Power Topics Newsletter

Topic 04/2004 – 15

PXS Rectifier Shelf Options

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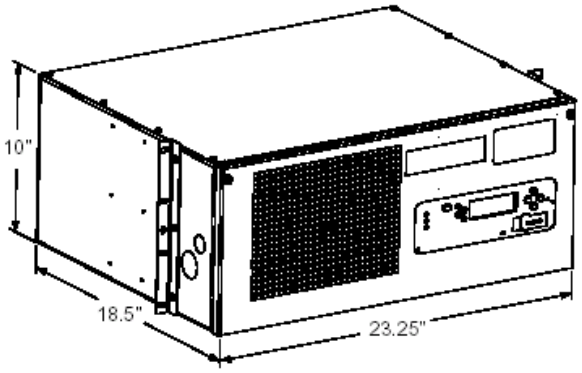
The Tyco Electronics family of Power Expansion Shelves (PXS) is a line of Galaxy Power System (GPS)-based rectifier shelves designed for use in open frame applications. This newsletter will offer an introduction to the various models of these shelves along with their best-suited applications.

The PXS original design intent was to provide a replacement for legacy ferroresonant or switchmode rectifiers within existing power plants that have reached their end-of-life, or to permit the addition of charging capacity to these systems, using Tyco's proven, state-of-the-art, 596-line of GPS plug-in rectifiers. The product has since grown to where new rack-mounted power plants are currently being installed, using the J85702H1 PXS shelf in several applications, a popular one being in concert with a Galaxy-based controller and the popular 26" wide J85500A2 rack, along with ED83018-31 distribution panels.

These modular rectifier shelves, which are available in +/-24V or –48V, consist of two or four 596 serial switchmode rectifier positions, either enclosed in a single frame-mount cabinet or on a single assembly without covers. The PXS family is designed to use GPS plant components, including 596 series rectifiers, cable and controller components. The PXS can be used in systems with or without batteries. The shelves feature single-phase AC input with a phase-to-phase voltage within the range of 176-264Vac. Currently the PXS line has three available shelf types: two position with a parallel control cable interface; four position with a parallel control cable interface; and four position with a serial interface. These shelves and their applications are discussed in detail in the remainder of this newsletter.

J85702H1 L-1 (-48V), L-2 (+24V), or L-3 (-24V)
Two-Position Shelf with Output Fuse and Parallel Control Cable Interface
(Ferro Replacement)



List 1 to List 3 are specifically designed for growth or replacement of J85502 / J85503 series ferroresonant rectifiers (25A, 50A, 100A, 125A, or 200A) in Lineage 2000 series battery plants. These PXS shelves provide alarms and accept control signals from XCS, CCS, ECS-6U/12U or MCS vintage controllers. These ferroresonant replacement options also will work with the Galaxy SC controller when it is equipped with its MCS-style (J85501F1 L-31) rectifier interface module. In addition, the shelf can be used in other vendors' systems that utilize parallel rectifier control and monitoring.

The ferro replacement PXS has the same physical dimensions and general aesthetics as the J85502B 50A ferroresonant rectifier that has been discontinued and may be reaching end-of-life condition in many existing power plants. The –48V L-1 PXS shelf may be used in the same rack space vacated by a defective J85502B, equipped with a single 596A, 50 amp plug-in rectifier, and, if current-limited to 45 amps, reuse the same AC input, DC output, and control cable wiring used previously for the ferro. A second option is to equip the new L-1 PXS shelf with two 596A modules, beef up the DC output cabling, and run a second AC input circuit, thus doubling the power density and either permitting higher capacity in the plant or opening up more rack space for use by other equipment.

While the J85502B dimensions are 10(H) x 23.25(W) x 12(D), the L-1 to L-3 PXS dimensions are 10(H) x 23.25(W) x 18.5(D). This extra 6.5 inches of depth in the PXS can be accommodated in the bay with movable mounting brackets, which allow the unit to be mounted flush back, flush front or halfway in between. These shelves are intended for use only in the standard 26" mounting frames that the ferros use. If 23" rack mounting is required, one of the other PXS options must be selected.

