

D

CBCBB

ED D

P b - . O&1O hgh CheZ KZg
) / O&OH CheZ KZg
 /: <hg h H < g
 hgh Z +. f (+f K hgh_AL(EL I h
 FHL M
 b f Lh_& Z Mf
 L e Z e -))DA %))DA Zg +F A
 L b ahg g b
 L e Z e I F %NLF Zg I P F H Z hgh
 Fh
 < e& & e < g Ehf bgh
 H H hgh CheZ I h hgh
 H Mf Z I h hgh
 : Z h e hgh ZJ G+Q, & +E I Z dZ

B

Aba g =MO
 L &h ;h %Q=LEFh f % hgZeOb h
 K h
 L %& hgh &hf hgh %L h Z
 Me hf G h hgh %L f Z hgh ; Z L Z hgh %
 I hgh hgh hgh I HE
 B < %Z h : hf Z hgh %E < %M
 F Z f g

CD B

Ma L<M++/): b Z aba _bbg g a hgh &
 h g =<=< hg ba - . O&1O hgh heZ
 Zg Zg Zc Z e h heZ h g h) / O B
 h_ Z f Z hgh Z hgh J G+Q, & +E Z dZ aZ
 hgh hgh hgh /: h g Ma b _hgh
 hgh Z aba&b Zg hgh &b h FHL M ba
 +. f (+f hg& b Zg h f hgh b a hg hgh
 hgh

L E	-	L b a l g _ g e l n g < h g g l g h h g e d _ g h -)) DA e Z l g e d _ g h 1)) DA < h g g l g h O < < e d _ g h + F A
OHNM	.	OHNM b h g a h h e Z h _ a d e h < h g g OHNM h a h Z Z b h h _ a e h b e D a OHNM g l g Z _ Z Z Z _ h f a LP g h O B a h e Z e h Z h b h g a OHNM g l g Z : Z e a Z g + . f l e b b
FH=	/	I F % N L F h < < F f h e l n g < h g g a l g h O < < h _ a b l g h < h g l g h < g F h e l n g < < F h Z l g f h h g a l g h h Z a b l g l e g F h e l n g I F f h b a h N e Z h g b F h N L F e Z l g a l g h h Z a b l g I F b a N L F
LP	0	< h g g LP h a l g h Z g h h Z Z Z b h LP b b g h O B a h a a a b a & b h F H L M l g h g & f M a l g h g b LP h g Z b h e Z a h a e & b h F H L M l g h _ & f N b Z g a h l < ; Z h f Z d a h g g l n g D a LP Z g Z Z f l g f b
; LM	1	; h h Z F h g g Z) Z Z b h h Z g LP Z g ; L M h _ h f Z e Z l g e Z h a Z b h a b a & b h F H L M
O < <	2	l g Z e O < < E = H h M a b Z g h g h e b b Z h O < < = h e b a Z f b Z Z b h e Z Z e h O < < Z h b e
: G =	)	L b g Z e b h g : G = b a D e l g h g g l n g h l G =
G		g Z e e b l g G b Z b b Z e l g a Z h g h e a h g h g h _ G a b a g h g a b Z g G e g h _ a b < h g g l g h O B b a Z)) d e b h Z g g Z e a b e Z l g G l g Z h f Z b Z e Z a h g

DB

B C

H h Z l g _ e Z b f Z Z g g e h a b g h

O B	l g h e Z Z g	- .	1	O
OHNM	H h e Z Z g	) /	0	O
	H Z l g c g l n g f Z	&)	+. .	<

O L =	A f Z g ; h F h e A ; F % : G L B C = < 8 1 8) & +) - b b Z l n g % Z e l g	& .	+	d O
	< a Z = b F h e < = F % : G L B C = < 8 1 8) + & +) - b b Z l n g % Z e l g	8 .	) .	d O

C = < h f g C l . . Z a Z .)) O A ; F Z e Z _ f Z g Z l g b a Z Z g Z L = h g h e h
+ C = < h f g C l . 0 Z a Z + .) O < = F Z e Z _ f Z g Z l g b a Z Z g Z L = h g h e h

D

E

K c	C g l n g h Z f b g a f Z e b Z g	0)	< (P
K c <	C g l n g h Z a f Z e b Z g	.	

L<M h b K c Zg K c g f hge Z _ g h hf Z c g hg f Z h_a b K c Zg K c Z gh Z
aZ Z b b h_ Z dZ b e% h_f Zg ha f e e aZ Z b b aZ a bg Zg e h h_a hg b b
hZ l<; hg aba a L<M++/): b f h g %a f Ze Z b %Zg gZe g bhgf gZeZ h Ma l<; hZ b Z a Z hg d
aZ b he h a eZ Zg a f Ze Z h_a L<M++/): <aZg hg a bgh hg_b Z hg h_a l<; hZ aZg a
_bbg h_a a Z hg dZg a _h a Z ZeK c Zg K c

