Phase Leg IGBT 7 Power Module

APTGX75A120T1G

Product Overview

The APTGX75A120T1G device is a phase leg 1200V, 75A Insulated-Gate Bipolar Transistor (IGBT) 7 power module.

The following figures show the electrical diagram and pinout location of the device.

Figure 1. Electrical Diagram

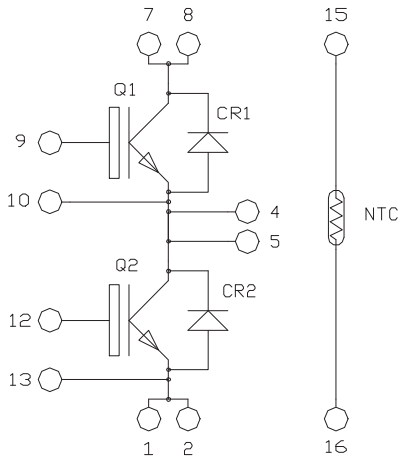
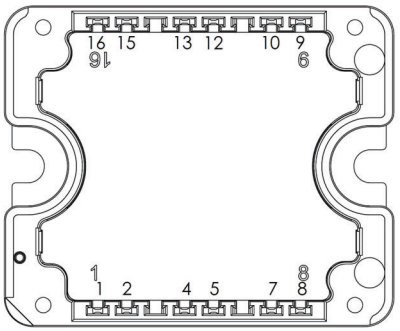


Figure 2. Pinout Location



Notes:

- Pins 7/8, 4/5, and 1/2 must be shorted together.
- All ratings are at T_J = 25 °C, unless otherwise specified.

CAUTION These devices are sensitive to electrostatic discharge. Proper handling procedures must be followed.

Features

The APTGX75A120T1G device has the following key features:

- IGBT 7
  - Low-voltage drop
  - Low-leakage current
- Very low-stray inductance
- Internal thermistor for temperature monitoring
- Al_2O_3 substrate and copper base plate

Benefits

The APTGX75A120T1G device has the following benefits:

- Direct mounting to heatsink (isolated package)
- Low junction-to-case thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Low profile
- RoHS compliant

Potential Applications

The APTGX75A120T1G device has the following potential applications:

- Welding converters
- Switched-mode power supplies
- Uninterruptible power supplies
- Electric Vehicle (EV) motor and traction drive

1. Electrical Specifications

The following sections show the electrical specifications of the APTGX75A120T1G device.

1.1 IGBT Characteristics (Per IGBT)

The following table lists the absolute maximum ratings (per IGBT) of the APTGX75A120T1G device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter		Maximum Ratings	Unit
V_{CES}	Collector-emitter voltage		1200	V
I_C	Continuous collector current	T_C = 25 °C	120	A
		T_C = 110 °C	75	
I_{CM}	Pulsed collector current, t_P limited by $T_{J(max)}$		150	
V_{GE}	Gate-emitter voltage		±20	V
	Transient gate-emitter voltage		±25	
P_D	Power dissipation	T_C = 25 °C	340	W

The following table lists the electrical characteristics (per IGBT) of the APTGX75A120T1G device.

Table 1-2. Electrical Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
I_{CES}	Zero gate voltage collector current	V_{GE} = 0V; V_{CE} = 1200V		—	—	15	µA
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15V I_C = 75A	T_J = 25 °C	—	1.55	1.8	V
			T_J = 125 °C	—	1.64	—	
			T_J = 175 °C	—	1.72	—	
$V_{GE(th)}$	Gate threshold voltage	V_{GE} = V_{CE}; I_C = 1.7 mA		5.15	5.8	6.45	
I_{GES}	Gate-emitter leakage current	V_{GE} = 20V; V_{CE} = 0V		—	—	150	nA