The L-1 to L-3 ferro replacement PXS shelf is equipped with a single output fuse block that may be equipped with an appropriately sized type TPL fuse or with a bus bar strap fuse substitute, depending on the installed rectifier capacity and the requirements of the plant into which it has been added. The –48V L-1 shelf uses the 596A2 (50 amp nominal) serial plug-in rectifier and therefore has 50A or 100A output options while the +24V L-2 shelf and –24V L-3 shelf use the 596B4 (100 amp nominal) and 596B5 or

596B6 (125A nominal, with & without displays respectively) serial plug-in rectifiers, leaving them with 100A, 125A, 200A or 250A output choices.

Rectifier output status and adjustment is accomplished through a GCM4 (24V) or GCM5 (-48V) plug-in card mounted on a CVC1 interface card, using a Vector-like soft-key display on the shelf. Each PXS shelf e/w the GCM/CVC1 combination is monitored and recognized by the plant controller as a single entity by its control cable, regardless of the number of plug-ins that are equipped. When used in a MCS or Galaxy SC plant where rectifier loads are monitored, a VI (current to voltage) circuit is used to provide the same 2V-10V load measurement signal to the controller that an equivalent-sized ferro rectifier would generate. Refer to the VI Circuit Configuration table at the end of this newsletter for the proper combinations of dip switch S2 settings on the CVC1 card of the PXS shelves and rectifier configurations in the MCS or Galaxy SC controllers that must be used to result in accurate load readings for the PXS shelves in those controllers. A 50mV shunt signal for the shelf load is also available for controllers using that style of load signal.

Each PXS shelf e/w the GCM/CVC1 combination accepts TR shutdown, HV shutdown, equalize (or boost), and restart signals from controllers capable of generating them. Alarm signals available to be monitored by the connected controller include RFA, ACF, MAN, TRH, and either CB(FA) or MAJ(2ACF/2RFA). External regulation sensing from a connected controller (R-, R+) is available or internal regulation jumpers may be set on the GCM/CVC1 control interface.

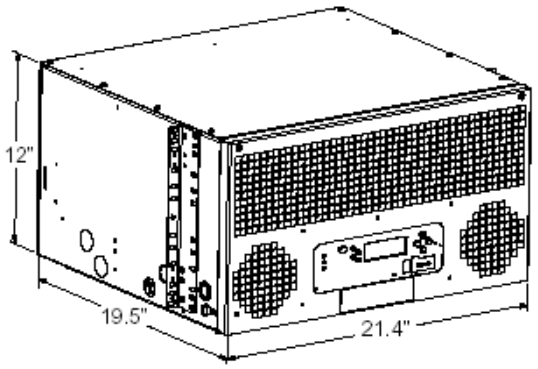
Dip switch S1 of the CVC1 card is used to control additional functions on the shelf as shown in the following:

- **S1-1**: 0 allows, or 1 disables shelf configuration changes via the display. **Default is 0.**
- **S1-2**: 0 sets the CB/CBR pair of a connected control cable to monitor a multiple ACF / multiple RFA condition from modules on the shelf. 1 sets the CB/CBR pair to monitor a fuse alarm from the PXS output fuse block. (Because of the way that the CB signal is handled by a MCS or Galaxy SC controller, shelves connected to these controllers should ONLY use setting 1, the output fuse block alarm.) **Default is 1.**
- **S1-3**: 0 results in a MAN Off (loss of power) signal to the connected controller on an ACF condition. 1 results in a PH/LOA/ACF signal for the ACF condition. (Because of the way that the PH signal is handled by a MCS or Galaxy SC controller for rectifier types assumed to be 3-phase units, shelves connected to these controllers should ONLY use setting 0, the MAN Off alarm.) **Default is 0.**
- **S1-4**: Reserved for future use.

Note that while plug-ins within a PXS shelf, using the GCM/CVC1 control interface, will load share among themselves, there is no forced load share with other ferros or PXS shelves within a plant. Small adjustments in the Float Set Point will often permit some spread of the plant load between shelves and other rectifiers. Refer to the GCM4/5 Menu Flow diagram at the end of this newsletter for the Set Point path.

Both positions on the L-1 to L-3 ferro replacement shelf may be fed from a common AC input circuit or each plug-in may be fed individually. These AC input requirements are summarized in the table at the end of this newsletter and are found on sheet-G1 of PXS wiring diagram T83493-30. AC knockouts for ½" (2) and 1" (1) are found on the left side of the enclosure while a grommet protects the DC cable entry on the right side.