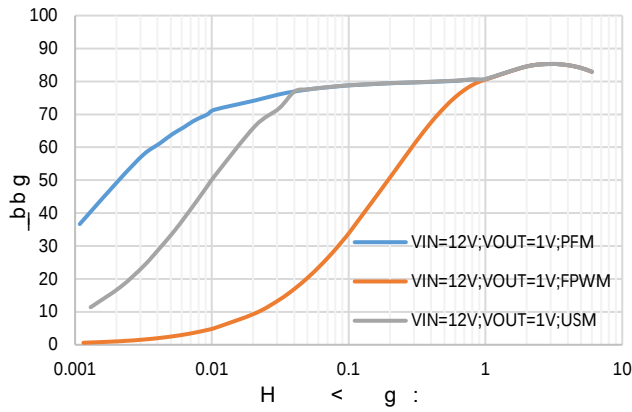
D DB B B B D B

O66 +O%M6&) < +. <% bZe Ze b g +. <				
O66	H Z hg hg heZ		- . 1	O
O66NOEH O66NOEH ARL	O hg NOEH b hg a ahe O66 NOEH A b		- - +. - - . +0)	O f O
B=	La h g g	G6) %F Z hg O66 hg	,	:
B	J b g g _hf O66	G6+O%Ch 6. O%Ch eZ %Ch b atg F Z hg O66 hg	,)	:
O<<	O<< hg gZeE=H e h heZ	B<<6) f :	- 0. . +.	O
O<<XEK	O<< hg gZeE=H eZ e hg	B<<6. f :	) .	
B<<XEBF	O<< hg gZeE=H g e b	O<< ah h h g	+0	f :
O6	K _ g heZ h_ ;	- . O5O hg 5 1O Z M f 6+. H<	) . 2-) /) /) /	O
B;	; hg e ZdZ g	O ; 6 +O	))	g

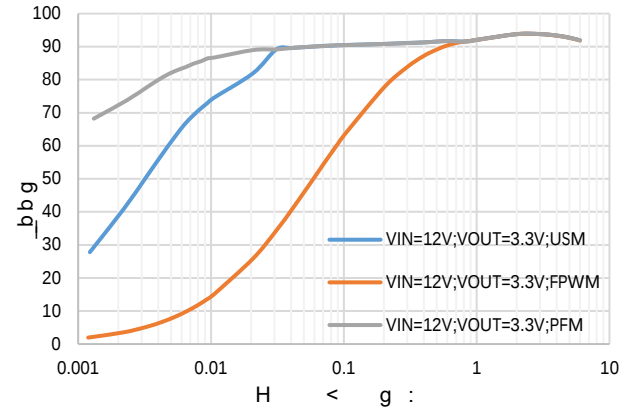


I _M =	I _h ab a		) .	f
O _i	I h hh l h g g a	B 6- f :	) /	O
B _{XE : D}	I h hh l e ZdZ g	O _i 6. O	.	:
B _{FI} XI	EL FHL M h bb g b	hf h h Z _g	0. 1. 2.	:
B _{FI} XG	EL FHL Mg Zb g b	hf Z _g h h %F H= hgg h O<<	+	:
M _{AB<NI}	Ab Zb _g f		0	f
O _{HOI XK}	O ; HOI a ahe h_Ok	O ; b _g	++	
O _{HOI X}	O ; HOI a ahe h_Ok	O ; Z _g	0	
O _{NOI X}	O ; NOI a ahe h_Ok	O ; Z _g	0.	
M _L =	Ma f Ze a h g a ahe	Mc b _g	/ ,	<
	A b		,)	<

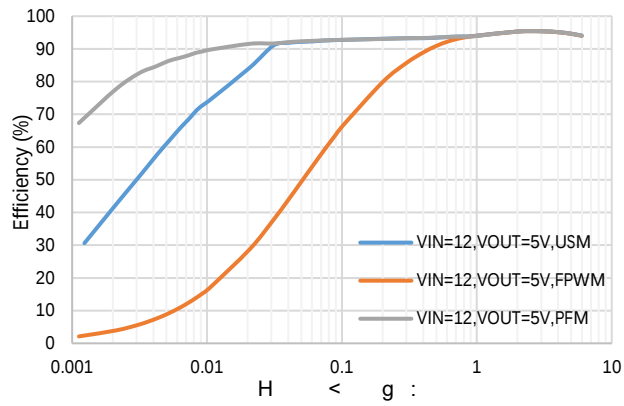
B B B D B



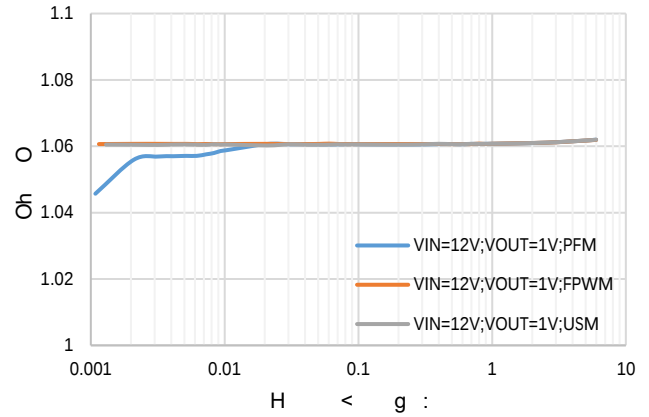
b + Pout (W) vs RL (ohms) for VIN=12V, VOUT=1V



