

4.4V-65V Vin, 2A, High Efficiency Synchronous Step-down DCDC Converter

FEATURES

C S XW Xad3 fa_af W3bb USfa e
 375 C C S XW fZfZW8a a YDVe fe,
 6W UFW_bWsf dW9 dSW , & 5 fa 5
 3_TWfAbWsf YFW_bWsf dWDS YW
 I VV b fHa fSYWDS YW&H(H
 5a a eA fb f5 dWf, 3
 H 8WTSU DWVdWUMHa fSYWSf 5
 fWdSW AE87Fe% _ (_ DVea
 a eZ fVa U dWf, (3
 a C VdWf5 dWf,% 3
 B WE bb Y aWBE YZf aSV
 8dW WU & :
 7 fW S 5 aU E UZd Sfa
 % _e fW S EaXefSd F_W
 Ba W9aaV VUSfad
 DS Va_ EbdVSEbWfd _ abfa XaddW UW7
 a 6dba f8 Ufa S V _ _ A F_W
 8 Ufa
 BdWea 7 STWFZdWZa VXdSV efSTW b f
 Ha fSYWG WdHa fSYW aU A fBdfWfa
 GH A FZdWZa VS V: efWVe
 E bbaefSd b fZbdWTSeWfa fb f
 A Wd a fSYWS VA WdFW_bWsf dWBdfWfa
 7EAB * BSU SYW

APR 2019 MC SPICID Lg(S)BDC 000TF01

REVISION HISTORY

AF7, BSYW _TWb XdbdW a edW ea e _S VXXIXa_ bSYW _TWb fZMU dWf Wba
 DW ea *, 5 efa_ WleS_ b Wb
 DW ea *, GbVSfWdWWS f bSdS_ WWe TSeW a fZW SfWf TSfUZ fWf VSfS
 DW ea *, GbVSfWB (faF S V8 Y dW % bVSfWH_{D78} SUU dSU fa SUbaee fZWWf dWfW_ bWbSf dW
 dS YW

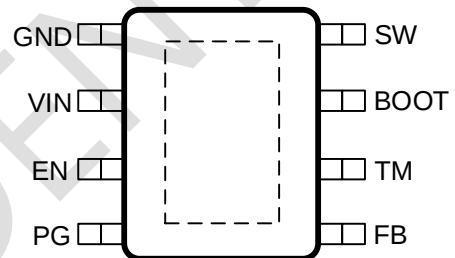
DEVICE ORDER INFORMATION

E5F (CEF7D	FSbW DWW	&	(C	*	7EAB *	F46
-------------	----------	---	-----	---	--------	-----

ABSOLUTE MAXIMUM RATINGS

A WlabWbSf YXWWSdfW bWbSf dW WbaafZW eW afW			
H 7	%	*	H
4AAF	%	+	H
EI	%	*	H
EI . e %	%	*	H
4AAF EI	%	(	H
84	%	(	H
B9	%		H
AbWbSf Y Ufa fW bWbSf dW < &	&		5
EfaSYWfW bWbSf dWFEF9	(		5

PIN CONFIGURATION



- (1) EfdWba TWa VfZaeW efW Wd3 Tea fW S _ _ DSf Y _S US eWWW UMbWl_ S Wf VS_ SYWFZWW UW eGaf Y SdS fWfW fa
 XG Ufa a fe WafXfe DWla _ WWW AbWbSfa 5a Vfa e 9
- (2) FZW S H fdS eWf afSYWe Y SdS fWfW T Wb Y S V WXXW a TWUZ
- (3) FZeSbb Wb fa fZWd Y Y afSYWWWSfW/T feW af WfWl S Sbb W afSYW
- (4) FZW5 U Wba WfW bWbSf dWbaWUfa fa bafWf fZWWUW d Ya WbaSVUa Vfa e < Ufa fW bWbSf dW WUWW 5
 ZW a WfW bWbSf dWbaWUfa eSuf W5a f a eX Ufa STa WfZWbWXXW _S _ _ abWbSf Y Ufa fW bWbSf dW dW/W
 XV _W

PIN FUNCTIONS

9 6		9 da V
H		b f e bb a fSYW5a WfS aUS T bSee USbSUfadXa_ H b fa 9 6 b BSfZ Xa_ H b fa ZYZXW WU T bSee USbSUfadS V9 6 _ ef TWSe eZaf Se baee TW
7	%	7 STW b ffa dW Sfad: YZ/ A a / A88 5S TWla WfW VdWf faH FZW fSb aXdWefadV WdXa_ H fa 9 6 Ua Wf Y7 b US SV effZW b f afSYW aU a ffZdWZa V 6a afXaSf
B9	&	AbW VdS ba WdYaaV XSY a fb f 5a Wf fa S e fSTW afSYWe bb fZda YZ S U dWf _ f YdWefad: YZ/ ba WdA= a / ba WdTSV FZWXSfYb e a ZW 7 / a 5S TWWXXabW ZW af eW
84		Wf Y b faXfZWfS e Ua V UfS UWWdS_b XW FZWfSb aXWfWl S XWVTSU dWefadV WdXa_ fZWa fb ffa 9 6 eW fZWa fb f a fSYWFZWWUWdW SfW 84 a fSYWfa fZW fWl S dWVWUW S WaX H f bUS

