



# CHAPTER 1

## **BRAKING OVERVIEW AND COMPONENT SPECIFICATIONS**

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## MANUAL OVERVIEW

### OVERVIEW OF THIS PUBLICATION

The *DURApulse* Dynamic Braking User Manual describes the installation, wiring, configuration, and operation of the dynamic braking unit and braking resistors as used with GS3 and GS4 series *DURApulse* AC Drives.

The content of this user manual may be revised without prior notice. Please visit the Automationdirect.com website to download the most recent version.  
([www.automationdirect.com](http://www.automationdirect.com))

### WHO SHOULD READ THIS MANUAL

This manual contains important information for those who will install, maintain, and/or operate any *DURApulse* GS3 or GS4 series AC Drive that makes use of the dynamic braking in their application.

### SUPPLEMENTAL PUBLICATIONS

The *DURApulse* AC Drive User Manuals (GS3-M & GS4-M) are available from AutomationDirect and should be used along with this manual to properly install and operate both the *DURApulse* AC drive and the *DURApulse* dynamic braking unit.

The National Electrical Manufacturers Association (NEMA) publishes many different documents that discuss standards for industrial control equipment. Global Engineering Documents handles the sale of NEMA documents. For more information, you can contact Global Engineering Documents at:

**15 Inverness Way East  
Englewood, CO 80112-5776  
1-800-854-7179 (within the U.S.)  
303-397-7956 (international)  
[www.global.ihs.com](http://www.global.ihs.com)**

NEMA documents that might assist with your AC drive systems are:

- Application Guide for AC Adjustable Speed Drive Systems
- Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems

### TECHNICAL SUPPORT

**By Telephone: 770-844-4200 (Mon.-Fri., 9:00 a.m.-6:00 p.m. E.T.)**

**On the Web: [www.automationdirect.com](http://www.automationdirect.com)**

Our technical support group is glad to work with you in answering your questions. If you cannot find the solution to your particular application, or, if for any reason you need additional technical assistance, please call technical support at 770-844-4200. We are available weekdays from 9:00 a.m. to 6:00 p.m. Eastern Time.

We also encourage you to visit our website where you can find technical and non-technical information about our products and our company. Visit us at [www.automationdirect.com](http://www.automationdirect.com).

### SPECIAL SYMBOLS



When you see the “notepad” icon in the left-hand margin, the paragraph to its immediate right will be a special note.



WHEN YOU SEE THE “EXCLAMATION MARK” ICON IN THE LEFT-HAND MARGIN, THE PARAGRAPH TO ITS IMMEDIATE RIGHT WILL BE A WARNING. THIS INFORMATION COULD PREVENT INJURY, LOSS OF PROPERTY, OR EVEN DEATH (IN EXTREME CASES).

## INTRODUCTION

### DYNAMIC BRAKING

All *DURApulse* GS3 and GS4 series AC drives are capable of dynamic braking to enable an AC motor with a high-inertia load to decelerate more rapidly than could be otherwise achieved, and to absorb the energy generated when a three-phase induction motor decelerates.

Applications with high-inertia type loads tend to cause the motor to regenerate energy back into the AC drive. This regeneration causes the AC drive’s internal DC bus voltage to rise, which can cause an over voltage fault. With dynamic braking, the energy generated by the overhauling motor is dissipated through dedicated braking resistors as heat.

As shown in the selection tables in this chapter, lower-capacity drives can connect directly to the optional external braking resistors, but higher-capacity drives also require optional dynamic braking units installed between the drives and resistors.

### DYNAMIC BRAKING UNITS

*DURApulse* dynamic braking units are used with larger *DURApulse* AC Drives to continuously monitor the drive’s DC bus voltage. When bus voltage exceeds a predetermined level (depending on the supply voltage) the dynamic braking unit dissipates the excess energy into external resistors in the form of heat. *DURApulse* dynamic braking units must be used along with GS series braking resistors to provide optimum braking performance.

*DURApulse* dynamic braking units are available for both 230V or 460V *DURApulse* AC Drives. MASTER/SLAVE configurations allow the use of multiple *DURApulse* dynamic braking units in order to accommodate the power ratings of larger *DURApulse* AC Drives and motors.

