SEMICONDUCTOR TECHNICAL DATA

1N5820 and 1N5822 are

TM

SCHOTTKY BARRIER RECTIFIERS 3.0 AMPERES 20, 30, 40 VOLTS

. . . employing the Schottky Barrier principle in a large area metal–to–silicon power diode. State–of–the–art geometry features chrome barrier metal, epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low–voltage, high–frequency inverters, free wheeling diodes, and polarity protection diodes.

- Extremely Low vF
- Low Power Loss/High Efficiency
- Low Stored Charge, Majority Carrier Conduction

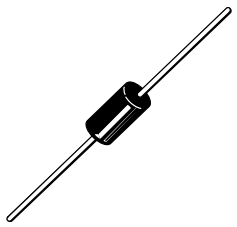
Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.1 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are

Order this document by 1N5820/D

Readily Solderable

- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16″ from case
- Shipped in plastic bags, 5,000 per bag
- Available Tape and Reeled, 1500 per reel, by adding a “RL’’ suffix to the part number
- Polarity: Cathode indicated by Polarity Band
- Marking: 1N5820, 1N5821, 1N5822



CASE 267–03 PLASTIC

MAXIMUM RATINGS

Rating	Symbol	1N5820	1N5821	1N5822	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	VRRM VRWM VR	20	30	40	V
Non–Repetitive Peak Reverse Voltage	VRSM	24	36	48	V
RMS Reverse Voltage	VR(RMS)	14	21	28	V
Average Rectified Forward Current (2) VR(equiv) 0.2 VR(dc), TL = 95°C (RθJA = 28°C/W, P.C. Board Mounting, see Note 2)	IO	3.0			A
Ambient Temperature Rated VR(dc), PF(AV) = 0 RθJA = 28°C/W	TA	90	85	80	°C
Non–Repetitive Peak Surge Current (Surge applied at rated load conditions, half wave, single phase 60 Hz, TL = 75°C)	IFSM	80 (for one cycle)			A
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	TJ, Tstg	65 to +125			°C
Peak Operating Junction Temperature (Forward Current applied)	TJ(pk)	150			°C

***THERMAL CHARACTERISTICS** (Note 2)

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	RθJA	28	°C/W

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.

(2) Lead Temperature reference is cathode lead 1/32″ from case. * Indicates JEDEC Registered Data for 1N5820–22.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Preferred devices are Motorola recommended choices for future use and best overall value.

***ELECTRICAL CHARACTERISTICS** (T_L = 25°C unless otherwise noted) (2)

Characteristic	Symbol	1N5820	1N5821	1N5822	Unit
Maximum Instantaneous Forward Voltage (1)	VF				V
(i_F = 1.0 Amp)		0.370	0.380	0.390	
(i_F = 3.0 Amp)		0.475	0.500	0.525	
(i_F = 9.4 Amp)		0.850	0.900	0.950	
Maximum Instantaneous Reverse Current @ Rated dc Voltage (1)	iR				mA
T_L = 25°C		2.0	2.0	2.0	
T_L = 100°C		20	20	20	

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.

(2) Lead Temperature reference is cathode lead 1/32″ from case.

* Indicates JEDEC Registered Data for 1N5820–22.

NOTE 1 — DETERMINING MAXIMUM RATINGS

Reverse power dissipation and the possibility of thermal runaway must be considered when operating this rectifier at reverse voltages above 0.1 V_{RWM}. Proper derating may be accomplished by use of equation (1).

$$T_{A(max)} = T_{J(max)} - R\theta_{JA}P_{F(AV)} - R\theta_{JA}P_{R(AV)} \quad (1)$$

where

$T_{A(max)}$ = Maximum allowable ambient temperature

$T_{J(max)}$ = Maximum allowable junction temperature (125°C or the temperature at which thermal runaway occurs, whichever is lowest)