SCTC

ELECTRICAL CHARACTERISTICS

H / &H F</ & 5 5 f bUS S WefWfW Wd 5

--	--	--	--	--

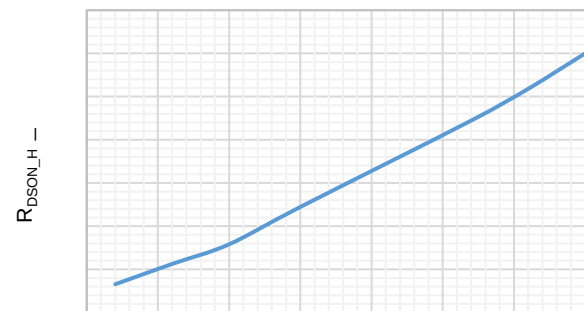
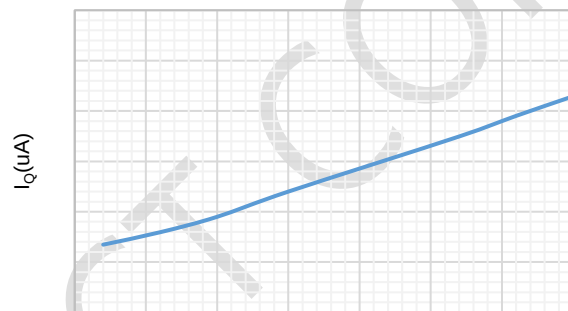
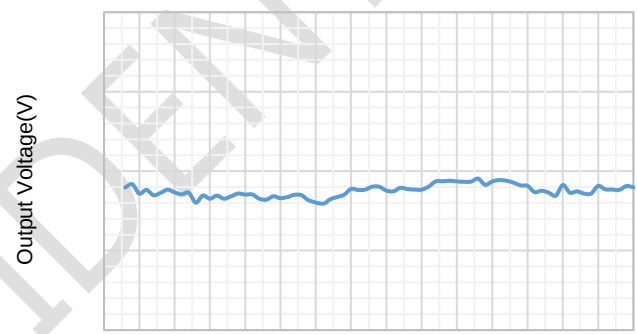
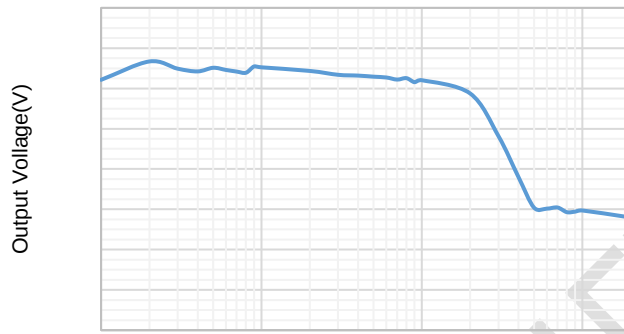
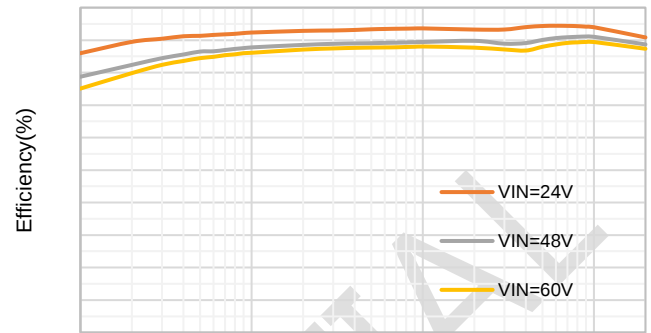
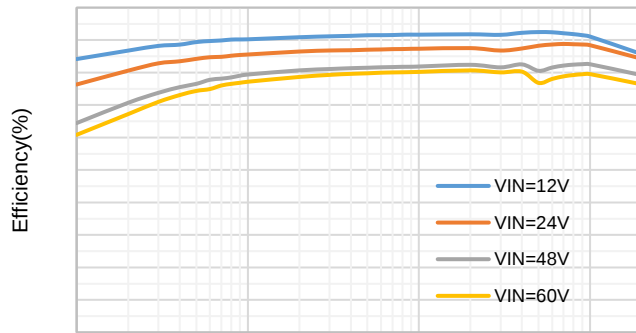
H	AbWsf Y b f a fSYW		&& (	H
H QGH A	b f GH AFZdVZa V : e fWfW e	H de Y	% && %	H _H
E: 6	EZ fVa U dWfXa_H b	7 /	(%	3
C	C VdUWfU dWfXa_H b	7 Xa Sf Y a e fUZ Y 4AAAF EI / H	% (	3
3Uf W07H	3Uf WU dWfXa_H b	H / &*H H AGF/ H a aSV		3

