

## FEATURES AND BENEFITS OF IMPULSE®•G+ ADJUSTABLE FREQUENCY DRIVES

### Exclusive SAFETY Features of IMPULSE•G+

- **Safe Operating Windows™** and Initial Program Values (see separate sheet).

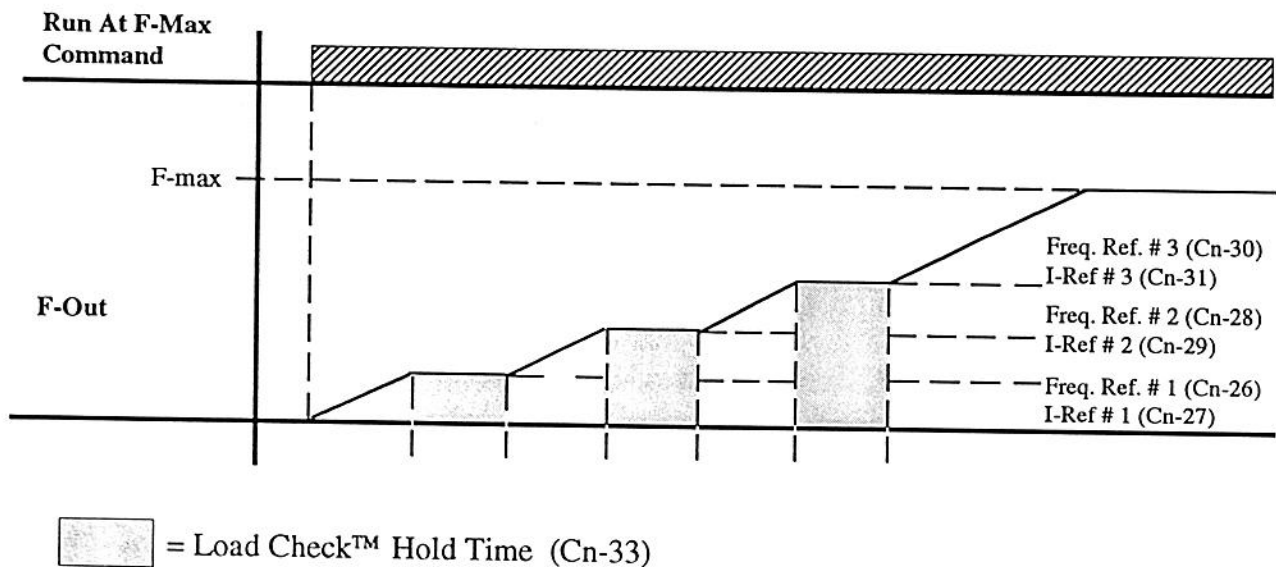
*Reduces the possibility of programming drive with unsafe windows -- creating situations where a crane may not be able to lift a load, or not be able to stop in a safe distance.*

- **Brake Release Sequence** -- via software. Since IMPULSE•G+ controls brake release and brake set, it can be programmed so brake will not release unless full torque is being output by the drive (sometimes referred to as "Torque Proving").

*Ensures that hoist will have full control of load before brake releases -- reduces potential loss of load.*

- **Load Check™** software functions (Patent Pending).

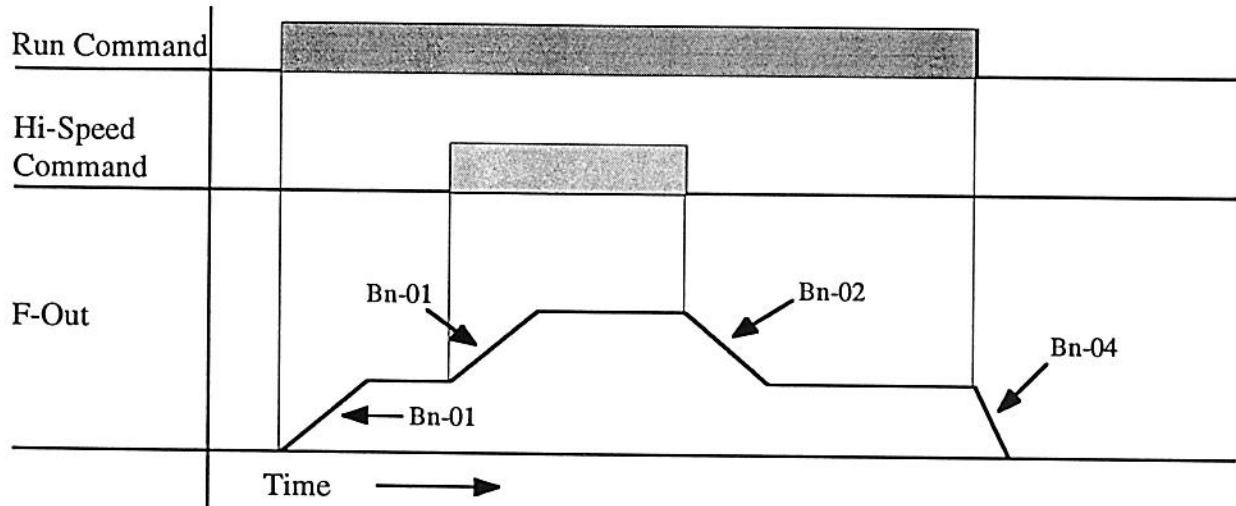
*Prevents lifting (and potential loss) of a load that is overweight.*



If Output Current (I-Out)  $\geq$  Load Check Current (Cn27/29/31) for Load Check Detection Time (Cn-32), then **IMPULSE•G+** base blocks (major fault). Forward operation is disabled. Reverse operation is enabled at  $\leq 10\%$  Maximum (Cn-19).

