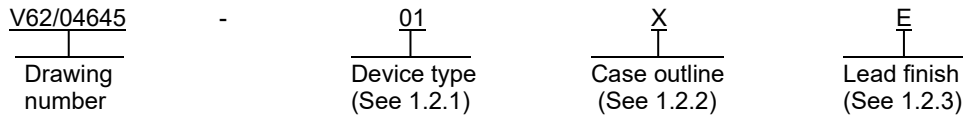


1. SCOPE

1.1 Scope. This drawing documents the general requirements of a high performance dual output, two phase synchronous DC/DC controller microcircuit, with an operating temperature range of -40°C to +125°C (device 01) and extended temperature range of -55°C to +125°C (device 02).

1.2 Vendor Item Drawing Administrative Control Number. The manufacturer's PIN is the item of identification. The vendor item drawing establishes an administrative control number for identifying the item on the engineering documentation:



1.2.1 Device type(s).

<u>Device type</u>	<u>Generic</u>	<u>Circuit function</u>
01	TPS5120-EP	Dual output, two phase synchronous DC/DC controller
02	TPS5120-EP	Dual output, two phase synchronous DC/DC controller

1.2.2 Case outline(s). The case outlines are as specified herein.

<u>Outline letter</u>	<u>Number of pins</u>	<u>JEDEC PUB 95</u>	<u>Package style</u>
X	30	MO-153	Plastic small outline

1.2.3 Lead finishes. The lead finishes are as specified below or other lead finishes as provided by the device manufacture:

<u>Finish designator</u>	<u>Material</u>
A	Hot solder dip
B	Tin-lead plate
C	Gold plate
D	Palladium
E	Gold flash palladium
Z	Other

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1.3 Absolute maximum ratings. 1/

Supply voltage (VCC)	-0.3 V to +30 V 2/
Input voltage:	
INV1, INV2, CT, PWM/SKIP, REG5V_IN, SOFTSTART1, SOFTSTART2,	
FLT, POWERGOOD pins	-0.3 V to +7 V
STBY1, STBY2, 5V_STBY, TRIP1, TRIP2 pins	-0.3 V to 30 V
Output voltage:	
LL1, LL2 pins	-1.0 V to 30 V
OUT1_u, OUT2_u pins	-1.0 V to 35 V
LH1, LH2 pins	-0.3 V to 35 V
OUT1_d, OUT2_d, 5V_OUT, FB1, FB2 pins	-0.3 V to 7 V
REF pin	-0.3 V to 3 V
OUT1_u, LH1 to LL1 pins	-0.3 V to 7 V
OUT2_u, LH2 to LL2 pins	-0.3 V to 7 V
Power dissipation (TA ≤ 25°C) (PD)	874 mW 3/
Operating junction temperature range (TJ)	-55°C to +150°C
Storage temperature range (TSTG)	-55°C to +150°C

1.4 Recommended operating conditions. 4/

Supply voltage range (VCC)	4.5 V minimum to 28 V maximum
Input voltage range (VI):	
INV1, INV2, CT, PWM/SKIP, SOFTSTART1, SOFTSTART2, FLT pins	6 V maximum
REG5V_IN, POWERGOOD pins	-0.1 V minimum to 5.5 V maximum
STBY1, STBY2, 5V_STBY pins	28 V maximum
OUT1_u, OUT2_u, LH1, LH2 pins	33 V maximum
TRIP1, TRIP2 pins	-0.1 V minimum to 28 V maximum
Oscillator frequency (fOSC)	500 kHz maximum
Operating free air temperature range (TA):	
Device 01	-40°C to +125°C
Device 02	-55°C to +125°C

Dissipation rating table.

Case outline	TA ≤ 25°C power rating	Derating factor above TA = 25°C	Power dissipation TA = 125°C
X	874 mW	6.993 mW/°C	175 mW

1/ Stresses beyond those listed under “absolute maximum rating” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

2/ All voltage values are with respect to the network ground terminal unless otherwise noted.

3/ See dissipation rating table.

4/ Use of this product beyond the manufacturers design rules or stated parameters is done at the user’s risk. The manufacturer and/or distributor maintain no responsibility or liability for product used beyond the stated limits.

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2. APPLICABLE DOCUMENTS

JEDEC PUB 95 – Registered and Standard Outlines for Semiconductor Devices

(Copies of these documents are available online at <https://www.jedec.org>.)