The following table lists the dynamic characteristics (per IGBT) of the APTGX75A120T1G device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{GE} = 0V V_{CE} = 25V f = 100 kHz		—	15.1	—	nF
C_{oes}	Output capacitance			—	0.19	—	
C_{res}	Reverse transfer capacitance			—	0.053	—	
Q_G	Gate charge	V_{GE} = ±15V V_{CE} = 600V I_C = 75A		—	1.25	—	µC
$T_{d(on)}$	Turn-on delay time	V_{GE} = ±15V V_{Bus} = 600V I_C = 75A R_G = 5.6Ω	T_J = 25 °C	—	164	—	ns
			T_J = 125 °C	—	178	—	
			T_J = 175 °C	—	185	—	
T_r	Rise time		T_J = 25 °C	—	48	—	
			T_J = 125 °C	—	53	—	
			T_J = 175 °C	—	57	—	
$T_{d(off)}$	Turn-off delay time		T_J = 25 °C	—	300	—	
			T_J = 125 °C	—	380	—	
			T_J = 175 °C	—	420	—	
T_f	Fall time		T_J = 25 °C	—	120	—	
			T_J = 125 °C	—	200	—	
			T_J = 175 °C	—	270	—	
E_{on}	Turn-on energy	V_{GE} = ±15V V_{Bus} = 600V I_C = 75A R_G = 5.6Ω di/dt = 1200 A/µs dv/dt = 3200 V/µs	T_J = 25 °C	—	8	—	mJ
			T_J = 125 °C	—	10.8	—	
			T_J = 175 °C	—	12.3	—	
E_{off}	Turn-off energy		T_J = 25 °C	—	5	—	
			T_J = 125 °C	—	7.7	—	
			T_J = 175 °C	—	9.5	—	
R_{Gint}	Internal gate resistance			—	2	—	Ω
I_{sc}	Short circuit data	V_{GE} ≤ 15V V_{Bus} = 800V t_P ≤ 8 µs	T_J = 150 °C	—	260	—	A
		V_{GE} ≤ 15V V_{Bus} = 800V t_P ≤ 7 µs	T_J = 175 °C	—	250	—	
R_{thJC}	Junction-to-case thermal resistance			—	—	0.44	°C/W

1.2 Diode Characteristics (Per Diode)

The following table lists the diode characteristics (per diode) of the APTGX75A120T1G device.

Table 1-4. Diode Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
V_{RRM}	Peak repetitive reverse voltage			—	—	1200	V
I_{RM}	Reverse leakage current	V_R = 1200V		—	—	5	µA
I_{FRM}	Repetitive forward current, t_P limited by $T_{J(max)}$			—	—	150	A
I^2t	I^2t value	t_p = 10 ms V_R = 0V	T_J = 125 °C	—	—	1150	A^2s
			T_J = 175 °C	—	—	740	
I_F	DC forward current	T_C = 80°C	T_J = 175 °C	—	75	—	A
V_F	Diode forward voltage	I_F = 75A V_{GE} = 0V	T_J = 25 °C	—	1.75	1.95	V
			T_J = 125 °C	—	1.6	—	
			T_J = 175 °C	—	1.52	—	
I_{RRM}	Reverse recovery current	V_{GE} = –15V I_F = 75A V_R = 600V di/dt = 1200 A/µs	T_J = 25 °C	—	43	—	A
			T_J = 125 °C	—	56	—	
			T_J = 175 °C	—	65	—	
Q_{rr}	Reverse recovery charge		T_J = 25 °C	—	4.9	—	µC
			T_J = 125 °C	—	10.2	—	
			T_J = 175 °C	—	13.7	—	
E_{rr}	Reverse recovery energy		T_J = 25 °C	—	1.5	—	mJ
			T_J = 125 °C	—	3.3	—	
			T_J = 175 °C	—	4.6	—	
R_{thJC}	Junction-to-case thermal resistance			—	—	0.7	°C/W

1.3 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the APTGX75A120T1G device.

Table 1-5. Thermal and Package Characteristics

Symbol	Characteristic			Min.	Typ.	Max.	Unit
V_{ISOL}	RMS isolation voltage, any terminal-to-case t = 1 min, 50/60 Hz			4000	—	—	V
L_{stray}	Stray inductance module			—	16	—	nH
d_{creep}	Creepage distance terminal-to-heatsink			—	13.4	—	mm
d_{clear}	Clearance distance terminal-to-heatsink			—	12.8	—	
R_{CE}	Lead resistance terminal to chip	T_C = 25 °C, per switch		—	1.8	—	mΩ
T_J	Operating junction temperature range			–40	—	175	°C
T_{STG}	Storage temperature range			–40	—	125	
T_C	Operating case temperature			–40	—	125	
τ_M	Mounting torque	To heatsink	M4	2	—	3	N.m
Wt	Package weight			—	66	—	g

The following table lists the temperature sensor NTC of the APTGX75A120T1G device.

