CQD600A70R

700V, αMOS5™ N-Channel Power Transistor

General Description

- Proprietary αMOS5™ technology
- Low $R_{DS(ON)}$
- Optimized switching parameters for better EMI performance
- Enhanced body diode for robustness and fast reverse recovery

Applications

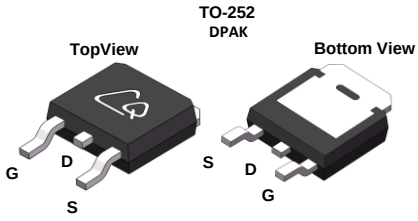
- Flyback for SMPS
- Charger,PD Adapter,TV,lighting

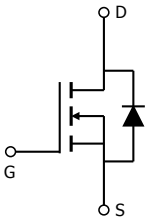
Product Summary

V_{DS} @ $T_{j,max}$	800V
I_{DM}	34A
$R_{DS(ON),max}$	< 0.6Ω
$Q_{g,typ}$	15.5nC
E_{oss} @ 400V	1.9μJ

100% UIS Tested
100% R_g Tested

Green Product





Orderable Part Number	Package Type	Form	Minimum Order Quantity
CQD600A70R	TO252	Tape & Reel	2500

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	Maximum	Units
Drain-Source Voltage		V_{DS}	700	V
Gate-Source Voltage		V_{GS}	±20	V
Gate-Source Voltage (dynamic) AC(f>1Hz)		V_{GS}	±30	V
Continuous Drain Current	T_C=25°C	I_D	8.5	A
	T_C=100°C		5	
Pulsed Drain Current [C]		I_{DM}	34	
Avalanche Current [C] L=1mH		I_{AR}	2.1	A
Repetitive avalanche energy [C]		E_{AR}	2.2	mJ
Single pulsed avalanche energy [H]		E_{AS}	19	mJ
MOSFET dv/dt ruggedness		dv/dt	100	V/ns
Peak diode recovery dv/dt			20	
Power Dissipation [B]	T_C=25°C	P_D	104	W
	Derate above 25°C		0.8	W/°C
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150	°C
Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds		T_L	300	°C

Thermal Characteristics

Parameter	Symbol	Typical	Maximum	Units
Maximum Junction-to-Ambient [A,D]	$R_{\theta JA}$	45	55	°C/W
Maximum Case-to-sink [A]	$R_{\theta CS}$	-	0.5	°C/W
Maximum Junction-to-Case [D,F]	$R_{\theta JC}$	1	1.2	°C/W

Electrical Characteristics (T_J=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV_{DSS}	Drain-Source Breakdown Voltage	I_D=250µA, V_{GS}=0V, T_J=25°C	700			V
		I_D=250µA, V_{GS}=0V, T_J=150°C		800		
BV_{DSS} /ΔTJ	Breakdown Voltage Temperature Coefficient	I_D=250µA, V_{GS}=0V		0.62		V/ °C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=700V, V_{GS}=0V			1	µA
		V_{DS}=560V, T_J=125°C			10	
I_{GSS}	Gate-Body leakage current	V_{DS}=0V, V_{GS}=±20V			±100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=5V, I_D=250µA		4		V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=10V, I_D=2.5A		0.53	0.6	Ω
g_{FS}	Forward Transconductance	V_{DS}=10V, I_D=4A		6.3		S
V_{SD}	Diode Forward Voltage	I_S=4A,V_{GS}=0V		0.86	1.2	V
I_S	Maximum Body-Diode Continuous Current				8.5	A
I_{SM}	Maximum Body-Diode Pulsed Current [C]				34	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=100V, f=1MHz		950		pF
C_{oss}	Output Capacitance			25		pF
$C_{o(er)}$	Effective output capacitance, energy related [I]	V_{GS}=0V, V_{DS}=0 to 480V, f=1MHz		22		pF
$C_{o(tr)}$	Effective output capacitance, time related [J]			100		pF
C_{rss}	Reverse Transfer Capacitance	V_{GS}=0V, V_{DS}=100V, f=1MHz		1.5		pF
R_g	Gate resistance	f=1MHz		2.1		Ω
SWITCHING PARAMETERS						
Q_g	Total Gate Charge	V_{GS}=10V, V_{DS}=480V, I_D=4A		15.5		nC
Q_{gs}	Gate Source Charge			5.8		nC
Q_{gd}	Gate Drain Charge			2.7		nC
$T_{d(on)}$	Turn-On DelayTime	V_{GS}=10V, V_{DS}=400V, I_D=4A, R_G=5Ω		20		ns
T_r	Turn-On Rise Time			8		ns
$T_{d(off)}$	Turn-Off DelayTime			33		ns
T_f	Turn-Off Fall Time			8		ns
T_{rr}	Body Diode Reverse Recovery Time	I_F=4A, dI/dt=100A/µs, V_{DS}=400V		260		ns
I_{rm}	Peak Reverse Recovery Current			20		A
Q_{rr}	Body Diode Reverse Recovery Charge			3.5		µC

A. The value of R_{qJA} is measured with the device in a still air environment with T_A=25° C.
B. The power dissipation P_D is based on $T_{J(MAX)}$=150° C in a TO252 package, using junction-to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used.
C. Repetitive rating, pulse width limited by junction temperature $T_{J(MAX)}$=150° C.
D. The R_{qJA} is the sum of the thermal impedance from junction to case R_{qJC} and case to ambient.
E. The static characteristics in Figures 1 to 6 are obtained using <300µs pulses, duty cycle 0.5% max.
F. These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of $T_{J(MAX)}$=150° C.
G.These tests are performed with the device mounted on 1 in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A=25° C.
H. L=60mH, I_{AS}=0.8A, R_G=25Ω, Starting T_J=25° C.
I. $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$.
J. $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$.

