SIT12xxI Family

DC/DC Transformer for SCALE-iDriver Gate Driver ICs
Providing Reinforced Isolation up to 1200 V

Product Highlights

Highly Flexible, Compact Footprint

- Dual channel DC/DC transformer optimized for forward converters
- Reinforced isolation for 600 V / 650 V / 1200 V IGBT and SiC MOSFET applications
- For use with all SCALE-iDriver™ ICs
- Choice of primary-to-secondary winding ratios
- -40 °C to 105 °C operating temperature range
- Light weight – only 9g
- Less than 10 pF coupling capacitance

Full Safety and Regulatory Compliance

- EN 61558-2-16+A1:2013 compliant
- 100% HIPOT tested at 5.4 kV RMS 1s (primary-to-secondary), 2.7 kV RMS 1s (secondary-to-secondary)
- High shock and vibration robustness
  - Easily meets IEC 60721-3-3 – Class 3M8 and IEC 60721-3-5 – Class 5M3
- VDE approved
- UL1446 approved

Green Package

- Halogen free and RoHS compliant

Applications

- General industrial applications
- Variable frequency and servo drives
- Static VAR compensators and active power filters
- Uninterruptible power supplies
- PV inverters
- Welding inverters

Description

The innovative transformer "isolated wire-in-wire" structure provides excellent reliability and strong isolation combined with low coupling capacitance. The high isolation capability is achieved without the need for mold compound. SIT12xxI transformers are UL and VDE approved, simplifying safety certification and reducing time-to-market. The SIT12xxI is a DC/DC transformer that delivers a secondary-side voltage of 25 V to support SCALE-iDriver gate driver ICs. SIT12xxI transformers are available with different winding ratios to accommodate a primary-side supply voltage of either 5 V or 15 V.

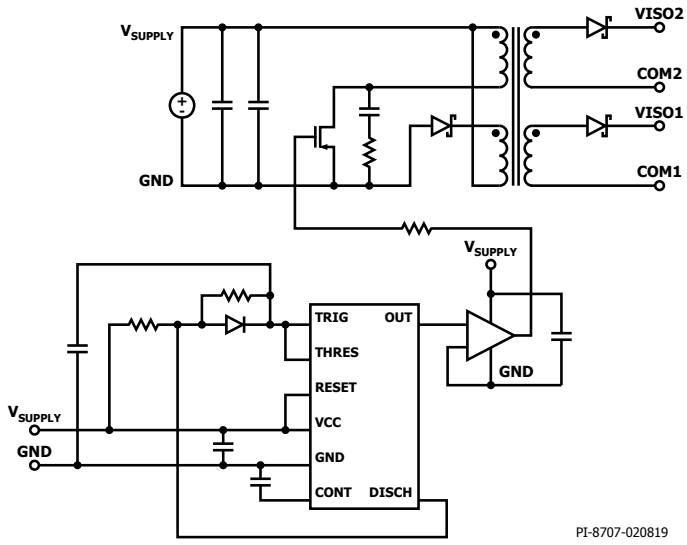


Figure 1. Typical Application Schematic.

Figure 2. SIT1217I and SIT1253I Transformers.

Product Portfolio

Product[3]	Power	Primary-Side Supply
SIT1253I	2 × 1.3 W	5 V
SIT1217I	2 × 1.3 W	15 V

Table 1. SIT12xxI Transformer Portfolio.

Pin Functional Description

Pin 1
Start of primary-side winding W1.

Pin 2
Start of primary-side winding W2.

Pin 3
End of primary-side winding W1.

Pin 4
End of primary-side winding W2.

Pin 5
Start of secondary-side winding W3.

Pin 6
End of secondary-side winding W3.

Pin 9
Start of secondary-side winding W4.

Pin 10
End of secondary-side winding W4.

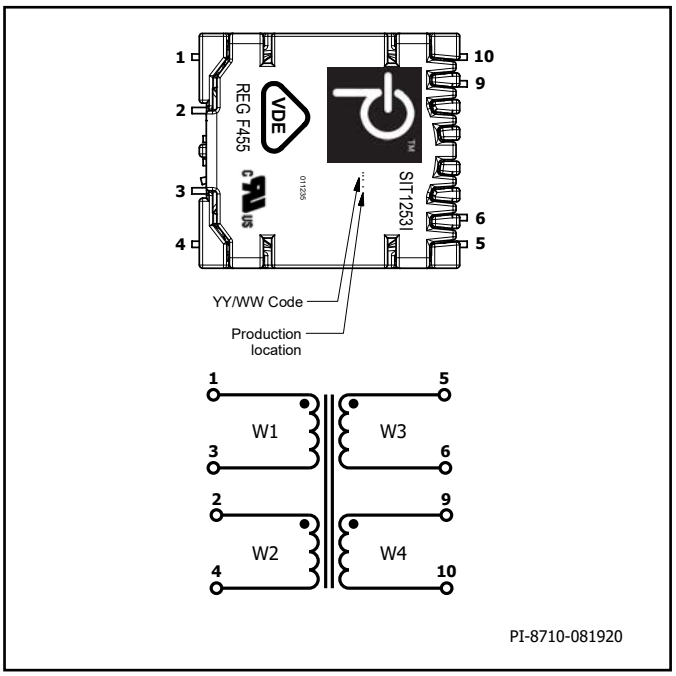


Figure 3. Top View Footprint and Pin Assignment.

Ratios				
	W1	W2	W3	W4
W1	X	1	5.33	5.33
W2	1	X	5.33	5.33
W3	0.19	0.19	X	1
W4	0.19	0.19	1	X

Table 2. Ratios SIT1253I.

