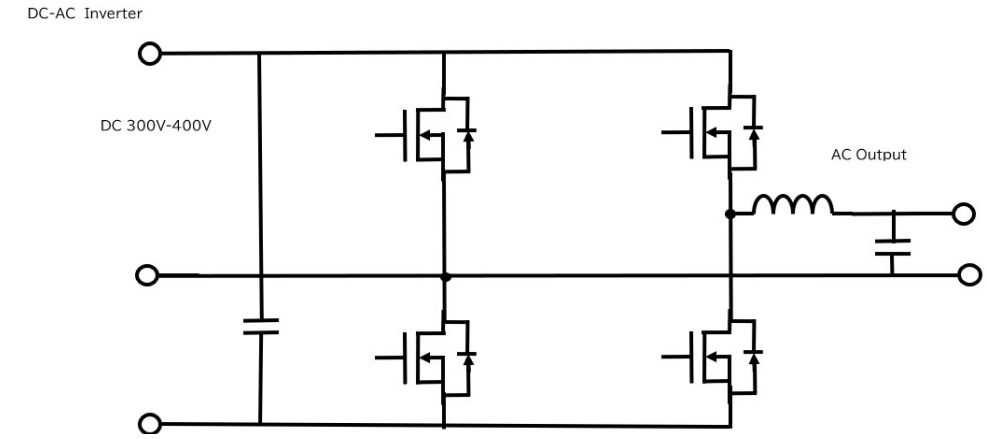
8) **Forward Converter** (Isolated) Low to High:PC, Industrial
ICE20N170 20A/600V Robust UIS
ICE60N130 25A/600V Lower FOM

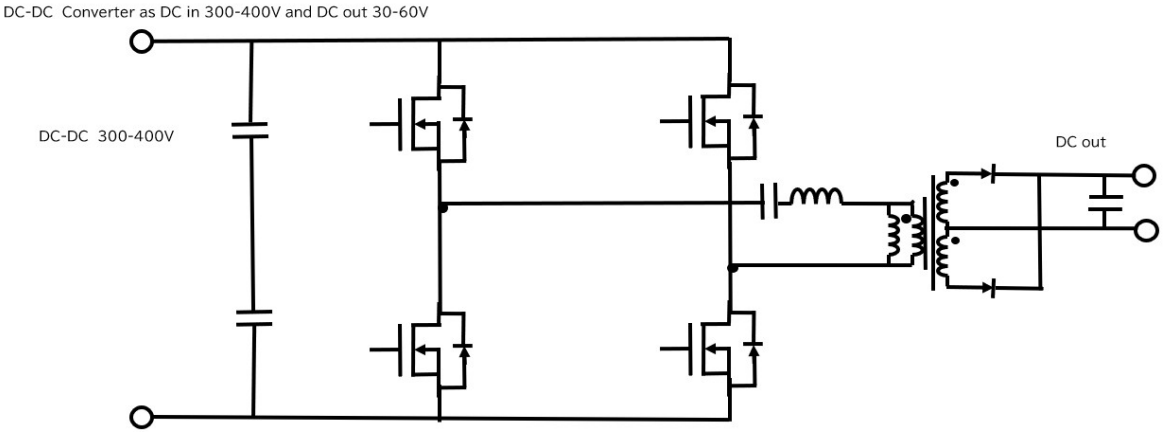


Example using an ICE20N170 and an ICE60N130. This system provides a wide range of outputs. The ripple voltage is lower compared to the flyback type, although the diode and choke coil must be included. The output voltage is determined by the turns ratio of the primary and secondary.