Table 1-6. Temperature Sensor NTC

Symbol	Characteristic		Min.	Typ.	Max.	Unit
R_{25}	Resistance at 25 °C		—	50	—	kΩ
$\Delta R_{25}/R_{25}$	—		—	5	—	%
$B_{25/85}$	T_{25} = 298.15K		—	3952	—	K
ΔB/B	—	T_C = 100 °C	—	4	—	%

$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

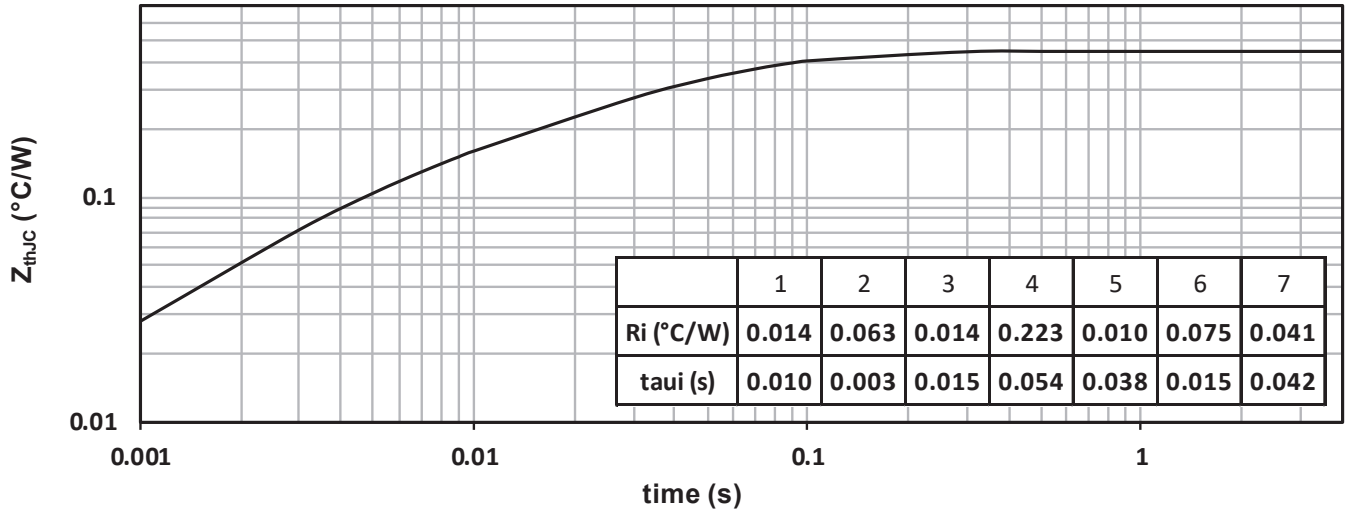
T: Thermistor temperature
R_T: Thermistor value at T

Note: For more information, see APT0406—Using NTC Temperature Sensor Integrated into Power Module.

1.4 Typical IGBT Performance Curve

The following figures show the IGBT performance curves of the APTGX75A120T1G device.

Figure 1-1. Maximum Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	0.014	0.063	0.014	0.223	0.010	0.075	0.041
taui (s)	0.010	0.003	0.015	0.054	0.038	0.015	0.042