Ratios				
	W1	W2	W3	W4
W1	X	1	1.73	1.73
W2	1	X	1.73	1.73
W3	0.58	0.58	X	1
W4	0.58	0.58	1	X

Table 3. Ratios SIT1217I.

Application Example and Component Selection

The transformers of the SIT12xxI family are designed for single switch forward converter topologies. Figure 4 shows an application example using SIT1253I, where the primary-side supply voltage is set to 5 V (with reference to GND). Figure 5 shows an application example using SIT1217I where the primary-side supply voltage is set to 15 V (with reference to GND).

For both designs, the input capacitors (C1 to C8) must be selected according to target power. For full power (1.3 W per output channel) an overall capacitance of 35 µF is required. The use of eight 4.7 µF capacitors in SMD 1206 packages is recommended in this case. The voltage rating of the capacitors must also be considered. The use of 16 V devices when using 5 V primary-side supply voltage (SIT1253I) and 25 V devices when a 15 V primary-side supply voltage (SIT1217I) is recommended.

The single forward switch S1 is controlled by a standard timer IC, here a TI TLC555Q is used (a CPLD, FPGA or micro controller can also be used). Resistors R_1, R_2 and C_9 and connecting the trigger input to the threshold-input causes the timer to self-trigger and run as a multi-vibrator. For SIT1253I and SIT1217I the recommended switching frequencies are 150 kHz and 260 kHz respectively. The duty cycle is set to 45% in both examples. Measurements across application conditions should be made to confirm safe operation.

To drive the forward switch, a standard MOSFET driver is connected to the output of the TLC555Q. An MCP1402 IC is recommended for this. To adjust the switching behavior of S1, R3 is placed between the output of MCP1402 and the MOSFETs gate terminal.

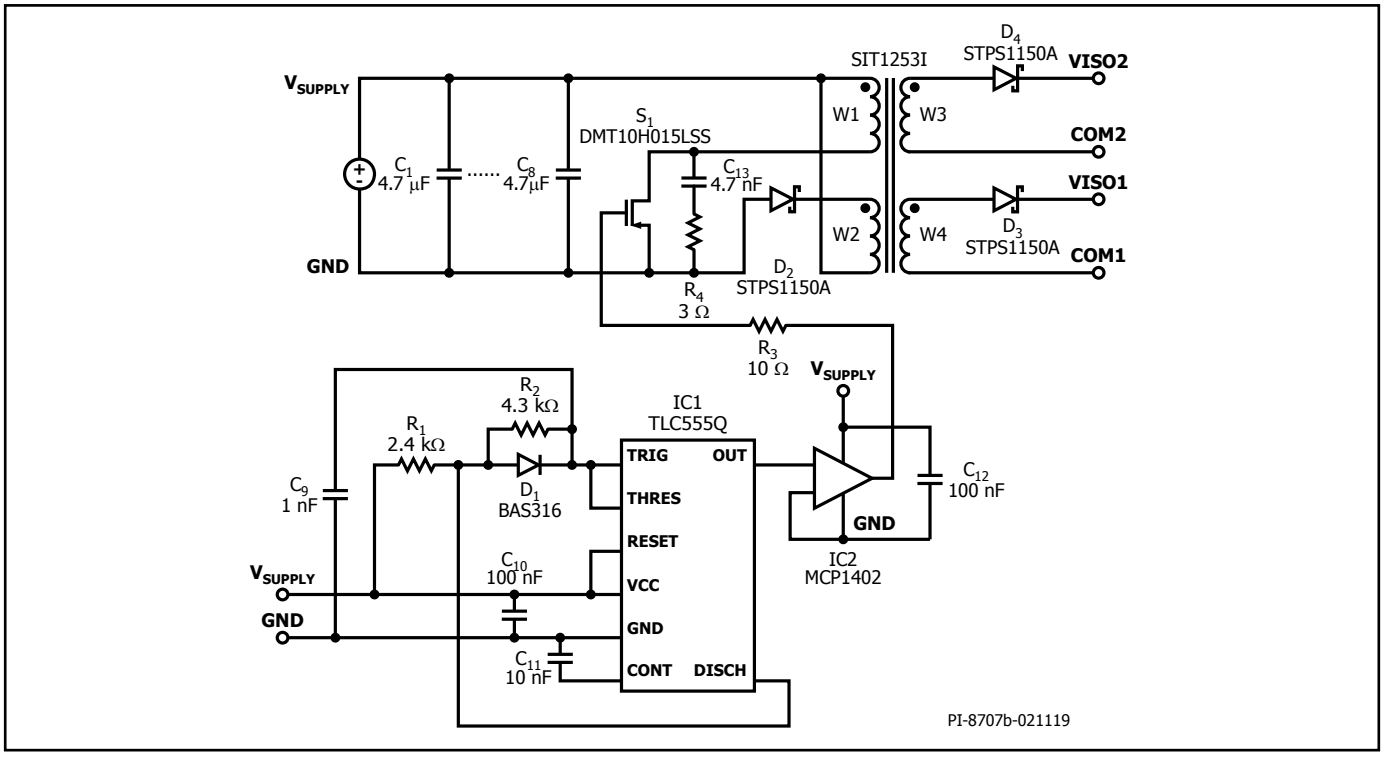


Figure 4. Application Example SIT1253I with 5 V Supply Voltage.

