# Configuration Option 동작 수정 요청!

Using "Config.txt" File

```
message=distance
loading=0
speed=10-30
linearity=0.93
output=linearity
saved=none
threshold=-60
```

Drive Distance : 1,234km

Vehicle Loading :
☑ None   ☐ >150kg

Continue / Pause

Save & End

**Raw-Data Display
in Time-domain
(Speed, Angle, Torque)**

Run / Stop

0km/h

10~30km/h

40~60km/h

Linearity = **.*%

Linearity = **.*%

Linearity = **.*%

'assist_torque'로 option변경시, 기울기값 표기!

✓ Message option
    : distance or date

✓ Loading option
    : 0 or 150

✓ Speed classification option
    : speed=10-30

✓ Output option
    : linearity or assist_torque

'assist_torque'로 option변경시, 변화없음!

✓ Saved option(loading of previously saved data or not)
    : none or saved03.txt

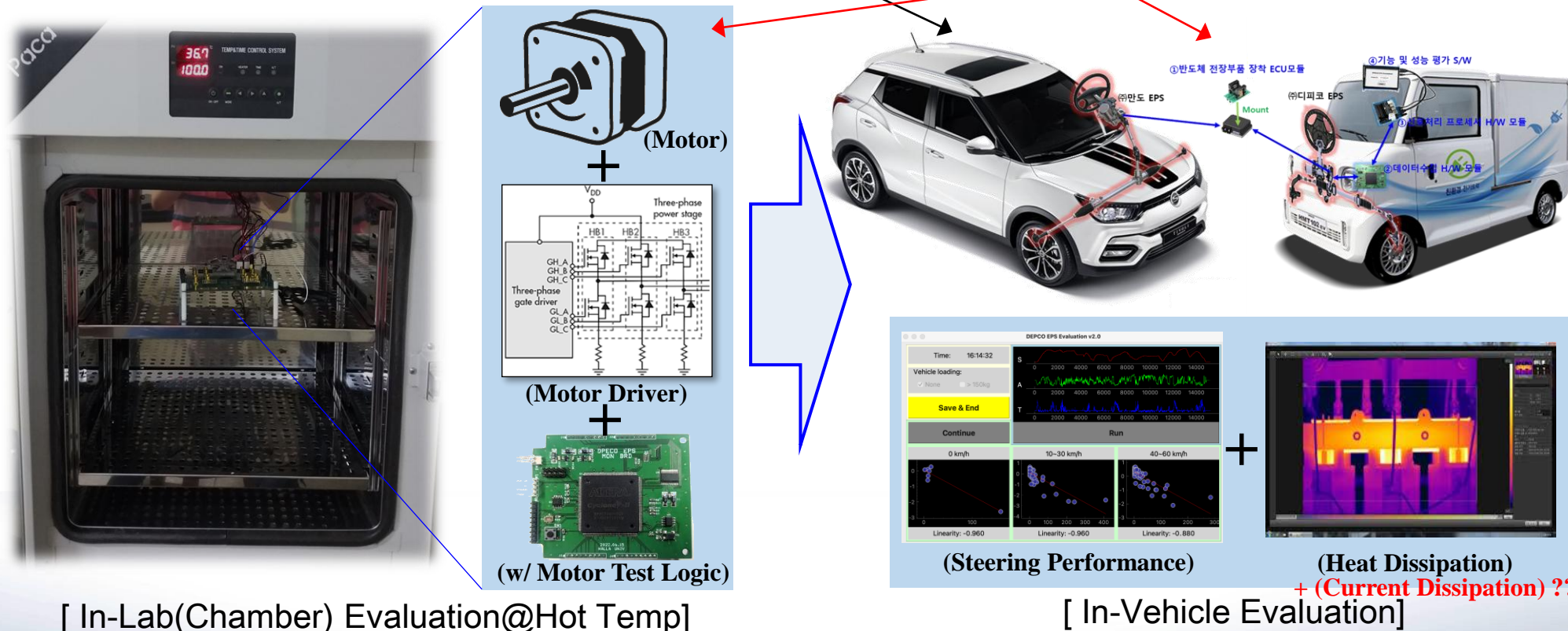✓ Vaild threshold option(7p) : 0~-99
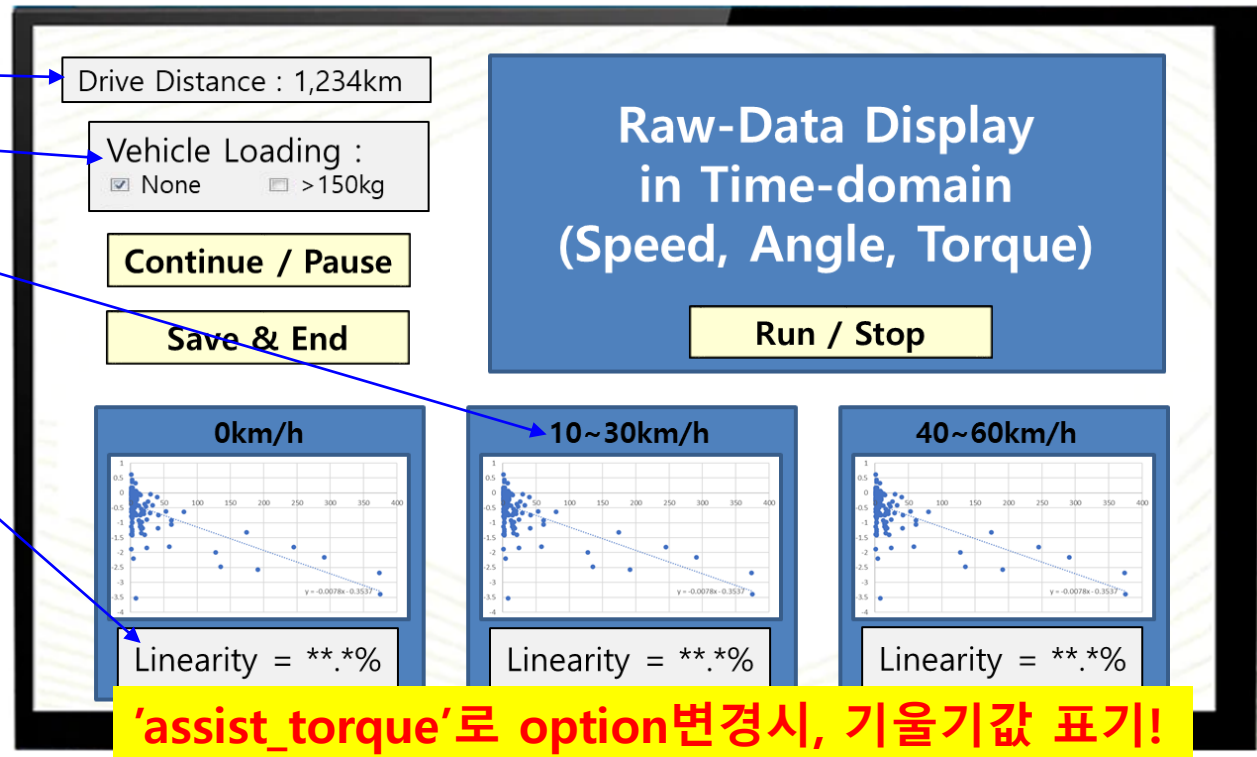
PowerFET PKG@EPS Evaluation

In-Lab ⇨ In-Vehicle Evaluation

- ✓ Mando(Tivoli GEN2) PowerFET ⇨ Liquid Cooling Package
- ✓ Dpeco(Potro P250) PowerFET ⇨ GaN TR
- ✓ Evaluation Item : Steering Performance **+ Heat&Current Dissipation**
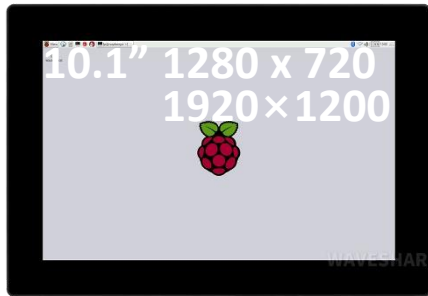

(Motor)

+

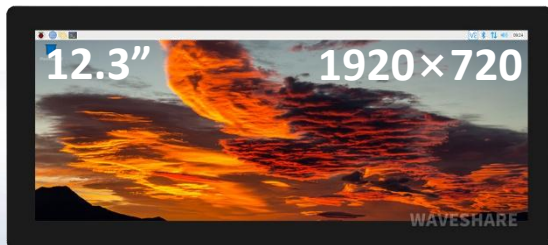(Motor Driver)

+

(w/ Motor Test Logic)

[In-Lab(Chamber) Evaluation@Hot Temp]

(Steering Performance)

+

(Heat Dissipation)
+ (Current Dissipation) ??