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

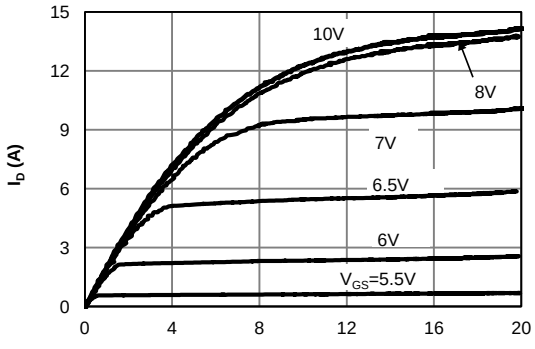


Figure 1: On-Region Characteristics

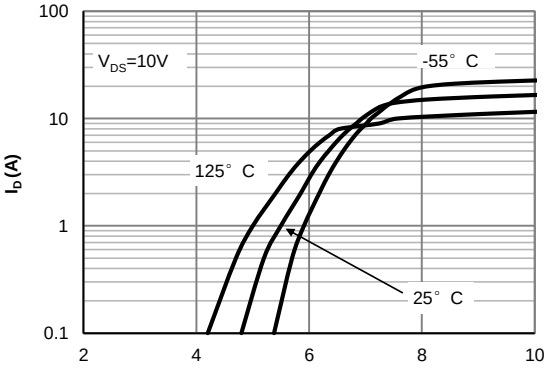


Figure 2: Transfer Characteristics

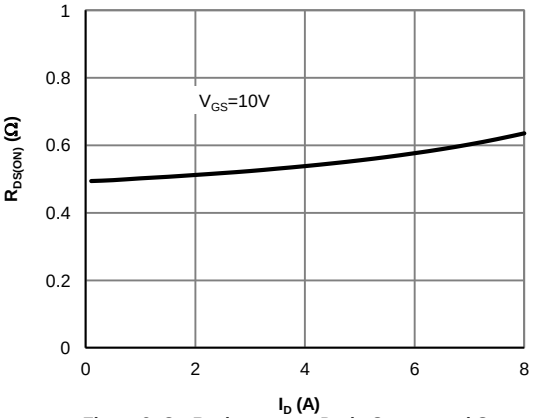


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

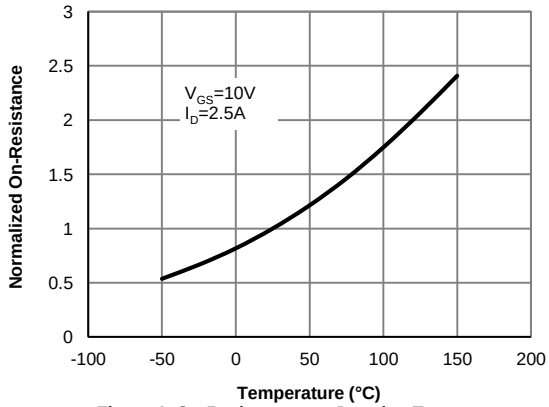


Figure 4: On-Resistance vs. Junction Temperature

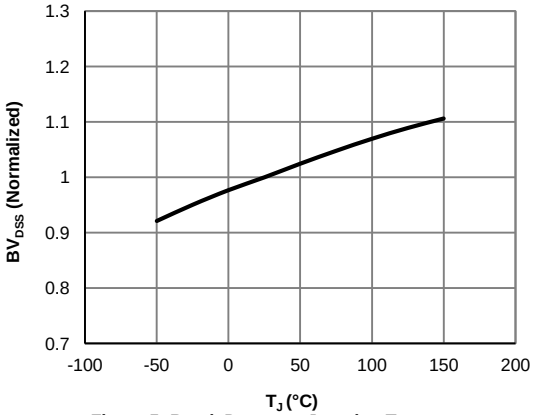


Figure 5: Break Down vs. Junction Temparature

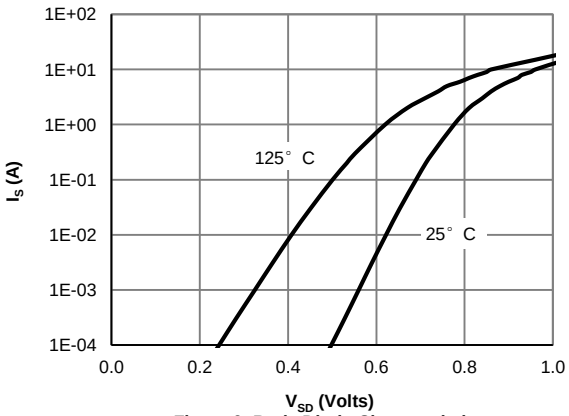


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