$P_{F(AV)}$ = Average forward power dissipation

$P_{R(AV)}$ = Average reverse power dissipation

$R\theta_{JA}$ = Junction–to–ambient thermal resistance

Figures 1, 2, and 3 permit easier use of equation (1) by taking reverse power dissipation and thermal runaway into consideration. The figures solve for a reference temperature as determined by equation (2).

$$T_R = T_{J(max)} - R\theta_{JA}P_{R(AV)} \quad (2)$$

Substituting equation (2) into equation (1) yields:

$$T_{A(max)} = T_R - R\theta_{JA}P_{F(AV)} \quad (3)$$

Inspection of equations (2) and (3) reveals that T_R is the ambient temperature at which thermal runaway occurs or where T_J = 125°C, when forward power is zero. The transition from one boundary condition to the other is evident on the curves of Figures 1, 2, and 3 as a difference in the rate of change of the slope in the vicinity of 115°C.

The data of Figures 1, 2, and 3 is based upon dc conditions. For use in common rectifier circuits, Table 1 indicates suggested factors for an equivalent dc voltage to use for conservative design, that is:

$$V_{R(equiv)} = V_{(FM)} \times F \quad (4)$$

The factor F is derived by considering the properties of the various rectifier circuits and the reverse characteristics of Schottky diodes.

EXAMPLE: Find $T_{A(max)}$ for 1N5821 operated in a 12–volt dc supply using a bridge circuit with capacitive filter such that I_{DC} = 2.0 A

($I_{F(AV)}$ = 1.0 A), $I_{(FM)}/I_{(AV)}$ = 10, Input Voltage = 10 V(rms), $R\theta_{JA}$ = 40°C/W.

Step 1. Find $V_{R(equiv)}$. Read F = 0.65 from Table 1, $V_{R(equiv)}$ = (1.41) (10) (0.65) = 9.2 V.

Step 2. Find T_R from Figure 2. Read T_R = 108°C @ V_R = 9.2 V and $R\theta_{JA}$ = 40°C/W.

Step 3. Find $P_{F(AV)}$ from Figure 6. **Read $P_{F(AV)}$ = 0.85 W @ $\frac{I_{(FM)}}{I_{(AV)}}$ = 10 and $I_{F(AV)}$ = 1.0 A.

Step 4. Find $T_{A(max)}$ from equation (3).

$T_{A(max)}$ = 108 − (0.85) (40) = 74°C.

**Values given are for the 1N5821. Power is slightly lower for the 1N5820 because of its lower forward voltage, and higher for the

1N5822. Variations will be similar for the MBR–prefix devices, using PF(AV) from Figure 7.

Table 1. Values for Factor F

Circuit	Half Wave		Full Wave, Bridge		Full Wave, Center Tapped*†	
Load	**Resistive**	**Capacitive***	**Resistive**	**Capacitive**	**Resistive**	**Capacitive**
Sine Wave	0.5	1.3	0.5	0.65	1.0	1.3
Square Wave	0.75	1.5	0.75	0.75	1.5	1.5

*Note that VR(PK) 2.0 Vin(PK). †Use line to center tap voltage for Vin.