- **Quick Stop™** software function -- ensures a rapid deceleration to Stop once a drive Run command is removed.

*Reduces the possibility of crane collision.*

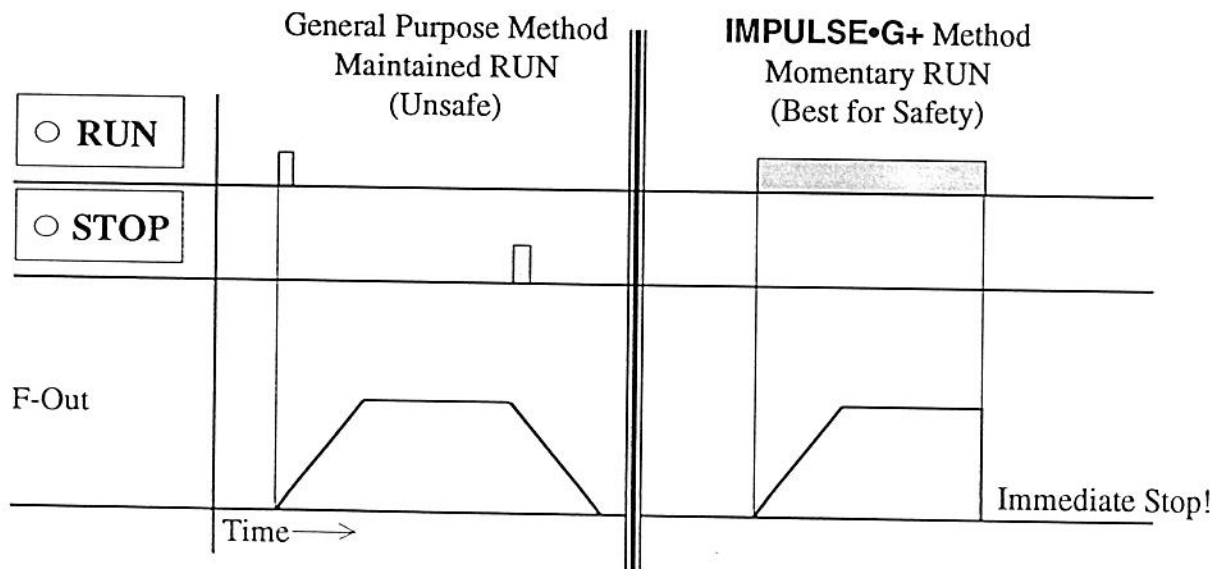


- **Automatic Keypad Lockout™** keeps unauthorized personnel from changing drive setup parameters.

*Reduces the possibility of programming unsafe values, and creating unsafe operation.*

- **RUN Button on Drive Keypad is Momentary** (not maintained).

*Reduces the possibility of a runaway crane.*



- **Phase Loss Detection** -- software function ensuring that IMPULSE•G+ will fault if a phase loss is detected.

*Brake will set immediately, retaining load, in case of a phase loss.*

- **PB Fault** -- software function ensuring that proper control input sequence is received from pushbutton or other operator.

*Drive should not operate if pushbutton, radio, infra-red, or other control is wired incorrectly.*

- **Microprocessor "Watch Dog"** option card is available to set the brake if the drive's CPU or clock should malfunction. -- **Patent Pending.**

*Prevents crane or hoist run away should the drive's microprocessor fail while the drive is running.*