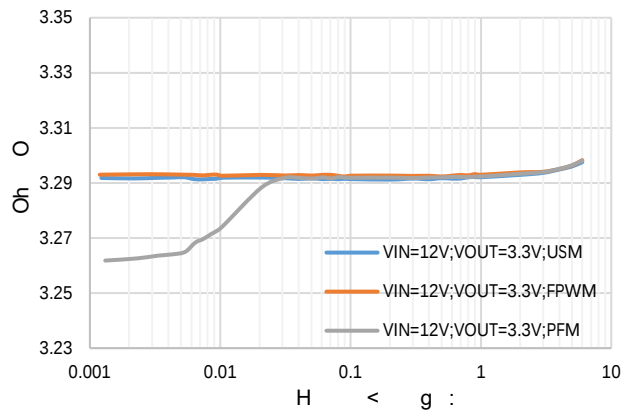
b , Pout (W) vs RL (ohms) for VIN=12V, VOUT=3.3V



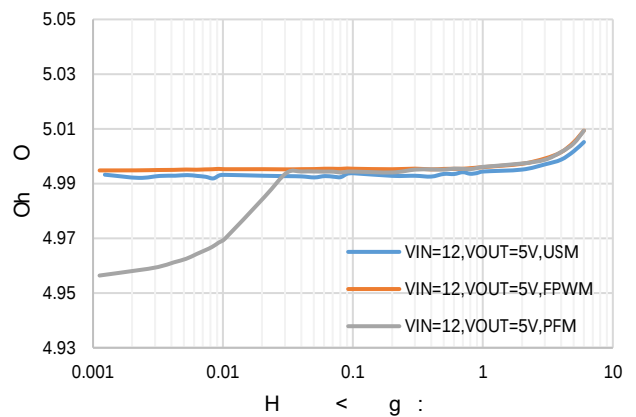
b - Efficiency (%) vs RL (ohms) for VIN=12V, VOUT=5V



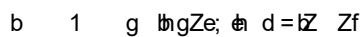
b . Vout (V) vs RL (ohms) for VIN=12V, VOUT=1V



b / Vout (V) vs RL (ohms) for VIN=12V, VOUT=3.3V



b 0 Vout (V) vs RL (ohms) for VIN=12V, VOUT=5V



D

Ma L<M++/): b Z- .O&1O %: hg h h g a h g d hg ba he +.f K hg
aba&b Zg +f K hg &b h FHL M Bf ef g a <hg Zg hg&f <HM fh hg heh
e h heZ % h b g e g Zg eZ Zg bg hg Zg f e a gZe_ g
hf g Zhg bg

Ma b a g _ g b e Z e %))dA %))dA Zg +FA % g b_ g L E Z %h h f b
ba a h _bbg h a gZe hf hg g b Ma L<M++/): _Z Zg gZe f h_ & Z
f h Z hb e g a g Zg h heZ h ahh g Z Ma b _Z a b_ g
h Zhg fh Z a a eZ g 3l e g Fh eZhg l F fh %NeZ & hgb Fh eZhg NLF fh
Zg h l e P b a Fh eZhg l P F fh Ma b g g b bZe ,): g gh eZ Zg e
fh hg bhg hZ ab aba _bbg Z a eZ

Ma L<M++/): aZ Z _Z e g Z & heZ h_ +.O ba +0)f O a b Ma G_ g hg _Z ba
Z bhg a ahe aZ Zg hZ c a g heZ e dh a ahe ba h gZe b h h
f Z Z aba NOEH f b f g eZhg G g gZe a b ba a g gZe e
g h a g <hgg g G g h O b ba Z))dO b h Z a b Z hf Z bZe

Ma L<M++/): _e h hg _Z g e a g &heZ e dh %a h h &heZ h hg %
h g h hg ba e & & e g e b g Zg ab fh %h aZ ah h hg Zg
a f Ze a h g h hg

Ma L<M++/): f e hg Zg hg&f <HM Fh hg he h b g _Z Zg bg ba h b b a g
_ g : a g h h _Z a b a g e % g a _ Z d heZ O; b e aZg a g gZe
_ g heZ OK %a aba&b FHL M J b g hg g hg hg&f Zg a g h g
b h aZ a h heZ Ma hg&f b f g a g heZ Zg h heZ : _ a
hg&f %a J g h _Zg a e &b FHL M J+ g hg Z_ Z f Zhg Ma g h g
h Zg a h Z Z bh Z b aZ P a g a h heZ Z Zg a O; Z e
a O; %a J g g hg hg&f Z_ Zgh a Z f Zhg Mab Z hg e & & e Z

Ma L<M++/): h d ba Zg gZe hf g Zhg h h f b g a e h Z b Zg Zg bg hg

h g g a FH= g f Zd a L<M++/): h d Z l e g Fh eZhg l F fh h f h a
h _bbg g a eZ : a h g Z _hf a Z eZ hg bhg %a g h g b Zeh
B a h g b %a Ze h a g h g Z a a h e % abab a
h g Z g hg h hg hg Zg b hg h hg hg fh Ma e &b FHL Mb g
h_ a g Z h g h g b : a eZ g _a Z a hg g hg
b hg h hg hg fh Ma hg&f b d a Zf Z b b g hg h hg hg fh Ma h_&f
g Z Z b Zd fh f h b aZ a h ba Z f Ze eZ g