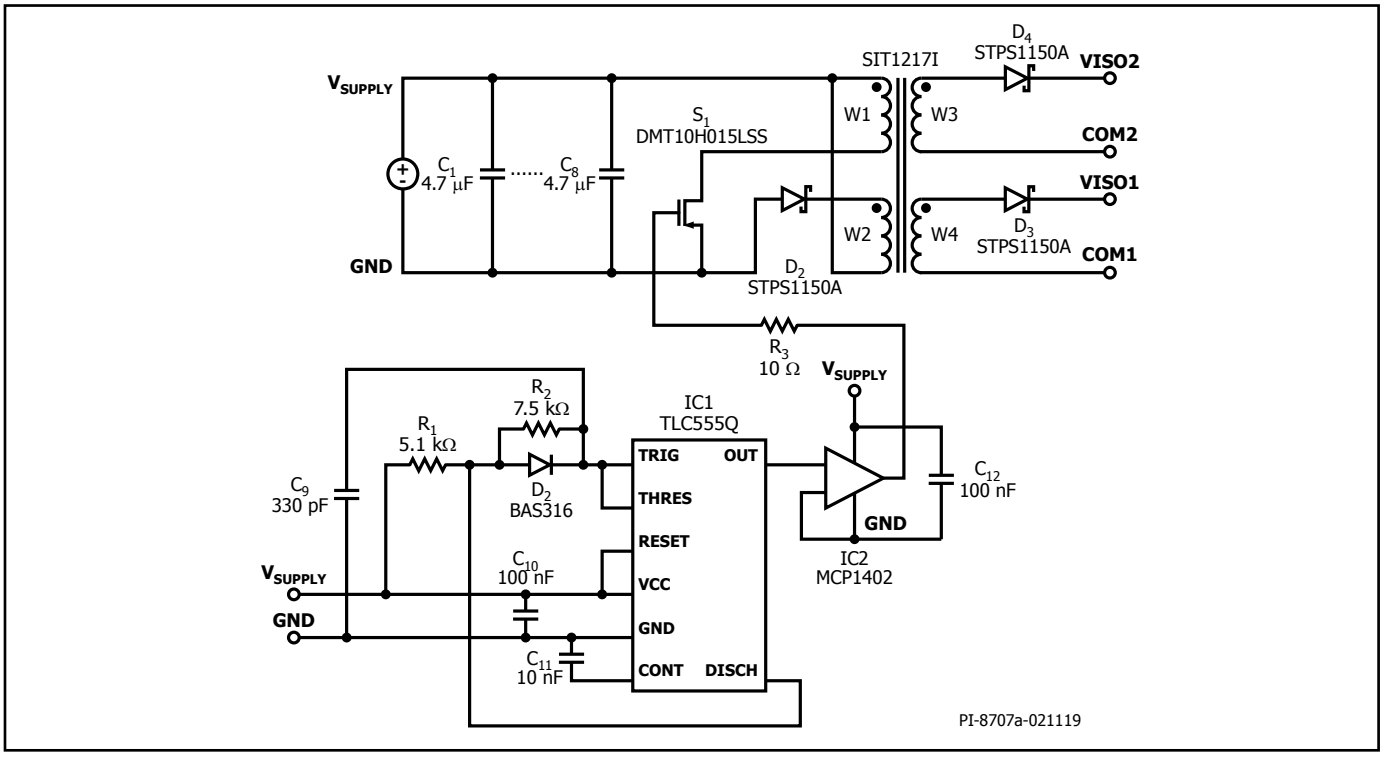


Figure 5. Application Example SIT1217I with 15 V Supply Voltage.

Pin	Return to Pin	Recommended Value	Symbol	Notes
VSUPPLY	GND	8 × 4.7 µF	C_1 to C_8	The use of X7S / 10% in a 1206 package is recommended with 16 V rated voltage for SIT1253I and 25 V rated voltage for SIT1217I.
TRIG	GND	1 nF / 330pF	C_9	The use of NP0 or C0G / 50 V / 5% in a 0603 package is recommended. 1 nF to be used for SIT1253I and 330 pF for SIT1217I.
VSUPPLY	GND	100 nF	C_{10}	The use of X7R / 10% in a 0603 package is recommended with 16 V rated voltage for SIT1253I and 25 V rated voltage for SIT1217I.
CONT	GND	10 nF	C_{11}	The use of X7R / 25 V / 10% in a 0603 package is recommended.
VSUPPLY	GND	100 nF	C_{12}	The use of X7R / 10% in a 0603 package is recommended with 16 V rated voltage for SIT1253I and 25 V rated voltage for SIT1217I.
VSUPPLY	DISCH	2.4 kΩ / 5.1 kΩ	R_1	The use of 1% / 0.1 W / 50 V thick film chip resistors in a 0603 package is recommended, with a value of 2.4 kΩ for SIT1253I and 5.1 kΩ with SIT1217I.
TRIG	DISCH	4.3 kΩ / 7.5 kΩ	R_2	The use of 1% / 0.1 W / 50 V thick film chip resistors in a 0603 package is recommended, with a value of 4.3 kΩ for SIT1253I and 7.5 kΩ with SIT1217I.
OUT MCP1402	G S1	10 Ω	R_3	The use of 1% / 0.1 W / 50 V thick film chip resistors in a 0603 package is recommended.
DISCH	TRIG	BAS316	D_1	The use of BAS316 100 V / 250 mA / 400 mW of NXP in a SOD323 package is recommended.
GND	Pin 2 W2	STPS1150A	D_2	The use of STPS1150A 150 V / 1 A / 620 mV @ I_F = 1 A of STMicroelectronics in a SMA package is recommended.
Pin 9 W4	VISO1	STPS1150A	D_3	The use of STPS1150A 150 V / 1 A / 620 mV @ I_F = 1 A of STMicroelectronics in a SMA package is recommended.
Pin 5 W3	VISO2	STPS1150A	D_4	The use of STPS1150A 150 V / 1 A / 620 mV @ I_F = 1 A of STMicroelectronics in a SMA package is recommended.
Pin 3 W1	GND	DMT10H015LSS	S_1	The use of DMT10H015LSS 100 V / 8.3 A / 1.2 W / 9.7 mΩ of Diodes Incorporated in a SO-8 case is recommended.
Pin 3 W1	R4	4.7 nF	C_{12}	Only for SIT1253I: The use of X7S / 10% in a 1206 package is recommended with 50 V rated voltage
C_{12}	GND	3 Ω	R_4	Only for SIT1253I: The use of 1% / 0.1 W / 50 V thick film chip resistors in a 0603 package is recommended
-	-	TLC555Q	IC1	The use of TLC555Q of TI in a SOIC D package is recommended.
-	-	MCP1402	IC2	The use of MCP1402 of Microchip in a SOT23-5 package is recommended.