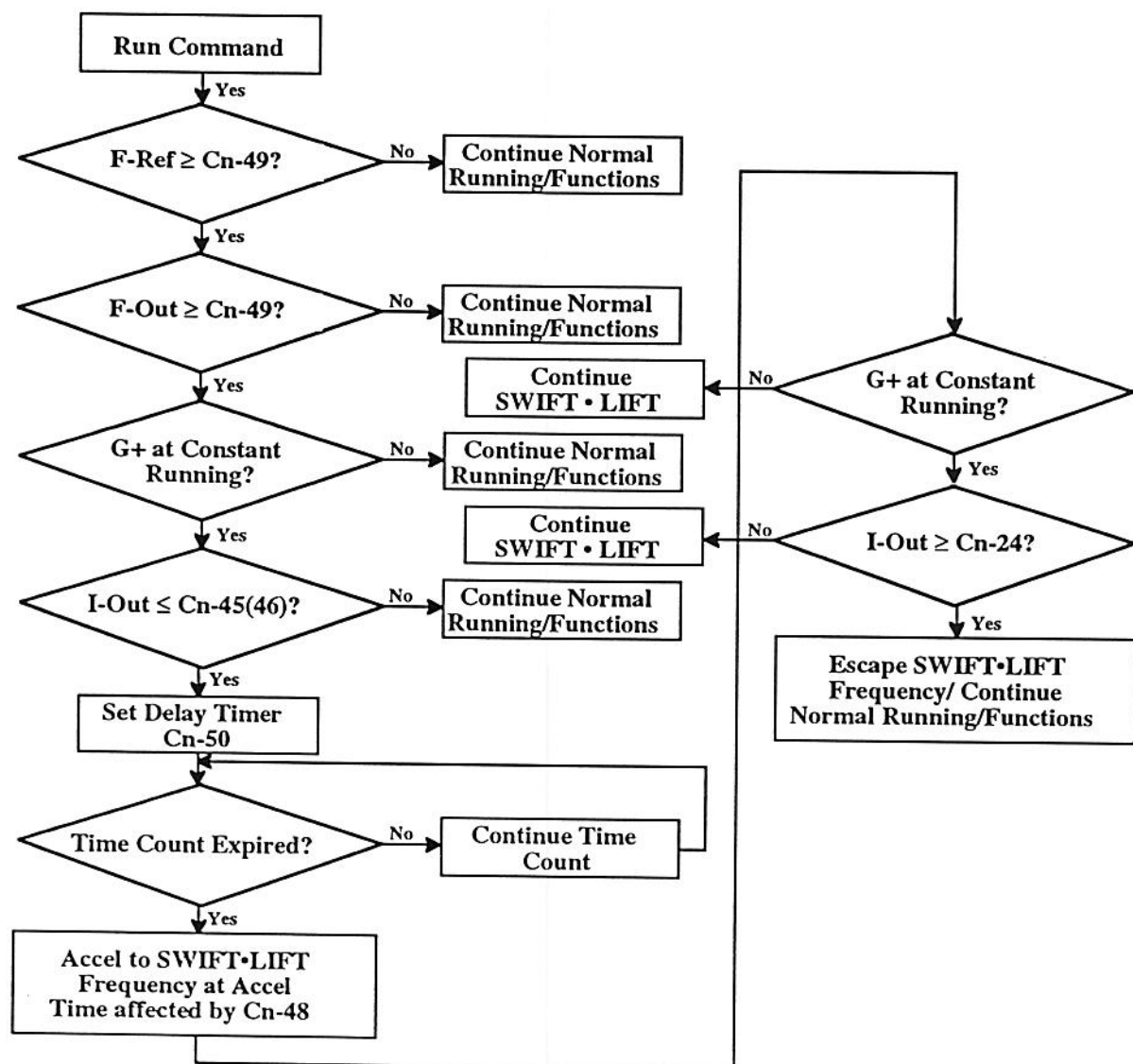
- Deletion of general purpose drive function "stall prevention during deceleration" which is unsafe for crane applications. This function lengthens the time to ramp to STOP.

*Ensures that a crane will stop within a safe deceleration time.*

## Exclusive PERFORMANCE Features of IMPULSE•G+

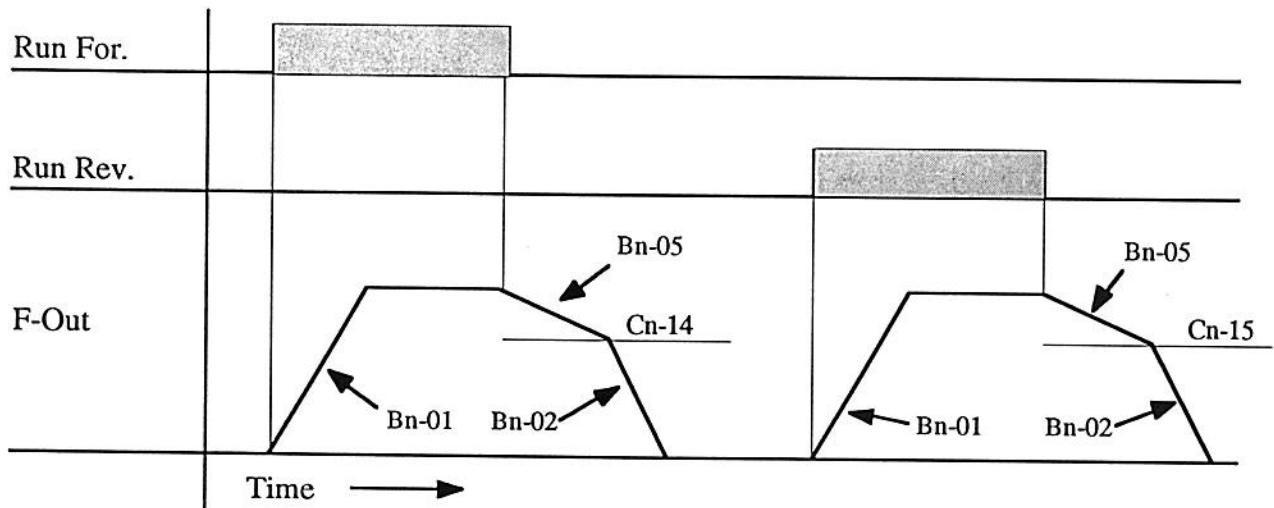
- **Swift-Lift™** -- software function which allows for overspeeding of motor under light load conditions. This is an automatic function when enabled, and is variable depending on the load.