J85702H1 L-5 (-48V) or L-6 (+24V)
Four-Position Shelf with Parallel Control Cable Interface
(New Plant or Ferro Growth)



The second PXS product is designed to mount in either 23" or 26" standard frames, using reversible and movable mounting brackets. These units are intended for adding or replacing power units in plants that use parallel rectifier control schemes. The dimensions of these growth shelves are 12"(H) x 21.42"(W) x 19.5"(D). The –48V List 5 shelf, which will hold up to four 596A2 (50A nominal) plug-in rectifiers, has a maximum capacity of 200A. The +24V List 6 shelf, which will accommodate up to four of either the 596B4 (100A nominal) or the 596B5 or 596B6 (125A nominal) plug-in rectifiers, has a maximum capacity of 400A or 500A.

With the exception that it has no DC output fuse block, the L-5/L-6 ferro growth PXS shelf can be considered just a larger capacity version of the L-1 to L-3 ferro replacement PXS, but boxed to fit in either a 23" or 26" rack. It utilizes the same GCM/CVC1 control and Vector-like soft-key interface/display and accepts or processes the same control & alarm signals for plant controllers using a single parallel control cable interface per shelf. The shelf is therefore recognized and monitored by a plant controller as a single entity, regardless of the number of plug-in rectifier modules that are equipped. Similar to the discussion with the L-1 to L-3 shelves, it is important to coordinate the configuration of the CVC1 VI circuit of the L-5/L-6 PXS and the rectifier type of a MCS or Galaxy SC controller in order to properly reflect the number of plug-ins that are equipped in the shelf when used in those controllers.

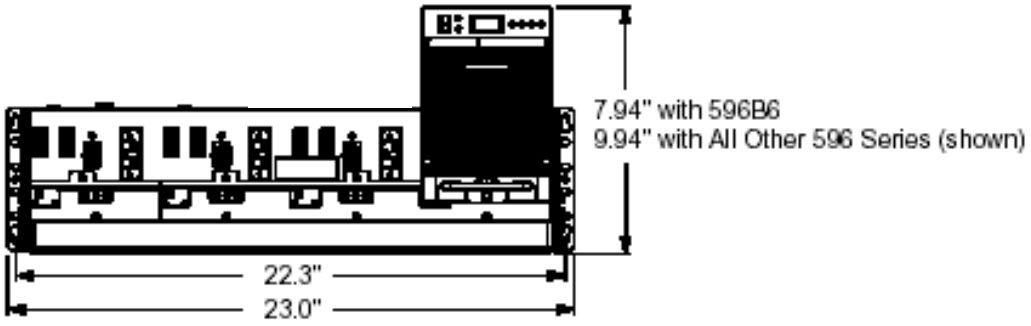
Some caution must be exercised when using the L-5/L-6 ferro growth PXS shelf with MCS controllers with less than the full complement of four plug-ins equipped or with 596B5/B6 type plug-ins, as the MCS has only a limited number of rectifier types that may be identified (using the TP leads of its control cable). A number of incompatible shelf plug-in combinations and programmed rectifier type identifications will result in

load readings for the shelf, as monitored by MCS, to be inaccurate, resulting in controller inconsistency or excess load reading conditions and problems with the MCS energy efficiency algorithm. Refer to the VI Circuit Configuration table at the end of this newsletter for the proper combinations of dip switch S2 settings on the CVC1 card of the PXS shelves and rectifier configurations in the MCS or Galaxy SC controllers that must be used to result in accurate load readings for the PXS shelves in those controllers. A 50mV shunt signal for the shelf load is also available for controllers using that style of load signal.

The same CVC1 dip switch S1 control options for the GCM4/5 cards detailed in the section for the L-1 to L-3 ferro replacement are also used with the L-5/L-6 ferro growth PXS shelf. Observe the same cautions regarding these settings when using these shelves with MCS or Galaxy SC controllers.