Table 4. PCB Layout and Component Guidelines.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Environmental Conditions						
Operating Ambient Temperature	T_A		-40		105	°C
Storage Temperature	T_S	Packaged	-30		70	°C
Climatic Category		IEC 60068-1		40 / 125 / 56		
Electrical Characteristics						
Turns Ratio		W1 : W2 : W3 : W4 SIT1253I		6 : 6 : 32 : 32		
		W1 : W2 : W3 : W4 SIT1217I		11 : 11 : 19 : 19		
Main Inductance	L	SIT1253I, @ 25 °C W1, W2 @ f_S = 100 kHz, V_0 ≤ 50 mV	32.5	50	67.5	µH
		SIT1217I, @ 25 °C W1, W2 @ f_S = 100 kHz, V_0 ≤ 50 mV	110.5	170	229.5	
Leakage Inductance	L_{LEAK}	SIT1253I, @ 25 °C W1 / W2 (W3 and W4 shorted) fs = 100 kHz, V_0 ≤ 50 mV			250	nH
		SIT1217I, @ 25 °C W1 / W2 (W3 and W4 shorted) fs = 100 kHz, V_0 ≤ 50 mV			600	
Coupling Capacitance	C_K	W1 / W2 – W3 / W4 fs = 100 kHz, V_0 = 50 mV			10	pF
Resistance	R_{DC1}	SIT1253I, W1 @ 25 °C			24	mΩ
		SIT1217I, W1 @ 25 °C			95	
	R_{DC2}	SIT1253I, W2 @ 25 °C			24	
		SIT1217I, W2 @ 25 °C			95	
	R_{DC3}	SIT1253I, W3 @ 25 °C			1.2	Ω
		SIT1217I, W3 @ 25 °C			0.7	
	R_{DC4}	SIT1253I, W4 @ 25 °C			1.2	
		SIT1217I, W4 @ 25 °C			0.7	
Power	P_{TOT}	Per Channel			1.3	W
Mechanical Characteristics						
Length	L		25.4	26	26.15	mm
Width	W				23.5	mm
Height	H				16.5	mm
Weight	m	SIT1253I		9.4		g
		SIT1217I		9.0		

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Insulation Characteristics						
Clearance and Creepage Distance		Primary Pins to Secondary Pins	19			mm
Clearance and Creepage Distances		Secondary Pins to Secondary Pins	10.5			mm
Competitive Tracking Index	CTI	Outer Housing	175			
Working Insulation Voltage	V_{IOWM}	W1 / W2 – W3 / W4 W3 – W4			849	V_{RMS}
Repetitive Peak Isolation Voltage	V_{IORM}	W1 / W2 – W3 / W4 W3 – W4			1200	V_{PEAK}
Hi-Pot Series Test Voltage	$V_{TEST, PRIM - SEC}$	W1 / W2 – W3 / W4 50 Hz / 1s	5400			V_{RMS}
	$V_{TEST, SEC - SEC}$	W3 – W4 50 Hz / 1s	2700			
Partial Discharge Extinction Voltage	$V_{PD, PRIM - SEC}$	W1 / W2 – W3 / W4 $C_K \leq 10$ pF		1800		V_{PEAK}
	$V_{PD, SEC - SEC}$	W3 – W4 $C_K \leq 10$ pF		1800		