*DURApulse* dynamic braking units (GS-1DBU, GS-2DBU, GS-3DBU and GS-4DBU) are approved by Underwriters Laboratories, Inc. (UL) and Canadian Underwriters Laboratories (cUL).

### Unpacking

After receiving the *DURApulse* dynamic braking unit, please check for the following:

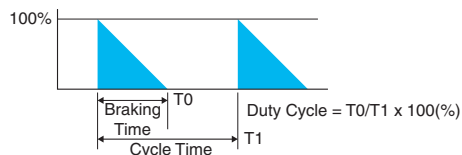
- Make sure that the part number indicated on the package corresponds with the part number of your order.
- Make sure that the package includes the *DURApulse* dynamic braking unit and the *DURApulse* dynamic braking unit User Manual.
- Inspect the contents to insure they were not damaged during shipment.

## BRAKING DUTY CYCLE

Application of a *DURApulse* dynamic braking unit should take into account how often the motor will stop or decelerate during normal operation. The Duty Cycle is the percentage of time the brake is actually used during deceleration in comparison to the time elapsed between each start or acceleration of the motor. This Duty Cycle percentage is necessary to allow the dynamic braking unit and braking resistor(s) sufficient time to dissipate the heat created during dynamic braking. If the Duty Cycle is exceeded, the braking resistor will not cool sufficiently, causing resistance to increase as the temperature rises with the loss of effective braking torque.

**Example:** If in a given application it is determined that it will take 10 seconds for the motor to decelerate to a stop using dynamic braking, then the motor can only be cycled on and off continuously every 1.6 minutes (100 seconds).

- $10 / 100 \times 100 = 10\%$  Duty Cycle



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*The maximum braking On-Time for the maximum 10% Duty Cycle is 10 seconds.*

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## OVERLOAD RELAY

### OVERLOAD RELAY PURPOSE

For safety purposes, install an external overload relay between the dynamic brake unit and the braking resistor. The thermal overload relay protects the braking resistor from damage due to frequent braking, or due to the braking unit operating excessively due to unusually high input voltage.

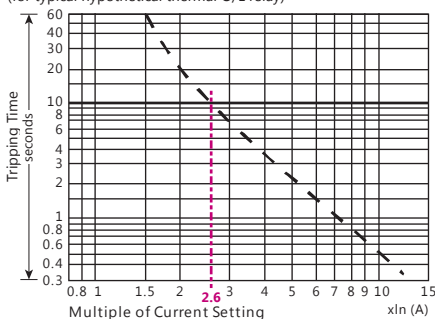
### OVERLOAD RELAY SELECTION PROCEDURE AND EXAMPLE

(For a GS4-4150 drive)

- 1) Select a thermal overload relay based on its overload capability.

Thermal Overload Response Curve

(for typical hypothetical thermal O/L relay)



Standard braking capacity for GS3 and GS4 AC drives is 10% duty cycle (tripping time = 10s). Determine the 10s Overload Capacity (Multiple of Current Setting) for your selected overload relay.

The intersection of the Trip Time (10s) and the Multiple of Current Setting is 2.6 (or 260%) for this example response curve.

The property of each thermal relay may vary by manufacturer, so please read the specifications carefully.

- 2) Use the appropriate AC Drive Braking Component Selection table in this chapter to find the Max Total Brake Current for the motor, drive, and braking components (126A for this example).

GS4 AC DRIVE BRAKING COMPONENT SELECTION													
DRIVE VOLTAGE	MOTOR POWER		125% BRAKING TORQUE @ 10% DUTY CYCLE						MAX BRAKING TORQUE				
	(HP)	(KW)	AC DRIVE MODEL # GS4-	BRAKING UNIT		BRAKING RESISTOR		BRAKE TORQUE (kg-m)	TOTAL BRAKE CURRENT (A)	MIN RESISTOR VALUE (Ω)	MAX TOTAL BRAKE CURRENT (A)	PEAK POWER (kW)	WIRING DIAG.
				QUANTITY	PART # GS-	QUANTITY	PART # GS-BR-						
460V	150	110	4150	1	5DBU	10	1K2W015	74.5	126	6.0	126	95.8	L

- 3) Divide the Max Total Braking Current by the Overload Capacity (126A / 2.6 = 48.46A), and select a thermal O/L relay which has the same or higher rated current. In this case, select a 50A relay.