*Provides additional productivity by allowing a crane or hoist hook to be moved into position more quickly.*



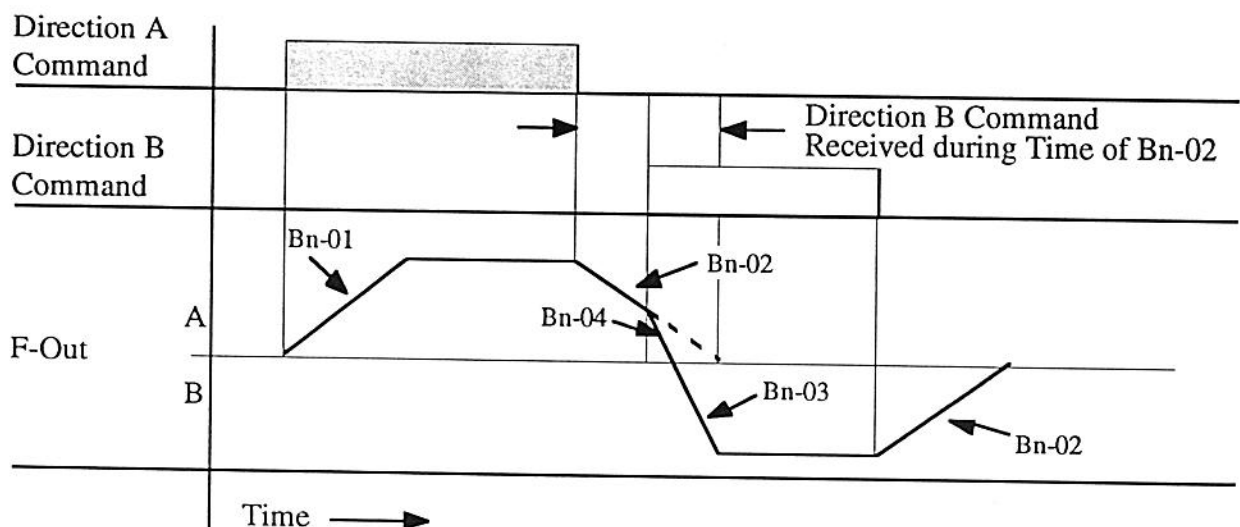
- **Automatic Alternate Deceleration™** -- software function which extends the deceleration time when motor is operating above its rated speed.

*Allows smooth, uninterrupted deceleration from fast speeds.*



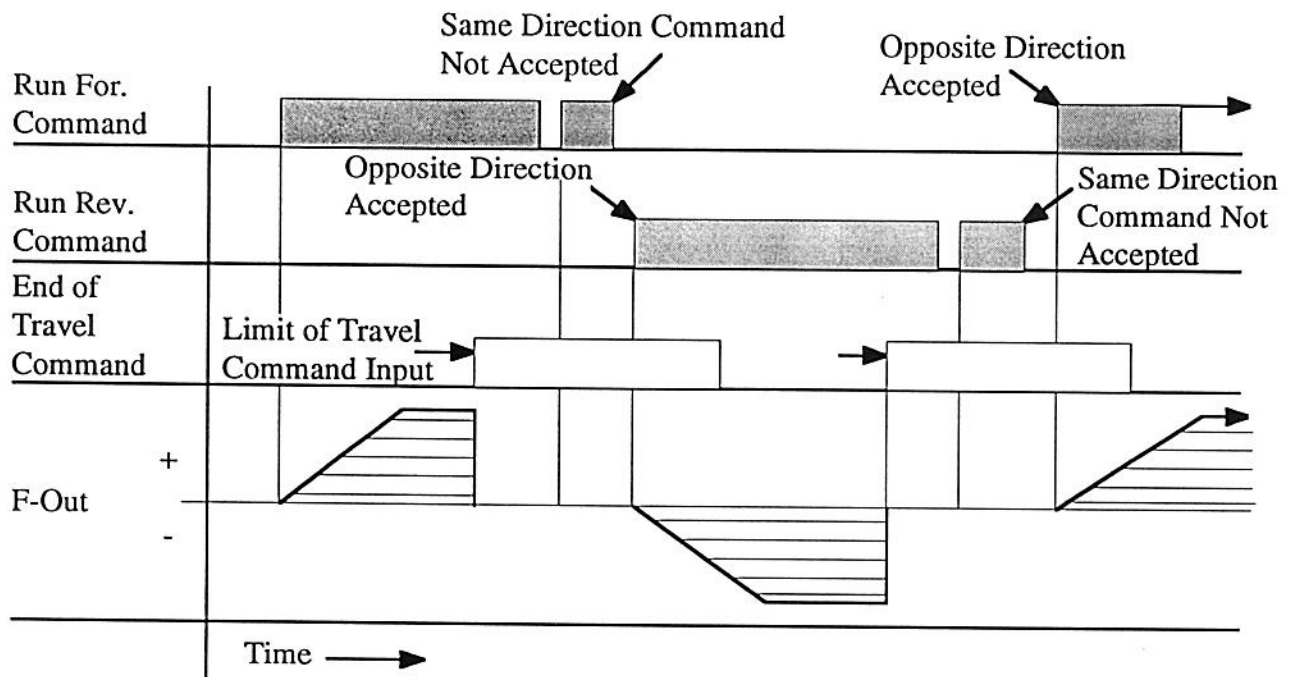
- **Reverse Plug Simulation™** -- software function which allows an operator to change direction of travel quickly.