Dimensions and Markings

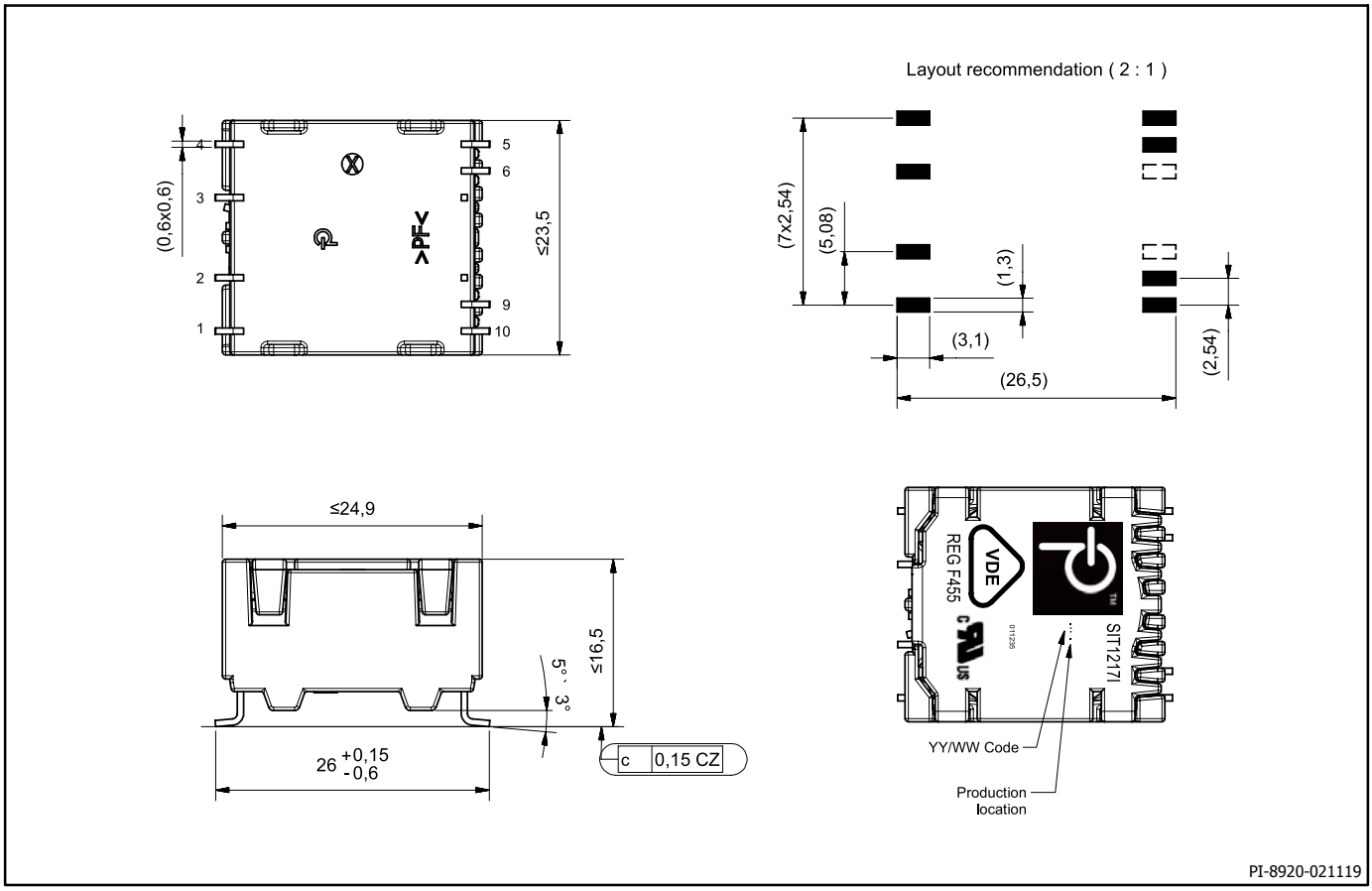


Figure 6. Dimensions and Markings of SIT1217I.

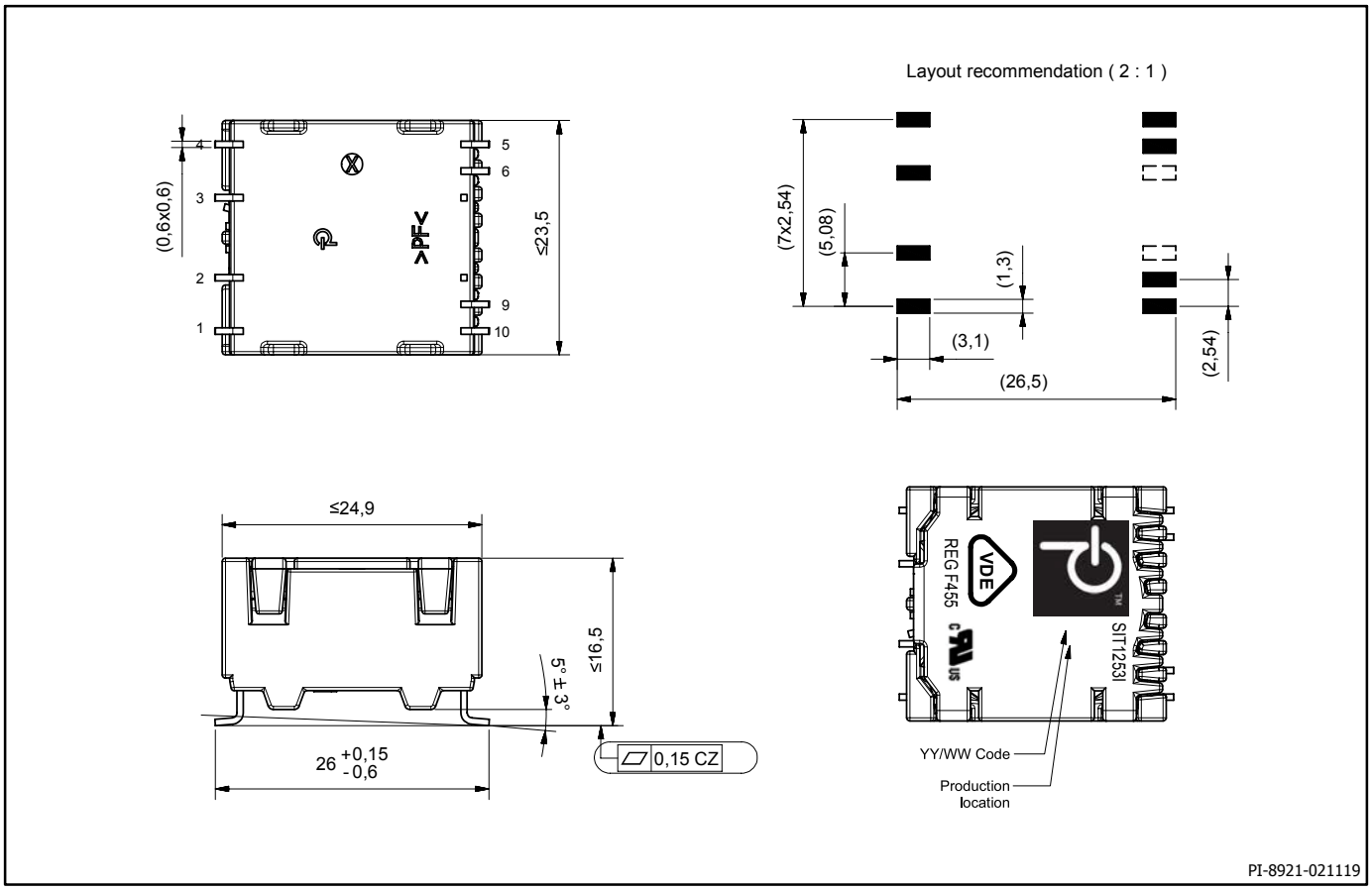


Figure 7. Dimensions and Markings of SIT1253I.