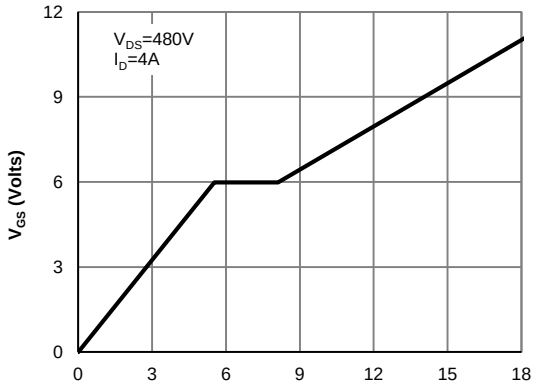


Figure 7: Gate-Charge Characteristics

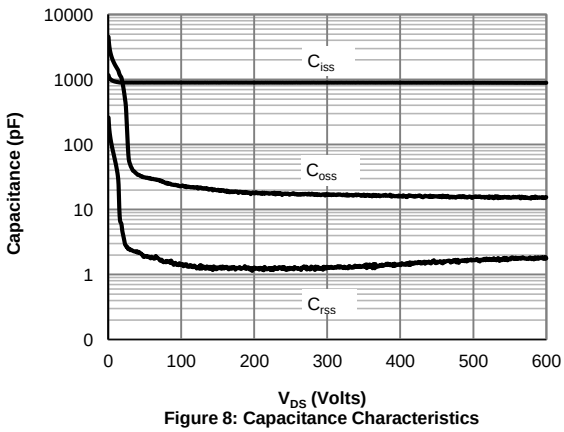


Figure 8: Capacitance Characteristics

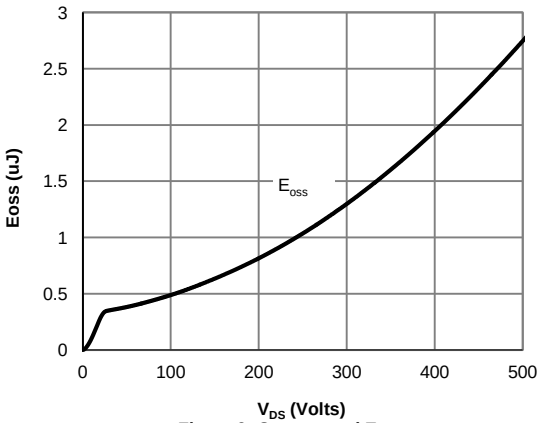


Figure 9: Coss stored Energy

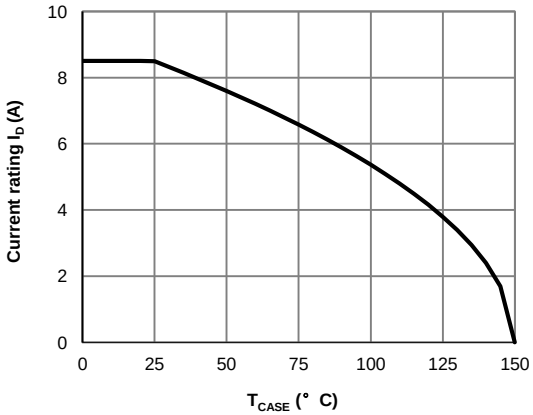


Figure 10: Current De-rating (Note F)

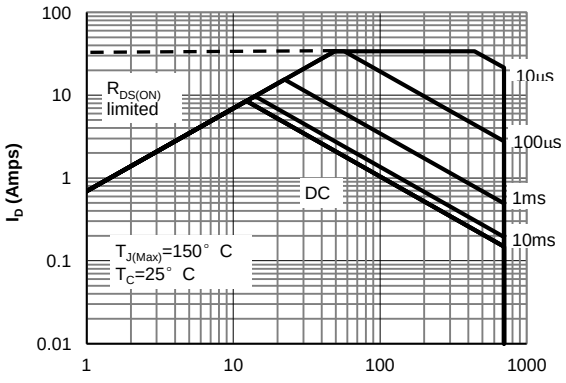


Figure 11: Maximum Forward Biased Safe Operating Area (Note F)

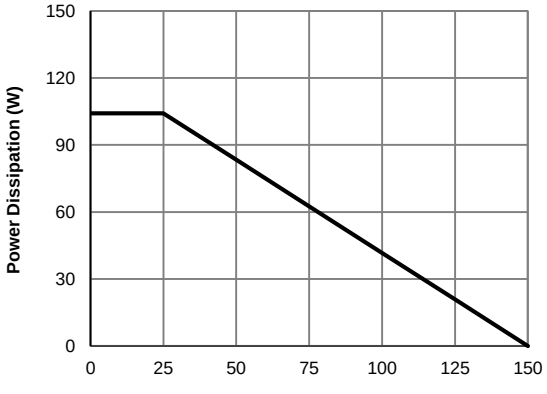


Figure 12: Power De-rating (Note B)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