3. REQUIREMENTS

3.1 Marking. Parts shall be permanently and legibly marked with the manufacturer’s part number as shown in 6.3 herein and as follows:

- A. Manufacturer’s name, CAGE code, or logo
- B. Pin 1 identifier
- C. ESDS identification (optional)

3.2 Unit container. The unit container shall be marked with the manufacturer’s part number and with items A and C (if applicable) above.

3.3 Electrical characteristics. The maximum and recommended operating conditions and electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.4 Design, construction, and physical dimension. The design, construction, and physical dimensions are as specified herein.

3.5 Diagrams.

3.5.1 Case outline. The case outline shall be as shown in 1.2.2 and figure 1.

3.5.2 Terminal connections. The terminal connections shall be as shown in figure 2.

3.5.3 Logic diagram. The logic diagram shall be as shown in figure 3.

3.5.4 Logic chart. The logic chart shall be as shown in figure 4.

3.5.5 Timing waveforms. The timing waveforms shall be as shown in figure 5.

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TABLE I. Electrical performance characteristics. 1/

Test	Symbol	Conditions V _{CC} = 7 V 2/ unless otherwise specified	Temperature, T _A	Limits		Unit
				Min	Max	
Reference voltage section						
Reference voltage	V _{ref}			0.85 typical		V
Reference voltage tolerance	V _{ref(tol)}	I = 50 μA	T _A = +25°C	-1.5	1.5	%
			T _J = -55°C to +125°C	-3.0	3.0	
Line regulation	R(egin)	V _{CC} = 4.5 V to 28 V, I = 50 μA			3	mV
Load regulation	R(egl)	I = 0.1 μA to 1 mA			5	mV
Oscillator section						
Frequency	f _{OSC}	PWM mode, C _T = 44 pF	T _A = 25°C	300 typical		kHz
High level output voltage	V _{OH}	DC		1.1 typical		V
		f _{OSC} = 300 kHz		1.17 typical		
Low level output voltage	V _{OL}	DC		0.5 typical		V
		f _{OSC} = 300 kHz		0.43 typical		
Error amplifier section						
Input offset voltage	V _{IO}		T _A = 25°C		10	mV
Open loop voltage gain				50		dB
Unity gain bandwidth				2.5 typical		MHz
Output sink current	I(snk)	V _O = 1 V		0.3		mA
Output source current	I(src)	V _O = 1 V		0.2		mA
Skip comparator section						
Hysteresis window	V _{hys}	SKIP mode		9 typical		mV
Duty control section						
Maximum duty cycle	DUTY	300 kHz, V _I = 0 V		83 typical		%

See footnotes at end of table.

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TABLE I. Electrical performance characteristics – continued. 1/

Test	Symbol	Conditions V _{CC} = 7 V 2/ unless otherwise specified	Temperature, T _A	Limits		Unit
				Min	Max	
Control section						
High level input voltage	V _{IH}	STBY1, STBY2		2.2		V
		PWM/SKIP, 5V_STBY		2.2		
Low level input voltage	V _{IL}	STBY1, STBY2			0.3	V
		PWM/SKIP, 5V_STBY			0.3	
5 V internal switch section						
Threshold	V(TO_H)			4.2	4.8	V
	V(TO_L)			4.1	4.7	
Hysteresis	V _{hys}			30	200	mV
5 V regulator section						
Output voltage	V _O	V _{CC} = 5.5 V to 28 V, I _O = 0 mA to 50 mA	T _A =25°C	4.8	5.2	V
Line regulation	R(egin)	V _{CC} = 5.5 V to 28 V, I = 10 mA			20	mV
Load regulation	R(egl)	V _{CC} = 5.5 V, I = 1 mA to 10 mA			40	mV
Short circuit output current	I _{OS}	5VREG = 0 V	T _A =25°C	65		mA
UVLO threshold voltage	V(TO_H)	5V_OUT voltage		3.6	4.2	V
	V(TO_L)			3.5	4.1	
Hysteresis	V _{hys}	5V_OUT voltage		20	150	mV
Output drivers section						
OUT_u sink current		V _O = 3 V		1.2 typical		A
OUT_u source current		V _O = 2 V		-1.5 typical		A

See footnotes at end of table.

