4.5V-85V Vin, 0.6A, High Efficiency Synchronous Step-down DCDC Converter with Programmable Frequency

- S e a Ej l qpN j ca60*1R)41R
- , *2= kjpej qkqo K qpl qp qmmajp
- , *4R - Baa _g Nabamaj _a Rkhp ca
- Ejpacn pa 31, i Dec d)Oe a j 1, , i Hks) Oe a Lks an l K OBAPo
- L qhoa Bnamqaj _u l k qh pdkj LBl %s epd -, , q= Mqeao_ajp qmmajpej Ohaal l k a
- 0i o Ejpanj hOkhp)op rpPie a
- = fqop ha Bnamqaj _u /, , GDv pk 4, , GDv
- L ma_eoekj Aj ha Pdmaodkh bkn Lrkcn i i ha Ej l qpRkhp ca Qj an)rkhp ca Hk_g K qp Lrkpa_pdkj QRHK%Pdmaodkh j Duopamaoeo
- u_ha) u) u_ha qmmajp Hie epej c
- K r an)Rkhp ca Lrkpa_pdkj
- K r an)Pai l an pqma Lrkpa_pdkj
- =r en ha ej j AOK L)4 L _g ca

- A)Pkkho
- A) egja(O_kkpan
- CL O Pn _gan

Pda O P. = -, eo , *2= ouj _drkjkqo q_g _kjr ampamo s epd s e a ej l qp r khp ca(n j cej c brki 0*1R pk 41R(s de_d ejpacn pao j 31, i dec d)oe a l K OBAP j 1, , i Hks)oe a l K OBAP*Pda O P. = -, (kl pej c pda _kjop jp)kj pie a KP%

JKPA6L ca jqi arnobknl nar ekqo nar emekj o i u ebanbnki l ca jqi arno ej pda _qmnajpr arnoekj *

Nar emekj -*; 6Naha oa pk l ngap*

Nar emekj -*. 6= l l he_ pekj s rabkri o(ql pa abbe_eaj _u _qmra*

Nar emekj -*/ 6Ql pa N- j N. _ h_qh pekj r hqa ej l ca --*

Nar emekj -*06Ql pa ARE AKN AN EJBKNI =PBKJ*

O P. = -, OPAN	P l a Naah	0, , ,	. = -,	4	AOKL)4

Krankl an pej c bnaa) empai l an pqna qj haoo kpdans eea j kpa -%

OS	4	Nacqh pknos ep_dejc kqpl qp* kjja_pOS pk j atpanj hlks anej q_pkn
Pdari h L	5	Da p eooe pakj l pdkb ea* Aha_pne_ hlu _kjja_pakj pk CJ lej*l qop a _kjja_pa pk crkqj lhjakj L bknlrklankl an pakj j klpe eva pdari hl arbkri j_a*

Krankl an pejc bnaa) enpai l an pqrna n jca qjhaook pdans eea jkpa

REJ	Ejl qprkhp ca n jca	0*1	41	R
RKQP	Kqpl qprkhp ca n jca	, *4	. 0	R
PF	Kl an pejc fqj_pakj pai l an pqrna	)0,	-. 1	

RAO	Dqi j k u l k ahD l %l an=JOEJFA A)FO), , -). , -0 ol a_bee_ pakj (hhl ejo-%	).	.	gR
	d rnca ar e_a l k ah l %l an=JOEJFA A)FO), , .) . , -0 ol a_bee_ pakj (hhl ejo-%	), *1	, *1	gR

(1) FA A k_qi ajpFAL-11 op pao pd p1, , R D l hkks o o bai jqb _pqrnejc s epd op j n AO _kjprkhl rk_aoo*
(2) FA A k_qi ajpFAL-13 op pao pd p. 1, R l hkks o o bai jqb _pqrnejc s epd op j n AO _kjprkhl rk_aoo*

N F=	Fqj_pakj pk i ea jppdari hrnaoeop j_a -%	0.	+S
N F	Fqj_pakj pk _ oa pdari hrnaoeop j_a -%	01*4	

-%O P l rkr e ao N F= j N F jqi arn o k jhu o nabarnaj_a pk aopae pa fqj_pakj pai l an pqrnao kbpda ar e_ao* N F= j N F rna jkp _d n _panepe_kbl _g ca epoalh(qpkbi ju kpdanouopai harah_d n _panepe_o ooq_d o pda aoecj j hukqpkbpda l nejpa _en_qep k n L %kj s de_d pda O P. = -, eo i kqjpa (pdari hl oeva(j atpanj hajr ekji ajp hb _pkrno*Pda L k n eo da poejg pd pe o k h ana pk pda ha o j pdari hl kbpda O P. = -, * d jcejc pda aoecj k n_kjbecqn pakj kbpda L k n _d jcao pda abbe_ea j_u kbpda da poejg j pdarnabkna pda _pq hN F= j N F *

REJ 904R(PF9)0, z-. 1 (pul e_ hr hqa eo pao pa qj an. 1 *

REJ	Kl an pejc ejl qprkhp ca		0*1 41	R
REJ QRHK	Ejl qpQRHK Pdrnaodkh Duopanaoeo	REJ neejc	0*. 0, ,	R i R
EOD J	Odqp ks j _qrnajpbnki REJ l ej	AJ 9, (jk hk	/	θ=
EM	Mqeao_ajp_qrnajpbnki REJ l ej	AJ bhk pejc(jk hk (jkj) os ep_dejc(KKP)OS 91R	-, ,	θ=