*Allows an operator to smoothly and quickly stop in the direction of travel, then quickly accelerate in the opposite direction.*



- **End of Travel Limit™** -- software function which allows contact closure input to the drive to immediately cease further operation in the direction of travel, but allow operation in the opposite direction only until the contact input to the drive is removed.

*Prevents crane collision with runway end stops.*



- **Automatic Slip Compensation™** -- software function. For hoist applications, slip can be compensated in a positive direction during hoisting, and slip can be compensated in a negative direction during lowering.

*Ensures speed regulation in both hoisting directions.*

- **"Alternate V/f Pattern"™** -- software function for raising and lowering. Due to motor regeneration during lowering, it is desirable to have a different Volts to Hertz ratio than that during hoisting.

*Ensures full lifting and holding capabilities for hoisting and lowering, as well as reducing motor heating.*

- **One-Step Speed Selection™** via IMPULSE drive software constant Sn-10 data selection.

*Enhanced drive performance via control flexibility.*

- **IMPULSE•Link™** serial data link software package is available to read IMPULSE drive program values, and provide the capability of uploading and/or downloading drive program values via IBM compatible PC.

*Allows increased ability to maintain and update accurate drive programming data.*

- **All "15 Pre-programmed Volts/Hertz Patterns"** are for crane/hoist "CONSTANT TORQUE" applications. One other V/f pattern may be manually programmed via keypad.

*Greatly reduces the possibility of programming unsafe operating parameters.*

### **RELIABILITY Features of IMPULSE•G+**

- **Dynamic Braking Capabilities** -- hardware function allows for up to 150% braking torque and 20% duty cycle. Up to 50% braking duty cycle rating is available using an external module.
- **Testing** of all IMPULSE drives is performed prior to shipment from *Electromotive Systems, Inc.* with a motor load and complete control input sequence.
- **Control Interface Boards** provide noise immunity and eliminate a need for interface relays or shielded cable connections to the drive control inputs. Drive terminal mounting method enhances reliability, and does not require any connectors.
- **Wiring Practices** initiated by *Electromotive Systems, Inc.* are consistent with noisy industrial environments (see separate sheets).
- *Electromotive Systems, Inc.* has shipped over 6,000 drives during a 2.5 year period for use on crane, hoist, and monorail applications.
- Two computer based upload and download functions are available to record, document, and duplicate drive program parameters.

*Breakdowns and down time are reduced.*

## ***SERVICE Considerations***

- **Experience** -- *Electromotive Systems, Inc.* has eight engineers with Electrical Engineering degrees, and four service technicians with Associate Degrees. Together, they have **combined experience of over 50 years** in applying controls, including adjustable frequency drives, to overhead traveling cranes and hoists.
- *Electromotive Systems, Inc.* is an **Authorized Service and Repair Center** for IMPULSE and Yaskawa drives. Yaskawa has fully trained and certified our technicians to repair and service drives (copies of certification documents are available upon request).
- **Special Check Functions** via keypad display make IMPULSE•G+ easy to troubleshoot.
- **IMPULSE•G+ User Manual and Troubleshooting Manual** are easy to read and use.
- *Electromotive Systems, Inc.'s Liberal Service Policy* allows for replacement drive shipment within 24 hours when a problem cannot be solved promptly by telephone.

*Outstanding application assistance, unsurpassed technical support, and quality service.*

## ***Future Considerations***

- *Electromotive Systems, Inc.* is dedicated to **Continuous Improvement**. One can expect on-going, new features and benefits to be developed for our IMPULSE line of adjustable frequency motor controls.
- New IMPULSE•G+ software under development:
  - **"Optimum Lift"**™ to reduce maximum speed and overspeed capability automatically depending on load conditions, line voltage, and calculated inertia of crane.
  - Simulated calculation of heating of dynamic braking resistors.

*Electromotive Systems, Inc. leads the pack in the application of adjustable frequency motor controls to overhead cranes, hoists, and monorails. Work with the industry leader!*





## ELECTROMOTIVE SYSTEMS, INC.

*On The Move*  
National Sales Meeting  
September 18 - 20, 1993

### IMPULSE G+

#### A. INTRODUCTION

The Impulse G+ adjustable frequency drive is suitable for high performance overhead material handling applications. The Impulse G+ can be applied to all hoists with mechanical load brakes or worm gear box hoists. The Impulse G+ drive has also been applied successfully to hoists without mechanical load brakes on motors 15HP and less. Impulse G+ drives can be used on traverse applications up through CMAA Class F.

#### B. BASIC SPECIFICATIONS

Horsepower: 1 to 60 HP (460 VAC) (up to 200 HP, Early 1994)  
1 to 30 HP (230 VAC) (up to 100 HP, Early 1994)

Horsepower is the most popular "yardstick" of measuring our industry uses to match the inverter to the motor. We must remember that the Impulse G+ drive is primarily a current(amps) rated power device, so the motor nameplate full load amps (FLA's) must not exceed the Impulse G+ continuous rated output amp rating.