[In-Vehicle Evaluation]

기능 추가에 따른 S/W 변경(1)

열화상카메라 추가 및 *Touch Display* 변경

https://www.flirkorea.com/products/flir-one-pro/?vertical=condition%20monitoring&segment=solutions

10.1" 1280 x 720
1920×1200

vs.

12.3"   1920×720

New!
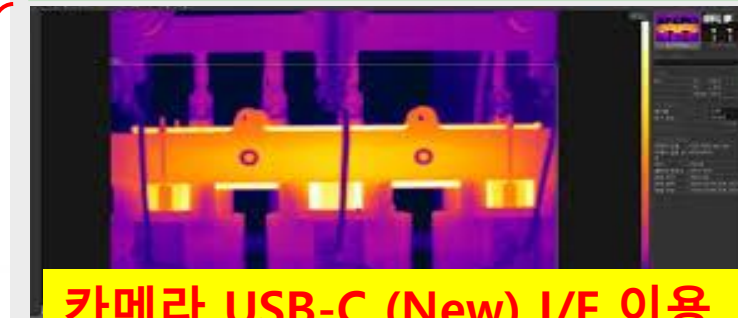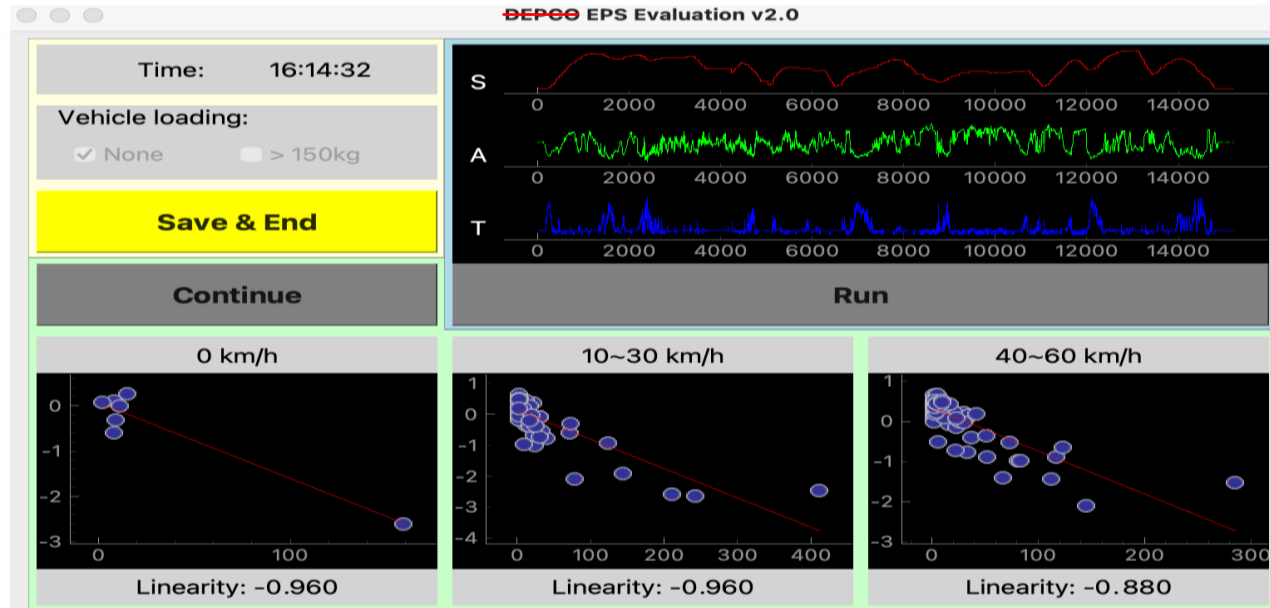
카메라 USB-C (New) I/F 이용
(Heat&Current Dissipation)

~~DEPCO~~ EPS Evaluation v2.0

Time:	16:14:32

Vehicle loading:
☑ None   ☐ > 150kg

Save & End

Continue

Run

0 km/h	10~30 km/h	40~60 km/h
Linearity: -0.960	Linearity: -0.960	Linearity: -0.880

Current Consumption

Mean = **.*mA

Max = **.*mA

Min = **.*mA

[S/W UI 구성 예시]
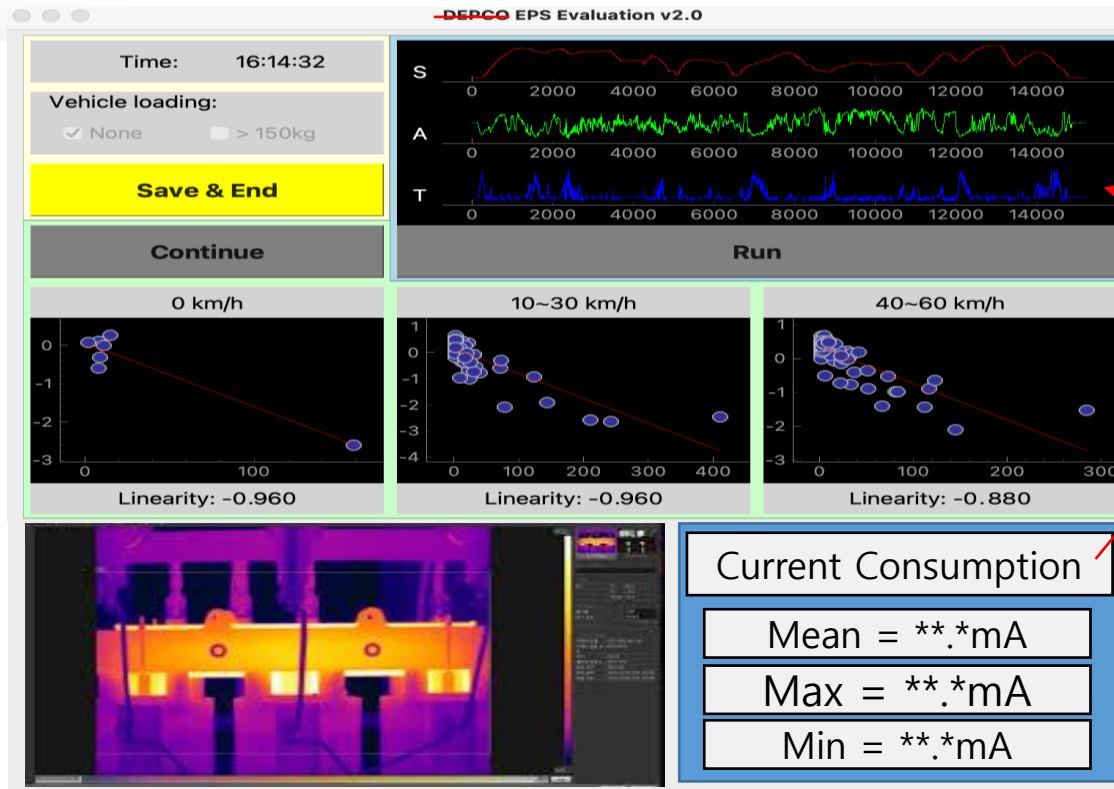
데이터 전송 Protocol에 추가!