9) DC-AC Inverter /DC-DC Converter

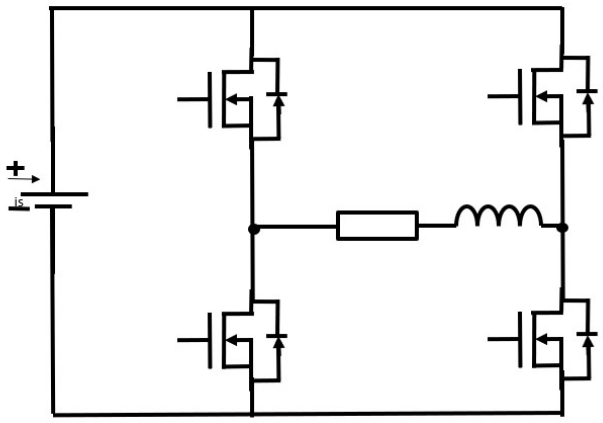
UPS 25A and 15A rated 600 and 650V
ICE60N130 25A/600V-Robust EAS
ICE25S65 25A/650V –Low FOM due to Low Qg
ICE15N60 15A/600V –Cost Effective
ICE15S60 15A/600V –Low FOM due to Low Qg





10) **Inverter**
Solar Inverter/ Micro Inverter

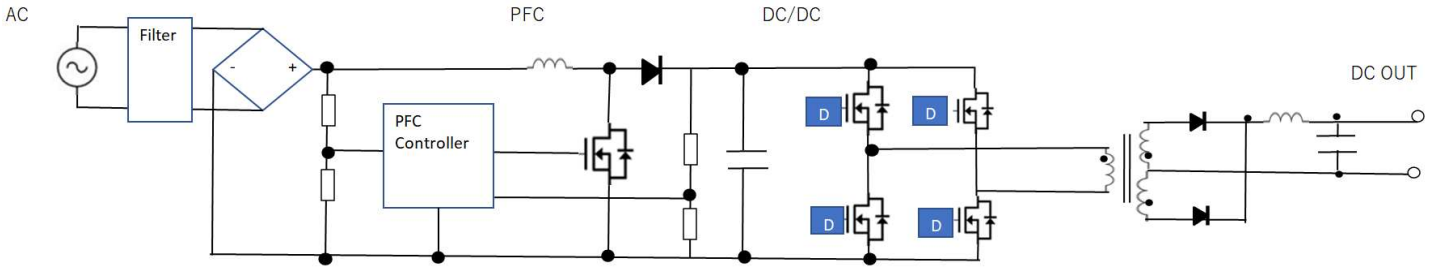
25A and 15A rated 600 and 650V
ICE25S65 25A/650V –Low FOM due to Low Qg
ICE15S60 15A/600V –Low FOM due to Low Qg