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TABLE I. Electrical performance characteristics – continued. 1/

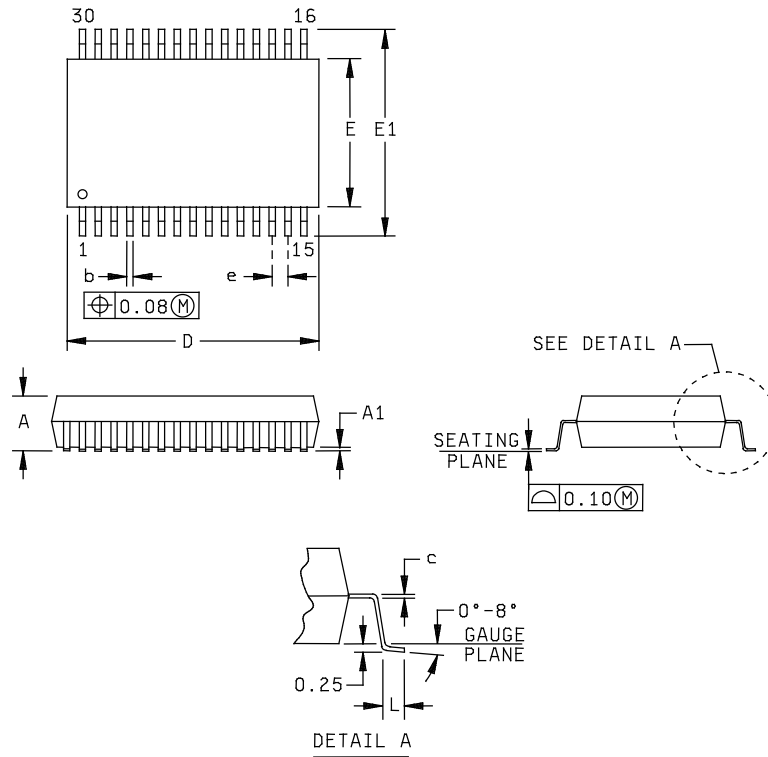
Test	Symbol	Conditions VCC = 7 V <u>2/</u> unless otherwise specified	Temperature, TA	Limits		Unit
				Min	Max	
Output drivers section - continued						
OUT_d sink current		VO = 3 V		1.5 typical		A
OUT_d source current		VO = 2 V		-1.5 typical		A
TRIP pin current	I(TRIP)		TA =25°C	11.5	14.5	µA
Soft start section						
Soft start current	I(SOFT)			1.6	2.9	µA
Threshold voltage (SKIP mode)	V(TO_H)			3.7 typical		V
	V(TO_L)			2.5 typical		
Output voltage monitor section						
OVP comparator threshold				0.91	0.99	V
UVP comparator threshold				0.64	0.72	V
PG comparator 1, 2 threshold				0.75	0.81	V
PG comparator 3, 4 threshold				0.88	0.94	V
PG propagation delay from INV to POWERGOOD		Turnon		13 typical		µs
		Turnoff		1.2 typical		
Timer latch current source		UVP protection		1.5	3.1	µA
		OVP protection		8	15	
Supply current section						
Supply current	ICC	CT = 0 V, INV = 0 V	TA =25°C		1.5	mA
Shutdown current	ICC(S)	STBY1, STBY2, 5V_STBY = 0 V	TA =25°C		10	µA
		STBY1, STBY2, 5V_STBY = 0 V	TA = -55°C to 125°C		20	

1/ Testing and other quality control techniques are used to the extent deemed necessary to assure product performance over the specified temperature range. Product may not necessarily be tested across the full temperature range and all parameters may not necessarily be tested. In the absence of specific parametric testing, product performance is assured by characterization and/or design.

2/ For device 01 TA = -40°C to +125°C; for device 02 TA = -55°C to +125°C unless otherwise specified.

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Case X



Dimensions									
Symbol	Millimeters		Inches		Symbol	Millimeters		Inches	
	Min	Max	Min	Max		Min	Max	Min	Max
A	---	1.20	---	0.047	E	4.30	4.50	0.169	0.177
A1	0.05	0.15	0.002	0.006	E1	6.20	6.60	0.244	0.259
b	0.17	0.27	0.007	0.011	e	0.50 NOM		0.019 NOM	
c	0.15 NOM		0.006 NOM		L	0.50	0.75	0.019	0.029
D	7.70	7.90	0.303	0.311					

NOTES:

1. This drawing is subject to change without notice.
2. Body dimensions do not include mold flash or protrusion.
3. Falls within JEDEC MS-153.

FIGURE 1. Case outlines - Continued.