Input Voltage: 380 to 460VAC +/- 10%, 200 to 230VAC +/- 10%

If the power input is different than the standard 230 or 460 VAC, a special Volts/Hertz pattern will need to be programmed into the drive. If the incoming voltage is greater or less than the 10% allowed tolerance an over voltage (OV) or under voltage (UV) fault will occur.

Input power frequency: 50/60 Hz +/- 5%

The input frequency will determine the "smoothness" of the generated output voltage waveform. A frequency of 60Hz will produce a more sinusoidal output waveform than a 50Hz input and more torque per amp will be produced. We have applied Impulse G+ drives on aircraft installations where the input power frequency was 400Hz with no problems or drive modifications.

Maximum Output Voltage: 380 to 460 VAC, 200 to 230 VAC

The maximum output voltage is proportional to input voltage. Because of the nature of the output voltage waveform, the Impulse G+ cannot "create" extra voltage beyond what is put in.

Minimum Output Voltage: 7 VAC (on a 230 V system) and 14 VAC (on a 460 V system).

As a "safe window" the Impulse G+ cannot be programmed for 0.0 VAC output which would result in no motor torque. As the output frequency is increased, the output voltage to the motor is increased at a proportional rate so that constant motor torque is maintained.

Output Frequency: 1.5 to 150 HZ

"Safe windows means that you will never put out a frequency without having some current (torque) always present. Our standard volts/hertz selection allows for an increasing current at low frequencies, in order to assure adequate torque at the low speeds. "Safe windows" does not allow the Impulse G+ drive to output less than 1.5 Hz. Operation below 1.5 Hz causes unstable motor operation at a severely reduced motor torque output. We do not allow operation above 150 Hz because most mechanical components on a crane (motors, bearings, gears, etc.) are not designed to overspeed by this much. A practical limit is between 90 and 100 Hz. Please refer to our Application Bulletin for more information on overspeeding.

Accel/Decel Time: Acceleration .5 to 6000 seconds  
Deceleration .5 to 25 seconds

The acceleration and deceleration is the total time it takes the Impulse G+ drive to ramp from zero speed to maximum drive programmed speed. The acceleration and deceleration times are completely independent from each other and their rate of change is linear. A maximum 25 second deceleration time is a "safe window" defined by EMS for obvious safety reasons.

### C. STANDARD FEATURES

Speed control methods available are:

1. Multistep using a cumulative type input contacts from the operator station with up to 5 speeds available.
2. Infinitely variable using a 2 step cumulative contact input from the operator station. This type of control is well suited for traverse applications where the Impulse G+ would decelerate the motor to a stop.
3. Infinitely variable using a 3 step cumulative contact input from the operator station. This type of control is well suited for hoist applications where a controlled deceleration to lower speeds is desirable, but where an immediate stop is necessary when the control station input is removed.
4. Multistep control for either 4 speeds from 2 input contacts (plus the forward or reverse contact input) or 8 speeds from 3 input contacts (in addition to the forward or reverse contact input). The input "speed" contacts are binary inputs coming from a source such as a PLC (programmable logic controller) on an automated system.
5. Stepless speed control is also available from an analog speed reference signal. In addition to a forward or reverse contact input, the Impulse G+ will increase its output frequency (and voltage) proportional to the input analog speed reference. This signal could be 0 to 10 VDC, or 4 to 20 mA. With the addition of an optional interface card, we can offer 0 to 20 VAC, or -10VDC to +10VDC (with a "Run" contact input).

The directional and speed reference inputs from the operator station will usually be run into a TC-GIF5 interface board. Our standard board accepts 120VAC input signals. Other input voltages such as 24VAC/DC, 32VAC/DC, 48VAC/DC, 120VDC and 220VAC/DC are available. Inputs are also acceptable from a PLC. The PLC's outputs must be either relay contact type or triac/transistor (solid state) with a 5,000 ohm, 5W pull down resistor. A load resistor board (model LRB-6), with 6 circuits is available as an option.

Stopping methods available are:

1. DECELERATE AT REMOVAL OF RUN COMMAND is typically used on a traverse application. Whenever a directional input is removed, the Impulse G+ drive will begin to decrease output voltage and frequency proportionally, which in turn reduces the motor speed. During this time 100% motor torque is still available and the system is going through regeneration. This "generated" power is dissipated as heat in resistors and is called dynamic braking.

When the Impulse G+ adjustable frequency drive and the motor(s) get down to zero speed, the drive signals the motor brake(s) (if used) to set. The motor brake(s) thus act only as a holding brake(s), not a stopping brake (s).

The decelerate at removal of run command can also be used on hoist applications where some block drift can be tolerated. In this instance, we use a very short decel time, say less than 1.0 sec. This short time allows the motor to come to a stop, before setting the brake, thereby substantially reducing wear and maintenance on the hoist brakes.

2. IMMEDIATE STOP AT REMOVAL OF RUN COMMAND is typically used on hoist applications. When the directional input is removed, the Impulse G+ output frequency and voltage immediately go to zero and the drive signals the motor brake (through a electro-mechanical contactor) to set, thus stopping the load. Smooth deceleration from a high speed down to lower speeds (except zero) is still obtainable through input signal closures such as those provided by a pushbutton station.