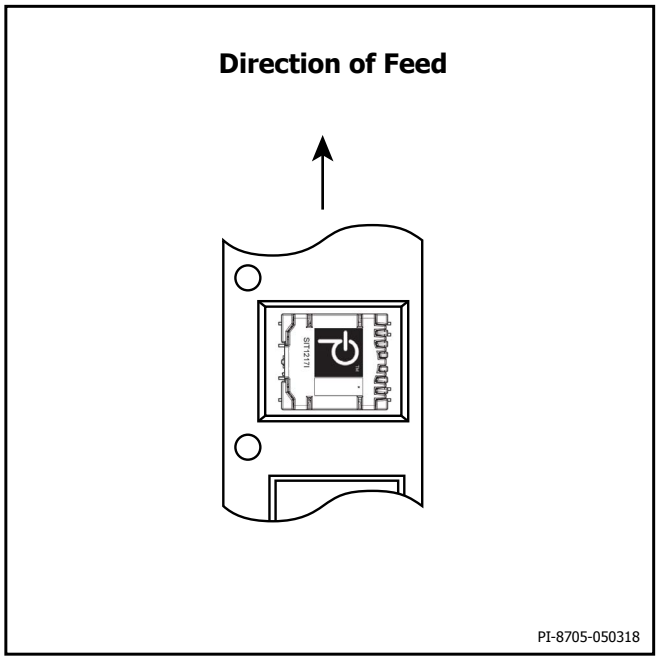


Figure 8. Part Orientation.

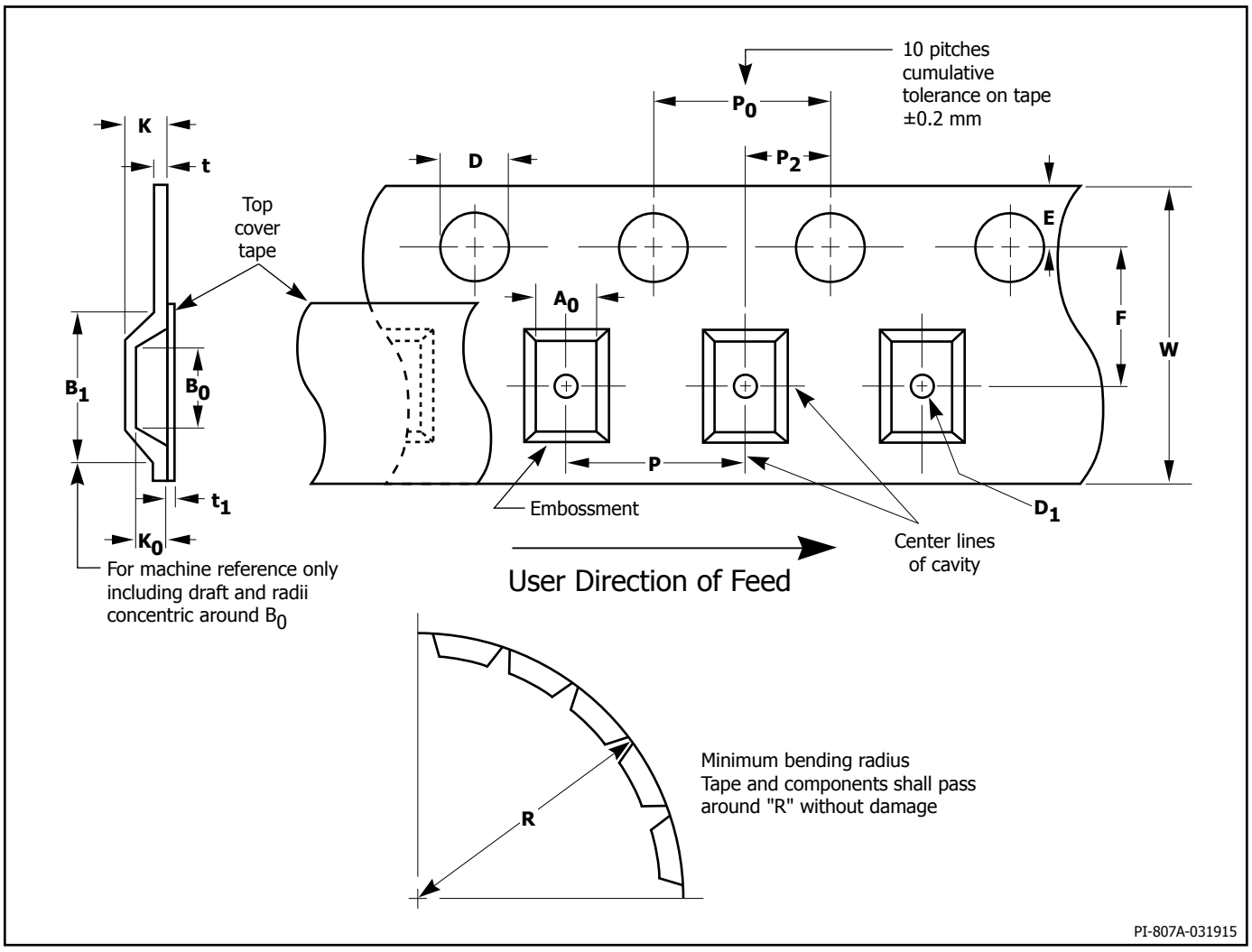


Figure 9. Tape Dimension Index.