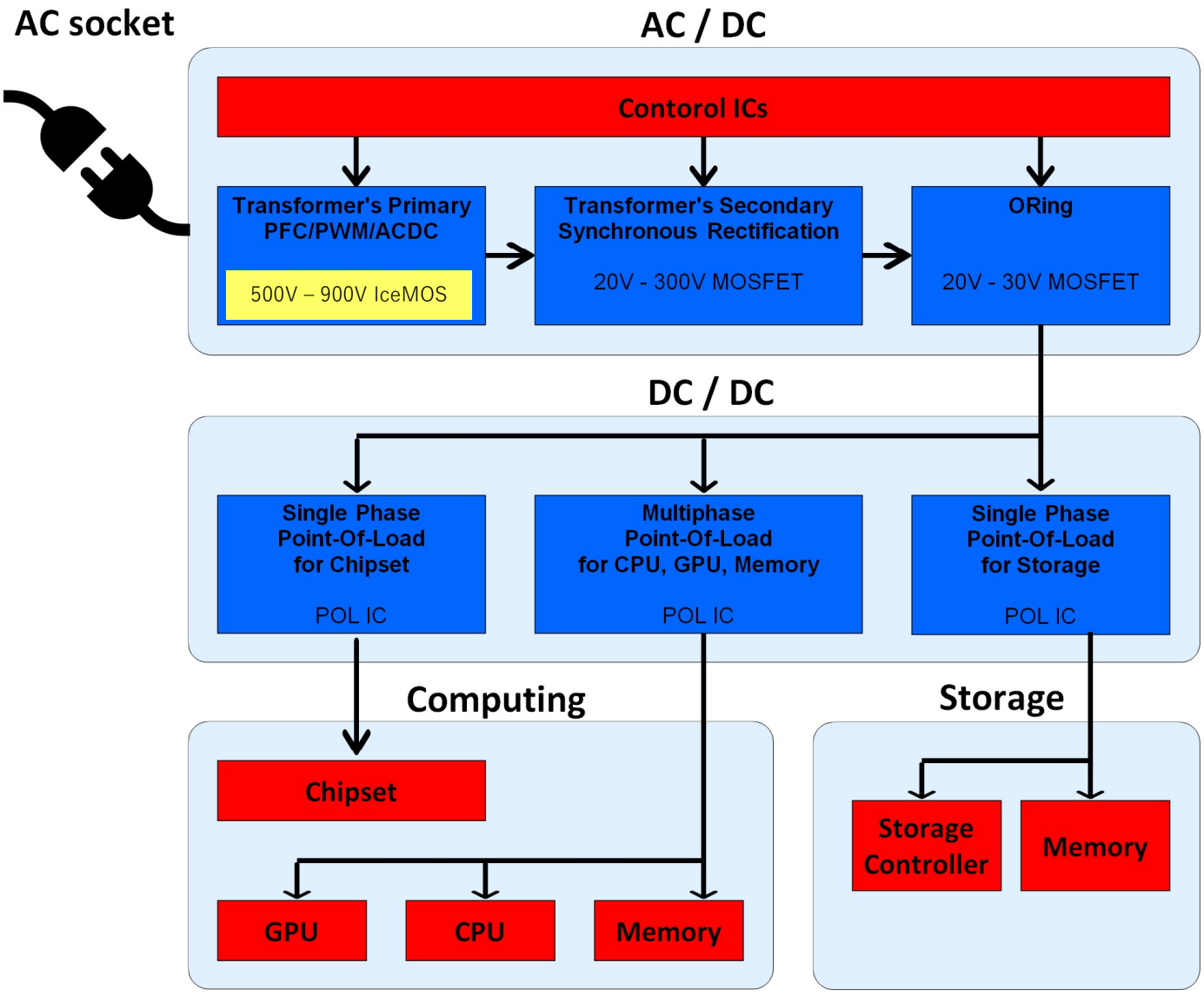


The case which needs high current in such Solar panel.

11) PFC/PWM/AC-DC
Data Center Power Supply
AC 90-265V
DC-DC 400V and Output 12V dc

ICE25S65 25A/650V –Low FOM due to Low Qg
ICE60N130 25A/600V-Robust UIS





MOSFETs with various current and voltage ranges are used according to the design and specifications.

12)LTE Rooter Load 5V 4A 54V 0.55A Power Module
ICE8S65FP 8A/650V/TO220FP

LTE Wi-Fi Router Power Supply

Key Device Technology: ICE8S65FP (8A,650V, TO220FP) and ICE11N70FP (11A,700V,TO220FP)

Long Term Evolution (LTE) routers, also known as “4G routers”, are a specific type of network router that can provide mobile broadband internet connectivity to devices via a Wi-Fi, Ethernet, or USB connection. They are categorized by their use of fourth-generation long-term evolution (4G LTE) and LTE-Advanced wireless modems, modules, or PCI Mini Cards to drive high-speed data transfer over cellular networks. These routers are very popular for machine-to-machine (M2M) and the Internet of Things (IoT) communications environments because they offer full-duplex communications links using frequency-division duplexing (FDD) or time-division duplexing (TDD) depending on the frequency band used. LTE router mobility can support devices moving at speeds of up to 350 kilometers per hour, with coverage of 5 to 100 km, along with individual channel bandwidths between 1.4 and 20 MHz. Antenna diversity and spatial multiplexing with MIMO features enhance the performance and speed. Using MIMO increases downlink speeds of up to 300 Mbps with low latency (10 mS).