기능 추가에 따른 S/W 변경(2)

Heat&Current Dissipation Evaluation Options

**전류소모 모니터링 추가!
: 3개(SAT) => 4개(SATI)**

**Options :
① update 주기@config file
: 1초, 5초, 10초, 30초, 1분, 5분
② start/reset button 추가!**

**Options :
① update 주기@config file : 1초, 5초, 10초, 30초, 1분, 5분
② jpg 파일 저장 option@config file : one-shot / hundred-times
③ jpg 파일 저장 button 추가!**
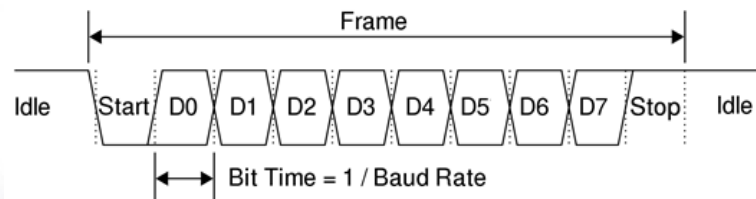
으로 변경 가능!

4

ASCII Protocol(기존)

Transfer Data (Baudrate: 57600bits/s, Transfer Interval:11.2332ms)
: Vehicle Speed / Handwheel ~~Angle~~(Torque) / Assistance Torque

No.	Trasfe Data(ASCII)	Transfer Value(HEX)	Packet#	Descirption
1	Vehicle Speed			
	SPD:+46.5,	40'h5350443A2B35362E352C	10	Vehicle Speed = +46.5km/h
	SPD:−02.0,	40'h5350443A2D30322E302C	10	Vehicle Speed = −2.0km/h
2	Handwheel Angle			
	ANG:+0720,	40'h414E473A2B303732302C	10	Handwheel Angle = +720°
	ANG:−1000,	40'h414E473A2D313030332C	10	Handwheel Angle = −1003°
3	Steering Torque			
	TRQ:+13.2^J	40'h5452513A2B31332E320A	10	Steering Torque = +13.2Nm
	TRQ:−05.9^J	40'h5452513A2D30352E390A	10	Steering Torque = −5.9Nm

8'h34   8'h2E

8'h2B 8'h36 8'h35

"SPD:+46.5,ANG:+720,TRQ:+13.2^J"

8'h3A   8'h2C   8'h0A

8'h53

8'h44

8'h50

ASCII Codes

DEC	HEX	OCT	Char	DEC	HEX	OCT	Char	DEC	HEX	OCT	Char
0	0	0	Ctrl-@ NUL	43	2B	53	+	86	56	126	V
1	1	1	Ctrl-A SOH	44	2C	54	,	87	57	127	W
2	2	2	Ctrl-B STX	45	2D	55	−	88	58	130	X
3	3	3	Ctrl-C ETX	46	2E	56	.	89	59	131	Y
4	4	4	Ctrl-D EOT		2F	57	/	90	5A	132	Z
5	5	5	Ctrl-E ENQ	48	30	60	0			133	[
6	6	6	Ctrl-F ACK	49	31	61	1			134	\
7	7	7	Ctrl-G BEL	50	32	62	2			135	]
8	8	10	Ctrl-H BS	51	33	63	3			136	^
9	9	11	Ctrl-I HT	52	34	64	4			137	_
10	0A	12	Ctrl-J LF	53	35	65	5			140	`
		13	Ctrl-K VT	54	36	66	6			141	a
	0C	14	Ctrl-L FF	55	37	67	7			142	b
		15	Ctrl-M CR	56	38	70	8			143	c
	0E	16	Ctrl-N SO	57	39	71	9			144	d
	0F	17	Ctrl-O SI	58	3A	72	:			145	e
		20	Ctrl-P DLE			73	;			146	f
	11	21	Ctrl-Q DC1		3C	74	<			147	g
	12	22	Ctrl-R DC2		3D	75	=			150	h
		23	Ctrl-S DC3			76	>			151	i
	14	24	Ctrl-T DC4		3F	77	?			152	j
	15	25	Ctrl-U NAK		40	100	@			153	k
	16	26	Ctrl-V SYN	65	41	101	A			154	l
	17	27	Ctrl-W ETB	66	42	102	B			155	m
	18	30	Ctrl-X CAN	67	43	103	C			156	n
	19	31	Ctrl-Y EM	68	44	104	D			157	o
	1A	32	Ctrl-Z SUB	69	45	105	E			160	p
	1B	33	Ctrl-[ESC	70	46	106	F			161	q
	1C	34	Ctrl-\ FS	71	47	107	G			162	r
	1D	35	Ctrl-] GS	72	48	110	H			163	s
		36	Ctrl-^ RS	73	49	111	I			164	t
	1F	37	Ctrl-_ US	74	4A	112	J			165	u
		40	Space	75	4B	113	K			166	v
	41		!	76	4C	114	L			167	w
	42		"	77	4D	115	M			170	x
	43		#	78	4E	116	N			171	y
	44		$	79	4F	117	O			172	z
	45		%	80	50	120	P			173	{
	46		&	81	51	121	Q			174		
	47		'	82	52	122	R			175	}
			(	83	53	123	S			176	~
		51	)	84	54	124	T			177	DEL
	2A	52	*	85	55	125	U				