D6EA Q	: YZeWw AE87F a dVefS UW	H4AAAF H EI / & H	% *	—
D6EA Q	a eWw AE87F a dVefS UW		(%	—

HD78	DWwUW a fSYWax84	F</ 5	++	H
		F</ & 5	+))	

Q E	: YZeWba Wd AE87F bV6 U dWf _ f fZdVZa V		& % &	3
Q E	a eWba Wd AE87F ea d YU dWf _ f fZdVZa V	F</ 5	%	3
		F</ & 5	(+	
L5 H: W b	L Wb U dVee WwUf adfZdVZa V : U b fdY WfZdVZa V a fSYW			_3

TYPICAL CHARACTERISTICS



SC

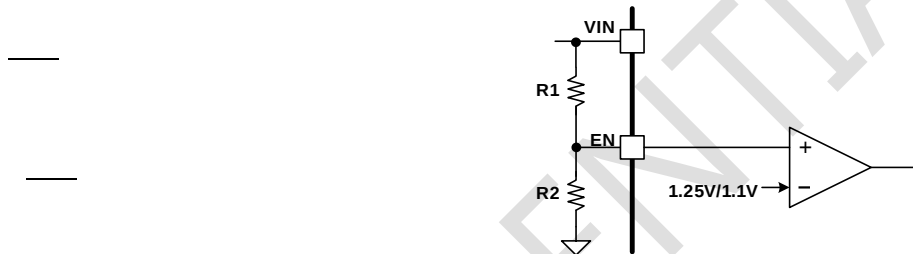
SCT CONFIDENTIAL

9 9 9 9 9 9 9 9 9

FZWE5F (C eWSTW ZWfZWH b a fSYWdeWSTa W% H S VfZW7 b a fSYWWUWefZWSTW
fZdWZa VaX H FZWWW UWeVeSTW ZW fZWH b a fSYWSeTWa % Had ZW fZW7 b a fSYW
eTWa H 8adfZWWW UWfa dV S eZ fVa _aWWSbb S a fSYWTWa (H fa fZW7 b eZ fVa
_aWfZWc WUWfU dWfVdabe fa (3 f bUS 3fS a fSYWSTa W)+ S V TWa H fZW fW S aYU
Ud f TWf dW a ZUZ Ua e _WSUWfS S_a faXU dWf

FZW7 b eS ZYZ a fSYWb S VUS af TWWxabW adXaSf Y FZWe_bWef S fa WSTWfZWabWef aX
fZWE5F (C efa Ua WUf fZW7 fa H FZeS a eW XefSf baXfZWE5F (C ZW H e fZ fZW
abWef YdS YW

8adSZYZWle efW GH A fZdWZa V Ua WUfS WfWfS dWefadV WfD S VD eZa 8 Y dW+ Xa H
fa 7 FZWGH A de YS VXS YfZdWZa VUS TWUSU SFWT 7c Sfa S V7c Sfa dWbWf W



I ZWfW

HdeW e de YfZdWZa VaXH GH A
Hxs eXS YfZdWZa VaXH GH A

9 8 Y dW+ E efW GH A T WSTWW W

FZWE5F (GdW SWe fZW fWfS dWUWUW a fSYWSf H fZ fa WfS UMa WfZWabWef YfW bWef dV
S V a fSYWdS YW FZWa fb f a fSYW eWf T S dWefadV WfD Xa fZWa fb f aWf fa fZW84 b f e
dWUa _WWW fa eW fa WfS UWadTWfWf dWefadV GeW7c Sfa %fa USU SFWdWefS UMaXdWefadV WfD
Fa _bda WfXUWU Sf YZf aSve SdWf S WdWefadV SdWdWUa _WWW : a WfD XfZW S WfSdWfaa ZYZ
fZWdWf Sfad TW_adWef eUWfTWfa a eWSXWf Ya fb f a fSYWSUJ dSU

%

I ZWfW

D84QFAB e fZWdWefadUa WUf YfZWa fb f fa fZW84 b

D84Q4AF e fZWdWefadUa WUf YfZW84 b fa fZWYda V

9 L

FZWE5F (C fWfSWeS fWfS eaXefSf Ud f fZSf dS_be fZWdWUWUW a fSYWxa Wfa a fSYWfa H
dWUWUW a fSYW fEE EaXefSf efdYYWfW T S aXfZWfa YUa Vfa e
FZWWW UWe Suf SFWfZa YZ7 adH GH A