N OKJ D	Dec d)oe a l KOBAP kj)naoeop j_a	R KKP)ROS 91R	31,	i
N OKJ H	Hks)oe a l KOBAP kj)naoeop j_a		1, ,	i

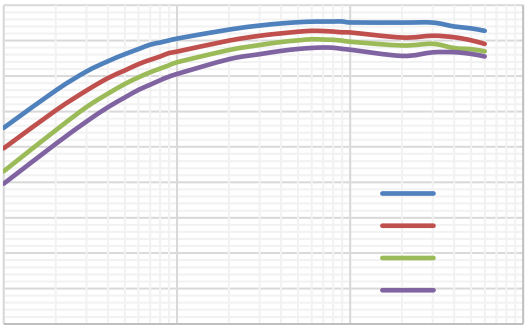
R_{NAB}	Nabamaj_arkhpcakbB		, *35. , *4 , *4, 4	R

$R_{AJ\ D}$	Aj ha dec d pdmaodkh		-*. -	R
$R_{AJ\ H}$	Aj ha hks pdmaodkh		-*, 1	R
$E_{AJ\ H}$	Aj ha lej lqhh)ql _qmmajp	AJ9-R	-	θ=
$E_{AJ\ D}$	Aj ha lej lqhh)ql _qmmajp	AJ9-*1R	0	q=
P_{oo}	Ejpanj hokbpop mppeia		0	i o

$B_{N=JCA\ NP}$	Bmamqaj_u n jca qoejc NPi k a		/, , 4, ,	gDv
B_{OS}	Os ep_dejc bmamqaj_u	N_{NP}91, , g - %	0. , 1, , 2, ,	gDv
$P_{KBB\ I\ E\boxtimes}$	I ejeie qi kbb)peia	$R_{E\boxtimes}$9-. R	. , , . 2,	j o

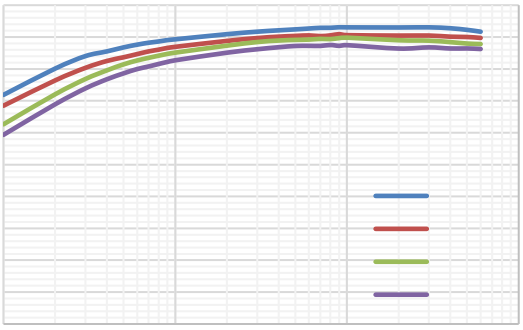
$E_{\boxplus\boxplus\ L}$	HOI KOBAP Ikoepeea _qmmajphie ep	Brki okqn_apk n ej	, *4	=
$P_{DE\ QL}$	De_ql s epejc peia	Jqi amokbokbp)op mp_u_hao	3	_u_hao
$_{DE\ QL}$	De_ql qpu_u_ha		-. *1	

R_{KRL}	Baa _gkramrkhpcas epdmaola_ppk mabamaj_arkhpca	R_B +R_{NAB} meejc R_B +R_{NAB} b hmejc	--, -, 1	
P_O	Pdari hodqpks j pdmaodkh	P_F meejc Duopamaoep	-23 /1	



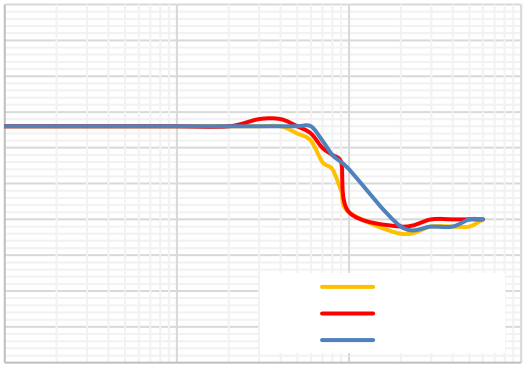
K

Bkcqna . * Abbe_aj _u r o Hk qmmajp Rkqp91R%

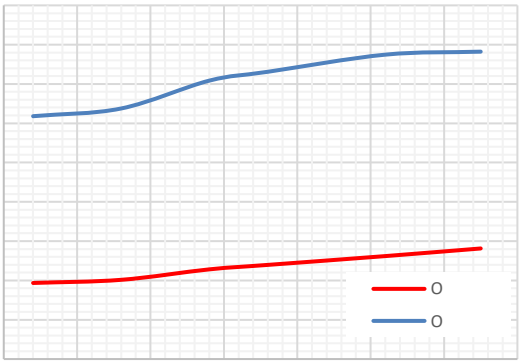


K

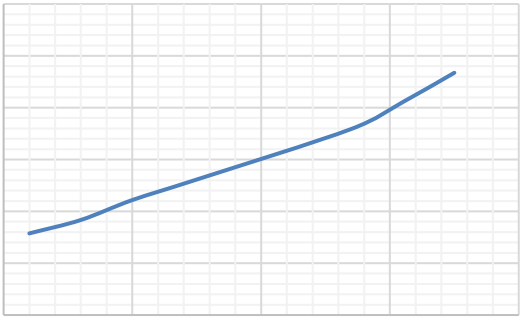
Bkcqna / * Abbe_aj _u r o Hk qmmajp Rkqp9-. R%