Figure 1-2. Output Characteristics, V_{GE} = 15V

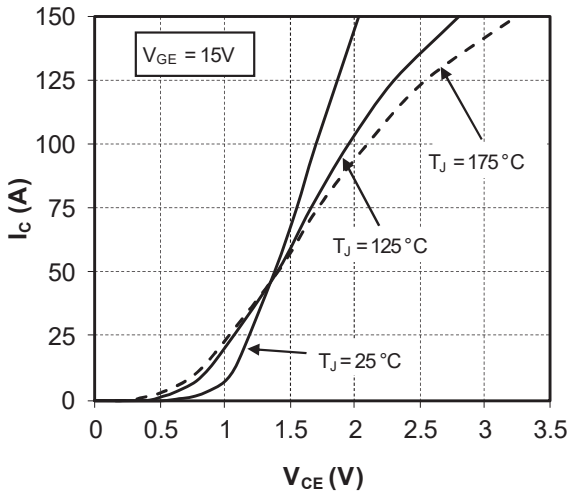


Figure 1-3. Output Characteristics, T_J = 175 °C

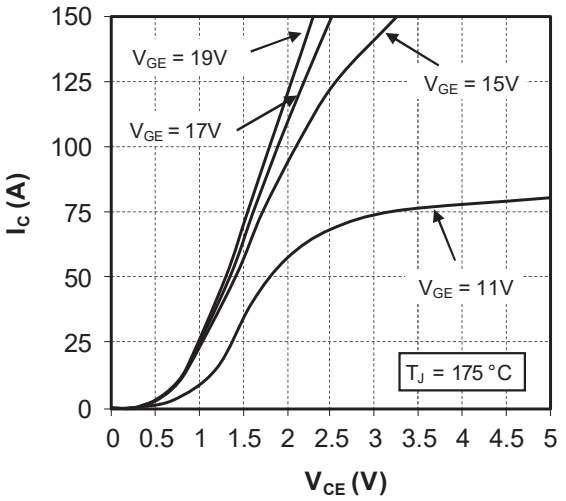


Figure 1-4. Switching Losses vs. Gate Resistance

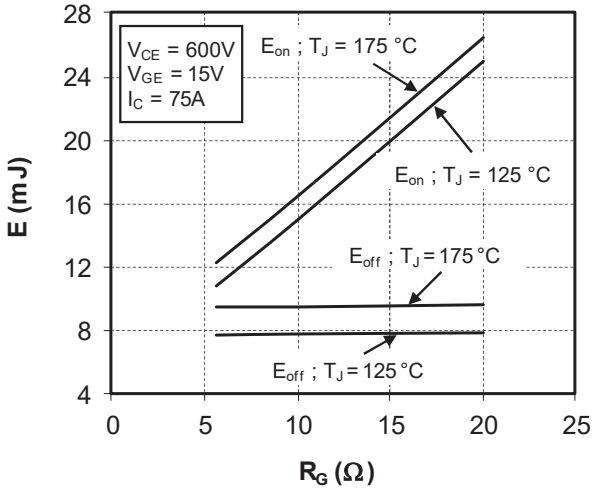


Figure 1-5. Switching Losses vs. Collector Current

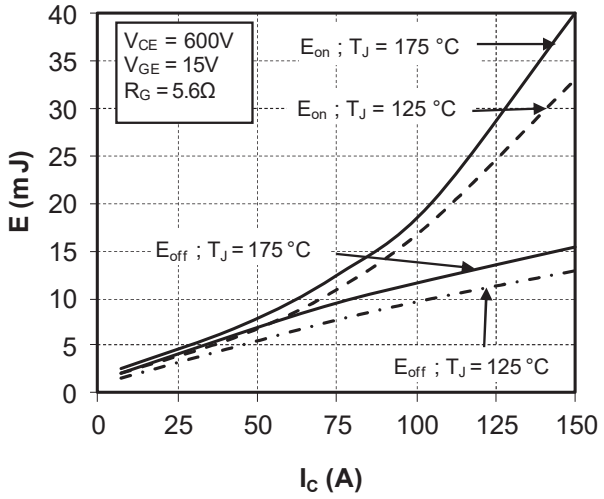


Figure 1-6. Operating Frequency vs. Collector Current

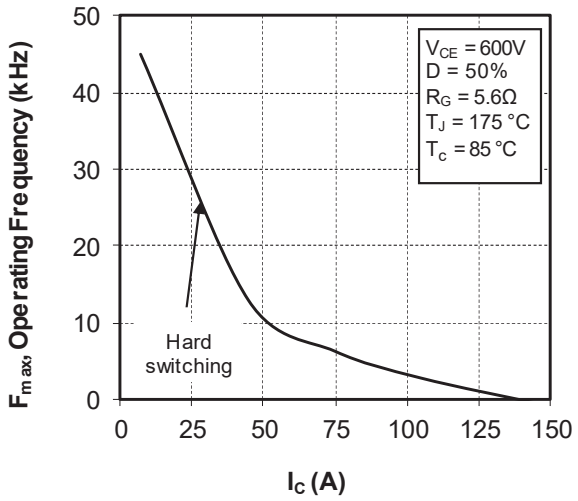