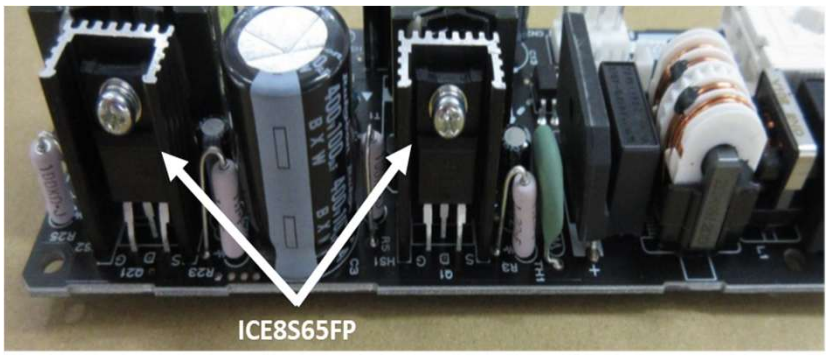
The designers of these routers are placing greater emphasis on more reliable efficient power MOSFET devices in their circuits. The ICE11N70FP (Gen1 technology) and the ICE8S65FP (Gen2 technology) are both idea for the LTE Wi-Fi Router application.

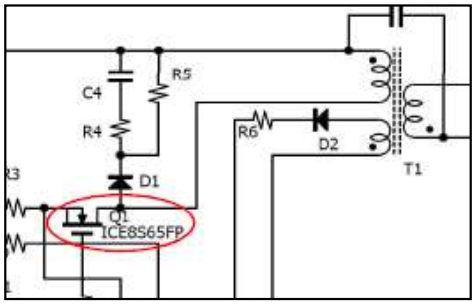
LTE Wi-Fi Router Case Study:

Customer “A” evaluated the ICE8S65FP as a replacement for the device from our competitor because of delivery problems. The table below shows the actual side-by-side comparison test results assessing the ICE8S65FP performance versus the device from “SUPPLIER-1”. The conclusion was that the ICE8S65FP had no issue for thermal characteristic and was a viable replace for the new Wi-Fi Router design in development. IceMOS got the design win!

			AC90V			AC100V			AC230V			AC264V		
CH. No.	REF.No.	SUPPLIER	Tc	ΔT	Tc (50°C)	Tc	ΔT	Tc (50°C)	Tc	ΔT	Tc (50°C)	Tc	ΔT	Tc (50°C)
7	Q1	SUPPLIER-1	68.55	38.70	88.70	65.50	36.15	86.15	65.20	36.80	86.80	66.80	38.50	88.50
	Q1	ICE8S65FP	64.30	34.95	84.95	62.60	33.50	83.50	60.70	32.80	82.80	63.10	34.55	84.55
		Δ	-	-	-3.75	-	-	-2.65	-	-	-4.00	-	-	-3.95
14	Q21	SUPPLIER-1	59.45	29.60	79.60	57.75	28.40	78.40	65.40	37.00	87.00	68.25	39.95	89.95
	Q21	ICE8S65FP	56.20	26.85	76.85	55.00	25.90	75.90	60.30	32.40	82.40	64.30	35.75	85.75
		Δ	-	-	-2.75	-	-	-2.50	-	-	-4.60	-	-	-4.20
Power Consumption (W)		SUPPLIER-1	59.6	-	-	58.5	-	-	57.6	-	-	57.8	-	-
		ICEMOS	59.1	-	-	58.4	-	-	57.5	-	-	57.7	-	-
		Δ	-0.50	-	-	-0.10	-	-	-0.10	-	-	-0.10	-	-

Power Module Load Conditions: 5V/4A and 54V/0.55A
Temperature Requirement: < 142° C @ 1.75W





- **Two MOSFETs used for LTE Router AC-DC**
- **AC in 90-100V**
- **Two lines DC out for DC 5V and 54V POE**