Bkcqna 0 * Hk Nacqh pkj Rkqp9-. R%

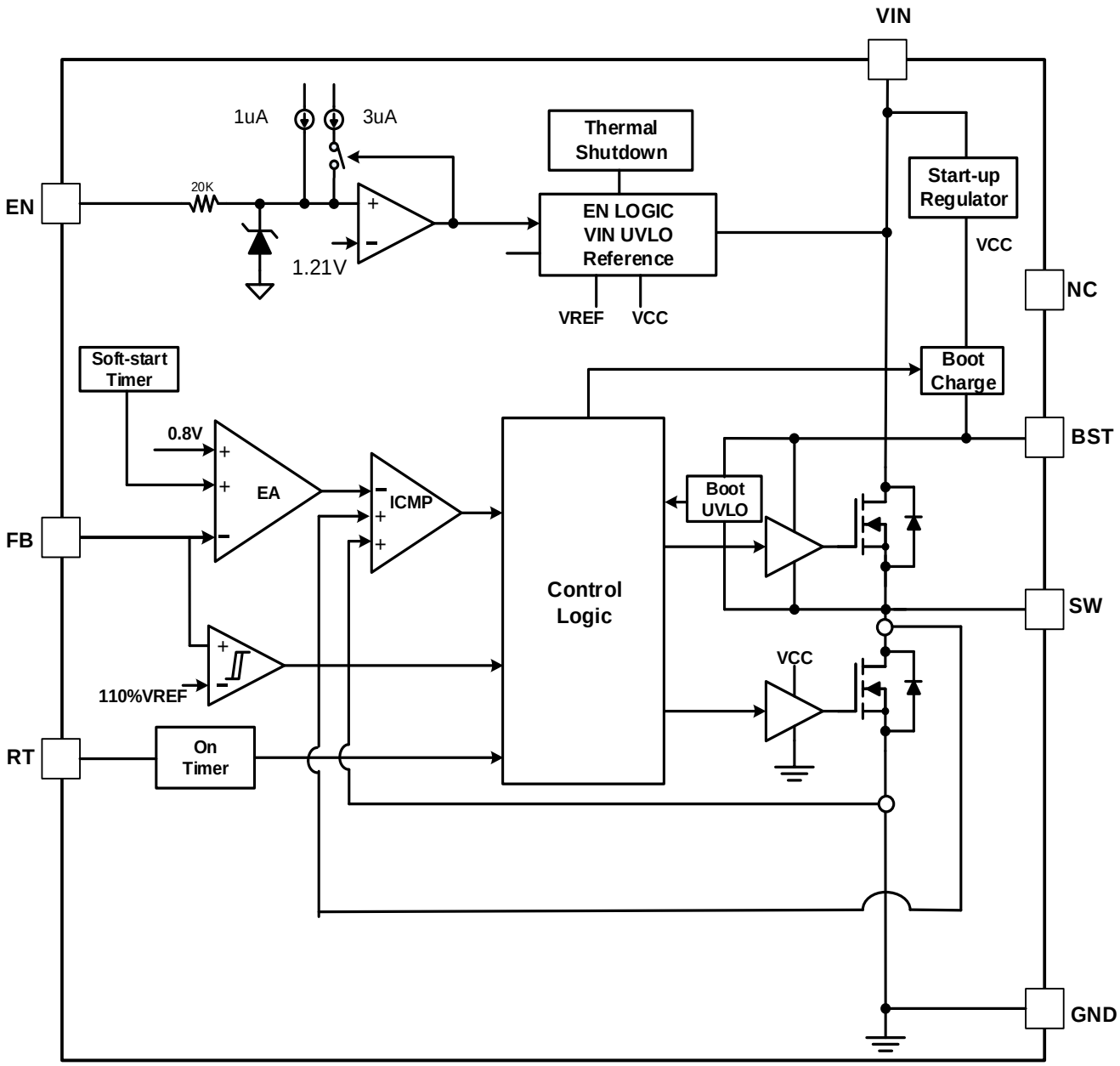


Bkcqna 1 Bnamqaj _u r o Pai l an pqna



Bkcqna 2 * Odqp) ks j qmmajpr o Pai l an pqna

Bkcqna 3 * Bnr o Pai l an pqna

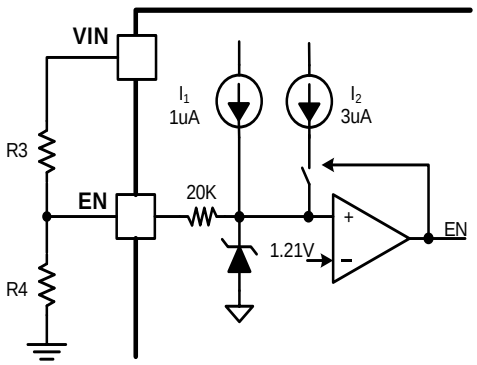


Bccqna 4* Bqj_pkj h lk_g ecn i

Pda O P. = -, eo 0*1R)41R ejl qp(, *2= kqpl qp(ejpanj h)_ki l ajo pa ouj_drkjkqo q_g _kjr anpans epd qehp)ej 31, i N okj dec d)oea j 1, , i N okj lhks)oea l ks anl KOBAPo

-%

. %



Becqna 5*Ouopai QRHK u aj ha eeea

S dana

Rop mp6Rej neea pdnaodkh pk aj ha pda are_a
Ropkl 6Rej b lhpdnaodkh pk eo ha pda are_a
E9-q=
E9/q=
RAJN9-*: -R
RAI B9-*; 1R