Figure 1-7. Gate Charge Characteristics

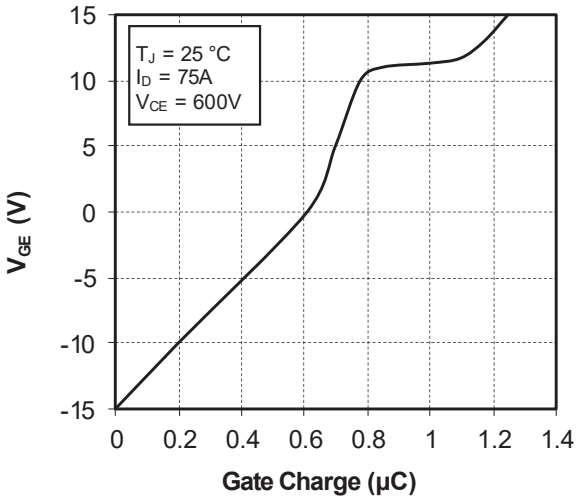


Figure 1-8. Transfer Characteristics

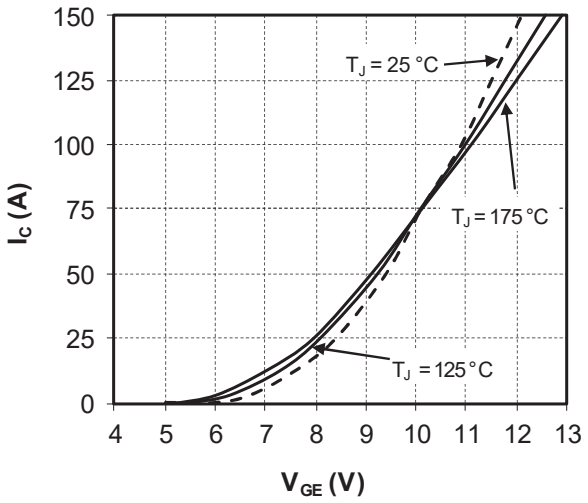


Figure 1-9. Capacity Characteristics

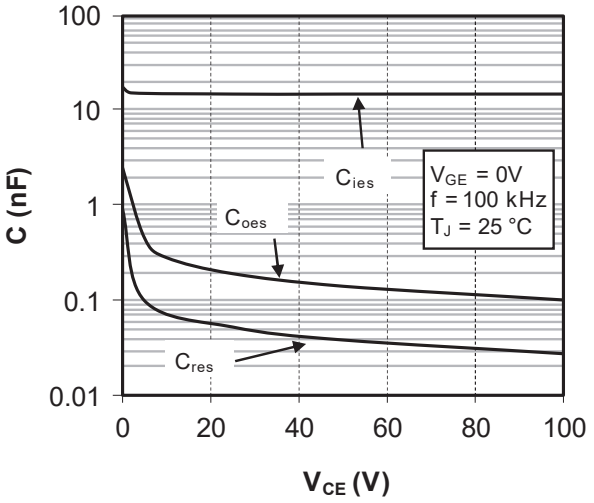
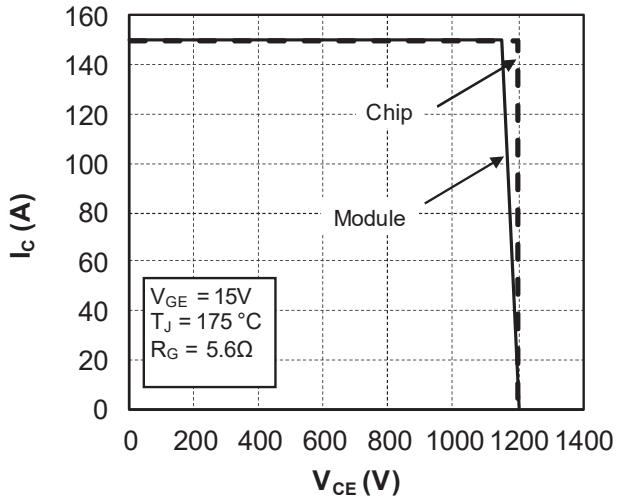


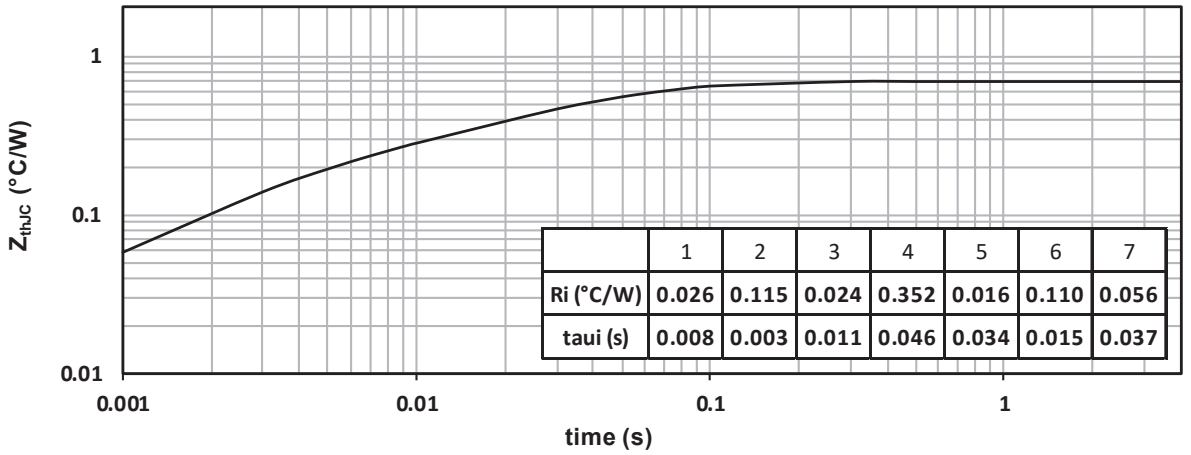
Figure 1-10. Reverse Bias Safe Operating Area



1.5 Typical Diode Performance Curve

The following figures show the diode performance curves of the APTGX75A120T1G device.