For wiring information, refer to “Overload Relay” in Chapter 3, page 3-2.

## DYNAMIC BRAKING COMPONENT SELECTION FOR DURAPULSE AC DRIVES

The following table provides the selection information for the *DURApulse* dynamic braking units designed for use with GS3 and GS4 series AC drives.

### BRAKING COMPONENT SELECTION FOR GS3 DURAPULSE DRIVES



**NOTE:** For braking resistor compatibility with other Automation Direct VFDs (GS10, GS20, ACN) consult the user manual Appendix A for each VFD. For WEG CFW drives, consult the Automation direct technical pages.

GS3 AC DRIVE BRAKING COMPONENT SELECTION															
DRIVE VOLTAGE	MOTOR POWER		125% BRAKING TORQUE @ 10% DUTY CYCLE***						MAX BRAKING TORQUE **			WIRING DIAGRAM **			
			AC DRIVE MODEL #	BRAKING UNIT QUANTITY	BRAKING RESISTOR		BRAKE TORQUE	TOTAL BRAKE CURRENT	MIN RESISTOR VALUE	MAX TOTAL BRAKE CURRENT	PEAK POWER				
	GS-	GS-			QUANTITY	GS-							(KG·M)	(A)	(Ω)
(HP)	(KW)	GS3-	GS-	QUANTITY	GS-	(KG·M)	(A)	(Ω)	(A)	(W)					
230V	1	0.7	21P0	0	n/a	1	21P0-BR	0.5	1.9	82	4.6	1.8	A		
	2	1.5	22P0			1	22P0-BR	1.0	3.8	82	4.6	1.8			
	3	2.2	23P0			1	23P0-BR	1.5	5.4	82	4.6	1.8			
	5	3.7	25P0			1	25P0-BR	2.5	9.5	33	11.5	4.4			
	7.5	5.5	27P5			1	27P5-BR	3.7	12.7	30	12.7	4.8			
	10	7.5	2010			1	2010-BR-ENC	5.1	19.0	20	19.0	7.2			
	15	11	2015			1	2015-BR-ENC	7.5	27.9	13.6	27.9	10.6			
	20	15	2020	1	2DBU	1	2020-BR-ENC	10.2	38.0*	10*	38.0*	14.4*	D		
	25	18	2025	1	2DBU	1	2025-BR-ENC	12.2	47.5*	8*	47.5*	18.1*			
	30	22	2030	1	2DBU	1	2030-BR-ENC	14.9	55.9*	6.8*	55.9*	21.2*			
	40	30	2040	2	2DBU	2	2040-BR-ENC	20.3	38.0*	10*	38.0*	14.5*	F		
	50	37	2050	2	2DBU	2	2050-BR-ENC	25.1	47.5*	8*	47.5*	18.1*			
	1	0.7	41P0	0	n/a	1	41P0-BR	0.5	1.0	160	4.8	3.6		A	
	2	1.5	42P0			1	42P0-BR	1.0	1.9	160	4.8	3.6			
	3	2.2	43P0			1	43P0-BR	1.5	3.0	160	4.8	3.6			
5	3.7	45P0	1			45P0-BR	2.5	5.1	130	5.8	4.4				
7.5	5.5	47P5	1			47P5-BR	3.7	7.6	91	8.4	6.3				
10	7.5	4010	1			4010-BR	5.1	10.1	62	12.3	9.3				
15	11	4015	1			4015-BR-ENC	7.5	15.2	39	19.5	14.8				
20	15	4020	1			4DBU	1	4020-BR-ENC	10.2	19.0*	40*	19.0*	14.4*		D
25	18	4025	1			4DBU	1	4025-BR-ENC	12.2	23.8*	32*	23.8*	18.1*		
30	22	4030	1			4DBU	1	4030-BR-ENC	14.9	27.9*	27.2*	27.9*	21.2*		
40	30	4040	1			4DBU	1	4040-BR-ENC	20.3	38.0*	20*	38.0*	28.9*		D
50	40	4050	1			4DBU	1	4050-BR-ENC	25.1	47.5*	16*	47.5*	36.1*		
60	45	4060	1			4DBU	1	4060-BR-ENC	30.5	55.9*	13.6*	55.9*	42.5*		
75	55	4075	2			4DBU	2	4075-BR-ENC	37.2	38.0*	20*	38.0*	28.9*		F
100	75	4100	2			4DBU	2	4100-BR-ENC	50.8	55.9*	13.6*	55.9*	42.5*		

