INSTALLATION INSTRUCTIONS

Original Issue Date: **1/12**
Model: **14RESA, 14RESAL, 20RESA, 20RESAL, and 48RCL (single-phase)**
Market: **Residential/Commercial**
Subject: **Load Control Module (LCM) Kits GM77177-KP1-QS and -KP2-QS**

Introduction

The load control module (LCM) is designed to work with Kohler® residential/commercial generator sets that are equipped with the RDC2 or DC2 controller and an automatic transfer switch. This includes the following generator set models:

- 14RESA and 14RESAL
- 20RESA and 20RESAL
- 48RCL (single-phase only)

The load control module automatically manages up to six residential loads. Four power relays are provided for management of non-essential secondary loads, and two relays are available to control two independent air conditioner loads.

Note: Connect only non-essential loads to the load control module.

The load control module provides an automatic load management system to comply with Section 702.5 of NEC 2008. The installer is responsible for ensuring that the power system installation complies with all applicable state and local codes.

Two kits are available with either a pre-wired harness or terminal blocks for customer connections. See Figure 1. The pre-wired harness requires installation of the LCM within 2 feet of the distribution panel. The load control module with the optional pre-wire harness is shown in Figure 2. Figure 3 shows the load control module without the optional harness.

A status indicator provides visual indication that each load is connected (green) or disconnected (red). The status indicator also flashes to indicate a test condition.

A test button allows the operator to cycle the relays in the order of their assigned priority.

The Kohler® OnCue® program can be used to monitor the LCM operation and to label the loads with easy-to-understand text. See TP-6796, OnCue Software Operation Manual.

RDC2/DC2 controller firmware version 4.3 or higher is required for LCM operation. Check the version number on the controller and update the controller firmware, if necessary.

Before starting the installation, confirm that the generator set is equipped with one of the controllers shown in Figure 4. Read the entire installation procedure and compare the kit parts with the parts list at the end of this publication. Perform the steps in the order shown.

Kit Number	Description
GM77177-KP1-QS	Load control module with pre-wired harness
GM77177-KP2-QS	Load control module with terminal blocks

Figure 1 Kit Descriptions

Figure 2 Load Control Module with Optional Pre-wired Harness

Figure 3 Load Control Module with Terminal Blocks (cover removed)

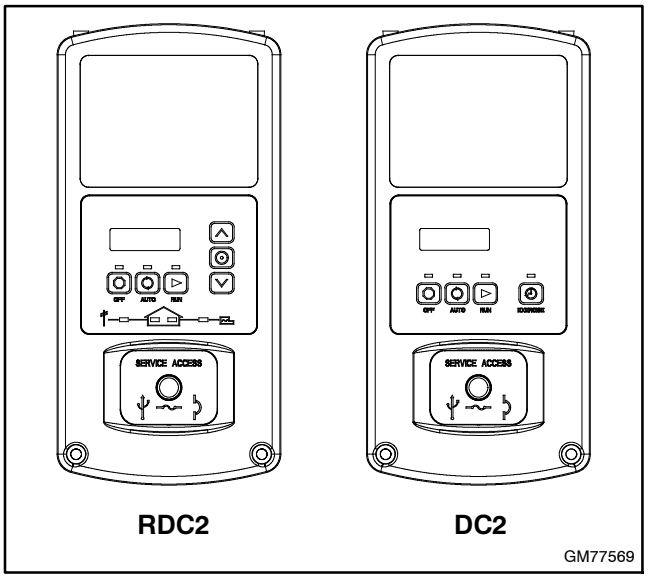
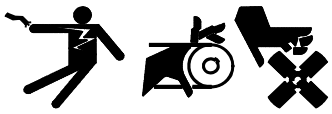


Figure 4 RDC2 and DC2 Controller Identification

Safety Precautions

Observe the following safety precautions while installing the kit.

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

1 Installation Procedure

1. Press the OFF button on the generator set controller.

2. Disconnect the utility power to the generator set.

3. Disconnect the generator set engine starting battery(ies), negative (–) lead first.

4. Remove the LCM enclosure cover. Cover the internal components to protect them from metal chips and debris.

   Note: Use separate conduit for the controller communication leads and the load connection wiring.

