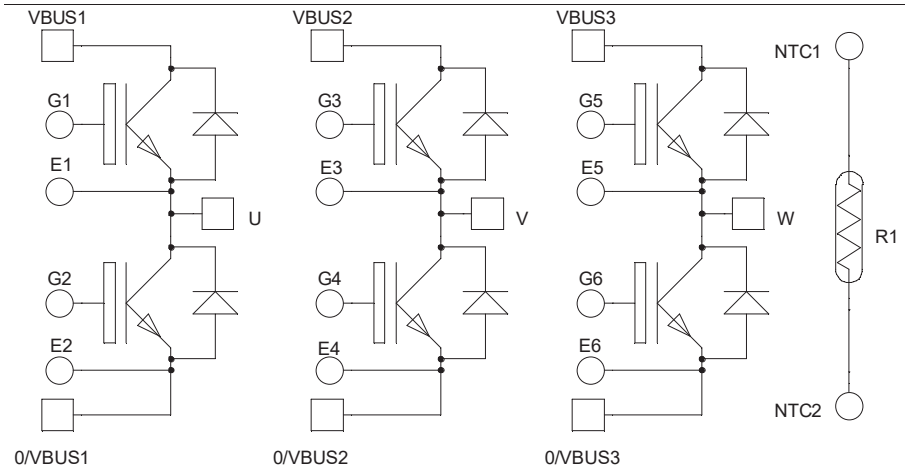
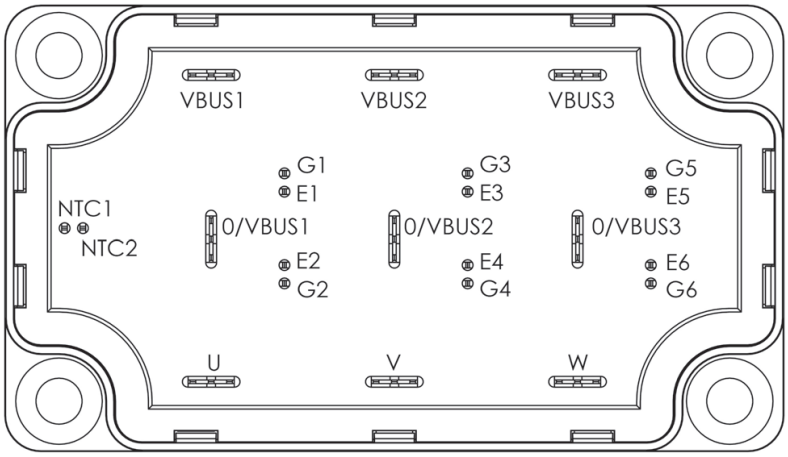
APTGTQ150TA65TPG

Triple Phase Leg High-Speed IGBT 5 Power Module

Product Overview

The APTGTQ150TA65TPG device is a three phase leg 650V, 150A Insulated-Gate Bipolar Transistor (IGBT) 5 power module.





Note: All ratings at T_J = 25 °C, unless otherwise specified.

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

Features

The following are the key features of APTGTQ150TA65TPG device:

- High-Speed IGBT 5
  - Low voltage drop
  - Low tail current
  - Switching frequency up to 100 kHz
  - Low leakage current
- Kelvin emitter for easy drive
- Very low stray inductance
- Lead frames for power connectors
- High level of integration
- Internal thermistor for temperature monitoring

Benefits

The following are the benefits of APTGTQ150TA65TPG device:

- Outstanding performance at high frequency operation
- 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

Applications

The following are the applications of APTGTQ150TA65TPG device:

- Welding converters
- Switched mode power supplies
- Uninterruptible power supplies
- Motor control

1. Electrical Specifications

The following sections show the electrical specifications of the APTGTQ150TA65TPG device.