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Device type	01		
Case outline	X		
Terminal number	Terminal symbol	I/O	Description
1	INV1	I	Inverting input of the CH1 error amplifier, skip comparator, and OVP1/UVP1 comparator.
2	FB1	O	Feedback output of CH1 error amplifier
3	SOFTSTART1	I/O	External capacitor from SOFTSTART1 to GND for CH1 softstart control. Separate soft-start terminals make it possible to set the start-up time of each output independently.
4	PWM/SKIP	I	PWM/SKIP mode select pin. The PWM/SKIP pin is used to change the output's operating mode. If this terminal is lower than 0.5 V, it works in PWM mode. When a minimum voltage of 2 V is applied, the device operates in skip mode. In light load condition (< 0.2 A), the skip mode gives a short pulse to the low-side FETs instead of a full pulse. With this control, switching frequency is lowered and switching loss is reduced. Also, the output capacitor energy discharging through the output inductor and low-side FETs is stopped. Therefore, this device achieves a higher efficiency in light load conditions.
5	CT	I/O	External capacitor from CT to GND for adjusting the triangle oscillator.
6	5V STBY	I	5 V linear regulator control
7	GND		Control GND.
8	REF	O	0.85 V reference voltage output. The 0.85 V reference voltage is used for setting the output voltage and the voltage protection. This reference voltage is dropped down from a 5 V regulator.
9	STBY1	I	Standby control for CH1. SMPS1 can be switched into standby mode separately by grounding the STBY1 pin.
10	STBY2	I	Standby control for CH2. SMPS2 can be switched into standby mode separately by grounding the STBY2 pin.
11	FLT	I/O	Fault latch timer pin. An external capacitor is connected between FLT and GND to set the FLT enable time up.
12	POWERGOOD	O	Power good open-drain output. When low, POWERGOOD reports an output fail condition. PG comparators monitor both SMPS's over voltage and UVLO of VREF5. The threshold is $\pm 7\%$. When the SMPS starts up, the POWERGOOD pin's output goes high. POWERGOOD also monitors VREF5's UVLO output.
13	SOFTSTART2	I/O	External capacitor from SOFTSTART2 to GND for CH2 softstart control. Separate soft-start terminals make it possible to set the start-up time of each output independently.
14	FB2	O	Feedback output CH2 error amplifier.
15	INV2	I	Inverting input of the CH2 error amplifier, skip comparator, and OVP2/UVP2.
16	LH2	I/O	Bootstrap capacitor connection fro CH2 high side gate drive.
17	OUT2_u	O	Gate drive output for CH2 high side switching FETs.
18	LL2	I/O	Bootstrap this pin low for CH2 high side gate driving return and output current protection. Connect this pin to the junction of the high side and low side FETs for a floating drive configuration.
19	OUT2_d	O	Gate drive output for CH2 low side gate drive.
20	OUTGND2		Ground for CH2 FET drivers.

FIGURE 2. Terminal connections.

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Device type	01		
Case outline	X		
Terminal number	Terminal symbol	I/O	Description
21	REG5V_IN	I	External 5 V input.
22	VREF5	O	5 V internal regulator output.
23	TRIP2	I	External resistor connection for CH2 output current control.
24	VCC		Supply voltage input.
25	TRIP1	I	External resistor connection for CH1 output current control.
26	OUTGND1		Ground for CH1 FET drivers.
27	OUT1_d	O	Gate drive output for CH1 low side gate drive.
28	LL1	I/O	Bootstrap this pin low for CH1 high side gate driving return and output current protection. Connect this pin to the junction of the high side and low side FETs for a floating drive configuration.
29	OUT1_u	O	Gate drive output for CH1 high side switching FETs.
30	LH1	I/O	Bootstrap capacitor connection for CH1 high side gate drive.

FIGURE 2. Terminal connections – Continued.