\* These values are per individual DBU, as seen between DBU terminals B1 and B2.

\*\* Wiring diagrams are shown in Chapter 3: Component Configuration and Wiring.

\*\*\* 10% Duty Cycle with maximum ON (braking) time of 10 seconds.

**BRAKING COMPONENT SELECTION FOR GS4 DURAPULSE DRIVES**

GS4 AC DRIVE BRAKING COMPONENT SELECTION																
DRIVE VOLTAGE	MOTOR POWER		125% BRAKING TORQUE @ 10% DUTY CYCLE***						MAX BRAKING TORQUE			WIRING DIAGRAM				
			AC DRIVE MODEL #	BRAKING UNIT		BRAKING RESISTOR		TOTAL BRAKE CURRENT	MIN RESISTOR VALUE	MAX TOTAL BRAKE CURRENT	PEAK POWER					
	QUANTITY	PART #		QUANTITY	PART #	BRAKE TORQUE	(A)						(Ω)	(A)	(KW)	
	(HP)	(KW)	GS4-	GS-	GS-BR-	(KG-M)										
230V	1	0.7	21P0	0	n/a	1	080W200	0.5	1.9	63.3	6	2.3	A			
	2	1.5	22P0			1	200W091	1.0	4.2	47.5	8	3.0				
	3	2.2	23P0			1	300W070	1.5	5.4	38.0	10	3.8				
	5	3.7	25P0			1	400W040	2.5	9.5	19.0	20	7.6				
	7.5	5.5	27P5			1	1K0W020	3.7	19	14.6	26	9.9				
	10	7.5	2010			1	1K0W020	5.1	19	14.6	26	9.9				
	15	11	2015			1	1K5W013	7.5	29	12.6	28	10.6				
	20	15	2020			2	1K0W4P3	10.2	44	8.3	46	17.5				
	25	18	2025			2	1K0W4P3	12.2	44	8.3	46	17.5				
	30	22	2030			2	1K5W3P3	14.9	58	5.8	66	25.1				
	40	30	2040			2	1DBU	4	1K0W5P1	20.3	75*	4.8*		80*	30.4*	B
	50	37	2050			2	2DBU	4	1K2W3P9	25.1	97*	3.2*		120*	45.6*	
	60	45	2060			2	2DBU	4	1K5W3P3	30.5	118*	3.2*		120*	45.6*	G
	75	55	2075			3	2DBU	6	1K2W3P9	37.2	145*	2.1*		180*	68.4*	
100	75	2100	4	2DBU	8	1K2W3P9	50.8	190*	1.6*	240*	91.2*	J				
460V	1	0.7	41P0	0	n/a	1	080W750	0.5	1	190	4	3.0	K			
	2	1.5	42P0			1	200W360	1	2.1	126.7	6	4.6				
	3	2.2	43P0			1	300W250	1.5	3	108.6	7	5.3				
	5	3.7	45P0			1	400W150	2.5	5.1	84.4	9	6.8				
	7.5	5.5	47P5			1	1K0W075	3.7	10.2	54.3	14	10.6				
	10	7.5	4010			1	1K0W075	5.1	10.2	47.5	16	12.2				
	15	11	4015			1	1K5W043	7.5	17.6	42.2	18	13.7				
	20	15	4020			2	1K0W016	10.2	24	26.2	29	22.0				
	25	18	4025			2	1K0W016	12.2	24	23.0	33	25.1				
	30	22	4030			2	1K5W013	14.9	29	23.0	33	25.1				
	40	30	4040			4	1K0W016	20.3	47.5	14.1	54	41.0				
	50	40	4050			1	4DBU	4	1K2W015	25.1	50*	12.7*		60*	45.6*	A
	60	45	4060			1	4DBU	4	1K5W013	30.5	59*	12.7*		60*	45.6*	
	75	55	4075			2	3DBU	8	1K0W5P1	37.2	76*	9.5*		80*	60.8*	E
	100	75	4100			2	4DBU	8	1K2W015	50.8	100*	6.3*		120*	91.2*	
	125	90	4125			2	4DBU	8	1K5W013	60.9	117*	6.3*		120*	91.2*	B
	150	110	4150			1	5DBU	10	1K2W015	74.5	126*	6.0*		126*	95.8*	
	175	132	4175			1	6DBU	12	1K5W012	89.4	190*	4.0*		190*	144.4*	C
	200	160	4200			1	6DBU	12	1K5W012	108.3	190*	4.0*		190*	144.4*	
	250	185	4250			1	7DBU	14	1K5W012	125.3	225*	3.4*		225*	172.1*	I
300	220	4300	2	5DBU	20	1K2W015	148.9	252*	3.0*	252*	190.5*					