1.1 IGBT Characteristics (Per IGBT)

The following table lists the absolute maximum ratings (per IGBT) of the APTGTQ150TA65TPG device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter		Maximum Ratings	Unit
V_{CES}	Collector-Emitter voltage		650	V
I_C	Continuous collector current	T_C = 25 °C	150	A
		T_C = 80 °C	90	
I_{CM}	Pulsed collector current	T_C = 25 °C	300	
V_{GE}	Gate-Emitter voltage		±20	V
P_D	Power dissipation		365	W

The following table lists the electrical characteristics (per IGBT) of the APTGTQ150TA65TPG 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} = 650V		—	—	150	µA
$V_{CE(sat)}$	Collector emitter saturation voltage	V_{GE} = 15V	T_J = 25 °C	—	1.65	2.2	V
		I_C = 150A	T_J = 150 °C	—	1.9	—	
$V_{GE(th)}$	Gate threshold voltage	V_{GE} = V_{CE}; I_C = 1.5 mA		3.3	4.0	4.7	V
I_{GES}	Gate-Emitter leakage current	V_{GE} = 20V; V_{CE} = 0V		—	—	360	nA

The following table lists the dynamic characteristics (per IGBT) of the APTGTQ150TA65TPG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{GE} = 0V		—	9000	—	pF
C_{oes}	Output capacitance	V_{CE} = 25V		—	150	—	
C_{res}	Reverse transfer capacitance	f = 1 MHz		—	33	—	
Q_G	Gate charge	V_{GE} = 15V V_{CE} = 520V I_C = 150A		—	360	—	nC
$T_{d(on)}$	Turn-on delay time	V_{GE} = 15V	T_J = 150 °C	—	20	—	ns
T_r	Rise time	V_{Bus} = 400V		—	15	—	
$T_{d(off)}$	Turn-off delay time	I_C = 75A		—	205	—	
T_f	Fall time	R_G = 1Ω			26	—	
E_{on}	Turn-on energy	V_{GE} = 15V	T_J = 150 °C	—	2.25	—	mJ
E_{off}	Turn-off energy	V_{Bus} = 400V I_C = 75A R_G = 1Ω	T_J = 150 °C	—	0.9	—	
R_{Gint}	Internal gate resistance			—	1.7	—	Ω
R_{thJC}	Junction-to-case thermal resistance			—	—	0.41	°C/W

1.2 Diode Ratings and Characteristics (Per Diode)

The following table lists the diode ratings and characteristics of the APTGTQ150TA65TPG device.

Table 1-4. Diode Ratings and Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
V_{RRM}	Peak repetitive reverse voltage			—	—	650	V
I_{RM}	Reverse leakage current	V_R = 650V		—	—	50	µA
I_F	DC forward current		T_C = 25 °C	—	75	—	A
V_F	Diode forward voltage	I_F = 75A	T_J = 25 °C	—	1.35	1.9	V
		V_{GE} = 0V	T_J = 150 °C	—	1.3	—	
t_{rr}	Reverse recovery time	I_F = 37.5A	T_J = 25 °C	—	50	—	ns
		V_R = 400V	T_J = 150 °C	—	41	—	
Q_{rr}	Reverse recovery charge	di/dt = 1500A/µs	T_J = 25 °C	—	0.6	—	µC
			T_J = 150 °C	—	1.2	—	
R_{thJC}	Junction-to-case thermal resistance			—	—	1	°C/W

1.3 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the APTGTQ150TA65TPG device.

Table 1-5. Thermal and Package Characteristics

Symbol	Characteristic			Min.	Max.	Unit
V_{ISOL}	RMS isolation voltage, any terminal to case t = 1 min, 50 Hz/60 Hz			4000	—	V
T_J	Operating junction temperature range			–40	175	°C
T_{JOP}	Recommended junction temperature under switching conditions			–40	T_{Jmax}–25	
T_{STG}	Storage case temperature			–40	125	
T_C	Operating case temperature			–40	125	
Torque	Mounting torque	To heatsink	M6	3	5	N.m
Wt	Package weight			—	250	g

The following table lists the temperature sensor NTC of the APTGTQ150TA65TPG 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	—	%