13) PMF Circuit

ICE22N60W Device 22A/600V TO247

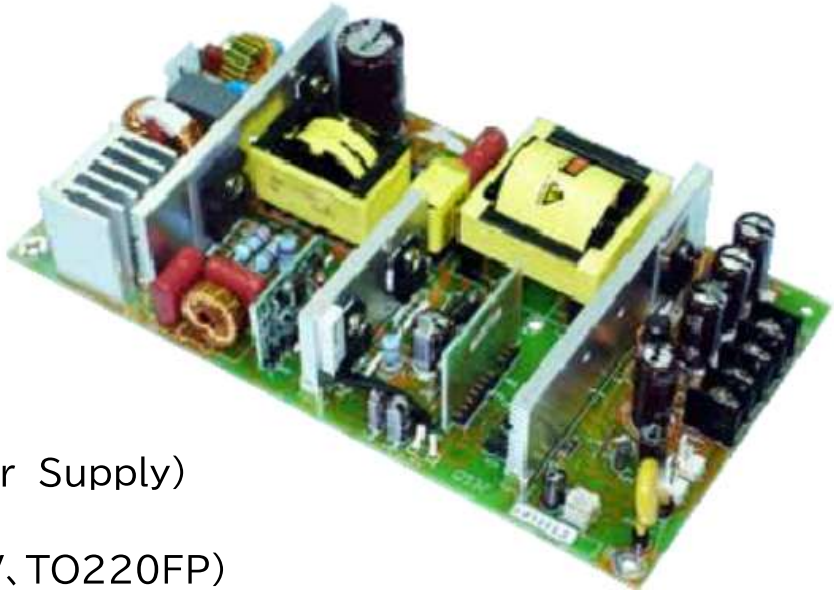
Design WIN CASE

Efficiency 86-88%

380W peak load

After evaluate with other 2competitor's samples, ICE22N60W win to adopt.

Reason of design win:Customer explained that other competitor's device did not functioned due to higher Vg. And Other competitor device sometime destroyed during function. Therefore Customer choose our ICE22N60W.



14) 100 V Power Module (Power Supply)

ICE20N60EFP (20A, 600V、TO220FP)