Frame

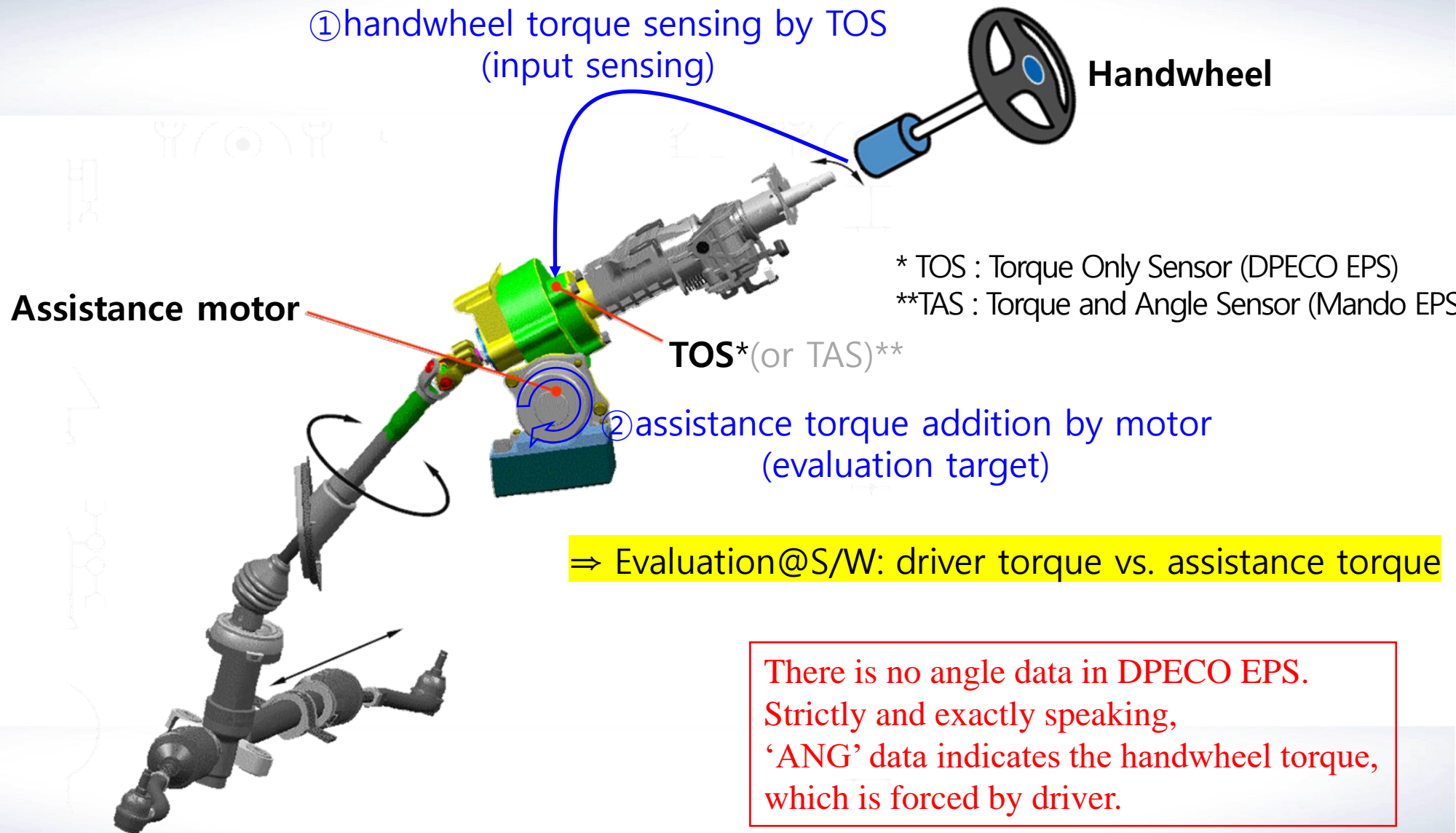Idle Start D0 D1 D2 D3 D4 D5 D6 D7 Stop Idle
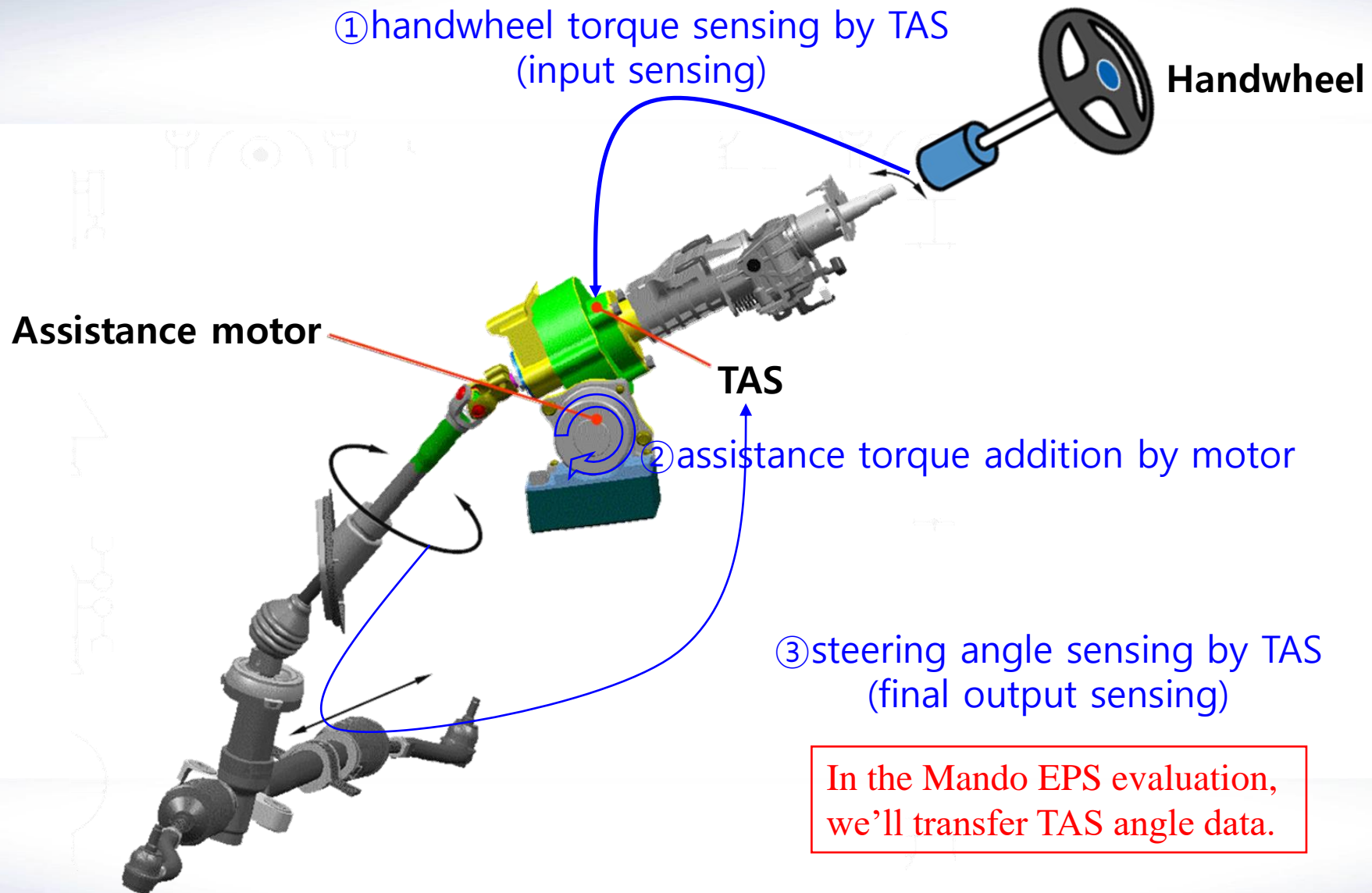
Bit Time = 1 / Baud Rate

ASCII Protocol(New)

Transfer Data (Baudrate: 57600bits/s, Transfer Interval:11.2332ms)
: *Vehicle Speed / Handwheel ~~Angle~~(Torque) / Assistance Torque*
+ / Current(Power) Dissipation

8'h34
8'h2E
8'h2B   8'h36   8'h35

"SPD:+46.5,ANG:+720,TRQ:+13.2,PWR:+10.1^J"