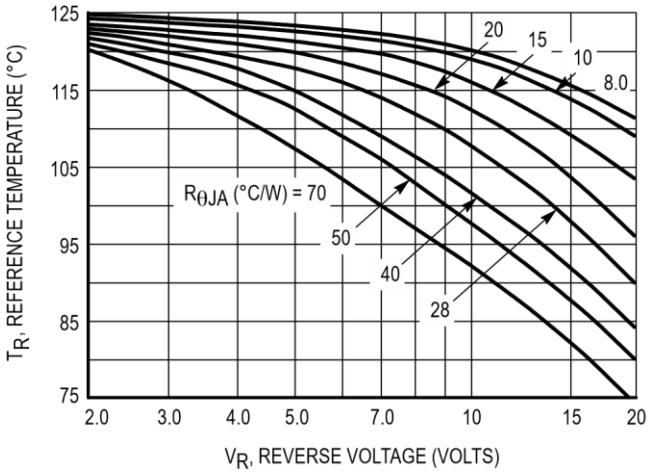


Figure 1. Maximum Reference Temperature 1N5820

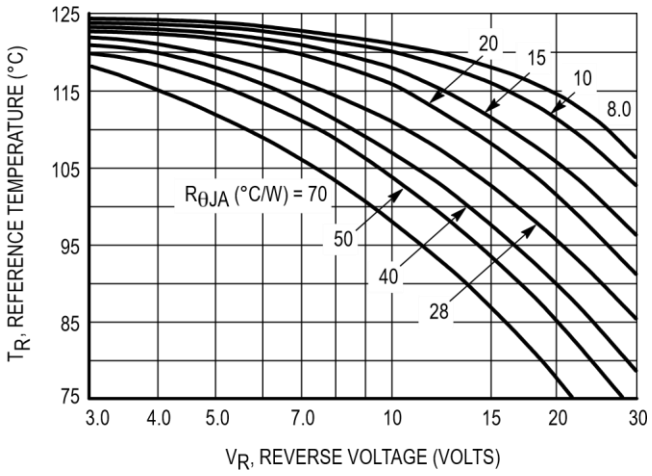


Figure 2. Maximum Reference Temperature 1N5821

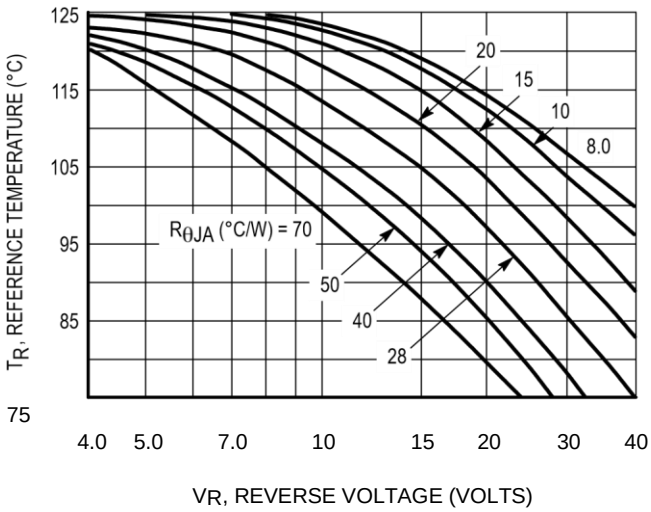


Figure 3. Maximum Reference Temperature

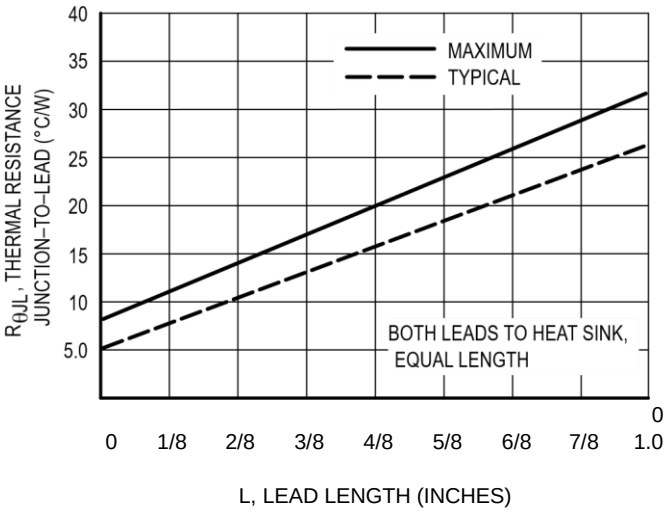


Figure 4. Steady–State Thermal Resistance 1N5822

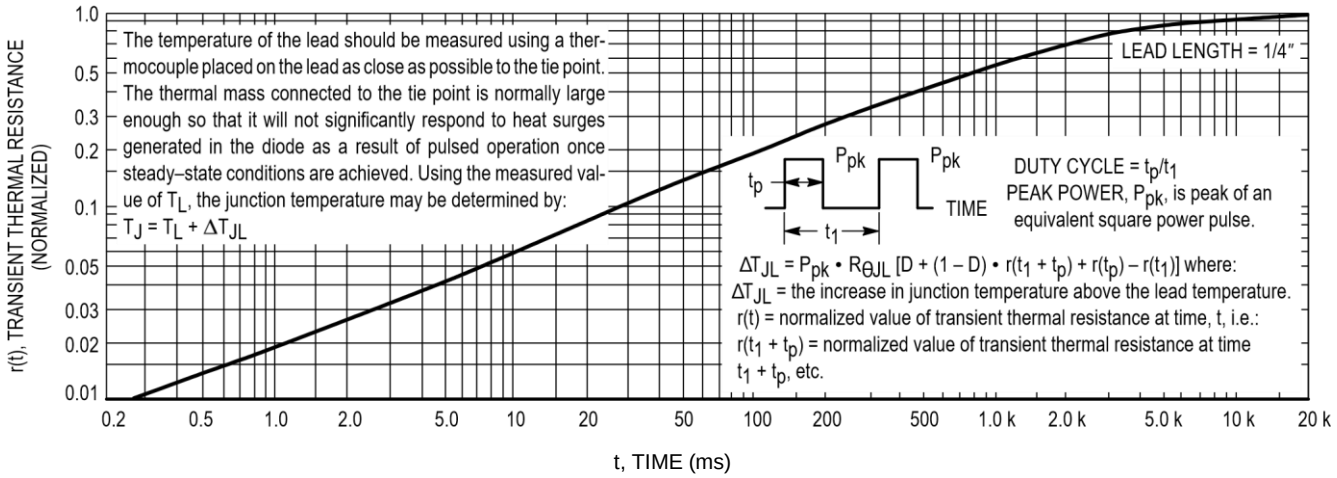


Figure 5. Thermal Response

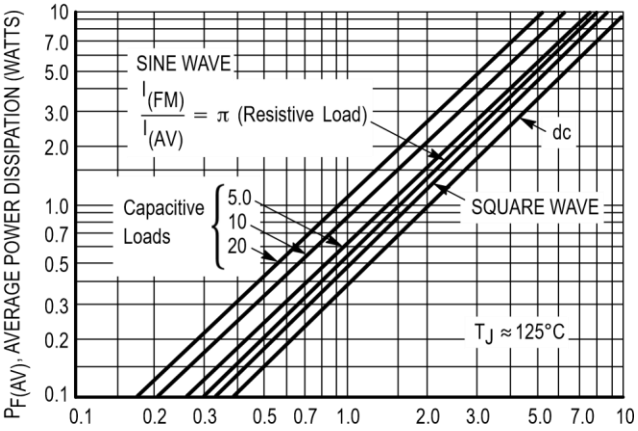
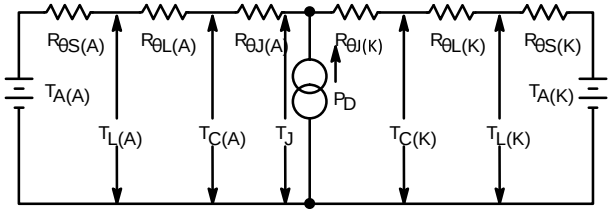


Figure 6. Forward Power Dissipation

1N5820–22 NOTE 3 — APPROXIMATE THERMAL CIRCUIT MODEL



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. For a given total lead length, lowest values occur when one side of the rectifier is brought as close as possible to the heat sink. Terms in the model signify:

T_A = Ambient Temperature T_C = Case Temperature

T_L = Lead Temperature T_J = Junction Temperature

$R\theta_S$ = Thermal Resistance, Heat Sink to Ambient

$R\theta_L$ = Thermal Resistance, Lead to Heat Sink

$R\theta_J$ = Thermal Resistance, Junction to Case

P_D = Total Power Dissipation = P_F + PR

P_F = Forward Power Dissipation

P_R = Reverse Power Dissipation

(Subscripts (A) and (K) refer to anode and cathode sides, respectively.) Values for thermal resistance components are: $R\theta_L$ = 42°C/W/in typically and 48°C/W/in maximum