Pda O P.=-, nacqh pao pda ejpanj hnabarnaj_arkhp ca p, *4R s epd ±- pkhan j_akran pda klan pejc pai lan pqna j rkhp ca n jca* Pda kqpl qp rkhp ca eo oap u naoepkn eeean bnki pda kqpl qp jk a pk pda B lej* Ep eo na_ki i aj a pk qoa - pkhan j_akn appan naoepkno* Qoa Amq pkj / pk _ h_qh pa naoepj_akb naoepkn eeearo* Pk ie lnkra abbe_aj_u phec dp hk o(h nc anr hqa naoepkno na na_ki i aj a *Dksaran(epda r hqao na pkk dec d(pda nacqh pkns ekh a i kna oqo_alpe ha pk jk ea bba_pejc kqpl qp rkhp ca __qn _u*

/ %

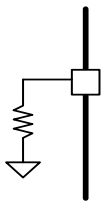
s dana

- NB PKL eo pda naoepkn_kjja_pejc pda kqpl qp pk pda B lej*
- NB KP eo pda naoepkn_kjja_pejc pda B lej pk pda crkqj *

Pda O P.=-, ejpac npao j ejpanj hokbp)op np _en_qep pd p n i lo pda nabarnaj_arkhp ca bnki vark rkhpo pk , *4R nabarnaj_arkhp ca ej 0i o*Ep pda AJ lej eo lqhha alhks -*; 1R(os ep_dejc opklo j pda ejpanj hokbp)op np naoapo* Pda okbp)op np hok naoapo qnejc odqp ks j qa pk pdani hkranhk ejc*

Pda os ep_dejc bnamqaj_u kbpda O P.=-, eo oap u l h _ejc naoepkn aps aaj NP lej j pda crkqj *

Ej naoepkn oappejc bnamqaj_u i k a(naoepkn l h _a aps aaj NP lej pk pda crkqj oapo pda os ep_dejc bnamqaj_u kran s e a n jca bnki /, , GDv pk 4, , GDv*NP lej eo jkp hks a pk a habpdhk pejc k n odkmpa pk pda crkqj *Qoa Amq pkj 0 knpda l hkpej Becqna -, *pk apani ejapda naoepj_abkn os ep_dejc bnamqaj_u jaa a *



S dana(

bos eo os ep_dejc _hk_g bnamqaj_u

Becqna -, *Oappejc Bnamqaj_u

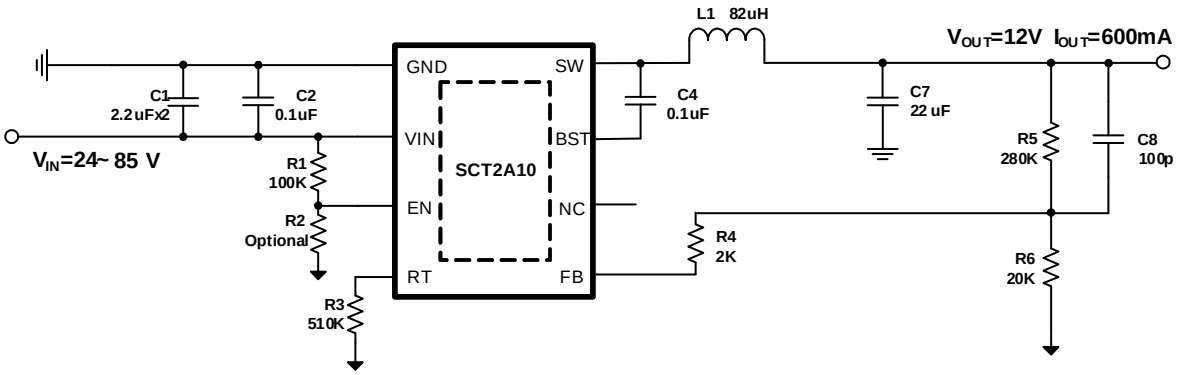
*

=j atpanj h kkpopn l _ l _ejkn aps aaj KKP l ej j OS l ej l ks ano pda bhk pej c c pa meanpk decd)oe a l ks an l KOBAP*Pda kkpopn l _ l _ejkn rkhp ca eo _d nca bnki j ejpacn pa rkhp ca nacqh pkn s daj decd)oe a l ks an l KOBAP eo kbb j hks)oe a l ks an l KOBAP eo kj*

Pda ej q_pkn _qnnajp eo i kjepkna qnej c hks)oe a l KOBAP M. kj* Pda O P. =-, e l hai ajpo kr an _qnnajp l nkpa_pekj s epd _u_ha) u)_u_ha hei epej c hks)oe a l KOBAP r hpau _qnnajp j hks)oe a l KOBAP r hpau _qnnajp pk rke ej q_pkn _qnnajp nqjj ej c s u qnej c qjatl a_pa kr anhk knkqpl qpd n odknp _kj epekj*

Pda O P. =-, e l hai ajpo pda Kran)rkhp ca Lnkpa_pekj KRL _en_qepnu pk i ej e eva kqpl qp rkhp ca kranodkkp qnej c hk pn joeajp(na_kranej c bnki kqpl qp b qhp _kj epekj kn hec dp hk pn joeajp*Pda kran rkhp ca _ki l n pkn ej KRL _en_qep _ki l nao pda B l ej rkhp ca pk pda ej panj hnabanaj_a rkhp ca*S daj B rkhp ca at _aa o --, kb ej panj h ,*4R nabanaj_a rkhp ca(pda decd)oe a l KOBAP pqnjo kbbpk rke kqpl qp rkhp ca _kjpejqa pk ej _na oa*S daj pda B l ej rkhp ca b hho alks -,1 kb pda ,*4R nabanaj_a rkhp ca(pda decd)oe a l KOBAP _ j pqnj kj c ej*