   Note: Low voltage wiring must enter the enclosure above the power relays to ensure separation of circuits per NEC requirements. Route the low voltage wiring to avoid contact with: 1) line voltage field wiring to the relays; 2) live parts of the relays; and 3) and all insulated lead wires to the relays – contacts and coil. See Figure 28.

5. Mark the location of an opening in the side of the enclosure for the communication leads. The opening must be above the power relays. See Figure 28. Cut an opening in the enclosure for the generator set communication leads.

   Note: For outdoor installations, use watertight conduit hubs.

6. If the LCM is not equipped with a pre-wired harness, use the knockout provided in the bottom of the enclosure for the load leads.

7. Mount the load control module (LCM) enclosure on the wall near the main distribution panel. See the dimension drawing in Figure 28 for the mounting hole size and locations.

   Note: The mounting holes have gaskets to seal out moisture. Use washers with the mounting screws to protect the gaskets.

8. Install the current transformer (CT) on the emergency source lines. Installation inside the transfer switch enclosure is recommended.

   Note: Be sure to route the leads through the current transformer from opposite sides as shown in Figure 5. The leads must cross as they pass through the transformer.

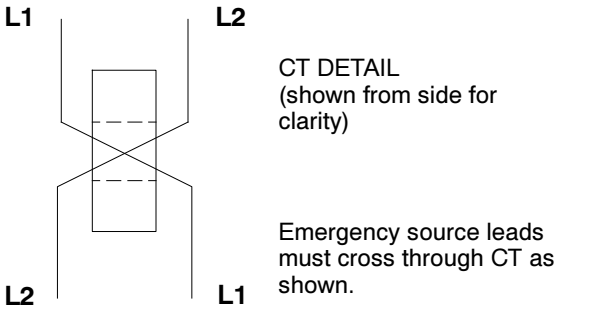
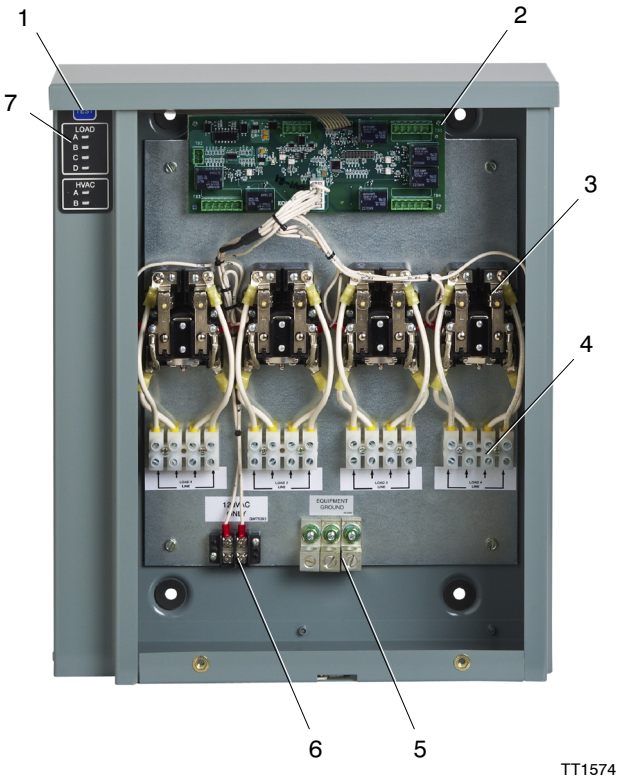


Figure 5 Current Transformer (CT) Wiring

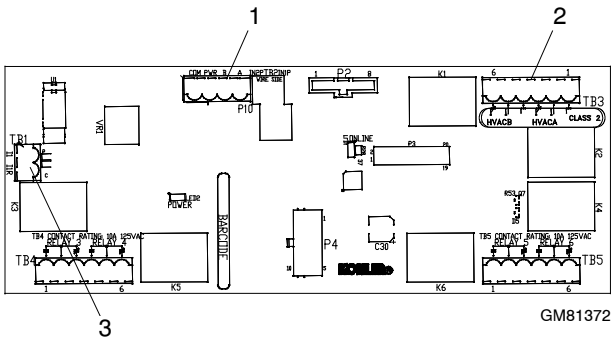


1. Test button
2. LCM circuit board (see wiring diagrams for connections)
3. Power relays (qty. 4)
4. Terminal blocks for load connection (w/o pre-wired harness)
5. Equipment ground
6. 120 VAC power connection
7. Status indicators