DLA WEAPONS SUPPORT COLUMBUS, OHIO	SIZE A	CODE IDENT NO. 16236	DWG NO. V62/04645
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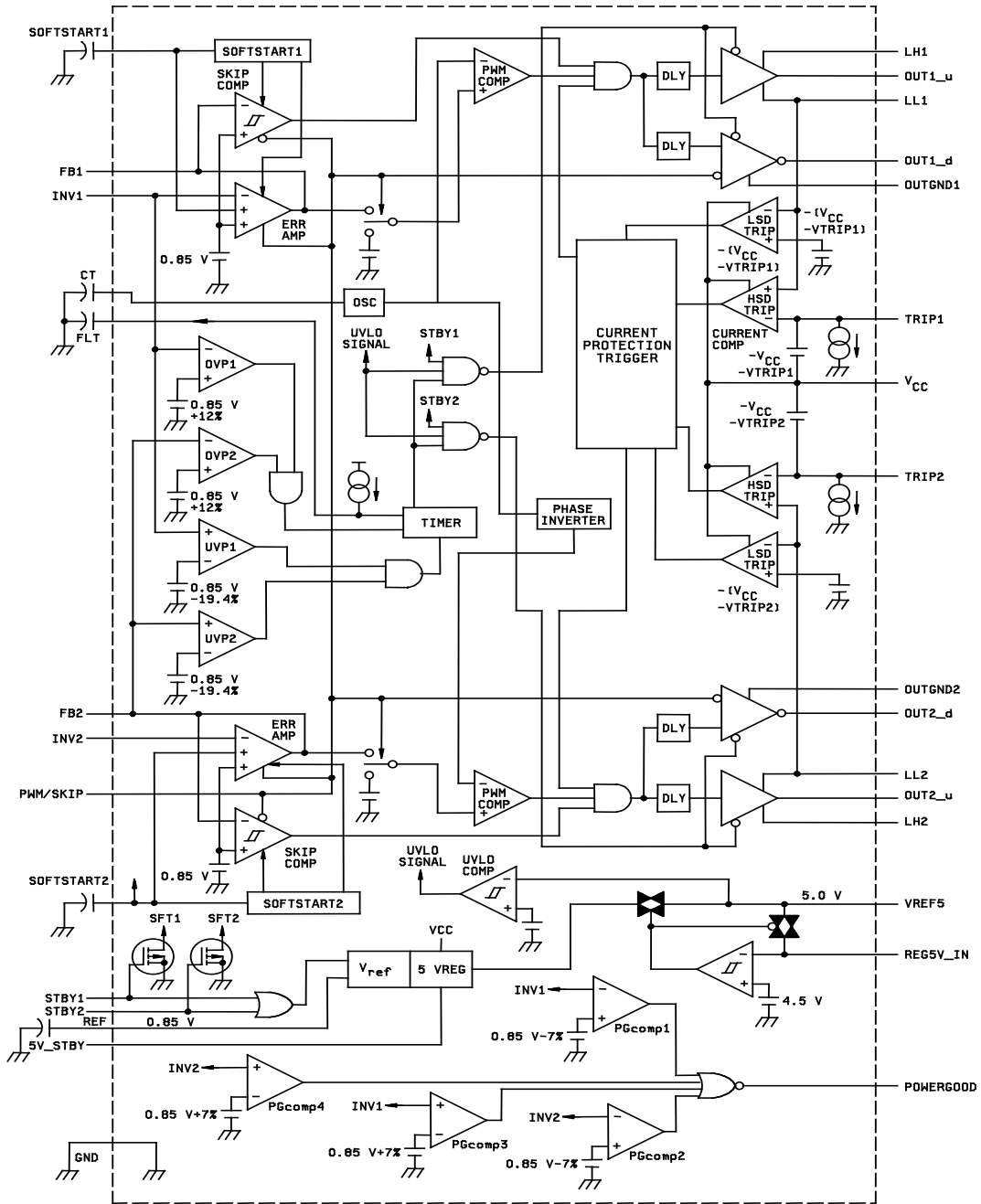


FIGURE 3. Logic diagram.