DWla WfXa _SZUW b Sf YbWfVaVadeZ fVa V Wfa a WfW_bWef dWdWfUfa

6 d YeaXefSf ZUW b eVeSTW FZWWSUfa efaYfZWfWbda WfWefSf b fZ _fW d eZU dWfS VS a
fZW eWfXfWfWfa fb fUSbSufadS YZYZWf aSV YUa Vfa e fZSfUS eWf dWf fa TadWfUa U dWf _fV d Y
efSf b fZa ffdYYWf YZUW b : U b eWSTWfa UMa fb fa fZUWefSfa adf _WWUWUWefEE ZUZWfW
ZSbbWef Xef

I ZW fZWa fb f a fSYWdabe TWa fZWeW S WfZWeaXefSf a fSYW fSU fZWWWUWSeW a fb f a fSYW
SUF S bdbadfa FZeef Sfa _S aUJ d WfWfZWfa YUa Vfa e,

I ZW fZW b f a fSYWefaa a 999_S fS fZWeWfa fb f a fSYW

I ZW a WU dWfaU dUS e YSWUdSeW a fb f afSYW

I ZW fZWSTa WUa Vfa eSdWdW a W fZWa fb f afSYW ef UdSeW WdeafefSd 4 f feZa VTW afW
fZSf XfZWa fb f afSYWWdabe TVa %) V Wfa a WU dWf ZUW b TWfdYYWdW

Fa dW UW7 fZWE5F (C _bW Wfe 8dW WU EbdWSEbWUfd _ 8EE FZWb ddaeWaXebdWSEbWUfd _
e fa W_ SfWbW W_ ee a e Sf ebWUXUdW WUW T ebdWY fZWWW_ ee a e Sddee S WdS YWaX
XW WUW dSfZWfZS SbSd fZ X W W WU X Ufa _aef e efW_e Ua fS Y fZWE5F (C

9 9
9 9

9 9
9 9

9

E5F (C e fUZ fa S W U dWf Ua fda _aVW3XWfZWZYZeW AE87F e f d W aX fZW a eW
AE87F dW S abW f fZW V UfadU dWf Vdabe TWa fZWdW dW S W U dWf 6 d YfZebWdV fZW
WfUaU U UW TWTaU W Xa_ efSc Y ea fZWe fUZ Y XWt WU WUdSeWE UWa f_WaXZYZeW
AE87F eX W S f e _ _ _ S WfZef bWaXX Ufa dW T W fZSfaXS W UW e YS5a efS fA F_W
5AF Ua fda eUZW_W

9

9

9

9

FZW V UfadU dWf e _a fadWV d YZYZeW AE87F C S V a eW AE87F C a FZWE5F (C
_bW_Wfe a W U dWf bdaWUfa fZ U UWT U UW _f Y ZYZeW AE87F bVS U dWf S V a eW
AE87F S W U dWf fa S a V V UfadU dWf d Y S S V d Y WbWUW a WdSVada fb f ZSdVeZad
Ua Vfa

I ZW a WdSV

999

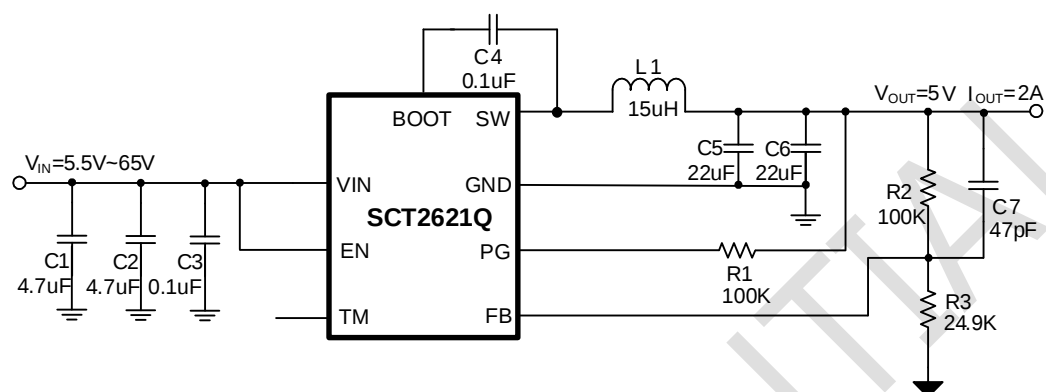


8ad_adW Xad_Sfa e Ua fWf Ua

E Ua 5a fWfFWZ aaY 5a fV 3 DYZfeDVdW W

BdV Uf 8a Wd e, E5F (C

APPLICATION INFORMATION



b fHa fSYW	&H &*H ad S H fa (H
A fb fHa fSYW	H
S A fb f5 dWf	3
E fUZ Y8dW WU	& :
A fb f a fSYWdbb W bV\$ fa bV\$	* H
Fd eWf DWba eW 3 fa 3 aSVefW	& H