100W Power Supply

Input 90Vac to 264Vac47－63Hz

Input current 4A max 115Vac, 2A max /230Vac

Inrush current 40A maz 115Vac , 80A max 230Vac

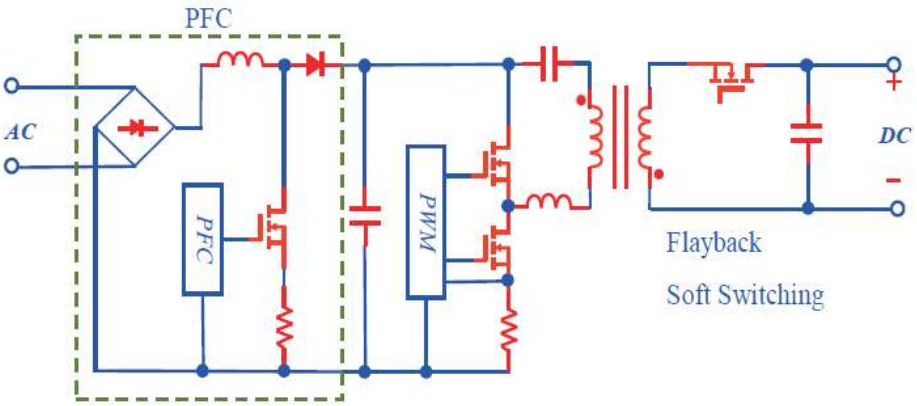
Output

Vo 24V, Peak load 8.4A

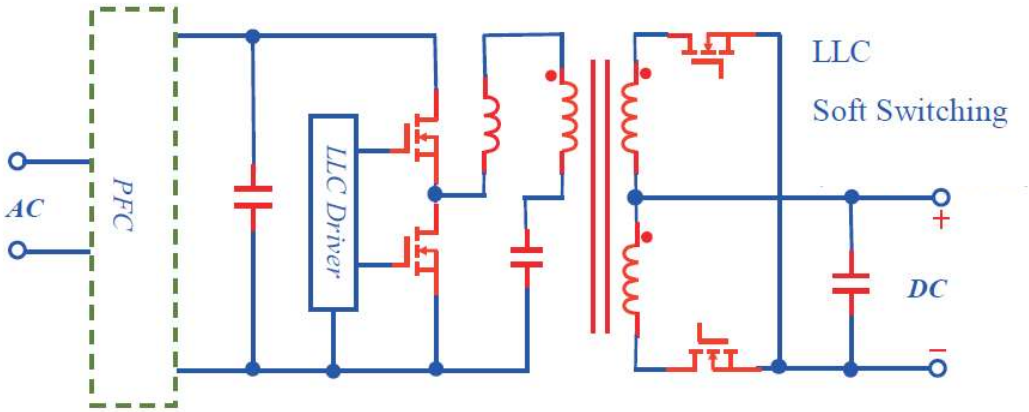
ICE20N60EFP

15) Asymmetrical ZVS Flyback
120W to 300W with PFC

ICE47N60W ,47A/600V TO247
2 MOSFETs
Design WIN CASE FOR EURO Maker
Two MOS with PFC,Single & Multiple output

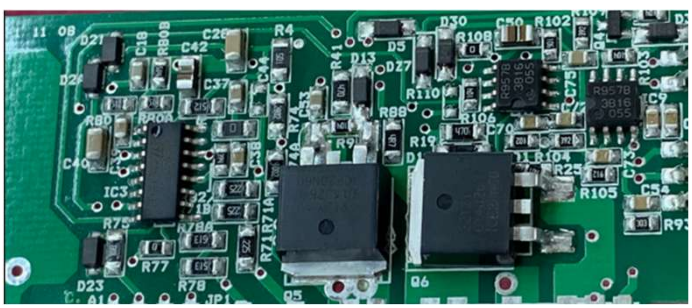


16)Half Bridge LLC Resonant Soft Switching ZVS 200W Single Output with PFC , Peak and Surge Load



ICE22N60B 2 MOSFETs
22A,600V D2PAK

ICE20N60B 2 MOSFETs
20A,600V D2PAK



IceMOS
Cooler than Cool

Product Table

GEN	Product	BVDSS Min. (V)	ID Max. (A)	RDSON Max. (Ω)	Qg Typ. (nC)	FOM (Ω・nC)	IAR (A) Avalanche Current	Package *Pbfree TO=TO220* FP=Full Pak* W=TO247* D=TO252 L=DFN88 ,LK=DFN56 B=TO263 T=TOLL C=Wafer*
1	ICE47N60	600	47	0.068	189	12.85	20	W,C
	ICE60N130	600	25	0.15	84	12.60	11.5	TO,FP,W,C,B
	ICE22N60	600	22	0.16	84	13.44	11	TO, B ,W, T
	ICE20N170	600	20	0.199	59	11.74	10	TO,FP,W,C,B,T
	ICE20N60	600	20	0.19	59	11.21	10	TO,FP,W,B,C,T
	ICE19N60	600	19	0.22	59	12.98	9.5	L8x8
	ICE15N73	730	15	0.35	75	26.25	7.5	TO,FP,W ,T
	ICES15N60	600	15	0.24	52	12.48	9.5	TO,FP,L8x8,B,T
	ICE13N60	600	13	0.27	48	12.96	9	TO,FP,L8x8,B,T
	ICE11N70	700	11	0.25	84	21.00	5	TO,FP,W,B,C ,T
	ICE10N60	600	10	0.33	43	14.19	5	TO,FP,W,B,L8x8,T
	ICES10N60	600	10	0.36	40	14.40	7	D
	ICE8N60	600	8	0.52	32	16.64	6	TO,FP,W,B,L8x8, T,D,LK
2	ICE32S60	600	32	0.078	47	3.67	10	TO,FP,W,C,T
	ICE25S65	650	25	0.133	34	4.52	8	TO,FP,W,C,B, T
	ICE24S65	650	24	0.141	34	4.79	8	L8x8
	ICE15S60	600	15	0.175	30	5.25	5	TO,FP,W,C,B ,T
	ICE14S65	650	14	0.195	24	4.68	5	TO,FP,W,C,B ,T
	ICE8S65	650	7.8	0.4	11.5	4.60	2.7	TO,FP,W,B,C,D,LK56,T

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