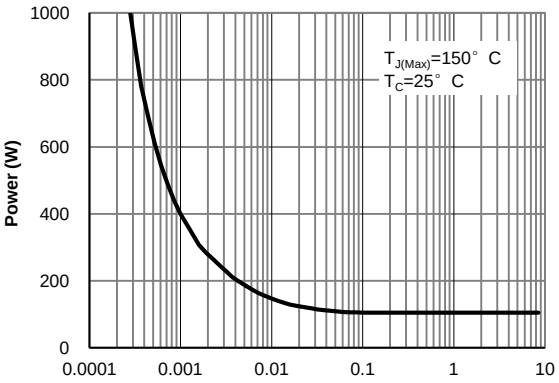


Figure 13: Single Pulse Power Rating Junction-to-Case (Note F)

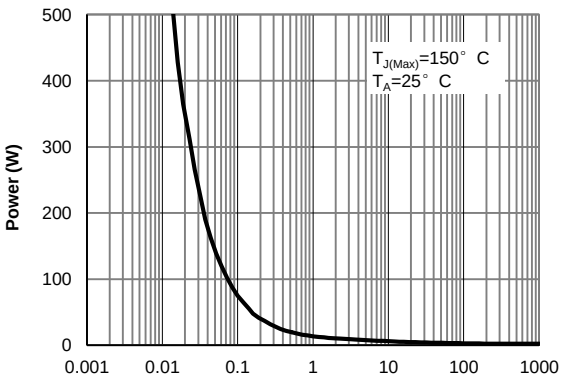


Figure 14: Single Pulse Power Rating Junction-to-Ambient (Note G)

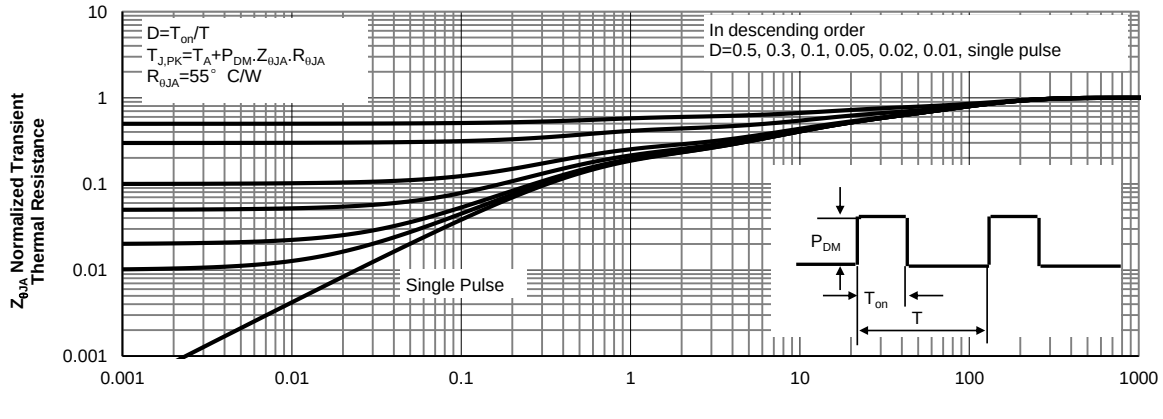


Figure 15: Normalized Maximum Transient Thermal Impedance (Note G)

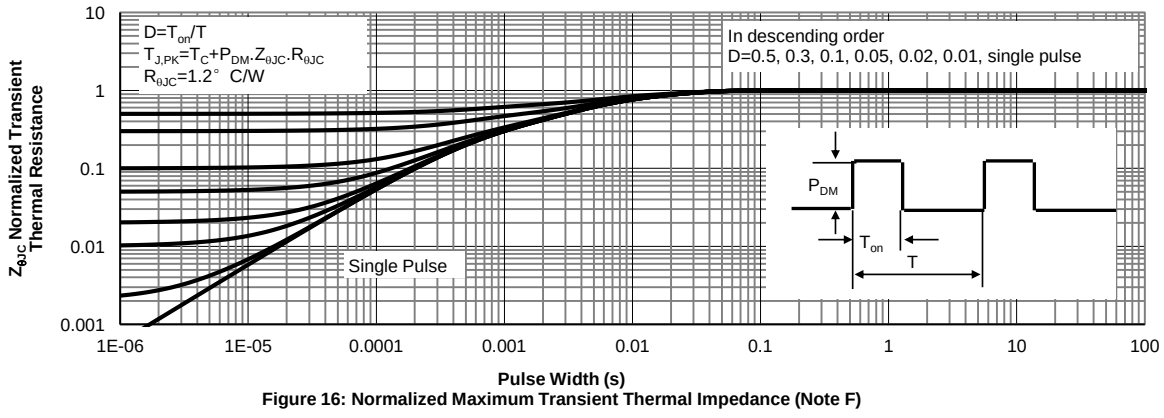
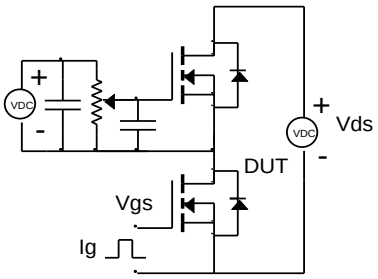
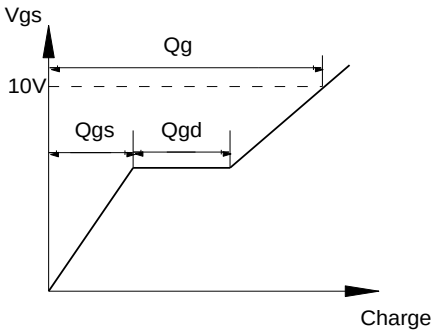