Package Type	Tape Size	A_0	B_0	B_1	D	D_1	E	F	K
	44 mm	22.6 - 23	27.2 - 27.6	32.84 typ	1.5 - 1.6	N/A	1.65 - 1.85	20.1 - 20.3	17.6 Max

Package Type	Tape Size	K_0	P	P_0	P_2	R	t	t_1	W
	44 mm	17 - 17.4	31.9 - 32.1	3.9 - 4.1	1.85 - 2.15	60	0.45 - 0.55	0.05 typ	43.7 - 44.3

Table 5. Tape Dimension (in mm).

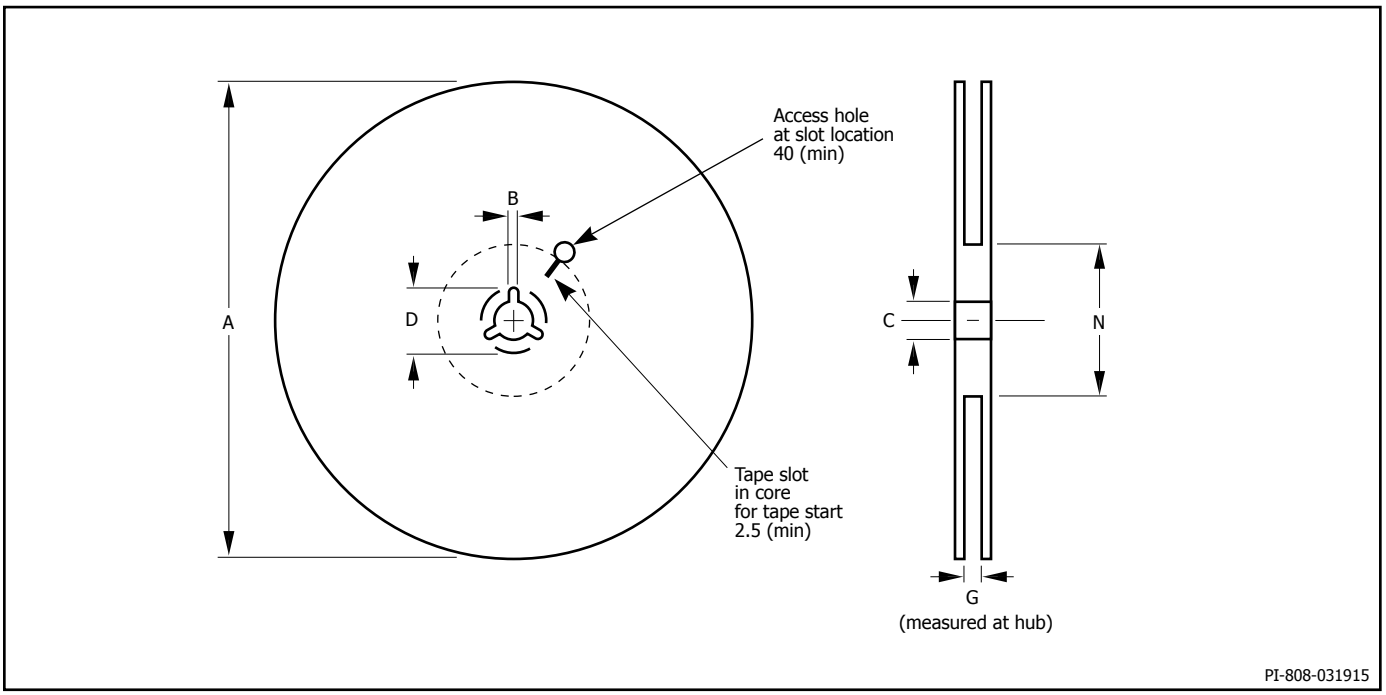


Figure 10. Tape Dimension Index.

Package Type	Tape Size	A	B	C	D	G	N
	44 mm	328 - 332	2.1 - 2.5	12.75 - 13.25	21.4 - 21.9	44.4 - 46.4	100 Min

Table 6. Reel Dimensions.

Solder Temperature Profiles

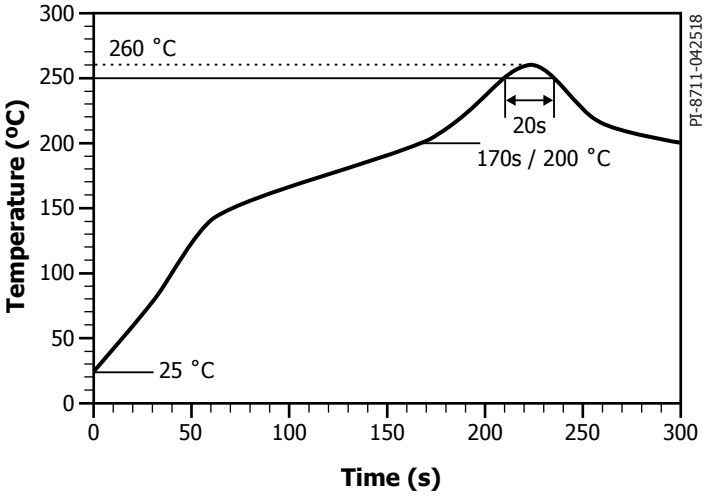


Figure 11. Solder Profiles According to JEDEG J-STD 020C / Reflow.