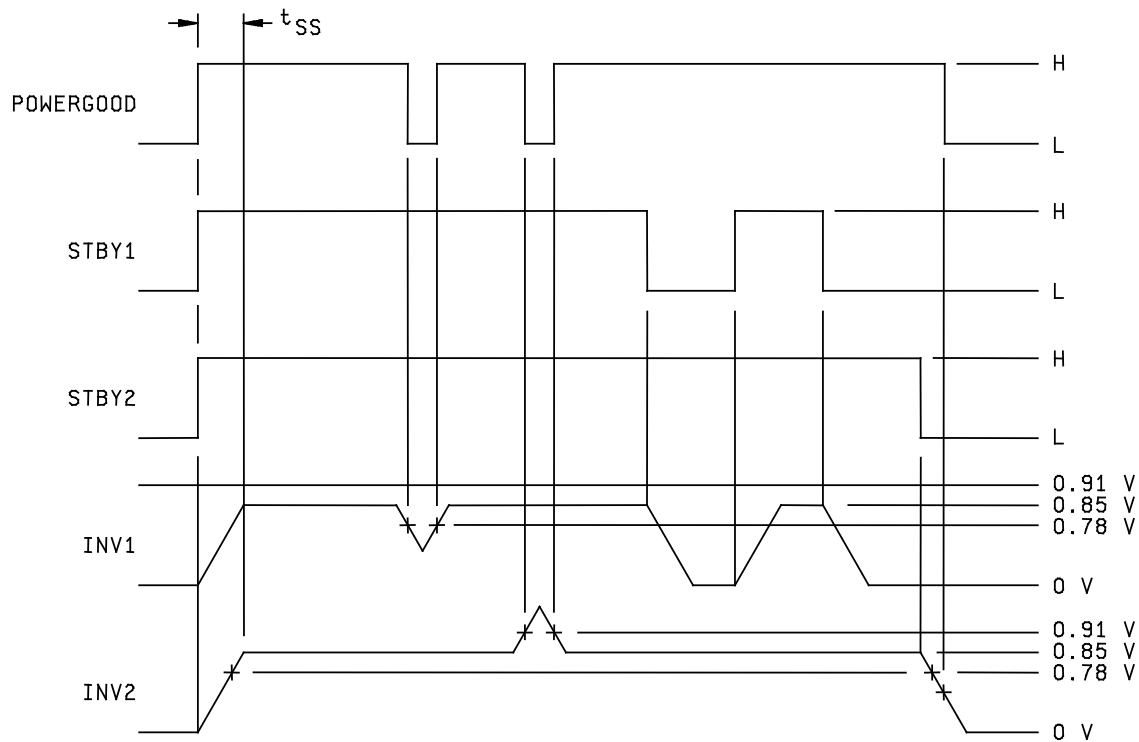
<p align="center">DLA WEAPONS SUPPORT COLUMBUS, OHIO</p>	<p align="center">SIZE A</p>	<p align="center">CODE IDENT NO. 16236</p>	<p align="center">DWG NO. V62/04645</p>
		<p align="center">REV D</p>	<p align="center">PAGE 11</p>

5V_STBY	STBY1	STBY2	SMPS1	SMPS2	5 V REGULATOR	POWERGOOD
L	L	L	Disable	Disable	Disable	Disable
L	L	H	Disable	Enable	Enable	Active <u>1/</u>
L	H	L	Enable	Disable	Enable	Active <u>1/</u>
L	H	H	Enable	Enable	Enable	Active
H	L	L	Disable	Disable	Enable	L
H	L	H	Disable	Enable	Enable	Active <u>1/</u>
H	H	L	Enable	Disable	Enable	Active <u>1/</u>
H	H	H	Enable	Enable	Enable	Active

1/ POWERGOOD is set high during a softstart.

FIGURE 4. Logic chart.

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NOTE: During a softstart, this channel's powergood comparator output is fixed low (POWERGOOD output is high).

FIGURE 5. Timing waveforms.

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4. VERIFICATION

4.1 Product assurance requirements. The manufacturer is responsible for performing all inspection and test requirements as indicated in their internal documentation. Such procedures should include proper handling of electrostatic sensitive devices, classification, packaging, and labeling of moisture sensitive devices, as applicable.

5. PREPARATION FOR DELIVERY

5.1 Packaging. Preservation, packaging, labeling, and marking shall be in accordance with the manufacturer’s standard commercial practices for electrostatic discharge sensitive devices.

6. NOTES

6.1 ESDS. Devices are electrostatic discharge sensitive and are classified as ESDS class 1 minimum.

6.2 Configuration control. The data contained herein is based on the salient characteristics of the device manufacturer’s data book. The device manufacturer reserves the right to make changes without notice. This drawing will be modified as changes are provided.

6.3 Suggested source(s) of supply. Identification of the suggested source(s) of supply herein is not to be construed as a guarantee of present or continued availability as a source of supply for the item. DLA Weapons Support Columbus maintains an online database of all current sources of supply at <https://landandmaritimeapps.dla.mil/programs/smcr/>.

Vendor item drawing administrative control number <u>1/</u>	Device manufacturer CAGE code	TSSOP (DBT) package	EVM (Evaluation Module)
V62/04645-01XE	01295	TPS5120QDBTREP	TPS5120EVM-151
V62/04645-02XE	01295	TPS5120MDBTREP	TPS5120EVM-151

1/ The vendor item drawing establishes an administrative control number for identifying the item on the engineering documentation.

CAGE code

01295

Source of supply

Texas Instruments, Inc.
12500 TI Blvd.
Dallas, TX 75243

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