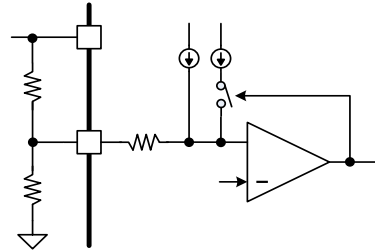
eZhg a FH= g f Zd a b h d Z l F ba NeZ & hgb Fh eZhg NLF fh h d a
b a g _ g h h _a Z h b Z be _ g Ma NLF fh e df hgbh a Z h _h a aba &
b Zg e &b FHL M P a g h a aba&b Zg e &b FHL M Z h _h , , %a e &b FHL M
h h ghg

bbg gda dZ b f a aZga Z dZ

Ma L<M++/): b gZ e a g a OEG g heZ b Z h -+.OZg a G g heZ a gZ e
a ahe h_ 10 Ma b b bZ e a g a OEG g heZ Ze d , 21Oh a g a G g heZ
b d O: g gZe .: e g h h G g Z d a b gZ e a g G g dZ
G g b Zaba heZ g aZ Zg hgg h OEG b e h Z a b
h Zaba f NOEH a ahe %hgg Zg gZe b h bb K Zg K+ ah g g b 2_hf OEG
h G Ma NOEH b g Zg Ze a ahe Zg Ze e Zhg Zg Zhg+ b e

a

O_b b b g a ahe h_O g NOEH
O_{Ze} b Z g a ahe h_O g NOEH



b 2 L f NOEH gZ e bb

Ma L<M++/): e a g gZe _ g heZ Z) /O ba he Zg h a h Z g f Z
Zg heZ Zg Ma h heZ _ b Z b h bb _hf a h gh h a ; g B b
hf f g h he Zg h b h N Zhg, h Ze e b Zg h_ b h bb
Mh f h _bbg Z d a dZ %e Ze b h Z hf f g Ah %_a Ze Z hh ab a%
a a

L EL &	<hgg h G=	hZ	<hgg h O<<
L b a g	-))DA	1))DA	+))DA

Ma L<M++/): _Z a b_ g h Z h g f h Z h a h Z h h Z f f h a FH= h Ma
h Z f f h h f Z h g b h h h h Z e Ma f h h b a h Z Z a h Zg b gh
Z e h f h b h h Z h g < h a h h a G h Zg e a b a g _ g

FH= L &	hZ	<hgg h G=	<hgg h O<<
L b a g	I F ba NLF	I F	<<F

Ma I h h h I h b a h h_Zg h g Z h P a g a ; h b b Z e g 2. Zg
). h_Ok a I b h Zg h Z Z Z.)) & a f : h b h h_) d h)) d b
h f f g h h h O<< Ma I HH= h b h a g a ; h h e Z Z e g 1. h b
h . h_Ok h e h NOI Zg HOI 4h h Zg g h_a f Z e a h g h h a h_& Z h

: g gZe h h Z Z Z h g; HHM h Zg LP h a h Z h b h a b a & b h
FHL M Ma h h Z Z Z h h e Z b a Z _ h f . O O < < h a g a b a & b h FHL M b h _
Zg h & b h FHL M b h g

Ma h h & g h b H<E b f e f g h L<M++/): h Z e & & e Z e h g h e
b b Ma b a g b f h g b h h a H Z h_a a b a & b M J f Z h a h & b
M J + Z h h h e Z M a b h e Z b h h h g Z e h a b a g = h a h g f h_a a b a &
b M b a % a b a g h Z Z Z h Z f h h e Z % h e Z % a h g &
f Zg a h h h Z e = h a h g f h_a h & b M b a % a b g Z h Z e
Ma Z Z Z e h_a b a g b a h Z g B N M

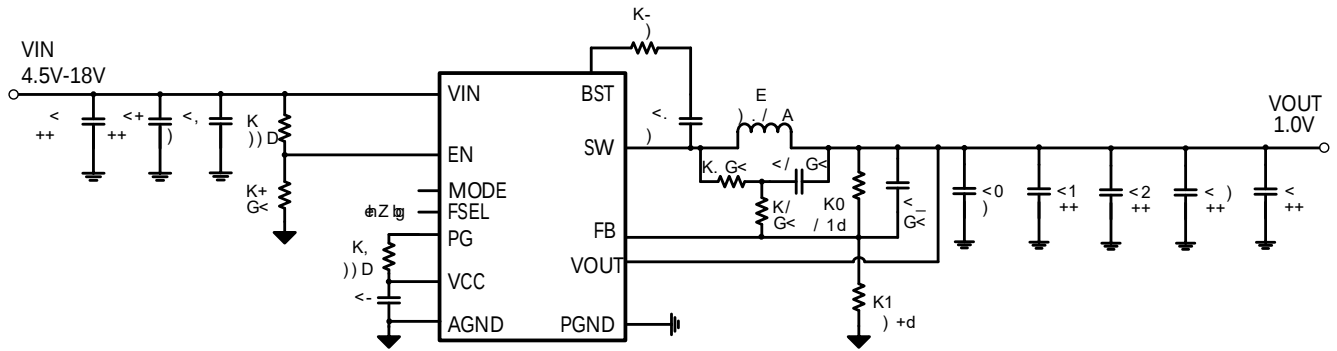
B_a f Z Z h h h e Z h_a h & b M b Z h a h e Z h h h g Z e h g h b % a
h b M Z h g g h a g e e h f h a Z g a H < E e e a b a a h g
Z Z h e h a b h_Z e h g h e a h Z g b a b a a Z g a H < E a a h e h g a Z e h_a
Z d h Z d h h b e g P a g a g b h b % a h h e Z g h h Z a h Z
f Zg b a b a a Z g a Z a h g Zg h : _ h_ Z g b a f Z h f % a g a h
h e Z Z e h 0. h_a Z h e Z % a NOI h f Z Z h b Zg a h g a b f f h e %
a b & Z Z _ Z a b f h_0 f P a g a h g h g h g b f h % a h h e Z
g h a h Z e