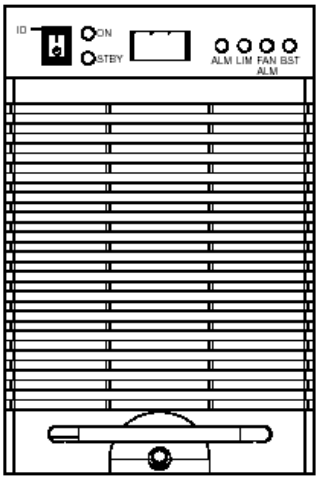
Each plug-in position of the L-5/L-6 ferro growth PXS shelf may be served independently with separate AC input circuits. Also permitted, for the 596A2 or 596B4 plug-ins, is serving each pair of shelf positions with a common AC input circuit. These AC input requirements are summarized in the table at the end of this newsletter and are found on sheet-G1 of PXS wiring diagram T83493-30. Two AC knockouts for ¾" conduit are available on the left side of the enclosure while a grommet protects the DC cable entry on the right side.

J85702H1 L-7 or L-5A (-48V) or L-8 (+24V)
Four-Position Shelf with Serial Control Cable Interface
(New Plant)

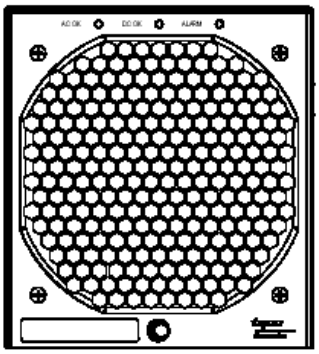


The L-7 (& 5A) / L-8 serial interface shelves provide four plug-in positions like the L-5 / L-6 shelves, but each plug-in is recognized and controlled by the plant controller as a separate rectifier and there is no common shelf shunt, control card, or display. Serial interface shelves can only be used with controllers that permit serial bus communication, presently the Tyco Galaxy Millennium, Galaxy Vector, and Galaxy SC/SCF (e/w BJC3 Rectifier Interface Board and, in the case of the SC, a L-36 Rectifier Interface Module). Rectifier plug-ins are automatically recognized and configured by these plant controllers as soon as each plug-in is inserted and has its ID set, while connected to the rectifier serial bus. These serial interface shelves may also be controlled by the serial bus of a L-1 to L-3 or L-5/L-6 PXS shelf if there will be no real plant controller in the system.

The –48V L-7 and L-5A shelves are identical electrically, but L-5A includes a cabinet enclosure similar to that of L-5 (but without a display), where L-7 and the +24V L-8 shelves have no enclosure, permitting the plug-in rectifiers' displays and controls to be observed. Better heat dissipation without the unit enclosure also permits the L-7 to be used with either the 596A2 (50A nominal) or 596D (100A nominal) plug-in rectifiers for a maximum shelf capacity of 200 amps or 400 amps, while the L-5A enclosed shelf is limited to use with just the 596A2, but still provides a maximum shelf capacity of 200 amps. The +24V L-8 shelf may be equipped with either 596B4 (100A nominal) or 596B5 or 596B6 (125A nominal) plug-in rectifiers for a maximum shelf capacity of 400 amps or 500 amps. Note that the 596B6 plug-in contains no display, so only minimal information regarding its condition will be available in the L-8 serial shelf that has no shelf display, making the 596B4 or 596B5 plug-ins more desirable options for use in it.



596A2, 596B4, 596B5, or 596D



596B6

External dimensions and rack mounting information for the L-5A serial (enclosed) shelf are identical to those for the L-5/L-6 shelf. The L-7/L-8 (open) serial interface shelves are 23" wide and may be mounted in 23" standard frames, or may be equipped with adapter brackets furnished with each shelf for mounting in 26" bays. When equipped with plug-ins, each L-7/L-8 shelf takes 8" (596B6-only) or 10" of rack space and has a total depth of 18". Rear insulator flaps protect live DC output terminals on the shelf rear when output cabling is terminated onto buses under the main shelf and exits the right side, as it does with the other J85702H1 shelf versions. These flaps are lifted when the shelf is placed into an existing ECS style frame (J85500D, J85500E, J85500G), permitting bus details and/or cable set connections from the rear of the shelf directly onto the charge bars of those plants.