\* These values are per individual DBU, as seen between DBU terminals B1 and B2.

\*\*\* Wiring diagrams are shown in Chapter 3: Component Configuration and Wiring.

\*\*\* 10% Duty Cycle with maximum ON (braking) time of 10 seconds.

## DYNAMIC BRAKING UNIT SPECIFICATIONS

The following table provides the specifications and applications for the *DURApulse* dynamic braking units designed for use with GS3 and GS4 series AC drives.

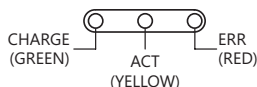
DYNAMIC BRAKING UNIT SPECIFICATIONS								
BRAKING UNIT PART NUMBER		GS-1DBU	GS-2DBU	GS-3DBU	GS-4DBU	GS-5DBU	GS-6DBU	GS-7DBU
NOMINAL VOLTAGE (VAC)		230			460			
MAX MOTOR CAPACITY (HP/[kW])		20 [15]	30 [22]	40 [30]	60 [45]	150 [110]	200 [160]	250 [185]
OUTPUT RATING	MAX DISCHARGE CURRENT (A) @ 10% DUTY CYCLE*	40	60	40	60	126	190	225
	CONTINUOUS DISCHARGE CURRENT (A)	15	20	15	18	45	50	100
	BRAKING STARTUP VOLTAGE (VDC)	330/345/360/ 380/400/415 ±3V		660/690/720/ 760/800/830 ±6V		618/642/667/690/ 725/750 ±6V		
	MAXIMUM ON-TIME (s)	10						
INPUT DC VOLTAGE (VDC)		200–415		400–830		400–750		
MIN EQUIVALENT RESISTOR FOR EACH BRAKING UNIT (Ω)		10	6.8	20	13.6	6	4	3.4
PROTECTION	POWER CHARGE LAMP/LED	Comes ON until DC bus voltage (+P – N) drops below 50VDC				Comes ON when DC bus voltage (DC+ – DC-) rises above 300VDC. Goes OFF when DC bus voltage (DC+ – DC-) drops below 100VDC.		
	BRAKING ACT LAMP/LED	ON during braking						
	FAULT ERR LAMP	ON if an over-temperature fault has occurred				n/a		
	OVERCURRENT LEVEL LED (A)	n/a				190	290	340
	OVERHEAT LED	n/a				Comes ON > 176°F [80°C]; Goes OFF < 149°F [65°C]		
	HEAT SINK OVERHEAT TEMPERATURE	203°F [95°C]				n/a		
	ALARM OUTPUT RELAY CONTACT	5A @ 120VAC/28VDC (RA,RB,RC)				3A @ 250VAC/28VDC (RA,RC)		
ENVIRONMENT	INSTALLATION LOCATION	indoor (no corrosive gases; no metallic dust)						
	OPERATING TEMPERATURE	14°F to 122 °F [-10 to +50 °C]						
	STORAGE TEMPERATURE	-4 to +140 °F [-20 to +60 °C]						
	HUMIDITY	less than 90% RH, non-condensing						
	VIBRATION	9.8 m/s <sup>2</sup> [1G] under 20Hz ; 2m/s <sup>2</sup> [0.2G] at 20–50 Hz						
MECHANICAL CONFIGURATION		IP50 wall-mount enclosed				IP10 wall-mount enclosed		