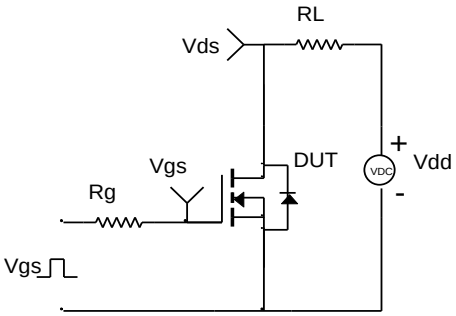
Figure 16: Normalized Maximum Transient Thermal Impedance (Note F)

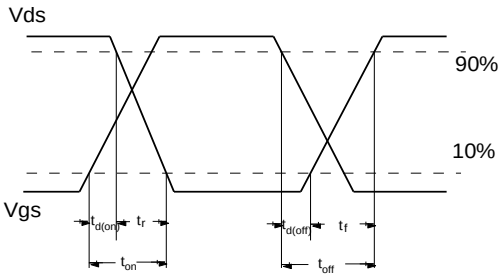
Gate Charge Test Circuit & Waveform



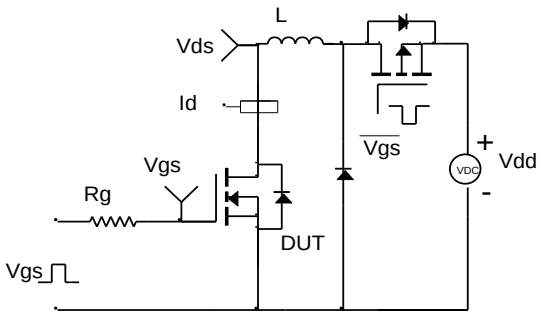


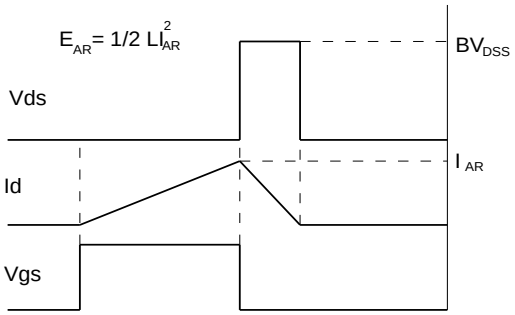
Resistive Switching Test Circuit & Waveforms



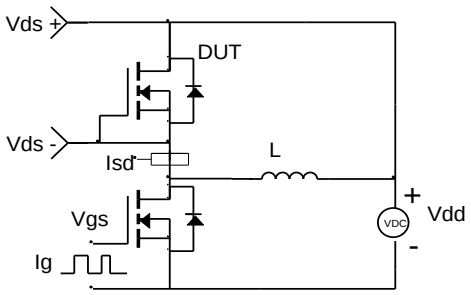


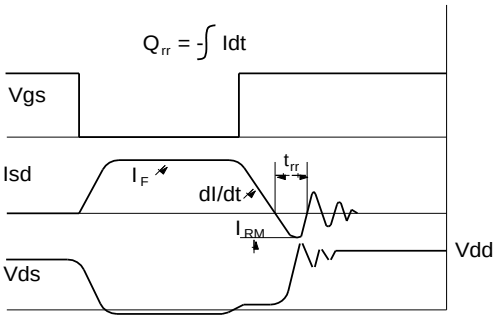
Unclamped Inductive Switching (UIS) Test Circuit & Waveforms