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

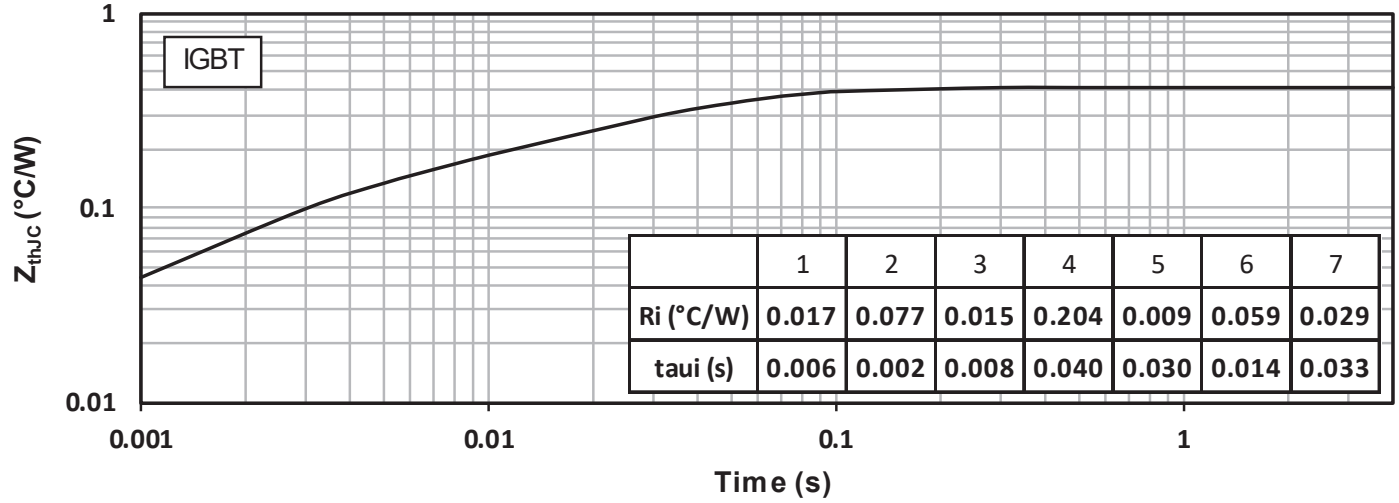
T: Thermistor temperature
R_T: Thermistor value at T

Note: See APT0406—Using NTC Temperature Sensor Integrated into Power Module for more information.

1.4 Typical IGBT Performance Curve

The following figures show the IGBT performance curves of the APTGTQ150TA65TPG device.

Figure 1-1. Maximum Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	0.017	0.077	0.015	0.204	0.009	0.059	0.029
taui (s)	0.006	0.002	0.008	0.040	0.030	0.014	0.033