Pda O P. =-, l nkpa_po pda are_a bnki pda i ca qnej c at _aoo ea da p j l ks an eo oe pekj _kj epekjo*Kj _a pda fqj_pekj pai l an pqna at _aa o -23 (pda ej panj hpdani hoaj okn opk l o l ks an l KOBAPo os ep_dej c*S daj pda fqj_pekj pai l an pqna b hho alks -/. (pda are_a naop npo s epd ej panj hokbpop npl d oa*



Ejl qpRkhp ca	04R Jkri h . 0R pk 41R
Kqpl qpRkhp ca	-. R
I t ie qi Kqpl qp qmmajp	2, , i =
Os ep_dej c Bnamqaj_u	1, , GDv
Kqpl qprkhp ca mel ha l a g pk l a g%	1, i R
Pn j oeajpNaol kjoa 2, i = pk 10, i = hk opal	Rkqp9 0, , i R

Pda kqpl qpr klp ca eo oap u j atpanj hnaoeopkn e e an N1 j N2 ej pul e_ h l l he_ pkj o_dai pe_* Na_ki i aj a N2 naoeopj _a eo -, *. G * Qoa amq pekj 1 pk _ h_qh pa N1 *

—— 1%

s dana6

- RNAB eo pda baa _g nabanaj_a r klp ca(pul e_ h , *4R

Table 1. R_5, R_6 Value for Common Output Voltage (Room Temperature)

/*/ R	2/*1 G	., G
1 R	-, 1 G	., G
-. R	. 4, G	., G
. 0 R	14, G	., G

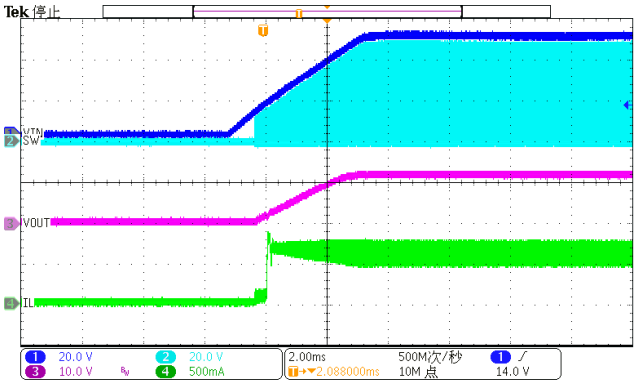
=j at panj hr klp ca e e an j aps kng kb N. bnki pda ej l qp pk AJ l ej

- RKQP eo pda kqpl qprkhp ca
- REB eo pda ejl qprkhp ca

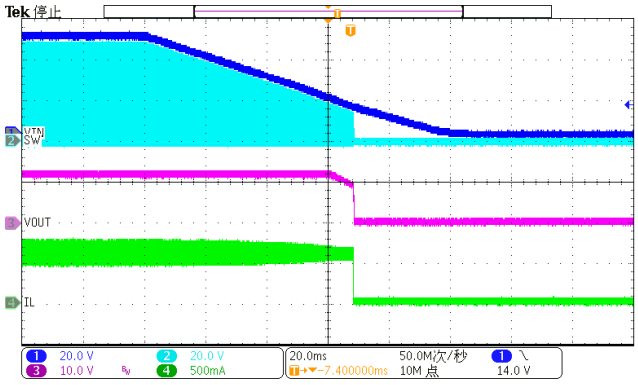
Oej_a pda ej q_pkn)_qmmajp nel ha ej_na oao s epd pda ejl qprkhp ca(ok pda i tie qi ejl qprkhp ca ej l lhe_ pkj eo
hs uo qoa pk _ h_qh pa pda i ejie qi ej q_p j_a nam qeea *Qoa Amq pkj 5 pk _ h_qh pa pda ej q_p j_a r hqa*

Pda r klp ca n pejc kbpda ejl qp_ l _ekni qop a cma panpd j pda i tie qi ejl qprklp ca*= j pda _ l _ekni qop
hok d ra mellha _qmmajp n pejc cma panpd j pda i tie qi ejl qp _qmmajp mellha*Pda NI O _qmmajp ej pda ejl qp
_ l _ekn

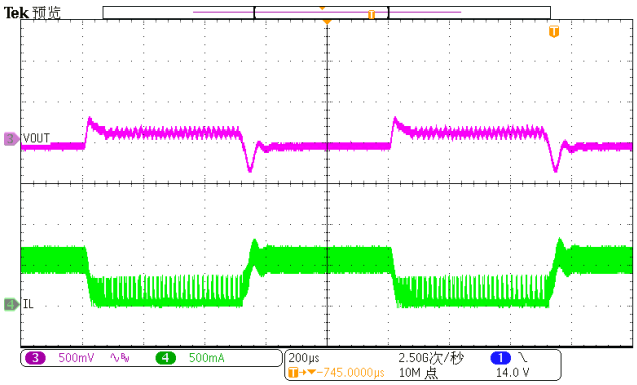
Rej 904R(Rkqp9 -. R(qj haoo kpdans eoa j kpa