#### D. SPECIAL FEATURES

QUICK STOP will allow the Impulse G+ drive to decelerate in a shorter time when a directional input is removed. This is a feature that can be beneficial when approaching another overhead crane, stationary machine, runway end stops, etc. If this feature is desired, special consideration should be given to the sizing of dynamic braking components, especially in high duty cycle applications, in order to dissipate the power generated by rapidly decelerating the kinetic energy of a moving crane.

REVERSE PLUG SIMULATION will allow the Impulse G+ drive to decelerate at an alternate (faster) rate down to zero speed and accelerate in the opposite direction at an alternate (faster) rate. This function attempts to simulate the phase reversal done on induction motors for quick direction changes. Reverse plugging is a typical method of stopping crane operators use with conventional contactor control. Reverse plug simulation does not instantly reverse phasing to the motor (which is hard on motors and mechanical components). Like the Quick Stop feature, dynamic braking components will need to be given special consideration.

END OF TRAVEL LIMIT function allows a bridge or trolley to be decelerated to a stop when a single, maintained limit switch contact (normally open) is input into a Impulse G+ "soft terminal". As long as the limit switch is still tripped, a directional contact in the original direction will be ignored. When a opposite direction signal is received by the Impulse G+, the drive will command the motor to run in that direction. Once the limit switch is untripped, operation in both directions is allowed. The Impulse G+ will remember which direction the crane was running when tripped and not allow further travel in that direction. The previous method to accomplish this was by using two separate limit switches with trip arms strategically located or by using one limit switch with 2 normally open contacts which close at different positions of the limit switch arm.

SWIFT LIFT allows overspeeding of the motor when the hoist or crane is lightly loaded. This is a very useful feature on production line cranes which try to minimize the "dead time" between moving of loads. Load on the crane/hoist is directly proportional to the motor current at constant speed. Since the Impulse G+ can measure motor current during constant speed, it can "calculate" the load on the crane/hoist. If this current value is less than a pre-determined value, the drive can be enabled to automatically go to its Swift Lift frequency (up to 120Hz) which increases motor speed. Because motor torque is reduced at frequencies above 60 Hz only light or no loads can be moved safely at this faster speed.

PHASE LOSS DETECTION monitors output current to the motor to assure that all three phases are being fed equal amounts of current. If the three phase currents are severely unbalanced, erratic and unstable motor operation will occur. If one of the three phases is opened during operation motor torque will be substantially reduced. This torque depletion can be very dangerous on a worm gear type hoist or on a non-mechanical load brake hoist and will adversely affect performance on traverse applications.



## SUMMARY OF FEATURES AND BENEFITS OF IMPULSE®•G+ ADJUSTABLE FREQUENCY DRIVES

	<b>IMPULSE•G+ Features</b>	<b>Benefits</b>
<b>SAFETY</b>	<b>Safe Operating Windows™</b> and Initial Program Values	<i>Reduces the possibility of programming drive with unsafe windows -- creating situations where a crane may not be able to lift a load, or not be able to stop in a safe distance.</i>
	<b>Brake Release Sequence</b> -- via software. Since IMPULSE•G+ controls brake release and brake set, it can be programmed so brake will not release unless full torque is being output by the drive (sometimes referred to as "Torque Proving").	<i>Ensures that hoist will have full control of load before brake releases -- reduces potential loss of load.</i>
	<b>Load Check™</b> software functions	<i>Prevents lifting (and potential loss) of a load that is overweight.</i>
	<b>Quick Stop™</b> software function -- ensures a rapid deceleration to Stop once a drive Run command is removed.	<i>Reduces the possibility of crane collision.</i>
	<b>Automatic Keypad Lockout™</b> keeps unauthorized personnel from changing drive setup parameters.	<i>Reduces the possibility of programming unsafe values, and creating unsafe operation.</i>
	<b>RUN Button on Drive Keypad is Momentary</b> (not maintained).	<i>Reduces the possibility of a runaway crane.</i>
	<b>Phase Loss Detection</b> -- software function ensuring that IMPULSE•G+ will fault if a phase loss is detected.	<i>Brake will set immediately, retaining load, in case of a phase loss.</i>
	<b>PB Fault</b> -- software function ensuring that proper control input sequence is received from pushbutton or other operator.	<i>Drive should not operate if pushbutton, radio, infra-red, or other control is wired incorrectly.</i>
	<b>Microprocessor "Watch Dog"</b> option card is available to set the brake if the drive's CPU or clock should malfunction.	<i>Prevents crane or hoist run away should the drive's microprocessor fail while the drive is running.</i>
<b>PERFORMANCE</b>	Deletion of general purpose drive function "stall prevention during deceleration" which is unsafe for crane applications. This function lengthens the time to ramp to STOP.	<i>Ensures that a crane will stop within the programmed deceleration time.</i>
	<b>Swift-Lift™</b> -- software function which allows for overspeeding of motor under light load conditions. This is an automatic function when enabled, and is variable depending on the load.	<i>Provides additional productivity by allowing a crane or hoist hook to be moved into position more quickly.</i>
	<b>Automatic Alternate Deceleration™</b> -- software function which extends the deceleration time when motor is operating above its rated speed.	<i>Allows smooth, uninterrupted deceleration from fast speeds.</i>
	<b>Reverse Plug Simulation™</b> -- software function which allows an operator to change direction of travel quickly.	<i>Allows an operator to smoothly and quickly stop in the direction of travel, then quickly accelerate in the opposite direction.</i>
	<b>End of Travel Limit™</b> -- software function which allows contact closure input to the drive to immediately cease further operation in the direction of travel, but allow operation in the opposite direction only until the contact input to the drive is removed.	<i>Prevents crane collision with runway end stops.</i>
	<b>Automatic Slip Compensation™</b> -- software function. For hoist applications, slip can be compensated in a positive direction during hoisting, and slip can be compensated in a negative direction during lowering.	<i>Ensures speed regulation in both hoisting directions.</i>
	<b>Alternate V/f Pattern™</b> -- software function for raising and lowering. Due to motor regeneration during lowering, it is desirable to have a different Volts to Hertz ratio than that during hoisting.	<i>Ensures full lifting and holding capabilities for hoisting and lowering, as well as reducing motor heating.</i>