Figure 6 LCM Components (model without pre-wired harness shown)

9. Connect the CT to connector TB1 on the LCM circuit board using customer-supplied wiring. See Figure 7 and Figure 10.

10. Connect the controller interface connection to 4-position terminal block P10 on the LCM circuit board. See Figure 7. See Section 2.4 for more information about the interface connections.



1. RDC2/DC2 controller interface connection P10
2. HVAC connections
3. CT connection TB1

Figure 7 LCM Circuit Board Customer Connections

11. Note the load priorities shown in Figure 8 and connect loads accordingly. Also see Section 2 for more wiring information and refer to the wiring diagrams in Section 7.

    Note: Priority 1 is considered the most critical and will add first and shed last. Priority 6 is considered the least critical and will add last and shed first.

    a. If the LCM with terminal blocks is used, connect load connections to the terminal blocks for Loads A, B, C, and D.

    b. If the pre-wired harness is used, connect the loads to the harness. See Figure 9 for the harness connections.

Priority	Relay
1	Load A
2	HVAC A
3	Load B
4	Load C
5	HVAC B
6	Load D
Note: Priority 1 (Load A) adds first and sheds last.	

Figure 8 Load Priority

Power Relay Load Interconnection		
Label	**Color**	**Description**
L1A-CB	Orange	Load 1 – Circuit Breaker A
L1B-CB	Orange	Load 1 – Circuit Breaker B
L1A-L	Orange	Load 1 – Load A
L1B-L	Orange	Load 1 – Load B
L2A-CB	Brown	Load 2 – Circuit Breaker A
L2B-CB	Brown	Load 2 – Circuit Breaker B
L2A-L	Brown	Load 2 – Load A
L2B-L	Brown	Load 2 – Load B
L3A-CB	Red	Load 3 – Circuit Breaker A
L3B-CB	Red	Load 3 – Circuit Breaker B
L3A-L	Red	Load 3 – Load A
L3B-L	Red	Load 3 – Load B
L4A-CB	Yellow	Load 4 – Circuit Breaker A
L4B-CB	Yellow	Load 4 – Circuit Breaker B
L4A-L	Yellow	Load 4 – Load A
L4B-L	Yellow	Load 4 – Load B
GND	Green	Ground

Figure 9 Pre-Wired Harness Connections

12. Connect HVAC loads to TB3, if used. Note the priorities of HVAC A and HVAC B relative to Loads A through D. See Figure 8 and Section 3.3.

13. Write the names of the loads connected to each relay on the decal for future reference. For example, Load A may be a sump pump, and HVAC A may be the air conditioner. See Figure 10.

    Note: If the OnCue® Generator Management System is used, the load descriptions in OnCue's power chain view can be changed to identify the load connections. See TP-6796, OnCue Software Operation Manual.

14. Connect 120 VAC to the terminal block labeled 120 VAC in the lower left corner of the LCM enclosure. See Figure 6 and the wiring diagrams in Section 7. The circuit must be protected by a 15 amp fuse or circuit breaker (not provided).

    Note: When servicing the LCM, be sure to disconnect power to this circuit.

15. Install the LCM enclosure cover.

16. Check that the generator set is OFF.

17. Reconnect the generator set engine starting battery, negative (-) lead last.

18. Reconnect utility power to the generator set.

19. Check the items in the prestart checklist in the generator set Operation Manual. Then press the RUN button to start the generator set.