8'h53   8'h3A   8'h2C   8'h50   8'h3A   8'h0A
8'h44   8'h52
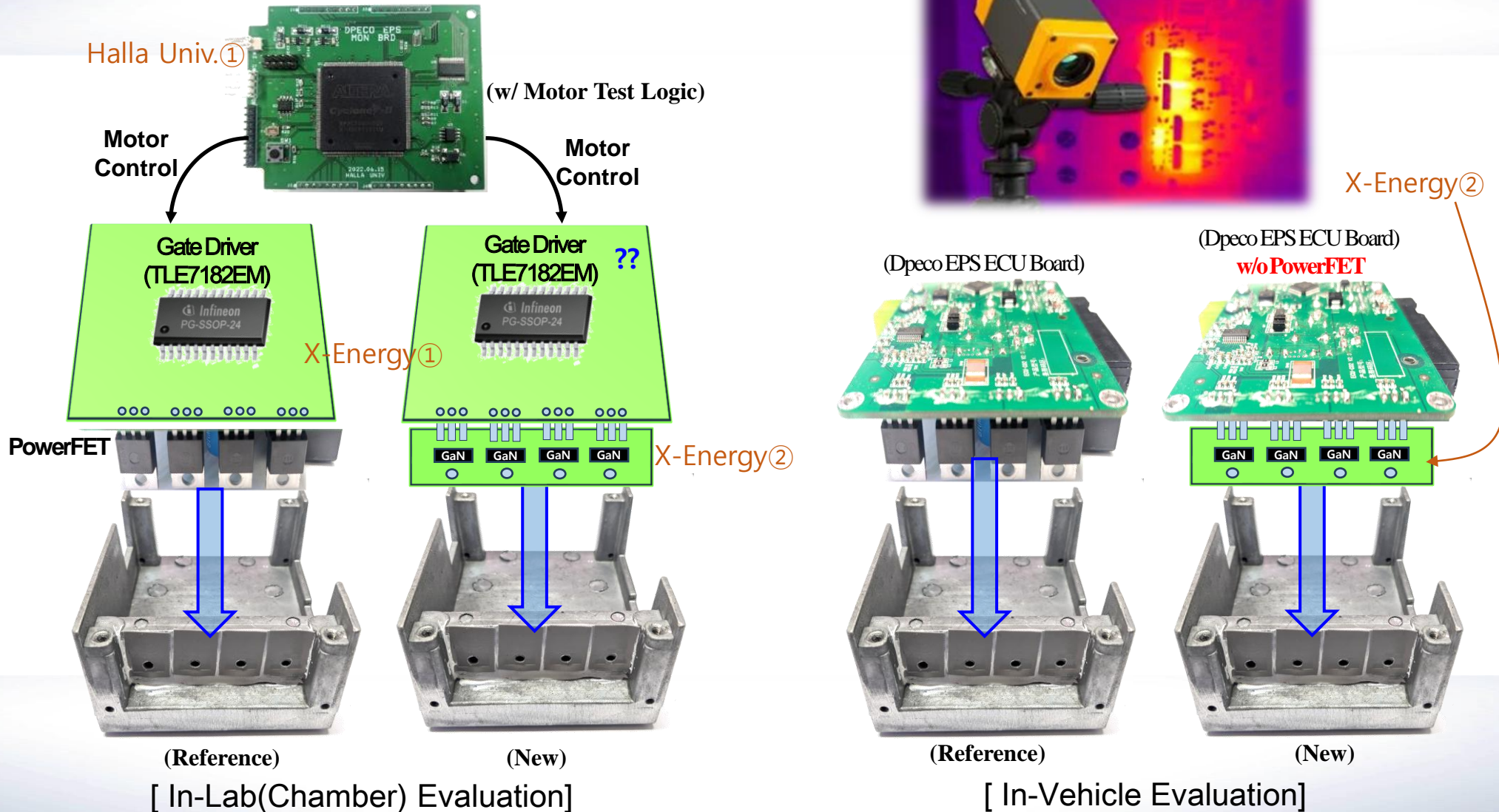8'h50   8'h57

DPECO EPS Operation

①handwheel torque sensing by TOS
(input sensing)

Handwheel

Assistance motor

* TOS : Torque Only Sensor (DPECO EPS)
**TAS : Torque and Angle Sensor (Mando EPS

TOS*(or TAS)**

②assistance torque addition by motor
(evaluation target)

⇒ Evaluation@S/W: driver torque vs. assistance torque

There is no angle data in DPECO EPS.
Strictly and exactly speaking,
'ANG' data indicates the handwheel torque,
which is forced by driver.

Mando EPS Operation

①handwheel torque sensing by TAS
(input sensing)

Handwheel

Assistance motor

TAS

②assistance torque addition by motor

③steering angle sensing by TAS
(final output sensing)

In the Mando EPS evaluation,
we'll transfer TAS angle data.

Appendix

Proposed GaN PKG@Dpeco EPS

PowerFET vs. GaN TR PKG

Halla Univ.①

(w/ Motor Test Logic)

Motor Control

Motor Control

Gate Driver (TLE7182EM)

Gate Driver (TLE7182EM) ??

X-Energy①

PowerFET

X-Energy②

(Reference)

(New)

[In-Lab(Chamber) Evaluation]

X-Energy②

(Dpeco EPS ECU Board)

(Dpeco EPS ECU Board)
w/o PowerFET

(Reference)

(New)

[In-Vehicle Evaluation]

Proposed PowerFET PKG@Mando EPS

Heat Sink vs. Liquid Cooling

Halla Univ.①

(w/ Motor Test Logic)

Motor Control

Motor Control

X-Energy③

X-Energy④

GateDriver (A4916)   PowerFET

GateDriver (A4916)

Halla Univ.②

Liquid Cooling PKG w/ PowerFET

External Pump

(Reference)

(New)
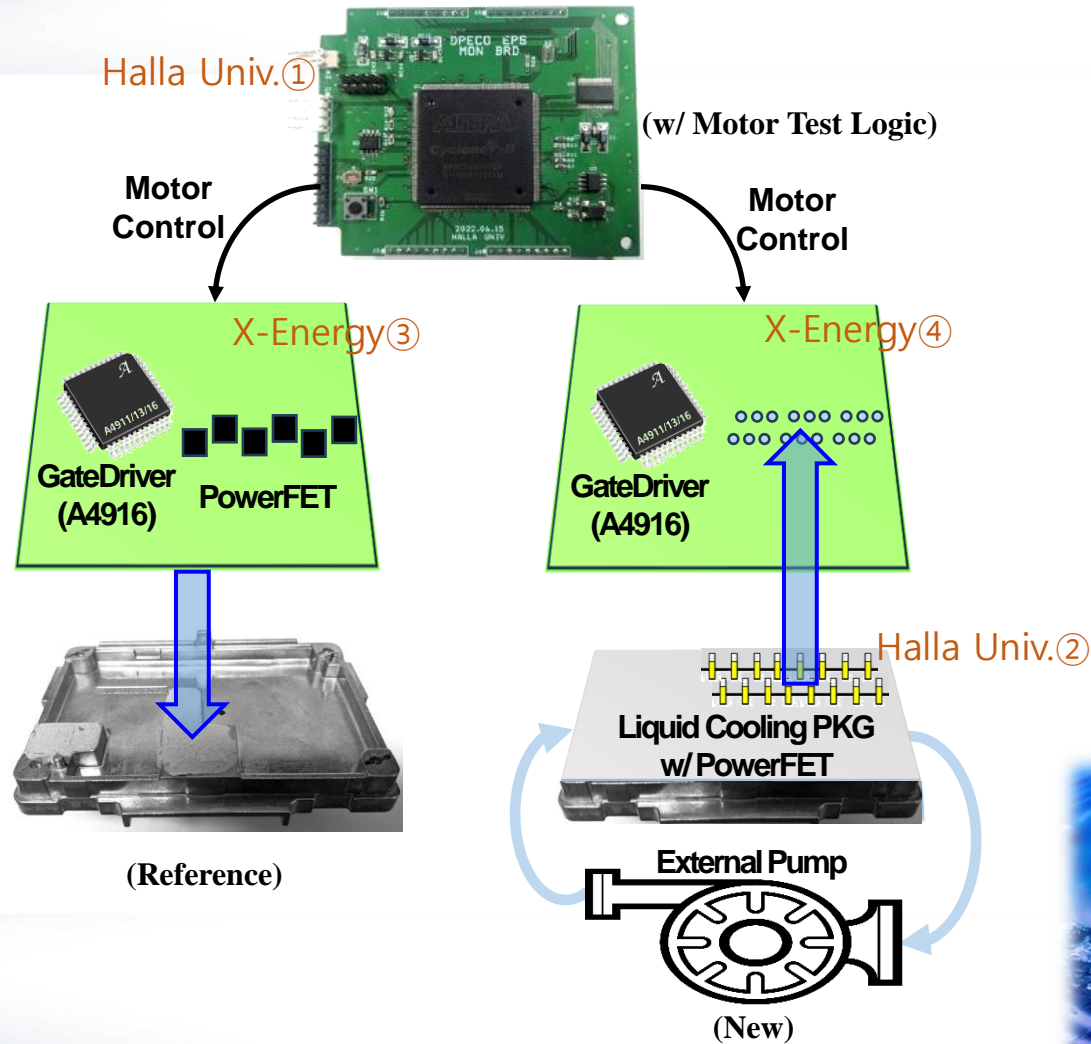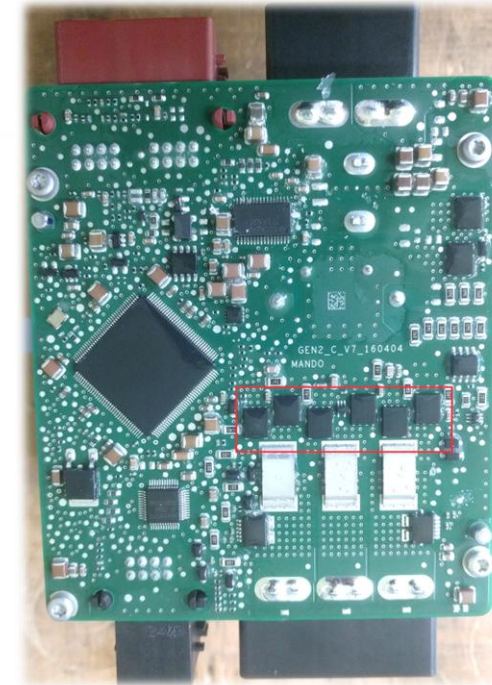
[Mando EPS ECU Board@Tivoli]