	<b>IMPULSE•G+ Features</b>	<b>Benefits</b>
<b>PERFORMANCE</b>	<b>One-Step Speed Selection™</b> via IMPULSE drive software constant Sn-10 data selection.	<i>Enhanced drive performance via control flexibility.</i>
	<b>IMPULSE•Link™</b> serial data link software package is available to read IMPULSE drive program values, and provide the capability of uploading and/or downloading drive program values via IBM compatible PC.	<i>Allows increased ability to maintain and update accurate drive programming data.</i>
	<b>All 15 Pre-programmed Volts/Hertz Patterns</b> are for crane/hoist constant torque applications. One other V/f pattern may be manually programmed via keypad.	<i>Greatly reduces the possibility of programming unsafe operating parameters.</i>
<b>RELIABILITY</b>	<b>Dynamic Braking Capabilities</b> -- hardware function allows for up to 150% braking torque and 20% duty cycle. Up to 50% braking duty cycle rating is available using an external module.	<i>Breakdowns and down time are reduced.</i>
	<b>Testing</b> of all IMPULSE drives is performed prior to shipment from Electromotive Systems, Inc. with a motor load and complete control input sequence.	
	<b>Control Interface Boards</b> provide noise immunity and eliminate a need for interface relays or shielded cable connections to the drive control inputs. Drive terminal mounting method enhances reliability, and does not require any connectors.	
	<b>Wiring Practices</b> initiated by Electromotive Systems, Inc. are consistent with noisy industrial environments.	
	Electromotive Systems, Inc. has shipped over 6,000 drives during a 2.5 year period for use on crane, hoist, and monorail applications.	
	Two computer based upload and download functions are available to record, document, and duplicate drive program parameters.	

### **SERVICE and FUTURE Considerations**

Electromotive Systems, Inc. has engineers and service technicians with **combined experience of over 50 years** in applying controls, including adjustable frequency drives, to overhead traveling cranes and hoists. An **Authorized Service and Repair Center** for IMPULSE and Yaskawa drives, Yaskawa has fully trained and certified our technicians to repair and service drives.

**Special Check Functions** via the keypad display make IMPULSE•G+ easy to troubleshoot. The **IMPULSE•G+ User Manual, and Troubleshooting Manuals** are both easy to read and use, and our **Liberal Service Policy** allows for replacement drive shipment within 24 hours when a problem cannot be solved promptly by telephone. *We offer outstanding application assistance, unsurpassed technical support, and quality service.*

Electromotive Systems, Inc. is dedicated to **Continuous Improvement**. One can expect new features and benefits to be developed for our IMPULSE line of adjustable frequency motor controls.

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## SAFE PROGRAMMING WINDOWS OF IMPULSE•G+ DRIVES

	Standard Yaskawa <u>VS616G3</u>	<u>IMPULSE•G+</u>
<b>Allowable Speed Range</b> (Torque is greatly reduced under 1.5 Hz and over 150 Hz)	0 - 400 Hz	1.5 - 150 Hz
<b>Deceleration Time</b> (Long deceleration time may be dangerous for traveling cranes on shorter runways)	0 - 6,000 seconds	.5 - 25 seconds
<b>Absolute Minimum Speed Output</b> (Torque is greatly reduced below 1.5 Hz)	0 Hz	1.5 Hz
<b>Programmable Minimum Voltage</b> (Torque is greatly reduced below 1.5 Hz, and if there is not sufficient voltage to provide motor magnetizing current)	0 Volts	7 Volts @ 1.5Hz
<b>Default Setting of Stopping Mode</b> (Immediate Stop/Base Block is required on hoist applications)	Ramp to Stop	Immediate Stop
<b>Stall Prevention During Decel</b> (Deceleration time can be automatically extended if enabled, over-riding Quick Stop function)	Enabled	Disabled
<b>Keypad Status During Power-Up</b>	Read and Write	Read Only
<b>Initial Default Program Values:</b>		
• Acceleration Time	10 seconds	5 seconds
• Deceleration Time	10 seconds	3 seconds
• Speeds 1 to 5	0 - 0 Hz	6 - 60 Hz