Figure 1-11. Maximum Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	0.026	0.115	0.024	0.352	0.016	0.110	0.056
taui (s)	0.008	0.003	0.011	0.046	0.034	0.015	0.037

Figure 1-12. Forward Characteristics

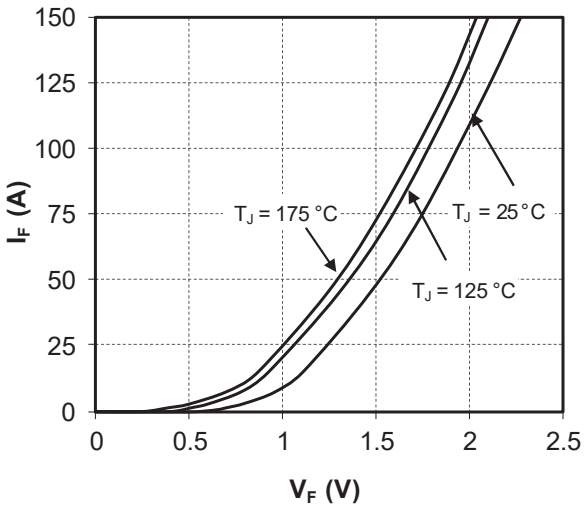


Figure 1-13. Switching Losses vs. Gate Resistance

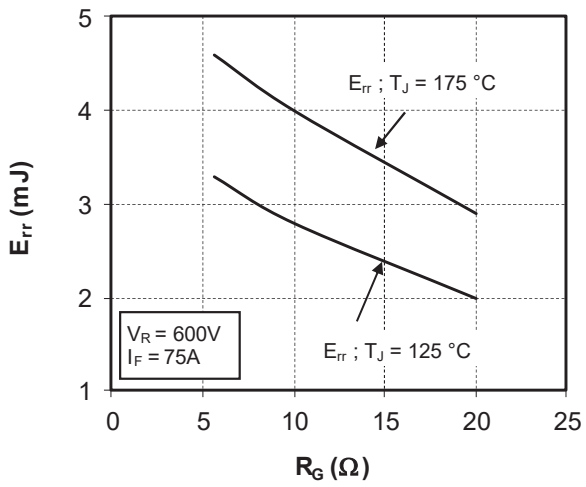
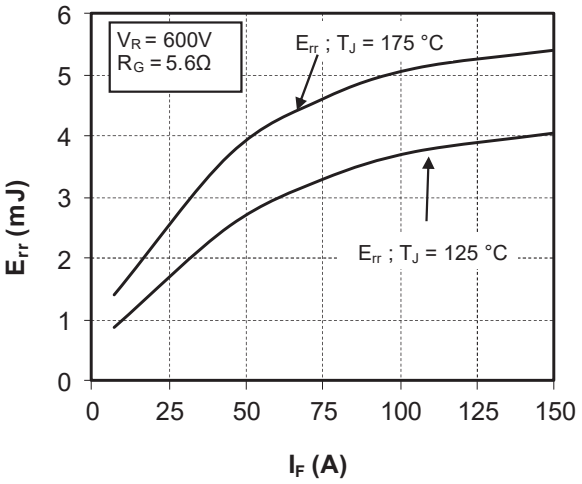