[In-Lab(Chamber) Evaluation]

Motor Driver Configuration

Mando EPS@Tivoli vs. Dpeco EPS@P250

EPS 제조사	Vehicle	Model명	Motor Control	Gate Driver	Drive TR(PowerFET)		
					Part	C_{in}	PKG
Mando	티볼리, i20, …	GEN2	3상	A4916 (Allegro Micro)	TBA	-	-
	…	GEN3			IAUC120N	3277/4260pF	PG-TDSON-8
	NX4, 투싼, …	GEN3K			IPLU300N	9300/12090pF	H-PSOF-8-1
- (Dpeco)	P250	-	단상	TLE7182 (Infineon)	IPP80N	2650/3440pF	TO220-3-1

A4916

TLE 7182

12
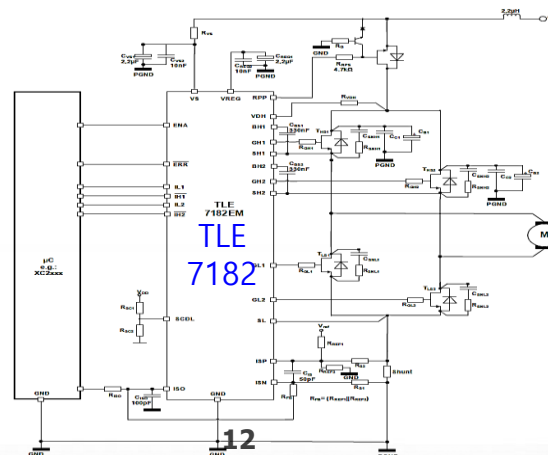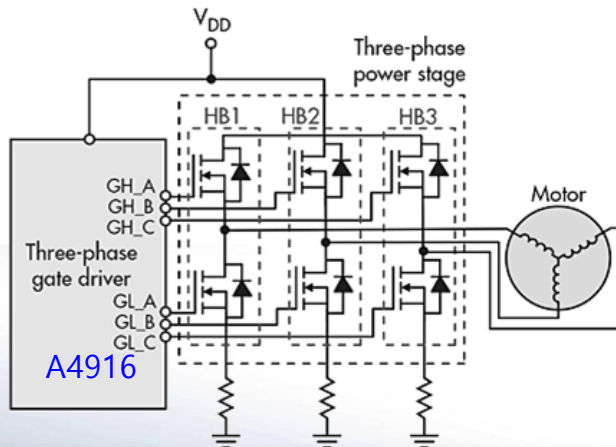
TOLL vs. TOLT@Infineon社 App. Note
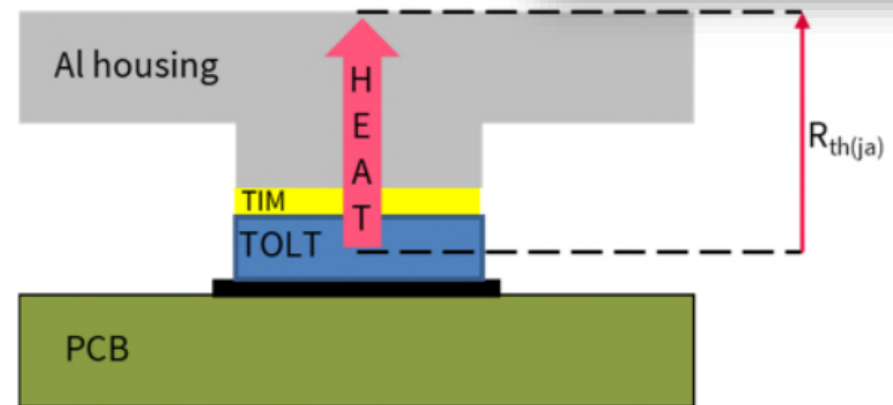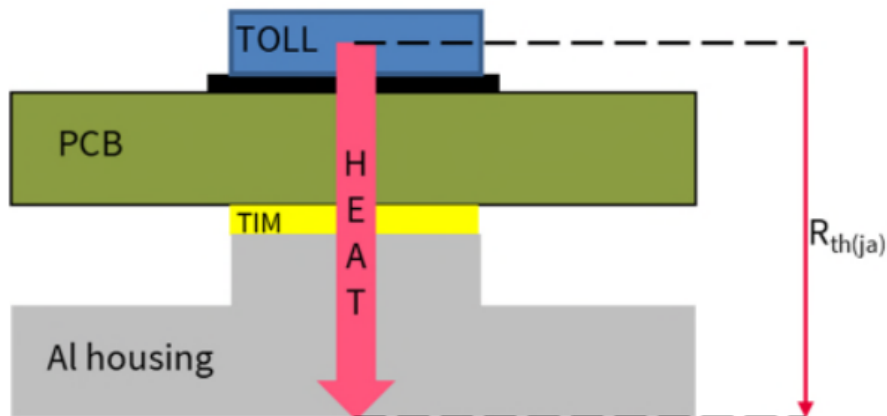
Table 1 Junction and PCB temperatures for each of the TOLL and TOLT with the housing left at free convection

	TOLL	TOLT	Percentage decrease
Junction temperature (°C)	155.9	95.1	39%
PCB temperature (°C)	155.4	93.5	40%

PG-HSOF-8-1

128.499 131.544 134.59 137.635 140.681 143.726 146.772 149.817 152.863 155.908

PG-HDSOP-16-1

89.7346 90.2211 90.7075 91.194 91.6805 92.1669 92.6534 93.1399 93.6263 94.1128
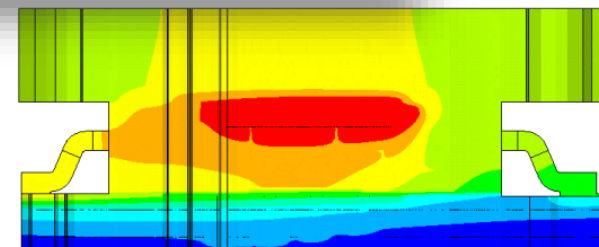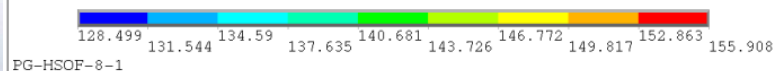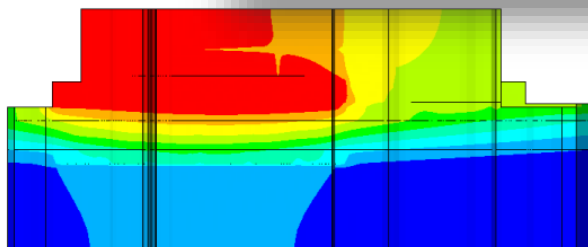
Heat Treatment@Mando vs. Dpeco EPS