\* 10% Duty Cycle with maximum ON (braking) time of 10 seconds

### LAMP/LED INDICATORS FOR DYNAMIC BRAKING UNITS

GS-1DBU, GS-2DBU, GS-3DBU, GS-4DBU

GS-5DBU, GS-6DBU, GS-7DBU



See "[DBU Jumper and Wiring Terminal Locations](#)" in Chapter 3 for locations of indicators.



**DYNAMIC BRAKING RESISTORS SPECIFICATIONS**

BRAKING RESISTOR SPECIFICATIONS				
PART NUMBER	POWER (W)	RESISTANCE ( $\Omega$ )	TYPE	DIMENSION DRAWING # (SEE CHAPTER 2)
GS-20P5-BR	80	200	open	1
GS-21P0-BR	80	200		1
GS-22P0-BR	300	100		1
GS-23P0-BR	300	70		1
GS-25P0-BR	400	40		1
GS-27P5-BR	500	30		2
GS-2010-BR-ENC	1000	20	enclosed	4
GS-2015-BR-ENC	2400	13.6		5
GS-2020-BR-ENC	3000	10		5
GS-2025-BR-ENC	4800	8		6
GS-2030-BR-ENC	4800	6.8		6
GS-2040-BR-ENC	3000	10		5
GS-2050-BR-ENC	4800	8	6	
GS-41P0-BR	80	750	open	1
GS-42P0-BR	300	400		1
GS-43P0-BR	300	250		1
GS-45P0-BR	400	150		1
GS-47P5-BR	500	100		2
GS-4010-BR	1000	75		3
GS-4015-BR-ENC	1000	50	enclosed	4
GS-4020-BR-ENC	1500	40		7
GS-4025-BR-ENC	4800	32		8
GS-4030-BR-ENC	4800	27.2		8
GS-4040-BR-ENC	6000	20		8
GS-4050-BR-ENC	9600	16		9
GS-4060-BR-ENC	9600	13.6		9
GS-4075-BR-ENC	6000	20		8
GS-4100-BR-ENC	9600	13.6		9
GS-BR-080W200	80	200		open
GS-BR-080W750	80	750	10	
GS-BR-200W091	200	91	10	
GS-BR-200W360	200	360	10	
GS-BR-300W070	300	70	10	
GS-BR-300W250	300	250	10	
GS-BR-300W400	300	400	10	
GS-BR-400W040	400	40	10	
GS-BR-400W150	400	150	10	
GS-BR-500W100	500	100	2	
GS-BR-750W140	750	140	12	

BRAKING RESISTOR SPECIFICATIONS (CONTINUED)				
PART NUMBER	POWER (W)	RESISTANCE ( $\Omega$ )	TYPE	DIMENSION DRAWING # (SEE CHAPTER 2)
GS-BR-1K0W4P3	1000	4.3	open	11
GS-BR-1K0W5P1	1000	5.1		11
GS-BR-1K0W016	1000	16		11
GS-BR-1K0W020	1000	20		11
GS-BR-1K0W075	1000	75		11
GS-BR-1K2W3P9	1200	3.9		11
GS-BR-1K2W015	1200	15		11
GS-BR-1K5W3P3	1500	3.3		11
GS-BR-1K5W012	1500	12		11
GS-BR-1K5W013	1500	13		11
GS-BR-1K5W043	1500	43		11