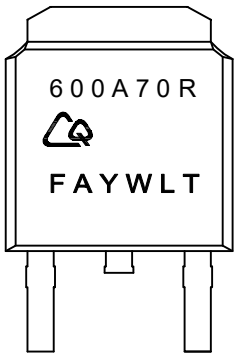
Diode Recovery Test Circuit & Waveforms





Document No.	PDCQ-00025
Version	A
Title	CQD600A70R Marking Description

TO252(DPAK) PACKAGE MARKING DESCRIPTION



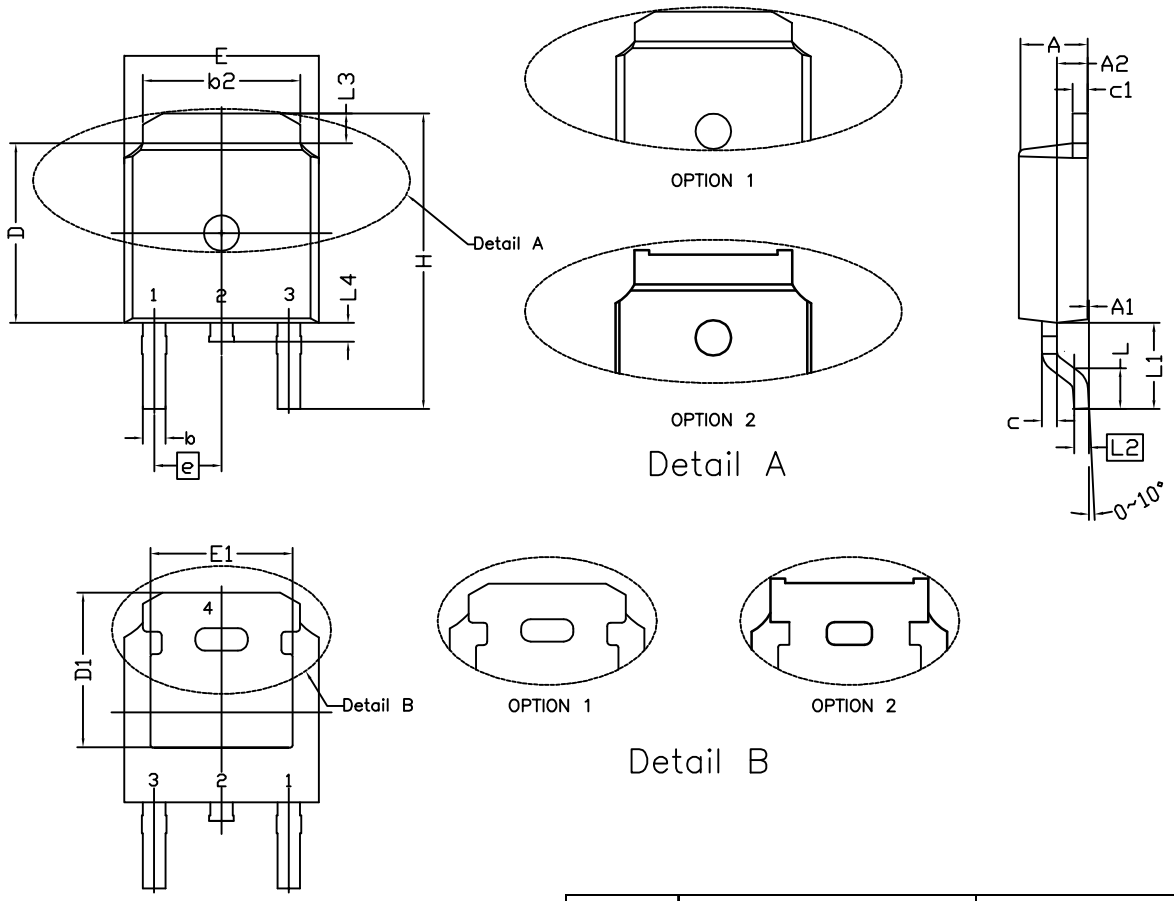
Green product

NOTE:
LOGO - CQAOS Logo
600A70R - Part number code
F - Fab code
A - Assembly location code
Y - Year code
W - Week code
L&T - Assembly lot code

PART NO.	DESCRIPTION	CODE
CQD600A70R	Green product	600A70R

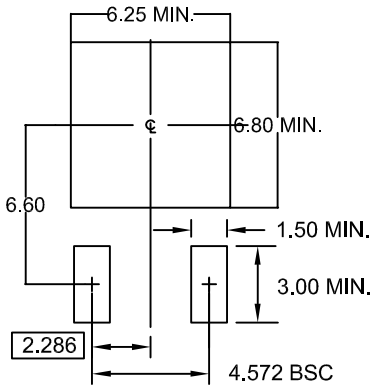
Document No.	POCQ-00012
Version	A

TO252 PACKAGE OUTLINE



SYMBOLS	DIMENSION IN MM			DIMENSION IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	2.184	2.286	2.400	0.086	0.090	0.094
A1	0.000	---	0.200	0.000	---	0.008
A2	0.889	1.041	1.170	0.035	0.041	0.046
b	0.635	0.762	0.889	0.025	0.030	0.035
b1	0.680	0.840	1.143	0.027	0.033	0.045
b2	4.953	5.340	5.500	0.195	0.210	0.217
c	0.450	0.508	0.610	0.018	0.020	0.024
c1	0.450	0.508	0.630	0.018	0.020	0.025
D	5.969	6.096	6.223	0.235	0.240	0.245
D1	5.210	5.249	5.380	0.205	0.207	0.212
E	6.350	6.604	6.800	0.250	0.260	0.268
E1	4.318	4.826	4.920	0.170	0.190	0.194
e	2.286 BSC			0.090 BSC		
e1	4.572 BSC			0.180 BSC		
H	9.398	10.033	10.500	0.370	0.395	0.413
L	1.270	1.520	2.032	0.050	0.060	0.080
L1	2.921 REF.			0.115 REF.		
L2	0.408	0.508	0.608	0.016	0.020	0.024
L3	0.889	1.016	1.270	0.035	0.040	0.050
L4	0.600	---	1.016	0.024	---	0.040