FZWa fb f afSYWeeWT S WfWd S dWefadV Wd
D S V D% f bUS Sbb USfa eUZW SfU
DWLa W W W D% dWefS UWe & += GeW7c Sfa
& fa USU SFWd

9

&

ZWdV

HD78 efZWXTSU dWdWUW afSYWf bUS
H

9

9

9

9

FZWdSdWeWWS XSuradeZa V TWLa eWdW eWUf Y V Ufade UZ Se V UfS UWeSf dSfa U dWf fZW
D E U dWfS V65 dWefS UW65D SdWd V UfS UWdW fe Vee V UfadU dWf dbb WS VfZWdWdWVe
fa a WLa fb f afSYWdbbW: a WdW fZW SdWd S W V UfadS S e UadWba Ve fa STYYWdbZ eUS e W
ZYZWeWdW dWefS UWS V a WdSf dSfa U dWf 3 YaaVd WadWdW YfZW V UfS UWfa eWefa S a
fZW V UfadWbS fa bWbS dbb WU dWf fa TWSbba Sfw % aXfZW S _ _ a fb fU dWf

FZWbWbS fa bWbS dbb WU dWf fZW V Ufad BB US TWUSU SFW Se 7c Sfa

9

I ZWdV

BB efZW V UfadWbS fa bWbS U dWf
efZW V UfS UWaX V Ufad

X efZWefUZ YXW WU

9

HAGF efZWa fb f afSYW

H efZW b f afSYW

E UWfZW V UfadU dWf dbb W UdSeVe fZfZW b f afSYWeafZW S _ _ b f afSYW Sbb USfa e
S S e eWfaUSU SFWfZW _ _ V UfS UWdW dW GeW7c Sfa (fa USU SFWfZW V UfS UW S W

9

I ZWdV

efZW _ _ V UfS UWdW dW

X efZWefUZ YXW WU

HAGF efZWa fb f afSYW

H s efZW S _ _ b f afSYW

AGF S efZW S _ _ 65 aSVU dWf

D eUaWUWfaX BB fa AGF

9

FZWfafS U dWfXa YfZda YZfZW V Ufad efZW V Ufaddbb WU dWfb efZWa fb fU dWf I ZW eWUf Y
S V UfadUZaaWfe SFW U dWf VebWUS fZWeSf dSfa U dWf SdWfZS fe bWbS abWbSfa U dWfS V
D E U dWf Sea af TWWUWW FZWdW fZWbWbS e fUZ YU dWf aX V Ufad B73= S V D E US TW
USU SFW Se 7c Sfa) S V7c Sfa *

999

*

I ZWW

B73= e fZW V UfadbV\$ U dWf

AGF e fZW65 aSVU dWf

BE e fZW V UfadbV\$ fa bV\$ U dWf

D E e fZW V Ufadd E U dWf

a WlaSV YadaSVfS eWfUa Vfa e fZW V UfadbV\$ U dWfUS U dWf b fa fZWe fUZU dWf fX
fZWWUW ZUZ ef bUS % 3 FZW_aefUa eWfSf WSbbdSUZ efaUZaaeWS V Ufadd fZSeSf dfa U dWf
dSf Y YdVfVfZS % 3 4W\$ eWafZW_S _ _ B73= _ fW T VW UW fZW_S _ _ a fb fU dWf fZSf fZW
E5F (C US VW W\$Sea W\$WVe a fZW V UfaddU dWf dbbWFZ e fZW_S _ _ W dW/a fb fU dWf Sea
S\$Wf e fZWeWUfa aX V US UWfZWe_S W V UfaddW fe SdW V UfaddU dWf dbb W\$V Yfa S a W
_S _ _ a fb fU dWf

FZW b fU dWf fa fZWeW Va 6565 Ua W\$W eVela f a e fZW W dWf dW dW SUsbSufadfa e bb fZW
35 U dWf fa fZWeW Va 6565 Ua W\$W Z W_S fS YfZW65 b f a fSYWGeWUSbSufad fZ a 7ED
XadTWVWbWad S UW5W\$ UUSbSufad fZJ D adJ) D VWUrdUe SdW e S e YWfW TWUS eWafZWd a
7EDS Ve_S fW bW\$ dW\$WUWfe S V f e efa Y dW\$ _ W\$Wfa eWS afZWd a W S WUSbSufad WY
8 fZ e_S bSU SYWe W (% fa XfW ZYZ W WU e fUZ Y aeW B SUMfZWe_S e WUSbSufadSe
UaeWfa H S V9 6 b e Sebae TW