Figure 1-14. Switching Losses vs. Forward Current



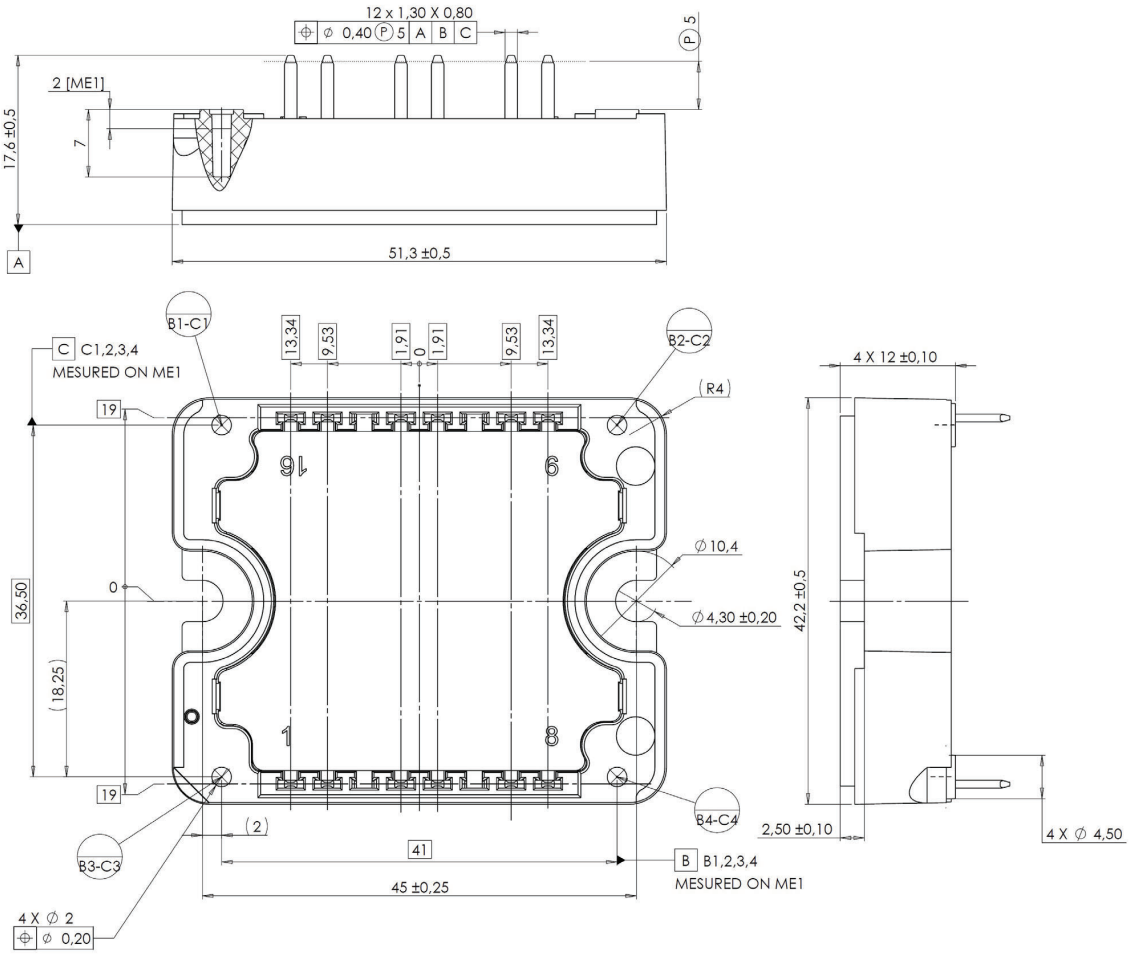
2. Package Specifications

The following section shows the package specification of the APTGX75A120T1G device.

2.1 Package Outline

The following figure shows the package outline drawing of the APTGX75A120T1G device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing



Note: For more information, see application note AN3500A - Mounting instructions for SP1F and SP3F power modules.

3. Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

Revision	Date	Description
A	09/2024	Initial revision

Microchip Information

The Microchip Website

Microchip provides online support via our website at www.microchip.com/. This website is used to make files and information easily available to customers. Some of the content available includes:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip design partner program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

Product Change Notification Service

Microchip's product change notification service helps keep customers current on Microchip products. Subscribers will receive email notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, go to www.microchip.com/pcn and follow the registration instructions.

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Embedded Solutions Engineer (ESE)
- Technical Support

Customers should contact their distributor, representative or ESE for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in this document.

Technical support is available through the website at: www.microchip.com/support

Microchip Devices Code Protection Feature

Note the following details of the code protection feature on Microchip products:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable". Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.

Legal Notice

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure

that your application meets with your specifications. Contact your local Microchip sales office for additional support or, obtain additional support at www.microchip.com/en-us/support/design-help/client-support-services.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Kleer, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, ClockWorks, The Embedded Control Solutions Company, EtherSynch, Flashtec, Hyper Speed Control, HyperLight Load, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, TimeCesium, TimeHub, TimePictra, TimeProvider, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, Clockstudio, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, EyeOpen, GridTime, IdealBridge, IGaT, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, IntelliMOS, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, MarginLink, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, mSiC, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, Power MOS IV, Power MOS 7, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQI, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, Trusted Time, TSHARC, Turing, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, and Symmcom are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