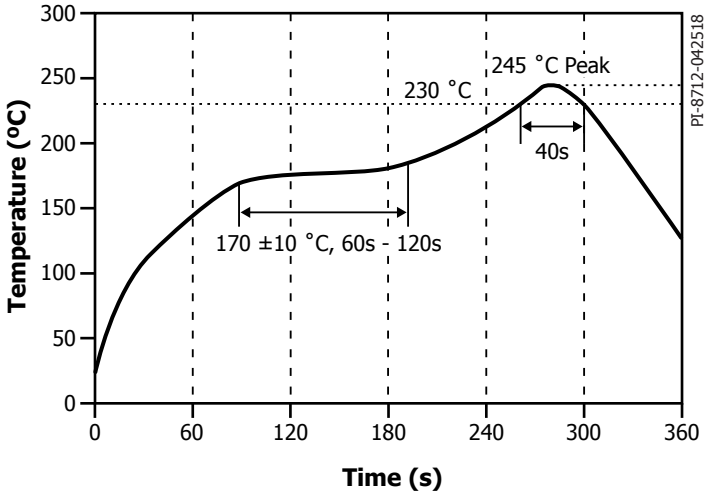


Figure 12. Recommended Reflow Profile for SMD-Components in Plastic Cases.

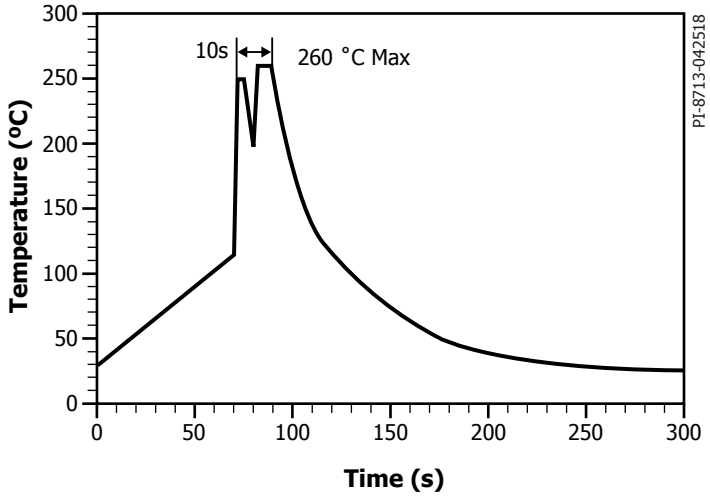
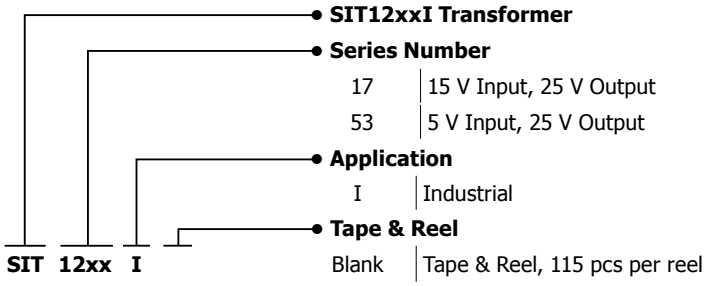


Figure 13. Solder Profiles According to BS CECC 00802 / Wave.

Regulatory Information Table

VDE	UL
DIN EN 61558-1 Safety of power transformers, power supplies, reactors and similar products - Part 1: General requirements and tests	UL 61800-5-1 Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements - Electrical, Thermal and Energy UL 1446 Systems of insulating materials
Certificate No. 40048903	E499028 for UL 61800-5-1 E501018 for UL 1446

Part Ordering Information



Revision	Notes	Date
B	Code A release.	02/19
C	Updated Pin Description of pins 5, 6, 9, 10 and pin assignment in Figure 3.	08/20

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World Headquarters
5245 Hellyer Avenue
San Jose, CA 95138, USA
Main: +1-408-414-9200
Customer Service:
Worldwide: +1-65-635-64480
Americas: +1-408-414-9621
e-mail: usasales@power.com

China (Shanghai)
Rm 2410, Charity Plaza, No. 88
North Caoxi Road
Shanghai, PRC 200030
Phone: +86-21-6354-6323
e-mail: chinasales@power.com

China (Shenzhen)
17/F, Hivac Building, No. 2, Keji Nan
8th Road, Nanshan District,
Shenzhen, China, 518057
Phone: +86-755-8672-8689
e-mail: chinasales@power.com

Germany (AC-DC/LED Sales)
Einsteinring 24
85609 Dornach/Aschheim
Germany
Tel: +49-89-5527-39100
e-mail: eurosales@power.com

Germany (Gate Driver Sales)
HellwegForum 1
59469 Ense
Germany
Tel: +49-2938-64-39990
e-mail: igbt-driver.sales@power.com

India
#1, 14th Main Road
Vasanthanagar
Bangalore-560052 India
Phone: +91-80-4113-8020
e-mail: indiasales@power.com

Italy
Via Milanese 20, 3rd. Fl.
20099 Sesto San Giovanni (MI) Italy
Phone: +39-024-550-8701
e-mail: eurosales@power.com

Japan
Yusen Shin-Yokohama 1-chome Bldg.
1-7-9, Shin-Yokohama, Kohoku-ku
Yokohama-shi,
Kanagawa 222-0033 Japan
Phone: +81-45-471-1021
e-mail: japansales@power.com

Korea
RM 602, 6FL
Korea City Air Terminal B/D, 159-6
Samsung-Dong, Kangnam-Gu,
Seoul, 135-728, Korea
Phone: +82-2-2016-6610
e-mail: koreasales@power.com

Singapore
51 Newton Road
#19-01/05 Goldhill Plaza
Singapore, 308900
Phone: +65-6358-2160
e-mail: singaporesales@power.com

Taiwan
5F, No. 318, Nei Hu Rd., Sec. 1
Nei Hu Dist.
Taipei 11493, Taiwan R.O.C.
Phone: +886-2-2659-4570
e-mail: taiwansales@power.com

UK
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The Westbrook Centre
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