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

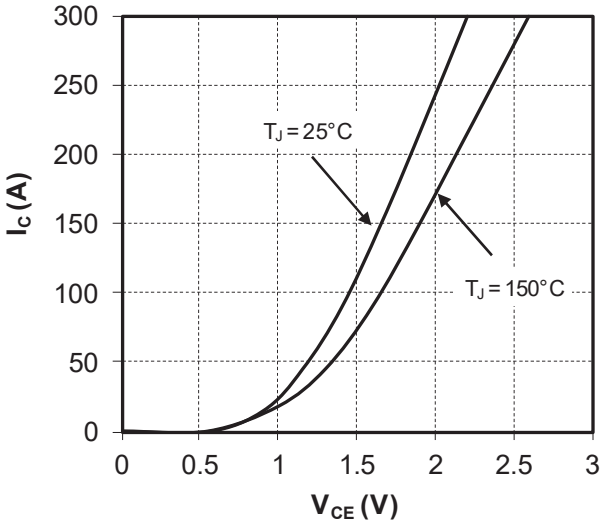


Figure 1-3. Output Characteristics, T_J = 150 °C

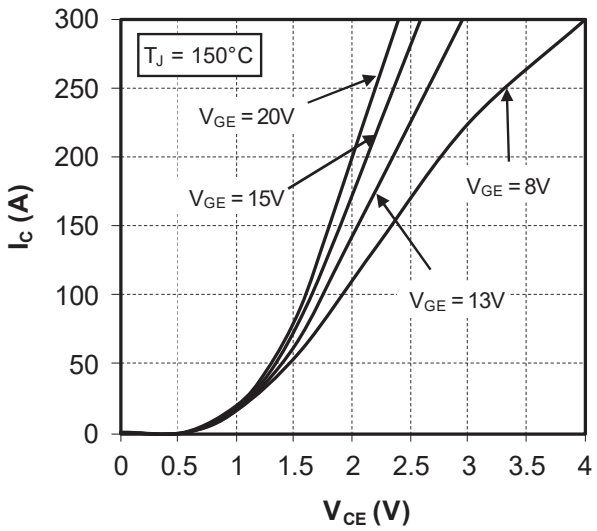


Figure 1-4. Transfer Characteristics

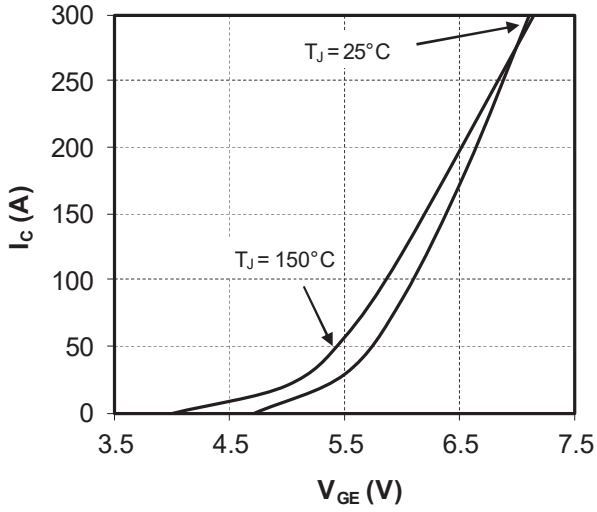


Figure 1-5. Energy Losses vs. Collector Current

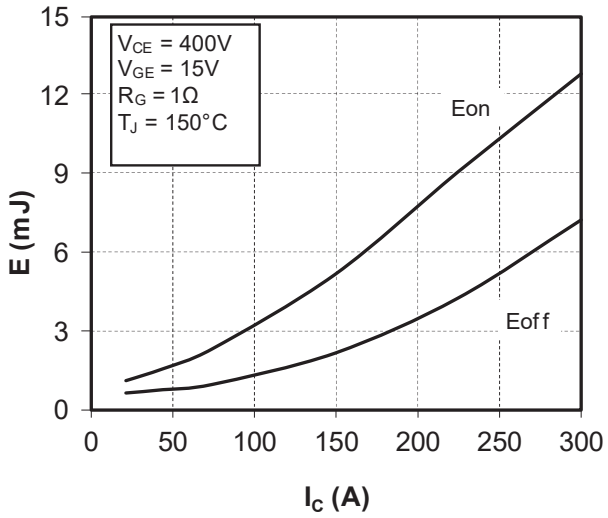