FZW a fSYWdSf YaXfZW b fUSbSufad ef TWYdVfVfZS fZW_S _ _ b f a fSYW3 VfZWUSbSufad ef
Sea ZS WS dbb WU dWf dSf Y YdVfVfZS fZW_S _ _ b fU dWf dbb WFZWD E U dWf fZW b f
USbSufadUS TWUSU S\$W e Y7c Sfa +

FZW adf USeWUa Vfa aU dSf H / H AGF ZWW

8ade_b XUSfa UZaaeWS b fUSbSufad fZ S D E U dWf dSf Y YdVfVfZS ZS XafZW_S _ _ aSV
U dWf

I ZW eWUf YUW\$ UUSbSufad f W\$W efa Ua eWd fZW W\$W W S WaXS USbSufad WUdW\$ Y Se fZW65
TSe a fSYW\$UdW\$e USbSufad U dW\$e Y

FZW b fUSbSufS UW S W\$W W\$W e fZW b f dbb W a fSYWafZWdW Sfad FZW b f a fSYWdbb WUS TW
USU S\$W e Y7c Sfa S VfZW_S _ _ b f a fSYWdbb WaU dSf V f U UW

8adfZe WS_b Wf a &) 8 J) D U\$W UUSbSufad dSfW Xad H bSdS W SdW eW 3 VS 8 Xad ZYZ
W WU XfW YUSbSufad e b SUM Se UaeWSe T Wfa fZWWU Wb e

3 8 U\$W UUSbSufad ef TWUa W\$W TW W\$W 4AAF b S V EI b Xad bW\$W bW\$W 3 U\$W U
USbSufad fZJ D adTWYdVfVfZS W\$W W\$W dU e dW\$ _ W\$W FZWUSbSufadeZa VZS WS H ad ZYZW a fSYW
dSf Y

FZW~~e~~WU~~f~~a aXa fb fUSbSUfad S~~X~~U~~f~~a fb f a fSYWdbb W ef~~V~~S efSfWS V aSVfdS eWfbW~~ad~~_S UW

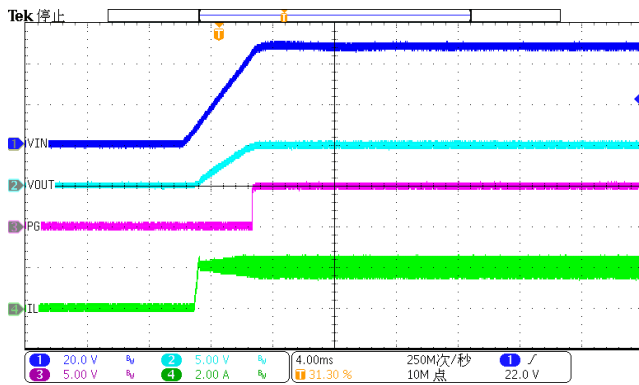
FZWa fb f dbb We~~e~~WfS Ua_baeW aXf a bSde A WeUS eW/T fZW V UfadU dWf dbb WYa YfZ~~a~~ YZ
fZW7c SWfE~~W~~W~~e~~ DW~~e~~efS UW7ED aXfZWa fb fUSbSUfadS VfZWafZW~~e~~US eW/T fZW V UfadU dWf dbb W
UZSdY YS VVeUZSdY YfZWa fb fUSbSUfad Fa SUZWWe_S a fb f a fSYWdbb WUZaaeWS a 7ED a fb f
USbSUfad WU~~W~~S_U USbSUfad 8ad U~~W~~S_U USbSUfad fZWUSbSUfS UWVa_ S~~f~~W~~e~~ fZWa fb f dbb W 8ad
e_b XUSfa fZWa fb f a fSYWdbb WUS TW~~W~~f_ S~~f~~W/T 7c Sfa W~~e~~dW

I ZW~~W~~

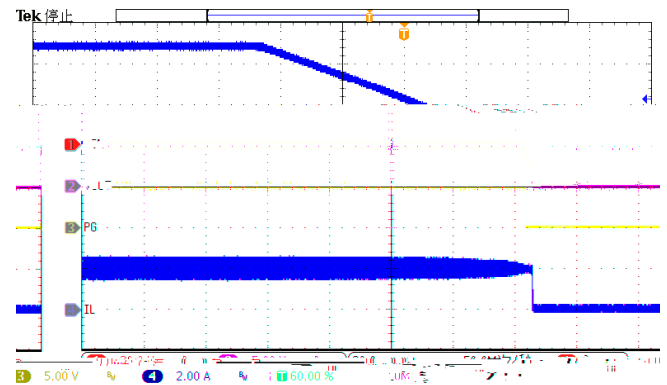
efZWa fb f a fSYWdbb W
X~~i~~ efZWe fUZ Y~~X~~W~~e~~ WU
efZW V UfS UWaX V Ufad
5_{AGF} efZWa fb fUSbSUfS UW
H_{AGF} efZWa fb f a fSYW
H efZW b f a fSYW