Ma a b h h g f h Z h f Z d a Z Z a h b b g h h Z e h Z a f Z e b Zg
h a h h

Ma L<M++/): _Z a Ng & h e Z I h h g NOI f h g b h h a h h e Z h a g &
h e Z h e Z P a g a _ Z d h e Z Z e h 0. h_Ok % a L<M++/): g a b f h g h a
g & h e Z g Z h e Z

Ma L<M++/): bf ef g a H &heZ l h lng HOI b b h Zgdf g h heZ h ahh lg
eZ Zg bg % h lg _hf h _Z e hg bng h e a eZ VgUgR Ma H L QhZi U RfCZ hG fo 2,v'p p P DJ K V

B E



b) L<M++/): = b g Zf e%OH

B _g OneZ	+O Gh f Ze- . O h 1O
H OneZ	O
F Z f f H < g	/ :
L b a _g g	1)) DA
H heZ b e Zd h Zd	/) f O

h hh tū heZ tū tū %ahh tū & LK Zf b Z Z bh : Zf b Z Z bh) b hf f g h
a h tū Z Z bh Zg Z) Zf b Z Z Z bh b hf f g h tū Z tū Z h be
h a OEG tū h_a L<M++/):

N Ztūg- h Ze tū a tū heZ b e3

P a 3

<E b a tū Z Z bh Ze
_ b a hg b atū _ g
B N M b a f Z f f tū Z _ g

= h a tū h g b e %a tū heZ aZg b_a b Z Z bb tū Zg Zg b Zg g
a h e Zg a OEG tū Bb hf f g h aZ gh a tū Z Z bZg hf Zd a tū heZ
b e e aZg)) f O g Ze % h +. O++ tū Zf b Z Z bh Z hf f g h f h h_
Z tū Ztūg <ahh a b a Z Z bh Ze Z _ tū ba hg b tū aba& Z Z bZg Zf b Z Z bh =<
tū _ % aba aZ Z hg tū e g hg a tū Ze _ b Z Z bZg

Ma h f Zg h tū h Z _ a h e Z Z h Ztūg%Zg bg aZ tū tūh Z tū %Zg
d hg bbg Ma tū h Ze %< b Zg =<K %Zg Z Ztūg g tū e g h a bbg
Zg a f Z gb h_a h heZ b e EZ tū Zg Ze tū h g b e Zg
a h eZ h tū h heZ b e h Z b =<K %Z tū Ze tū h be aba bbg tū
b KFL Zg h tū Ah %Z tū h batū Z b g tū h Zf tū tū g Ze aZ Z Z
b b Zg %a h g Z tū ab bbg Z Zg Z

tū h Ze Zg aZ +) h g ,) he Zg bagh g tū P a g a tū h g Z hZ a
Z Ztūge tū tū Zg Zg Z +) h ,. hf a Ze Z)& g g tū hg ah a
tū h g h tū Z Ztūg P a g e tū Zg tū h %ahh b Z g tū a Z Ztūg
g tū aZg b Zd g tū a h Ztūg

Mh Ze tū a g tū a h Z % a f Z f f tū heZ % tū f f h heZ % Z f f tū
g Zg f tū f b atū _ g h_a Z tū Ztūg% atū hg b tū a tū Zg ba &) he Zg
Zg tū & h hg tūg bbg

h Z d hg %Ze tū a tū h f tū f f Ze Z ah g tū Ztūg.

P a 3

D<= b a h bbg h tū h b e g tū b h a f Z f f h g

Ma h %a Zd b atū g h tū h % : b % Ze tū Z tū Ztūg /

L a Zd g tū : b tū aZg a g tū bh_a L<M++/): Zg e a tū h ba a Z Ztūg
g aba aZg a g tū b Ma tū h =< b Zg =<K Zg a h tū b gbb Zg e Z _ a
_ bbg h_h hg tūg <h tū b tū h a h f Z tū Zg b g tū h aZ b_g h
tū h Z Ztūg tū h % g b e g Z aba =<K Zg LK hg tūg tū Zg aba h
tū