Figure 1-6. Switching Energy vs. Gate Resistance

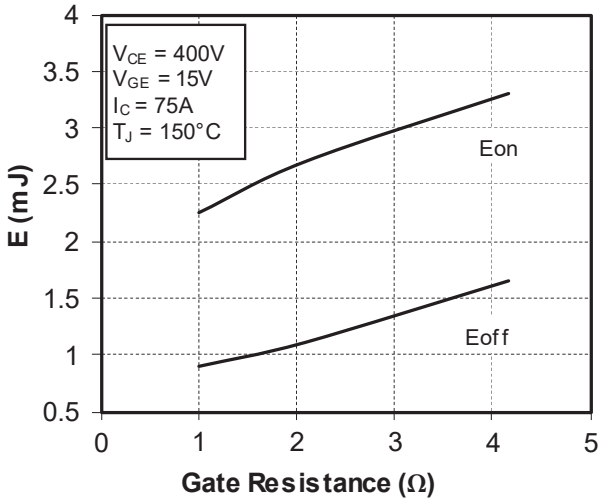
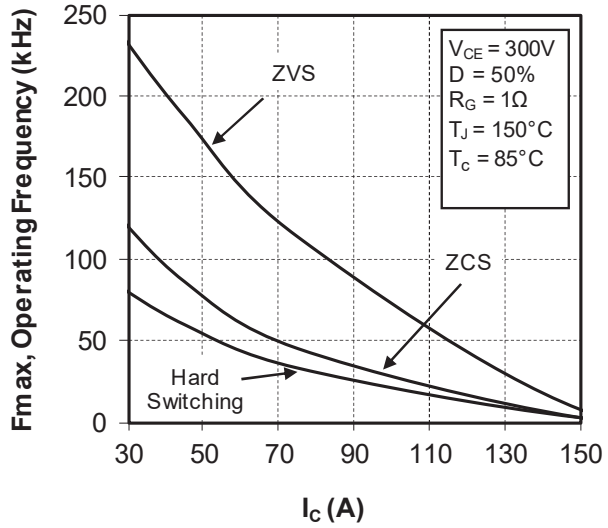


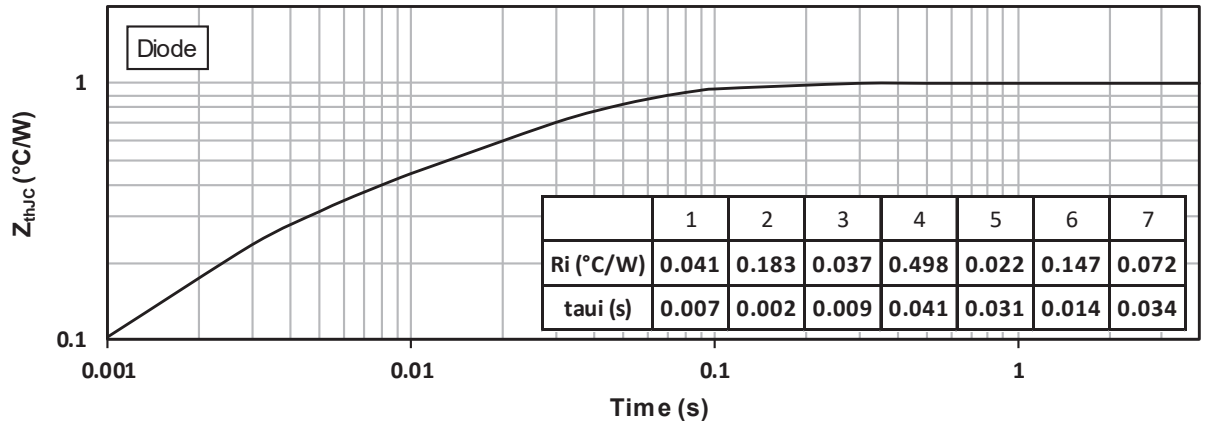
Figure 1-7. Operating Frequency vs Collector Current



1.5 Typical Diode Performance Curve

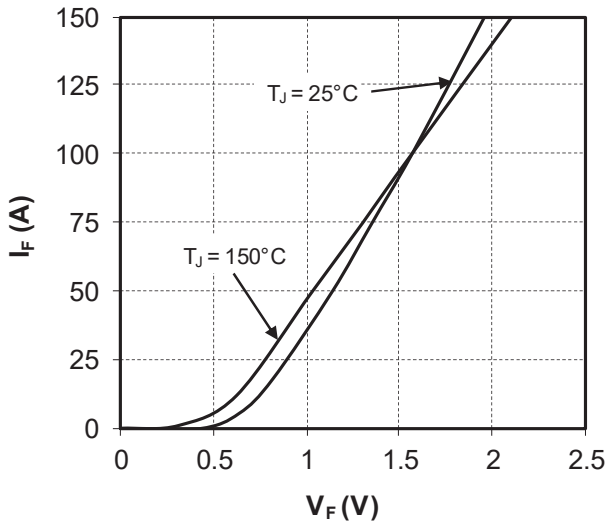
The following figures show the diode performance curves of the APTGTQ150TA65TPG device.