6 Wfa USbSUfade W~~W~~dSV Y W~~d~~65 TSe fZWTSe a fSYWUS eY XUS f dW UWUSbSUfS UW 5W~~S~~_U
USbSUfade US aeW_aef aXfZWdUSbSUfS UWSf d~~f~~W a fSYWFZW~~W~~adV W~~S~~ W_SdY a fZW a fSYWd~~f~~ Yfa
We d~~W~~SW~~e~~ S~~f~~W~~W~~U~~f~~ WUSbSUfS UWF bUS f a 8 U~~W~~S_Ua fb fUSbSUfade ad X~~d~~_aef Sbb USfa e

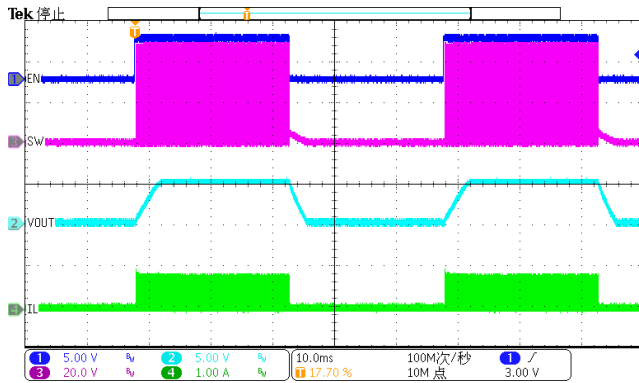
H / &*H H_{AGF}/ H 8_{EI} / & V_{ee}afZVd eW afW