RECOMMENDED LAND PATTERN

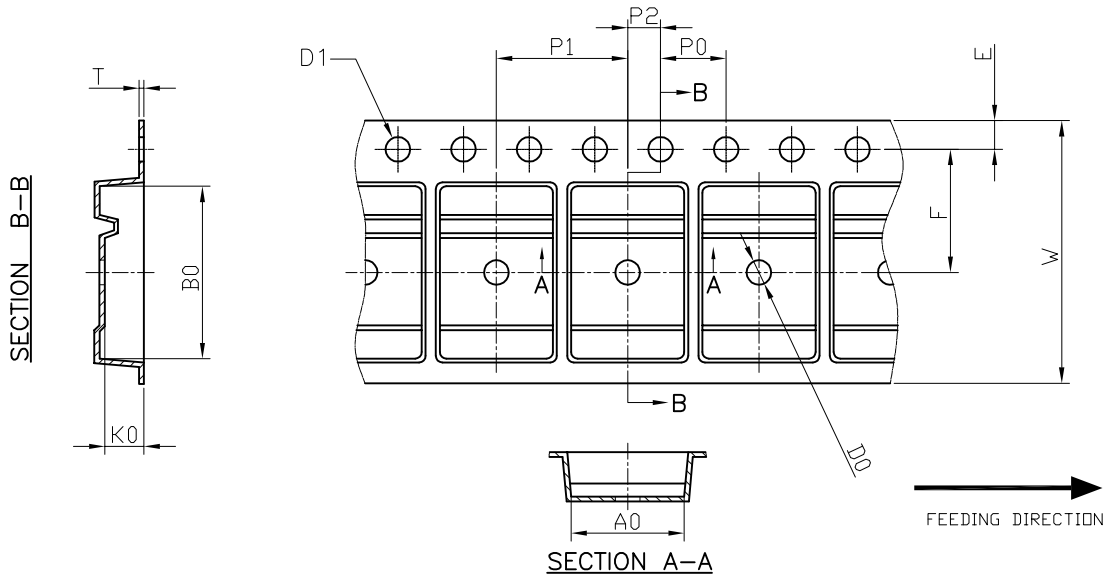


UNIT: mm

NOTE
1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS. MOLD FLASH SHOULD BE LESS THAN 6 MILS.
2. DIMENSION L IS MEASURED IN GAUGE PLANE
3. TOLERANCE 0.10 mm UNLESS OTHERWISE SPECIFIED
4. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.
5. REFER TO JEDEC TO-252 (AA)

TO252 Tape and Reel Data

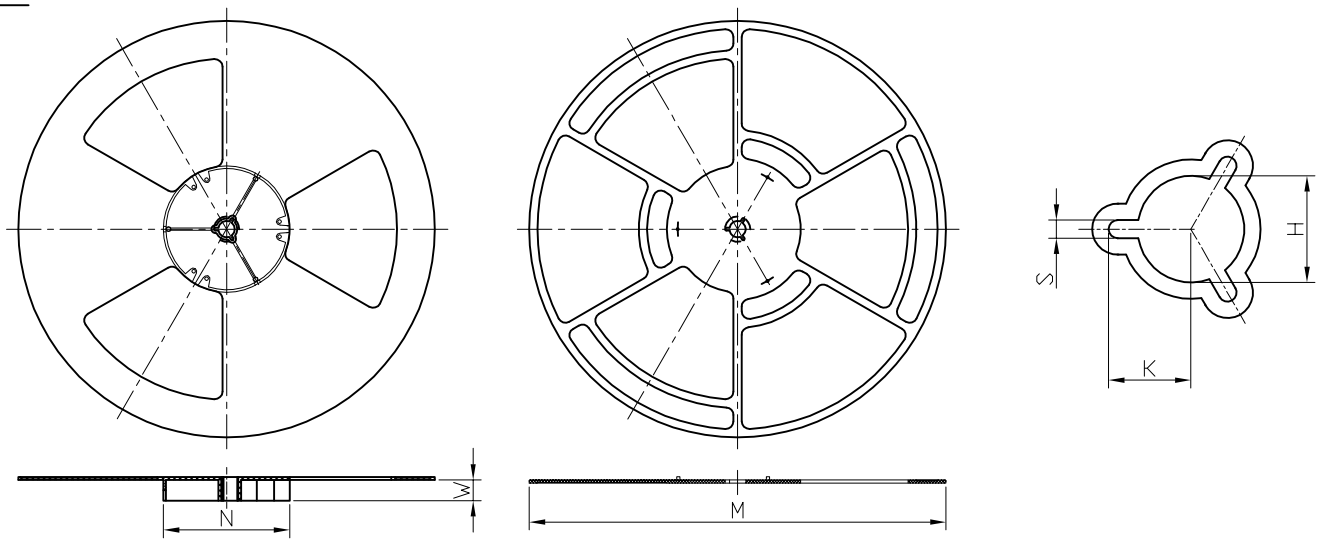
TO252 Carrier Tape



UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	W	E	F	P1	P0	P2	T
TO252 (16 mm)	6.90 ±0.10	10.50 ±0.10	2.50 ±0.10	1.50 +0.1 −0	1.50 +0.1 −0	16.00 ±0.30	1.75 ±0.10	7.50 ±0.10	8.00 ±0.10	4.00 ±0.10	2.00 ±0.10	0.30 ±0.05