Tivoli vs. P250 EPS
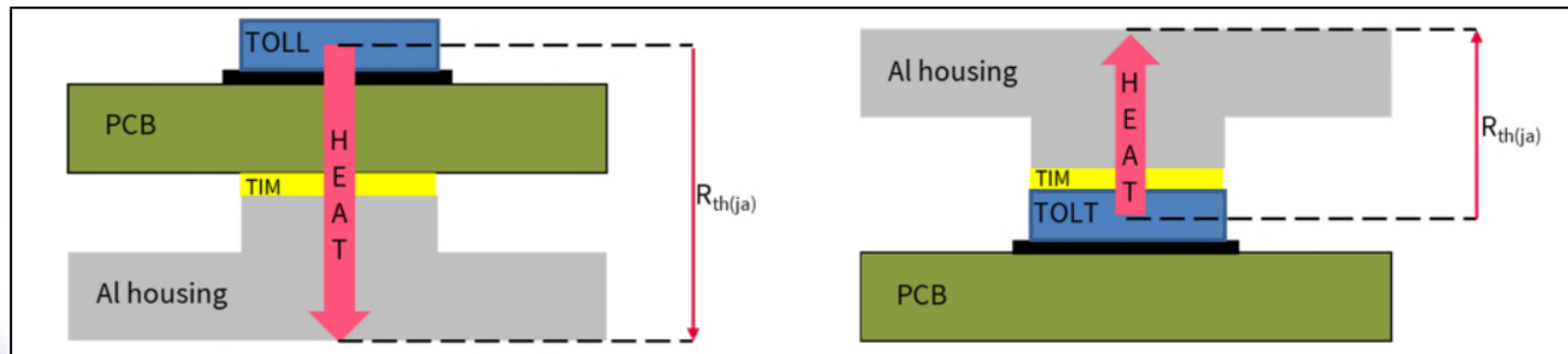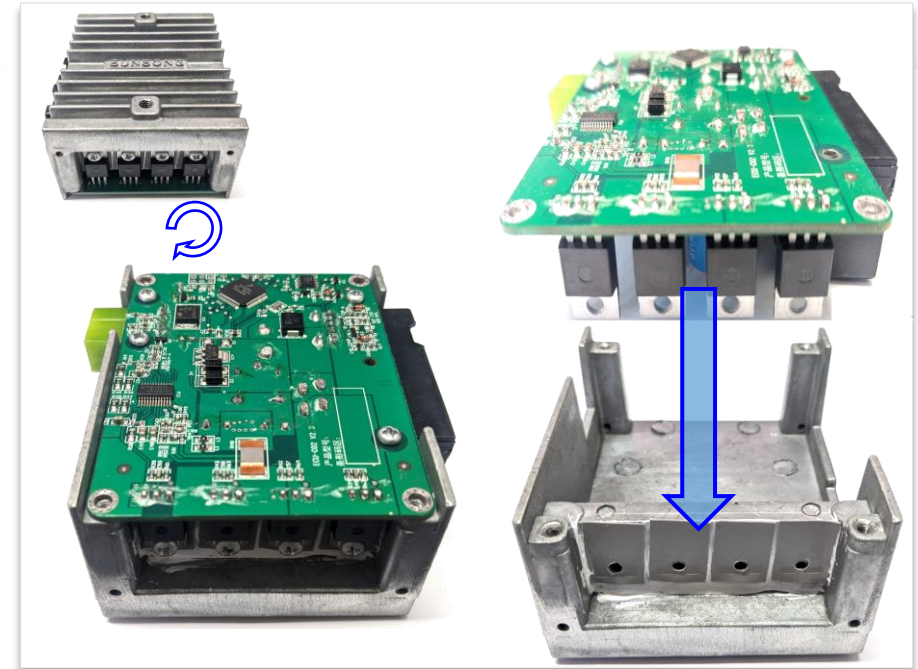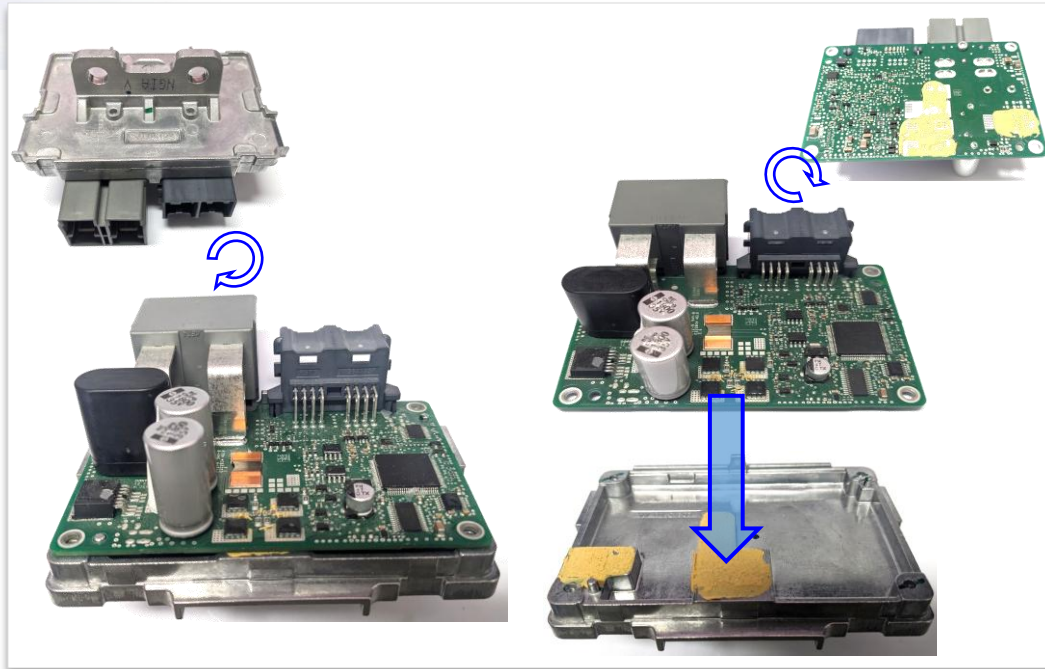
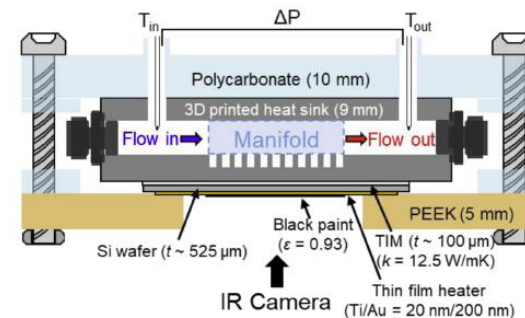# Liquid Cooling@Papers