Figure 1-8. Maximum Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	0.041	0.183	0.037	0.498	0.022	0.147	0.072
taui (s)	0.007	0.002	0.009	0.041	0.031	0.014	0.034

Figure 1-9. Diode Forward Characteristics



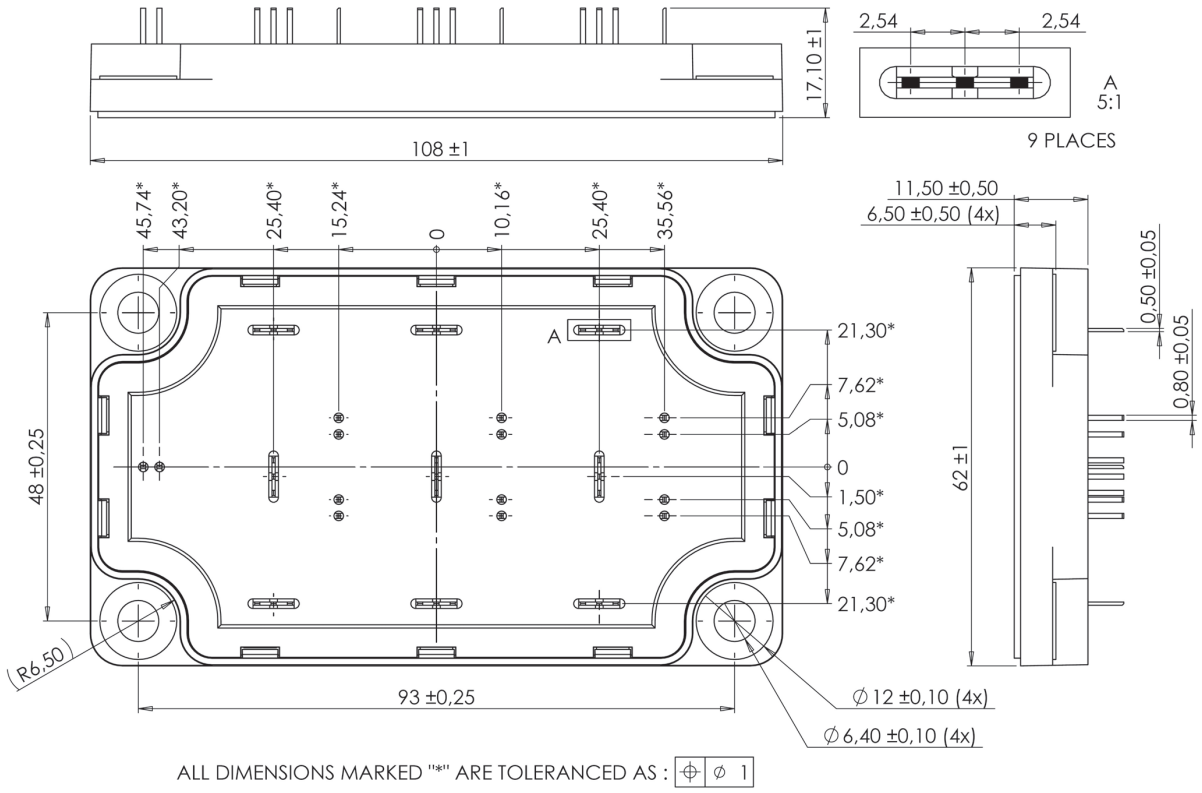
2. Package Specifications

The following section shows the package specification of the APTGTQ150TA65TPG device.

2.1 Package Outline

The following figure shows the package outline drawing of the APTGTQ150TA65TPG device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing



Note: See 1902—Mounting Instructions for SP6-P (12 mm) Power Modules for more information.

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	11/2022	Initial Revision

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