ISBN: 978-1-6683-0245-3

Quality Management System

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

Worldwide Sales and Service

AMERICAS	ASIA/PACIFIC	ASIA/PACIFIC	EUROPE
Corporate Office 2355 West Chandler Blvd. Chandler, AZ 85224-6199 Tel: 480-792-7200 Fax: 480-792-7277 Technical Support: www.microchip.com/support Web Address: www.microchip.com	**Australia - Sydney** Tel: 61-2-9868-6733	**India - Bangalore** Tel: 91-80-3090-4444	**Austria - Wels** Tel: 43-7242-2244-39 Fax: 43-7242-2244-393
Atlanta Duluth, GA Tel: 678-957-9614 Fax: 678-957-1455	**China - Beijing** Tel: 86-10-8569-7000	**India - New Delhi** Tel: 91-11-4160-8631	**Denmark - Copenhagen** Tel: 45-4485-5910 Fax: 45-4485-2829
Austin, TX Tel: 512-257-3370	**China - Chengdu** Tel: 86-28-8665-5511	**India - Pune** Tel: 91-20-4121-0141	**Finland - Espoo** Tel: 358-9-4520-820
Boston Westborough, MA Tel: 774-760-0087 Fax: 774-760-0088	**China - Chongqing** Tel: 86-23-8980-9588	**Japan - Osaka** Tel: 81-6-6152-7160	**France - Paris** Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79
Chicago Itasca, IL Tel: 630-285-0071 Fax: 630-285-0075	**China - Dongguan** Tel: 86-769-8702-9880	**Japan - Tokyo** Tel: 81-3-6880- 3770	**Germany - Garching** Tel: 49-8931-9700
Dallas Addison, TX Tel: 972-818-7423 Fax: 972-818-2924	**China - Guangzhou** Tel: 86-20-8755-8029	**Korea - Daegu** Tel: 82-53-744-4301	**Germany - Haan** Tel: 49-2129-3766400
Detroit Novi, MI Tel: 248-848-4000	**China - Hangzhou** Tel: 86-571-8792-8115	**Korea - Seoul** Tel: 82-2-554-7200	**Germany - Heilbronn** Tel: 49-7131-72400
Houston, TX Tel: 281-894-5983	**China - Hong Kong SAR** Tel: 852-2943-5100	**Malaysia - Kuala Lumpur** Tel: 60-3-7651-7906	**Germany - Karlsruhe** Tel: 49-721-625370
Indianapolis Noblesville, IN Tel: 317-773-8323 Fax: 317-773-5453 Tel: 317-536-2380	**China - Nanjing** Tel: 86-25-8473-2460	**Malaysia - Penang** Tel: 60-4-227-8870	**Germany - Munich** Tel: 49-89-627-144-0 Fax: 49-89-627-144-44
Los Angeles Mission Viejo, CA Tel: 949-462-9523 Fax: 949-462-9608 Tel: 951-273-7800	**China - Qingdao** Tel: 86-532-8502-7355	**Philippines - Manila** Tel: 63-2-634-9065	**Germany - Rosenheim** Tel: 49-8031-354-560
Raleigh, NC Tel: 919-844-7510	**China - Shanghai** Tel: 86-21-3326-8000	**Singapore** Tel: 65-6334-8870	**Israel - Hod Hasharon** Tel: 972-9-775-5100
New York, NY Tel: 631-435-6000	**China - Shenyang** Tel: 86-24-2334-2829	**Taiwan - Hsin Chu** Tel: 886-3-577-8366	**Italy - Milan** Tel: 39-0331-742611 Fax: 39-0331-466781
San Jose, CA Tel: 408-735-9110 Tel: 408-436-4270	**China - Shenzhen** Tel: 86-755-8864-2200	**Taiwan - Kaohsiung** Tel: 886-7-213-7830	**Italy - Padova** Tel: 39-049-7625286
Canada - Toronto Tel: 905-695-1980 Fax: 905-695-2078	**China - Suzhou** Tel: 86-186-6233-1526	**Taiwan - Taipei** Tel: 886-2-2508-8600	**Netherlands - Drunen** Tel: 31-416-690399 Fax: 31-416-690340
	China - Wuhan Tel: 86-27-5980-5300	**Thailand - Bangkok** Tel: 66-2-694-1351	**Norway - Trondheim** Tel: 47-72884388
	China - Xian Tel: 86-29-8833-7252	**Vietnam - Ho Chi Minh** Tel: 84-28-5448-2100	**Poland - Warsaw** Tel: 48-22-3325737
	China - Xiamen Tel: 86-592-2388138		**Romania - Bucharest** Tel: 40-21-407-87-50
	China - Zhuhai Tel: 86-756-3210040		**Spain - Madrid** Tel: 34-91-708-08-90 Fax: 34-91-708-08-91
			Sweden - Gothenberg Tel: 46-31-704-60-40
			Sweden - Stockholm Tel: 46-8-5090-4654
			UK - Wokingham Tel: 44-118-921-5800 Fax: 44-118-921-5820