Liquid Cooled 3D MPSoC by EPFL&IBM

https://doi.org/10.1109/TC.2013.127
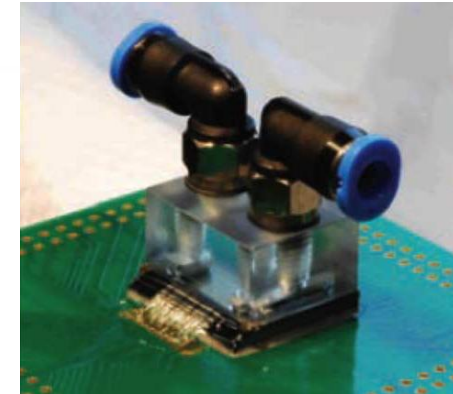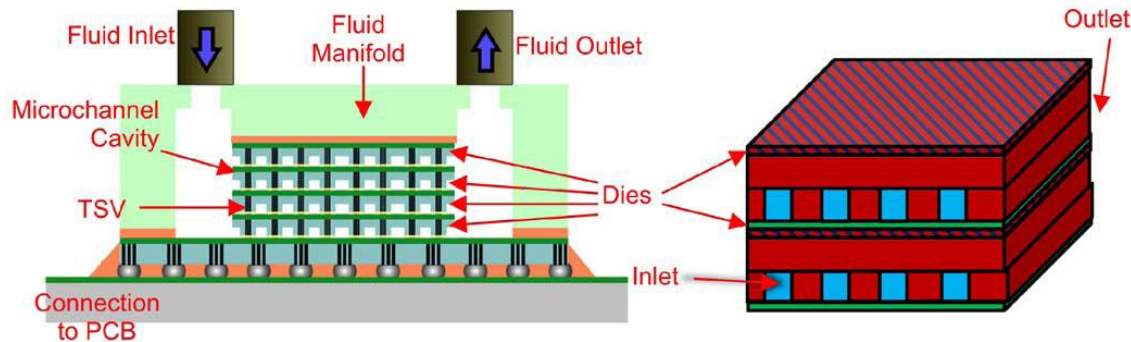
Liquid Cooling by Chung-Ang University
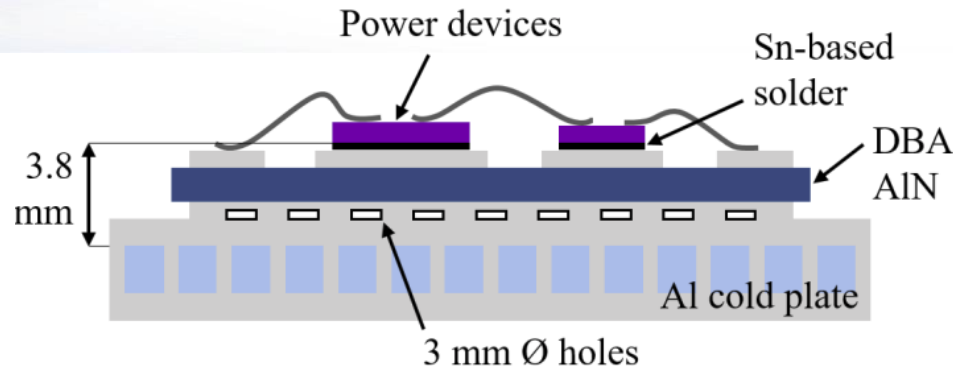

https://doi.org/10.1016/j.ijmecsci.2023.108228
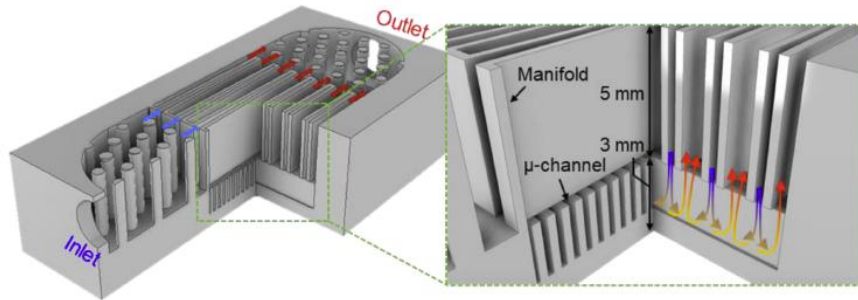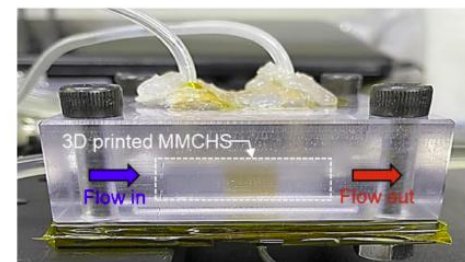
Liquid Cooling@Electric Vehicles

✓ **2010 Toyota Prious**

✓ **2012 Nissan Leaf**

✓ **2014 Honda Accord**

https://doi.org/10.1115/1.4040828
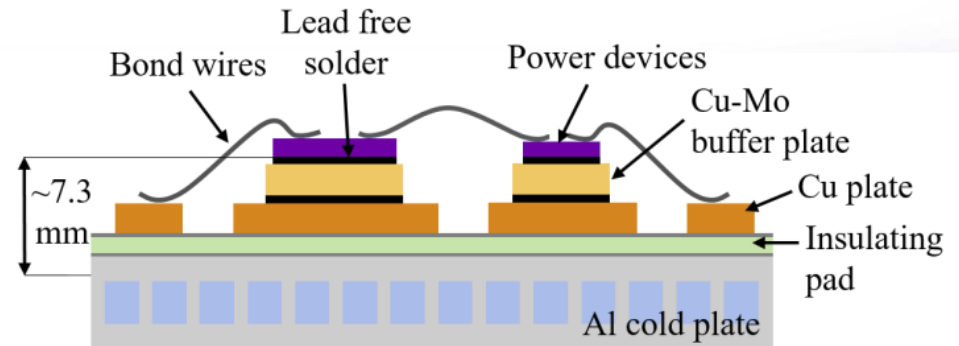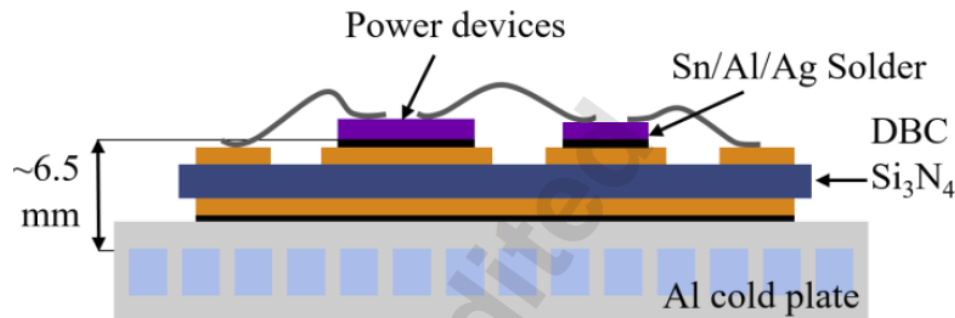
✓ **2016 Chevrolet Volt**

16
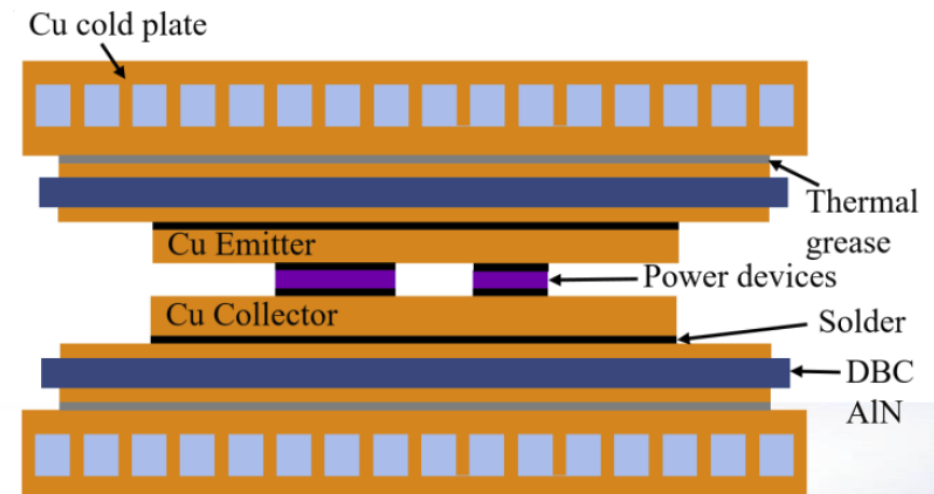
SiC Driver TR Module

Microchip社 MSCSM120VR1M11CT6AG