Ma e lng h_h Z Z bh heZ_ h heZ b e lg Z Z Zg eZ Zg bg h f Zg

Ma h b e b gZe hf h h_h Z Hg b Z a lg h g b e hlg a h a

a bZeg L b K b Zg LK h_a h Z Z bh Zg a h a b Z a lg h g b e

aZ lg Zg b aZ lg a h Z Z bh Mh Z ab f Zeh heZ b e % ahh Z e & LK h

Z Z bh e Zf b Z Z bh h Zf b Z Z bh % a Z Z bZg hf lgZ a h b e h

lf e bZlg%a h heZ b e Zg lf Z Zlg 0 b

0

P a

b a h heZ b e

LP b a b al_ g

E b a lg Zg h_lg h

<HNM b a h Z Z bZg

O_HNM b a h heZ

O b a lg heZ

= h Z Z bh Z lg g =< lZ % a lZ heZ Zg b gbb Zge Z Z bZg < Zf b

Z Z bh Zg e f h h_a b Z Z bZg Z Z heZ Ma _h %eZ f Z lg hg a heZ Zlg h

g Z Z _ b Z Z bZg M b Z e % h ++ Zf b h Z Z bh h d_h f h Z e Zlg

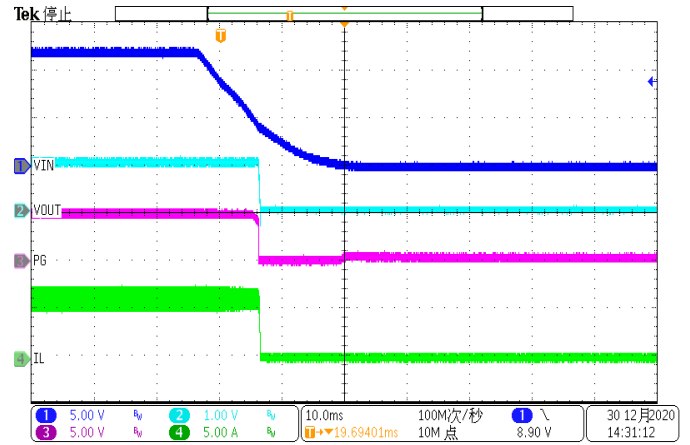
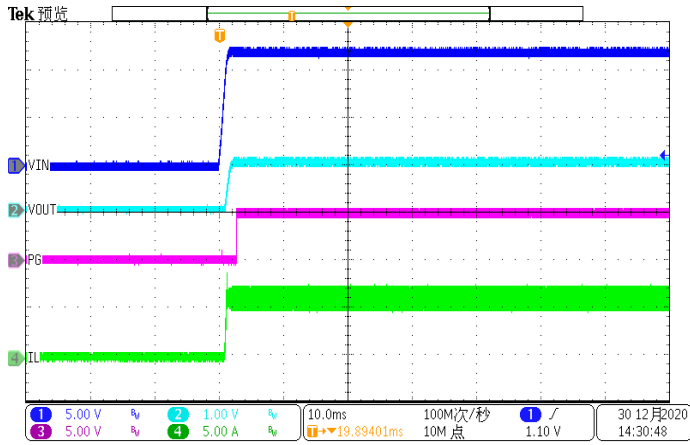
Ma L<M+ /): _Z gZe h Zf f Z e h heZ lg Z b h bb g h dK Zg K+ Z

ah g lg a bZeZ eZlg b b b) N Zlg 1 h Ze e a b h bb Ze

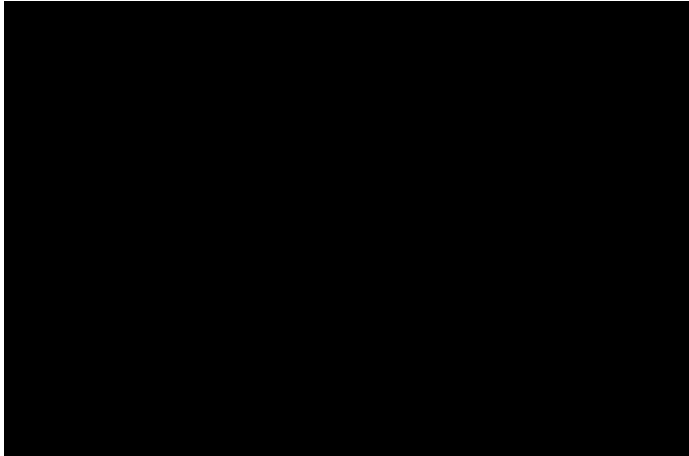
1

-))	)	) / 1	/ 1	) +	G:
	, ,	++	- . 2	) +	))
	.)	, ,	0.)	) +	++)
1))	)	) . /	/ 1	) +	G:
	, ,	.	- . 2	) +	))
	.)	++	0.)	) +	++)
+))	)	) - 0	/ 1	) +	G:
	, ,	+	- . 2	) +	))
	.)	.	0.)	) +	++)

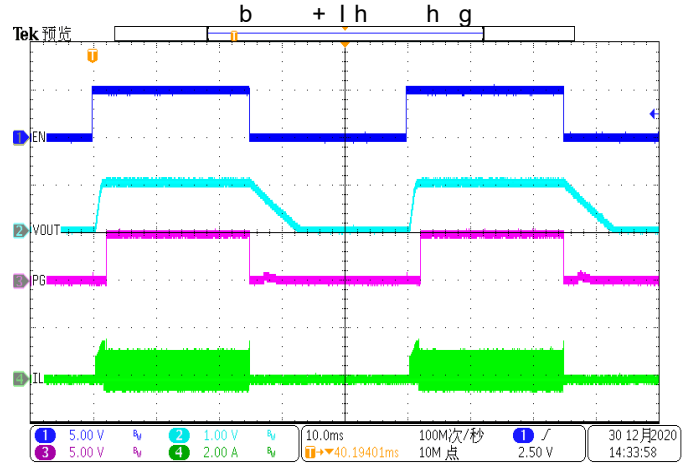
Nge h a b gh %a h gh hg bgh Z OBG6 +O%OHNM6 O%M f Z 6+ .<