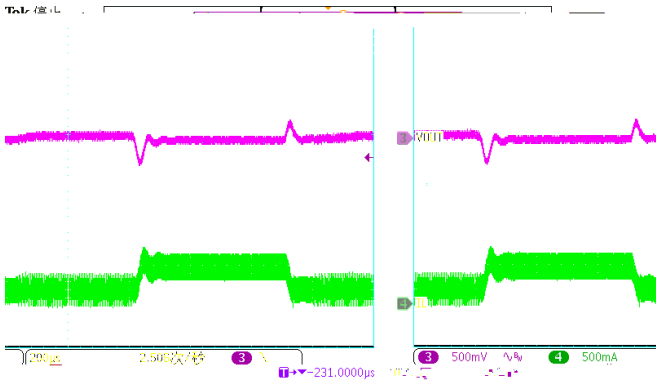
Bec qna -. *Lks anql



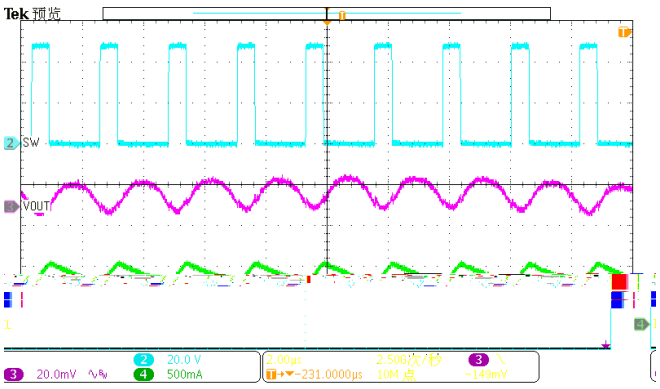
Bec qna -/ *Lks an ks j



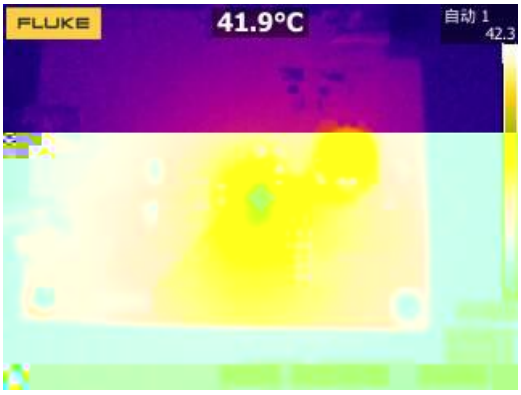
Bec qna -0*Hk Pn j oeajp , *, 2=), *10=(, *. 1=+qo%



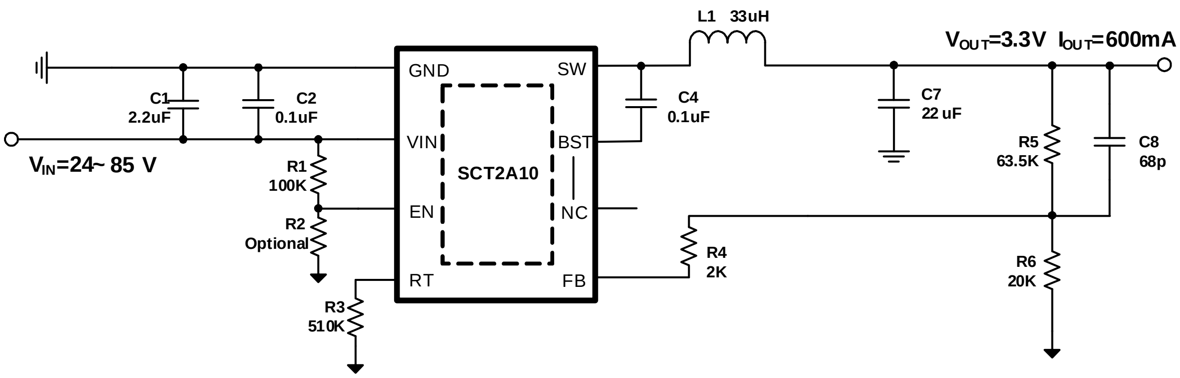
Bec qna -1*Hk Pn j oeajp , *-1=), *01=(, *. 1=+qo%