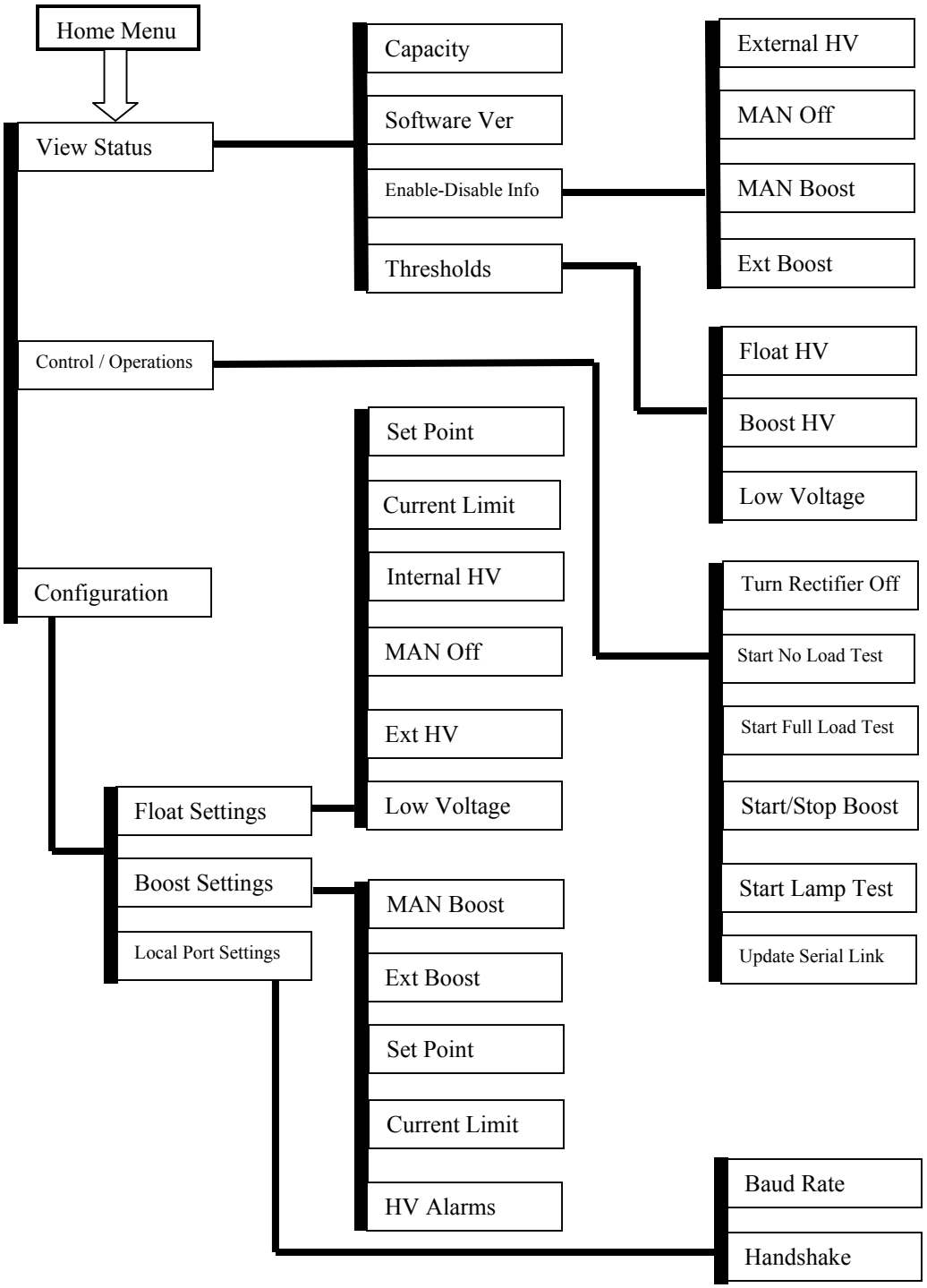
Because all plug-ins are recognized as separate rectifiers in these shelves, separate AC input circuits are used for each rectifier position. These AC input requirements are summarized in the table at the end of this newsletter and are found on sheet-G1 of PXS wiring diagram T83493-30. Rectifier plug-ins should be equipped right to left on these shelves to permit additional wiring to be run to the AC area below the left side of the shelf without disturbing working units in the future. Two AC knockouts for 1" conduit are available on the left side of the shelf for this wiring, while a grommet protects the DC cable entry (if used) on the right side.