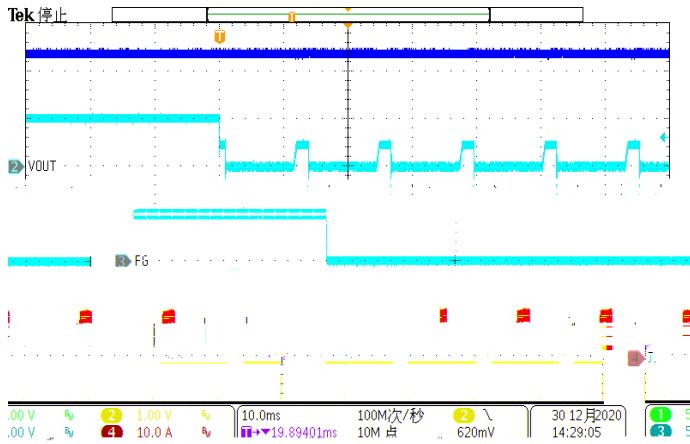
b l h



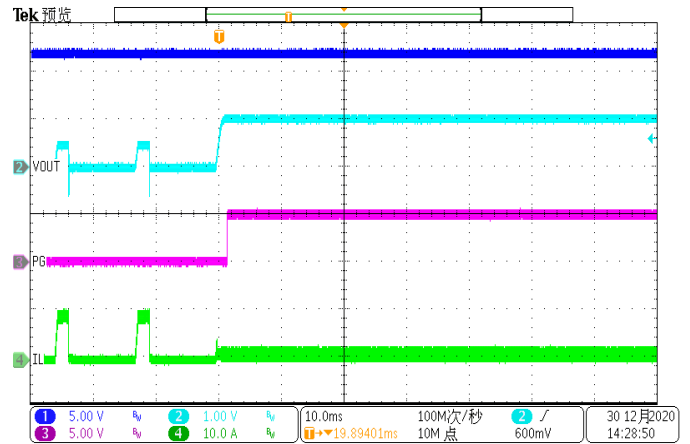
b , G h e Z 6/:



b - G h e Z 6) f:

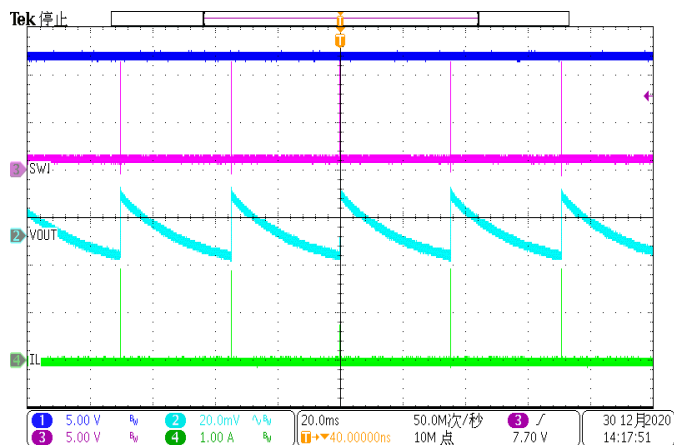
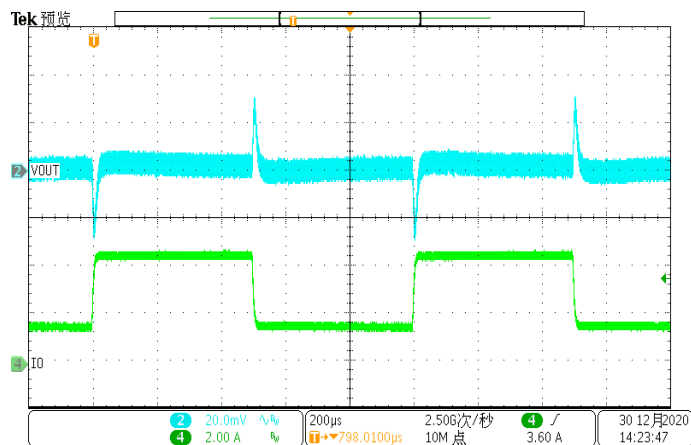


b . H < g l h hg : h aZ ah

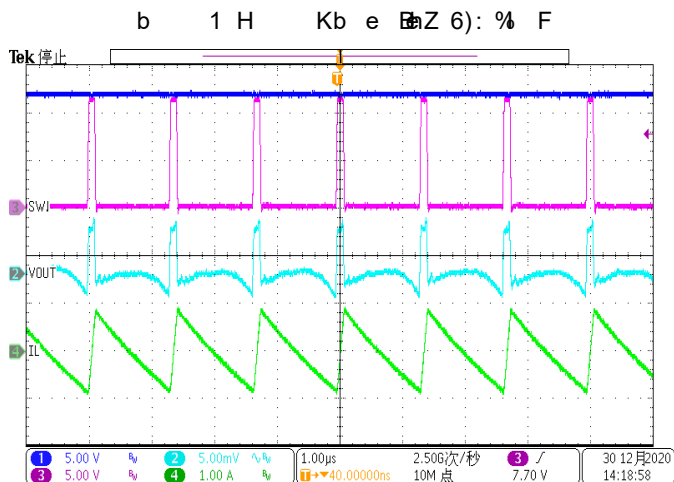
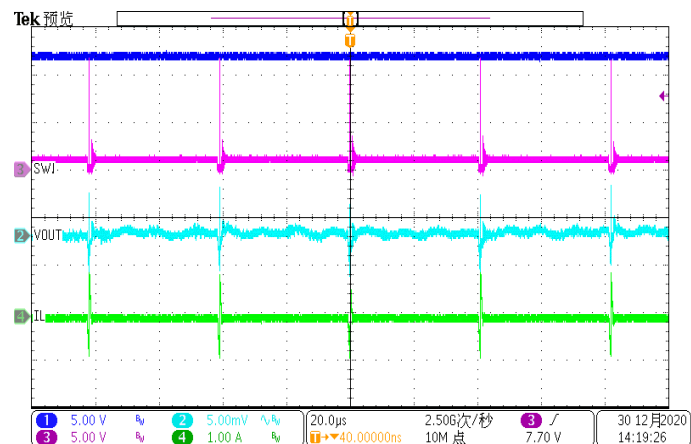