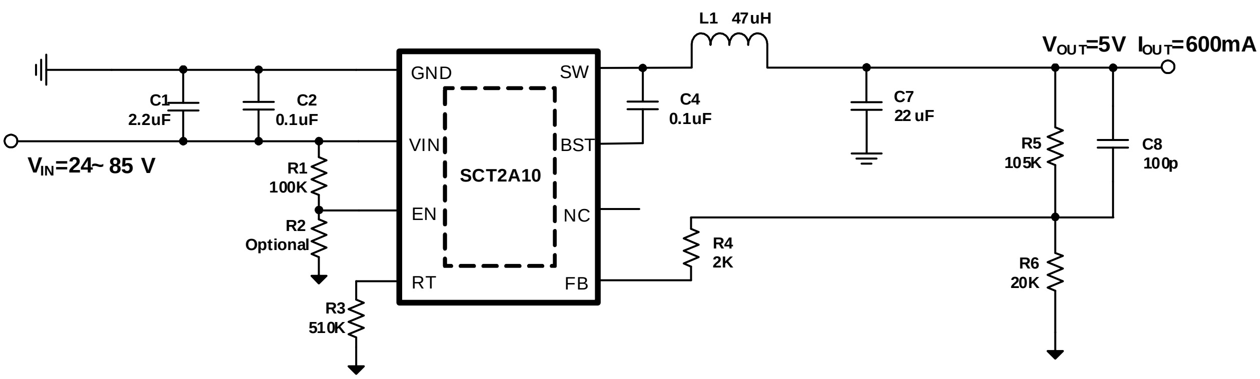


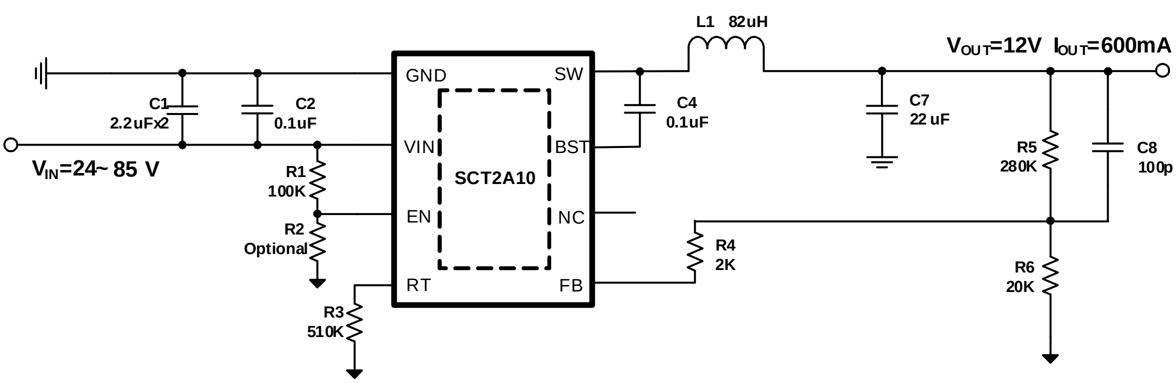
Bec qna -2*OS j RkqpNe l ha



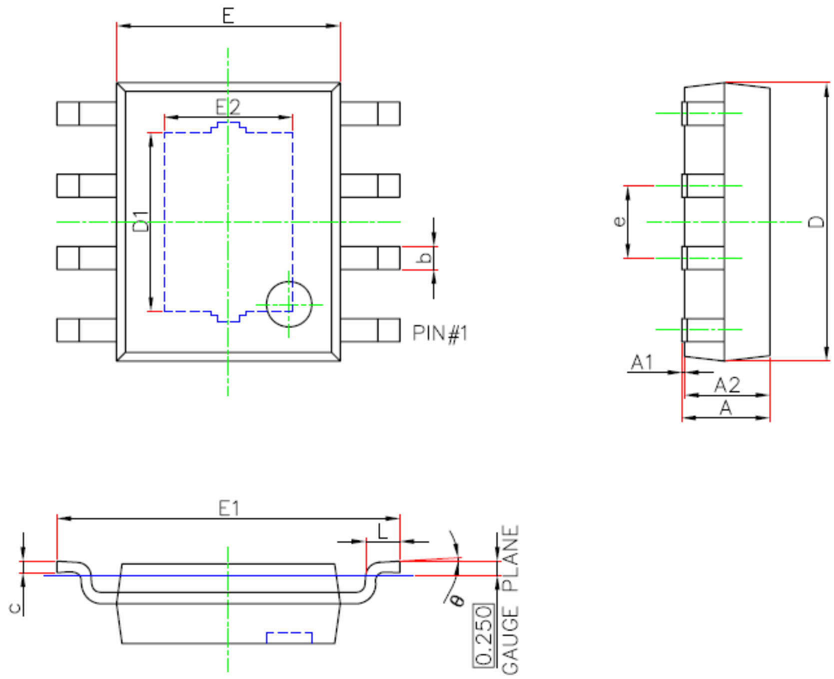
Bec qna -3*Pdani h(04REJ (-. Rkqp(, *2=


L1 33uH
VOUT=3.3V IOUT=600mA
GND
SW
C1
2.2uF
C2
0.1uF
C4
0.1uF
C7
22 uF
VIN
BST
SCT2A10
R5
63.5K
C8
68p
VIN=24~ 85 V
R1
100K
EN
NC
R2
Optional
R4
2K
RT
FB
R6
20K
R3
510K


L1 47uH
VOUT=5V IOUT=600mA
GND
SW
C1
2.2uF
C2
0.1uF
C4
0.1uF
C7
22 uF
VIN
BST
SCT2A10
R5
105K
C8
100p
VIN=24~ 85 V
R1
100K
EN
NC
R2
Optional
R4
2K
RT
FB
R6
20K
R3
510K


L1 82uH
VOUT=12V IOUT=600mA
GND
SW
C1
2.2uFx2
C2
0.1uF
C4
0.1uF
C7
22 uF
VIN
BST
SCT2A10
R5
280K
C8
100p
VIN=24~ 85 V
R1
100K
EN
NC
R2
Optional
R4
2K
RT
FB
R6
20K
R3
510K