PXS Rectifier Shelf AC Input Requirements						
PXS Shelf List	AC circuit per plug-in or per pair of plug-ins	Rectifier Type	AC Volts / Amps	Line Fuse Qty, Type	Input Circuit Breaker (Amps)	Input Conductor Size, Qty Including AC Grounding (Note *)
All	per plug-in	596A2, 596B4	208 / 21.2 240 / 18.4	2, FRN-R 25	2-pole 25 or 30	3, 10 AWG
7		596D	208 / 32.0 240 / 28.0	2, FRN-R 40	2-pole 40	2, 8 AWG, 1, 10 AWG EG
2, 3, 6, 8		596B5, 596B6	208 / 24.9 240 / 23.0	2, FRN-R 30	2-pole 30	3, 10 AWG
1		596A2 (45 amp)	208 / 17.3 240 / 15.0	2, FRN-R 20 (Note **)	2-pole 20 (Note **)	3, 12 AWG (Note **)
1-3, 5-6, 5A	per plug-in pair	596A2, 596B4	208 / 42.2 240 / 36.7	2, FRN-R 50 2, FRN-R 45	2-pole 50	2, 8 AWG, 1, 10 AWG EG

Notes:
* Conductor sizes shown are minimums per the 2002 NEC using 75-degree C listed conductors and terminations. If multiple circuits are combined into a common raceway, conductor ampacity derating per 2002 NEC Table 310-15(B)(2)(a) will be necessary and may result in a larger conductor size requirement. Shelves per J85702H1 L-1, 2, 3 have two, ½“ knockouts and one, 1” knockout for AC input. Shelves per J85702H1 L-5, 5A, & 6 have two, ¾” knockouts for AC input. Shelves per J85702H1 L-7 & 8 have two, 1” knockouts for AC input. Note that only one EG conductor is required per raceway. There are two positions furnished within each rectifier cabinet for EG termination.

** The 20 amp input protection and 12 AWG conductor option for the 596A2 rectifier type is intended only for retrofit applications of J85502B1 50A rectifiers permitting their input and output conductors to be reused. It is necessary to current-limit the J85702H1 rectifier shelf to 90% (45 amps) through its front display in order to utilize this option.

PXS Shelf GCM4/5 Menu Flow



Configuration Settings for CVC1 VI Circuit and MCS / Galaxy Rectifier Type For Various Shelf and Plug-in Unit Combinations				
Shelf	**Plug-in**	**CVC1 S2 Setting (Positions 1,2,3,4)**	**Galaxy Type**	**MCS Type**
L-1	1-596A	1111	G50 or J85502B	50A
L-1	2-596A	0111	G100 or J85503A	100A SCR
L-2/L-3	1-596B4 ***	0100	G100 or J85503A	100A SCR
L-2/L-3	2-596B4 ***	1011	G200 or J85503B	200A
L-5	1-596A	0101	G50 or J85502B	50A
L-5	2-596A	0110	G100 or J85503A	100A SCR
L-5	3-596A	1000	G150 or *J85502C	*125A
L-5	4-596A	1011	G200 or J85503B	200A
L-6	1-596B4 ***	1001	G100 or J85503A	100A SCR
L-6	2-596B4 ***	1010	G200 or J85503B	200A
L-6	3-596B4 ***	0011	**G400 or J85503C	**400A
L-6	4-596B4 ***	0011	G400 or J85503C	400A

The use of CVC1 S1.3 selecting MAN instead of ACF/Phase fail should be used for all rectifier capacities recognized as 3-phase rectifier types by the connected controller.

* Note: VI signal calibrated for lower capacity value due to MCS system controller options. Actual rectifier capacity is higher than configured capacity. Rectifier/Plant Drain Inconsistency alarms may result.

** Note: VI signal calibrated for higher capacity values due to system controller. Actual rectifier capacity is lower than configured capacity. Not recommended for controllers using an energy efficiency algorithm.

*** Note: Use of the 596B5 or 596B6 plug-in should be discouraged in Galaxy SC & MCS plants using the CVC1 VI signal.