b / H < g K eZ aZ ah h :

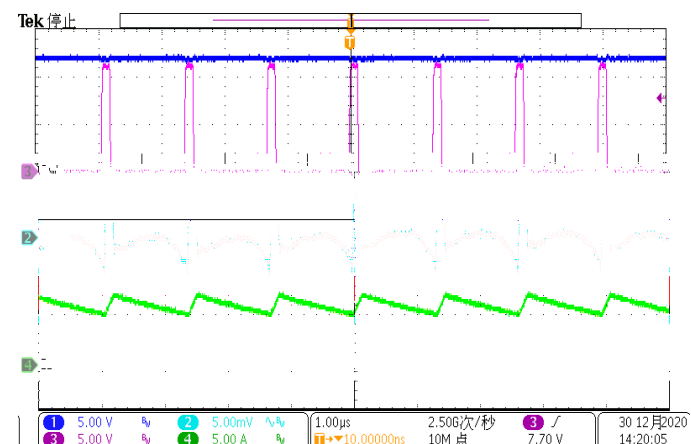
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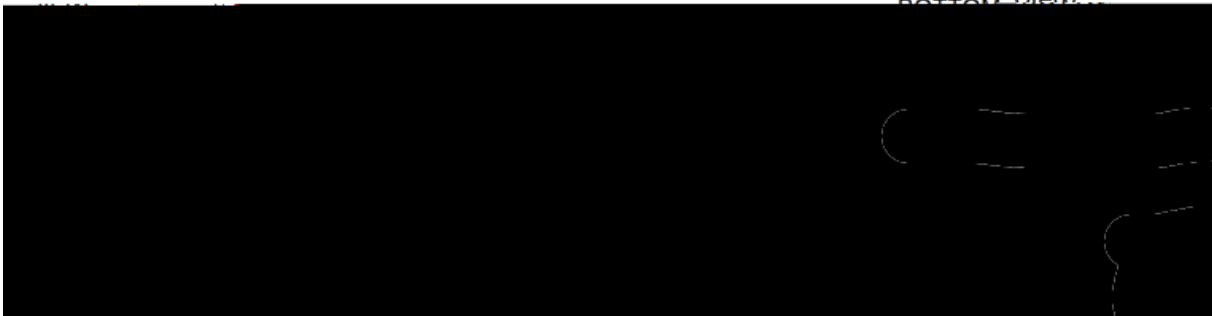
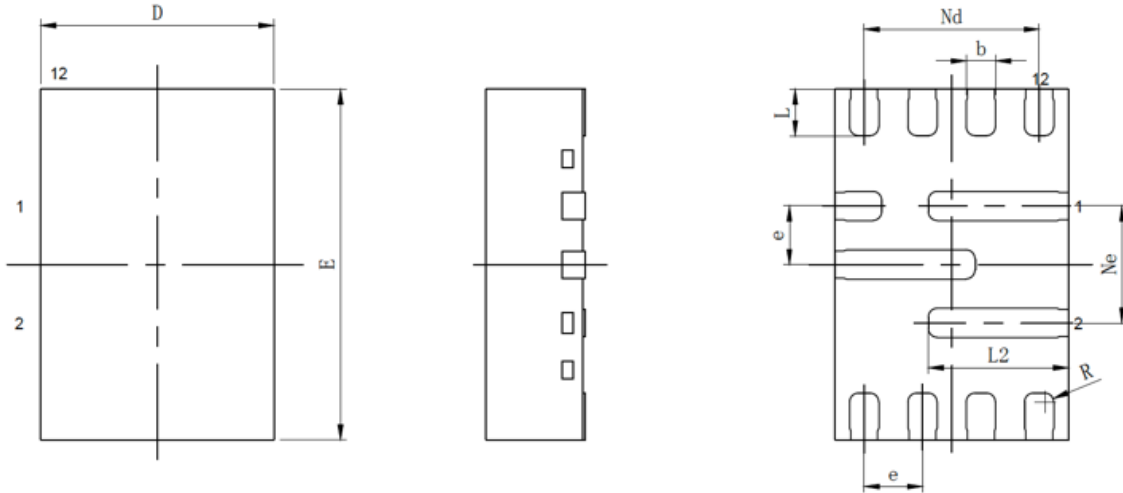
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