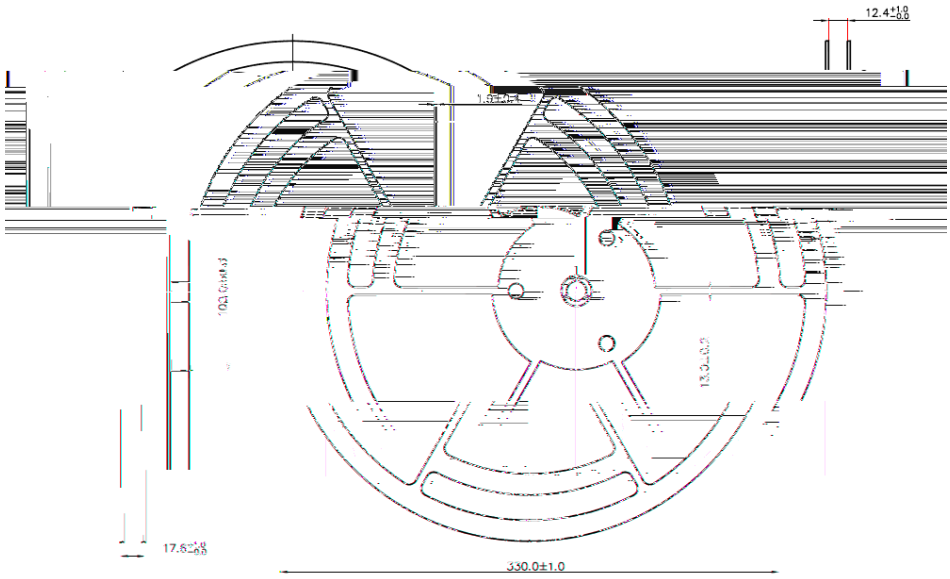
LrklanL hukqpeo _npe_ hbknO P.=-, o op ha j abe_eajpklan pekj*Pda pnj_aodekjZq_peYokb oplspe_dejc k no a _qmajpo knrklp cao na a ou pk ejpan _ps epd opn u ej q_p j_a j l n oepe_ _ l _ep j_a pk cajan pa jkeoa j acn a lanbkni j_a*Bkn appanmaoqhpo(bkhhks pdaoa cqeahejao ofGaklkg§46V

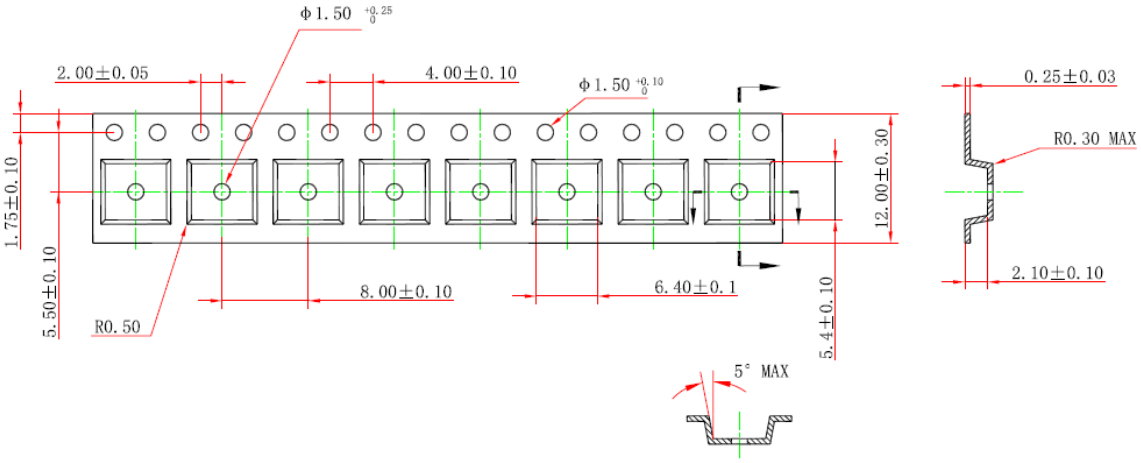


AOKL4+LL 51t-/,%L _g ca Kqphej a ė ajoėkjo

Oui kh	ė ajoėkjo ej l ėhė apamo		ė ajoėkjo ej Ej_dao	
	l ej*	l t*	l ej*	l t*
=	-*/,,	-*3,,	,*;1-	,*;23
=-	,*;,,	,*-,,	,*;,,	,*;,0
=.	-*/1,	-*11,	,*;1/	,*;2-
	,*//,	,*1-,	,*;-/	,*;.,
_	,*-3,	,*:1,	,*;,3	,*;-,
	0*3,,	1*-,,	,*-41	,*:,-
-	/*;1,	/*:1,	,*-.,	,*-.4
A	/*4,,	0*;,,	,*-1,	,*-13
A-	1*4,,	2*:,,	,*:.4	,*:00
A	.*-2,	.*/2,	,*;41	,*;5/
a	-*:3, O %		,*;1, O %	
H	,*0,,	-*:3,	,*;-2	,*;1,
θ	,	4	,	4

1. n s ej c l nkl koa pk a i a FA A l _g ca kqphej a l K)..,r ne pkkj*
2. n s ej c jkppk o_ ha*
3. =hhej a n ė ajoėkjo na ej i ėhė apamo*
4. Pdari hl od hn a okh ama kjpda k n*
5. ė ajoėkjo kbatl koa l kj kppki kbl _g ca k jkpej_hq a i kh bh od*
6. kjp _pL k n b ne_pkkj bkni ej ė qi okh ani og s a pkhan j_ao aps aaj pda l ejo*





Pdaejbkni pakjejpdeo k_qi ajpeooq fa_ppk _d jca sepdkqpjkpe_a*Qoaroodkqh s rn jp j cq n jpaapdapdeo l npu Ejpalha_pq hLrkl anpu necdpo na jkpejbnejca qlkj s daj ejpacn pejc Odee_kj kjpajpPa_djkhkcu O P%lrk q_poejpk ju l l he_pakj*O P s ehjkp ooqi a ju hac hnaolkjoe ekpu bkn juo e l l he_pakjo*