$R\theta_J$ = 10°C/W typically and 16°C/W maximum The maximum lead temperature may be found as follows:

TL = TJ(max)
TJL

where TJL RθJL ·
PD

NOTE 2 — MOUNTING DATA

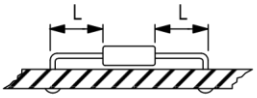
Data shown for thermal resistance junction–to–ambient (RθJA) for the mountings shown is to be used as typical guideline values for preliminary engineering, or in case the tie point temperature cannot be measured.

TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

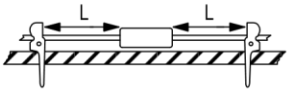
Mounting Method	Lead Length, L (in)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	50	51	53	55	°C/W
2	58	59	61	63	°C/W
3	28				°C/W

Mounting Method 1

P.C. Board where available



Mounting Method 2

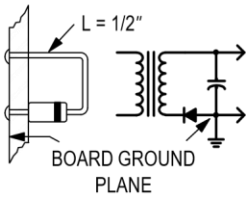


VECTOR PUSH–IN
is small.

TERMINALS T–28

Mounting Method 3

P.C. Board with copper surface
copper surface.



2–1/2„ x 2–1/2„

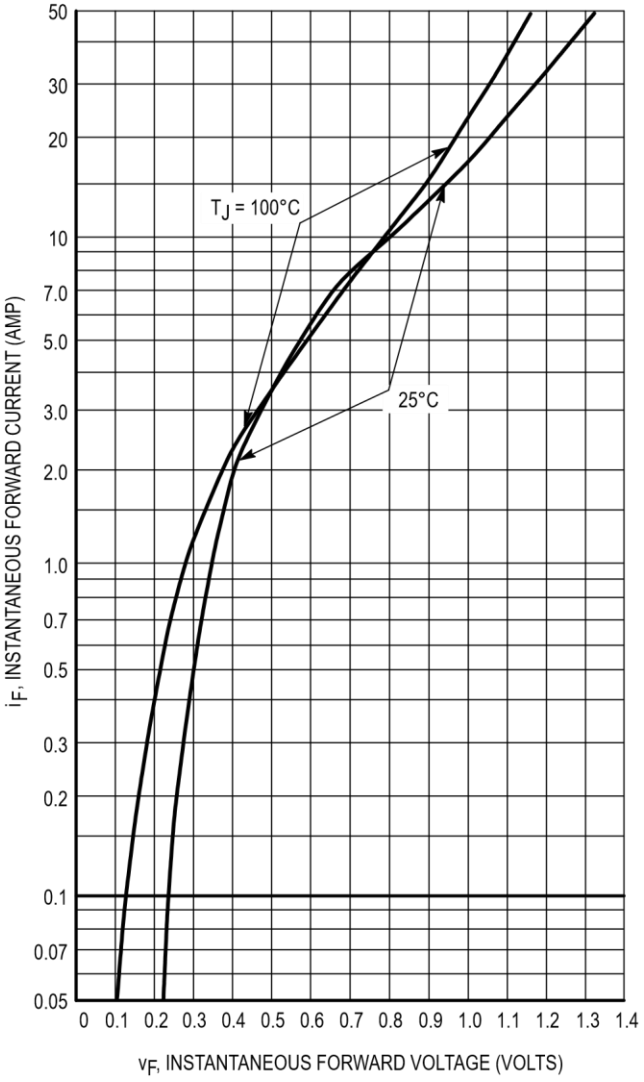


Figure 7. Typical Forward Voltage

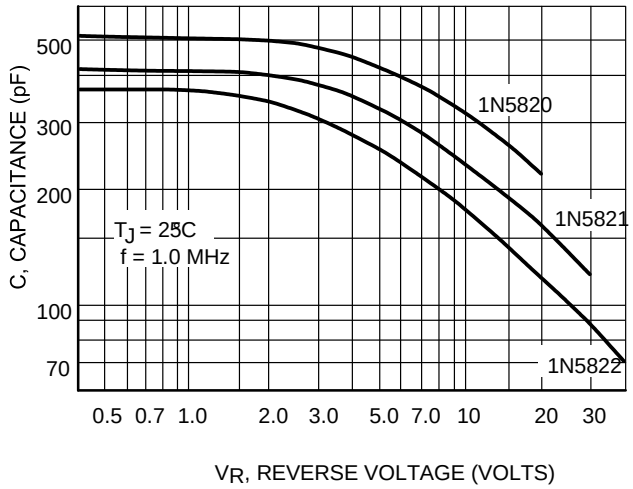


Figure 10. Typical Capacitance

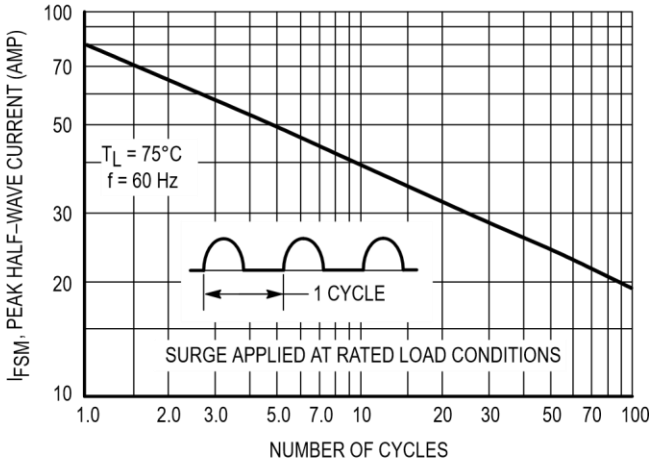


Figure 8. Maximum Non–Repetitive Surge Current

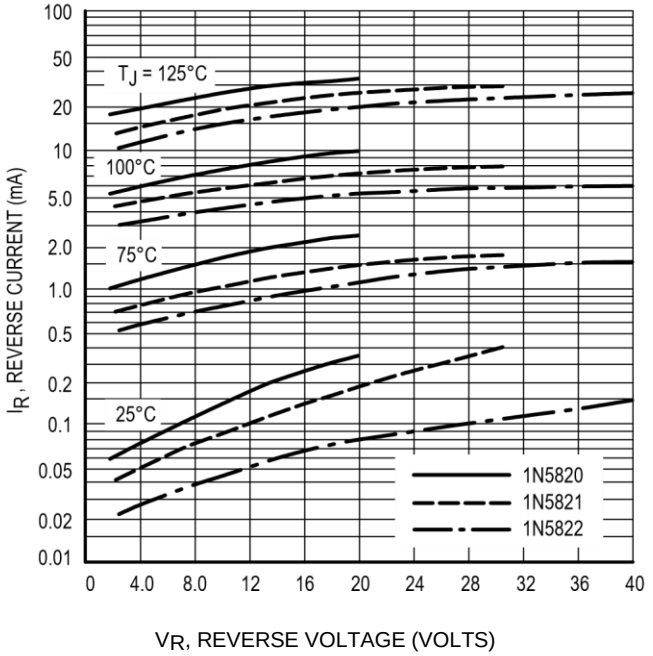
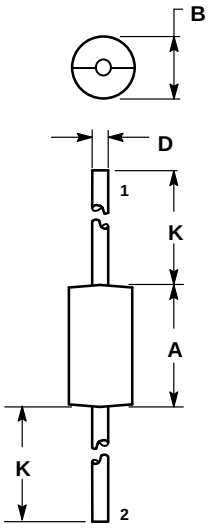


Figure 9. Typical Reverse Current

NOTE 4 — HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 11.)

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.370	0.380	9.40	9.65
B	0.190	0.210	4.83	5.33
D	0.048	0.052	1.22	1.32
K	1.000	—	25.40	—

STYLE 1:
PIN 1. CATHODE
2. ANODE

CASE 267–03
ISSUE C

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