TO252 Reel



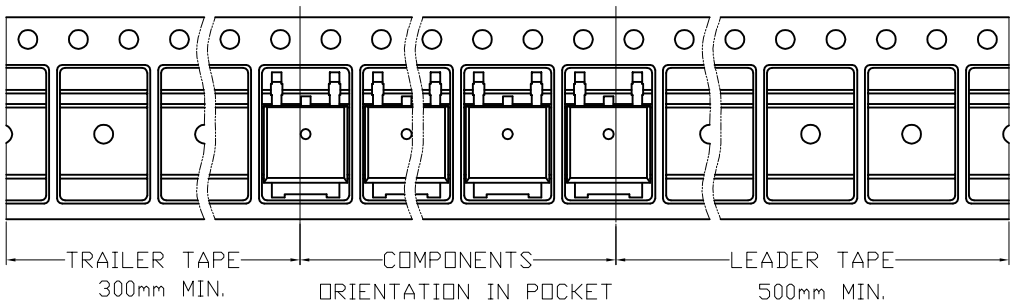
UNIT: MM

TAPE SIZE	REEL SIZE	M	N	W	H	K	S
16 mm	ø330	ø330.00 +0.25 −4.00	ø100.00 ±0.2	16.4 +2.0 −0.0	ø13.00 +0.50 −0.20	10.5 ±0.25	2.2 ±0.25

TO252 Tape

Leader / Trailer & Orientation

Unit Per Reel: 2500pcs



CQAOS Semiconductor
Product Reliability Report

CQD600A70R, rev A

Plastic Encapsulated Device

Chongqing Alpha & Omega Semiconductor, Limited

Jun, 2020

This CQAOS product reliability report summarizes the qualification result for CQD600A70R. Accelerated environmental tests are performed on a specific sample size, and then followed by electrical test at end point. Review of final electrical test result confirms that CQD600A70R passes CQAOS quality and reliability requirements. The released product will be categorized by the process family and be routine monitored for continuously improving the product quality.

I. Reliability Stress Test Summary and Results

Test Item	Test Condition	Time Point	Total Sample Size	Number of Failures	Reference Standard
HTGB	Temp = 150°C , Vgs=100% of Vgsmax	168 / 500 / 1000 hours	462 pcs	0	JESD22-A108
HTRB	Temp = 150°C , Vds=100% of Vdsmax	168 / 500 / 1000 hours	462 pcs	0	JESD22-A108
Precondition (Note A)	168hr 85°C / 85%RH + 3 cycle reflow@260°C (MSL 1)	-	4620 pcs	0	JESD22-A113
HAST	130°C , 85%RH, 33.3 psia, Vds = 80% of Vdsmax up to 42V	96 hours	693 pcs	0	JESD22-A110
H3TRB	85°C , 85%RH, Vds = 80% of Vdsmax up to 100V	1000 hours	693 pcs	0	JESD22-A101
Autoclave	121°C , 29.7psia, RH=100%	96 hours	924 pcs	0	JESD22-A102
Temperature Cycle	-65°C to 150°C , air to air,	1000 cycles	924 pcs	0	JESD22-A104
HTSL	Temp = 150°C	1000 hours	693 pcs	0	JESD22-A103
IOL	Δ Tj = 100°C	15000 cycles	693 pcs	0	MIL-STD-750 Method 1037

Note: The reliability data presents total of available generic data up to the published date.
Note A: MSL (Moisture Sensitivity Level) 1 based on J-STD-020

II. Reliability Evaluation

FIT rate (per billion): 3.82
MTTF = 29919 years

The presentation of FIT rate for the individual product reliability is restricted by the actual burn-in sample size. Failure Rate Determination is based on JEDEC Standard JESD 85. FIT means one failure per billion hours.

Failure Rate = $Chi^2 \times 10^9$ **/ [**2 (N) (H) (Af)**] =** 3.82
MTTF = 10^9 / FIT = 29919 years
Chi² = Chi Squared Distribution, determined by the number of failures and confidence interval
N = Total Number of units from burn-in tests
H = Duration of burn-in testing
Af = Acceleration Factor from Test to Use Conditions (Ea = 0.7eV and Tuse = 55°C)
Acceleration Factor [**Af**] = **Exp** [Ea / **k** (1/Tj u – 1/Tj s)]

Acceleration Factor ratio list:

	55 deg C	70 deg C	85 deg C	100 deg C	115 deg C	130 deg C	150 deg C
Af	259	87	32	13	5.64	2.59	1

Tj s = Stressed junction temperature in degree (Kelvin), K = C+273.16
Tj u =The use junction temperature in degree (Kelvin), K = C+273.16
k = Boltzmann's constant, 8.617164 X 10^{-5}eV / K