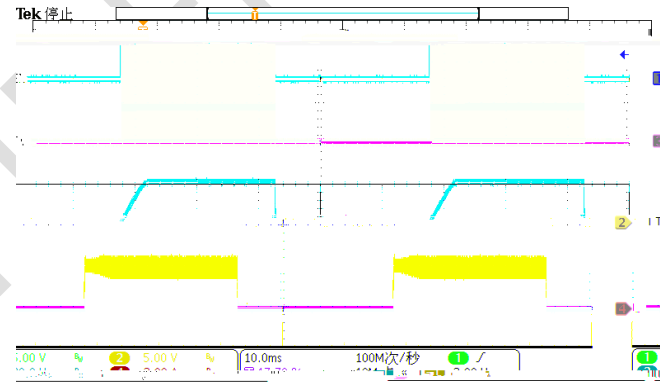
8 Y dW Ba Wd b A36/ 3



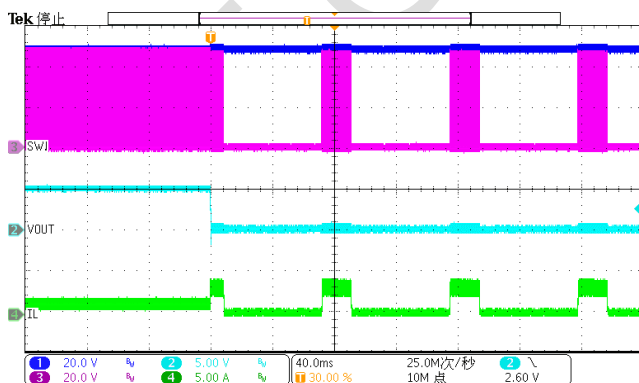
8 Y dW Ba Wd Va A36/ 3



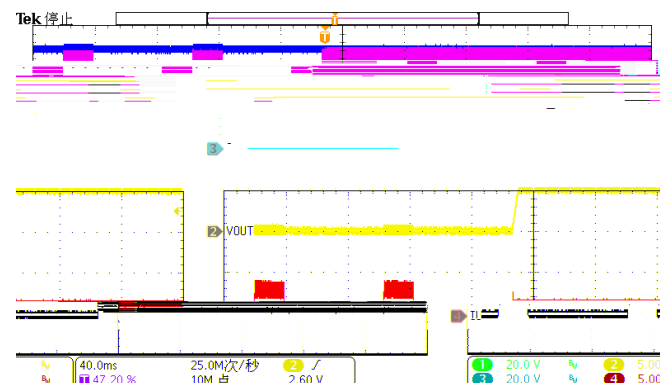
8 Y dW % 7 faYYW A36/ 3



8 Y dW & 7 faYYW A36/ 3



8 Y dW A Wd5 dWf BdfWf a 3 fa ZSd/eZaf



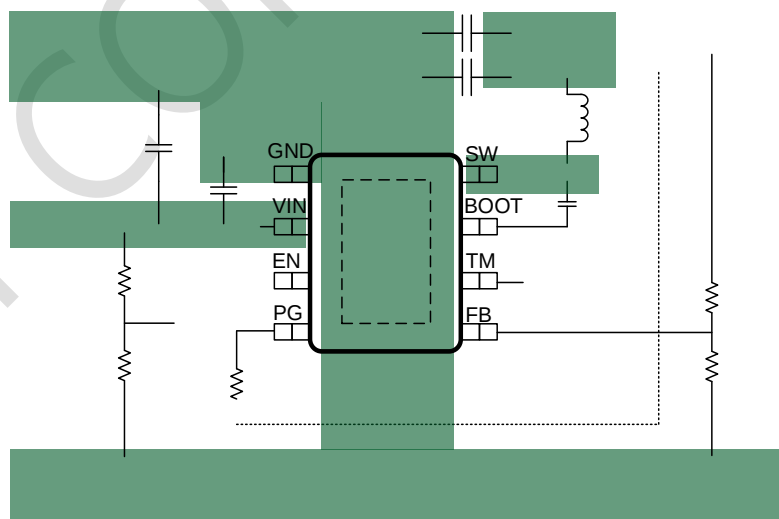
8 Y dW (A Wd5 dWf DWfSeW ZSd/eZaf a 3

999

SCT CONF

BdabW54 S a f e S U d f U S X d E 5 F (C e e f S T W S V W X U f a b W S f a F Z W f S U W e U a V U f Y X S e f e f U Z Y
U d W f e a d a f S Y W e S d W S e f a f W S U f f Z e f S V U S U W S V b S e f U U S b S U f S U W f a Y W W S f W a e W S V
W W S W b W a d S U W 8 a d T W W d e f e X a a f Z W e W Y W W V e S e T W a ,

1. Ba W Y d V Y e U Z W W e W U d f U S L T W S e W a X U S d Y b a W f Z W S S V Y f U Z T a U Y a e W
S e a U S f W f Z U a U X W W U F Z W f Z T a X d W e f a S W Y d V f S U W a V e f b W W U W S V b a W S d V
V e f d T f W W a B 5 4 E X W f b S U Y Y d V S d S a b f W f Z W S S V a f U S e Y a W Z W S d S
2. B S U M S a 7 E D U W S U U S b S U f a d S e U a e W f a H b S V f Z W Y d V S e b a e e T W f a d W U M b S e f U W W f
3. 8 a d a b W S f a S f X S f W a S V f Z W f a b e W W Y d V S d S e f b d W S W W S f W Z W S f V e e b S f Y S d S S W
e d M f a b e f U Z Y a a b f Z b a W Z S W a W b W W U W a X Y d V Y
4. F Z W T a f f a S W e S S W Y d V b S W L a W W W f a f Z W Y d V b S W a f a b S W T S e F Z W b a W b S V
e Z a V T W L a W W W f a T a f f a B 5 4 Y d V b S W e Y f b W S e V d W W f Z W 5 F Z W U W f W f Z W S
b S V e Z a V S S e T W e a W W W f a f Z W T a S d X d W U Z S U S e f d W Y f Z S V d W S T f e Y f b W f Z W S S e
W d W S f Z f Z W f Z W S b S V b d a b W e a W d Y f Z W S b S V f a Y d V b S f W a B 5 4 U S e W E I Z Y Z W d Y Y
S V a W e Z a a f T W e W e V a Y d S V Y f Z W S b W a d S U W f e d W a W W W V S W W d V d Z a V e a X f Z W S
S e T f S e S W d S a X W e V e d e a X e a W d a W a e e A S b b U S f a e Z W e a W d a W a e e f Z d f Z W S e
e a X L a U d b Y Y Y a d f W f Y U S T W e W f a S U Z W W S d W S f S T W b d U e e
5. A f b f V U f a d e Z a V T W b S U W U a e W f a f Z W E I b F Z W e f U Z Y S d S a X f Z W B 5 4 U a V U f a d W W f a
b d W W f W U W e W U S b S U f W L a b Y
6. F Z W D F E K 5 f W S e e W e f W f a a e W e a f Z W D F d e f a d e Z a V T W a U S f W S e U a e W S e b a e e T W f a f Z W 5
S V d f W f Z S W Y f Z e a X f S U W
7. G H A S V e f S V D F d e f a d e a a b U a b W e S f a S V X W W T S U U a b a W f e e Z a V U a W W f a e S e Y S
Y d V Z U Z e f d W d f a f Z W 9 6 b f Z a f S f W S Y f Z b a W Y d V
8. 8 a d S U Z W Y T W W f Z W S b W a d S U W S X d S W S a f e e f d Y d W a W W W



8 Y d W % B 5 4 S a f 7 S _ b W

SCT CONFIDENTIAL

999



SCT CONFIDENTIAL