20. Press the test button on the LCM and verify that the load relays operate in the order expected. See Section 5.

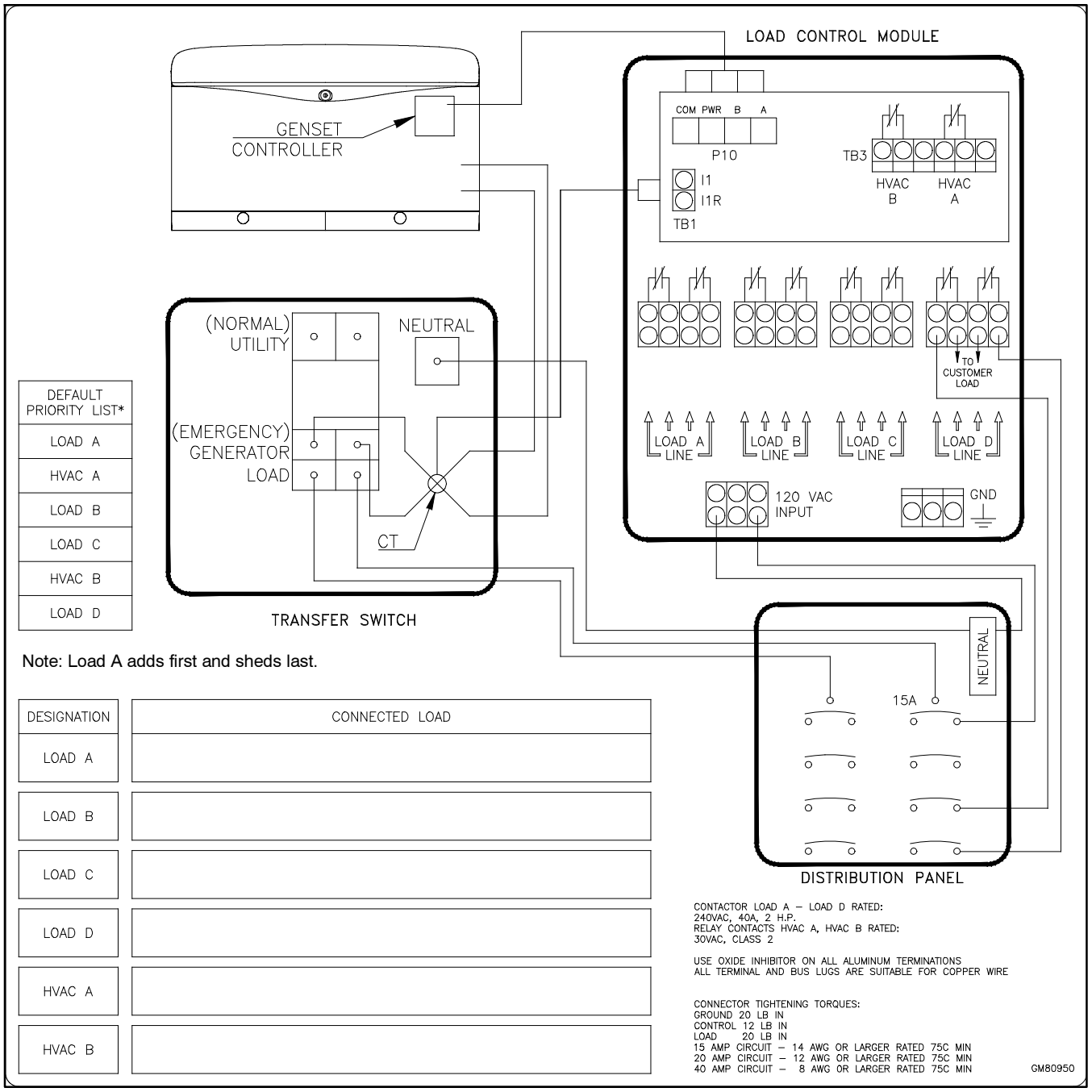


Figure 10 System Wiring Decal

2 Wiring

Refer to the wiring diagrams in Section 7.

Note: Low voltage wiring must enter the enclosure above the power relays to ensure separation of circuits per NEC requirements. Route the low voltage wiring to avoid contact with: 1) line voltage field wiring to the relays; 2) live parts of the relays; and 3) and all insulated lead wires to the relays – contacts and coil.

2.1 Power Relay Load Connections

The customer can either wire directly into terminal blocks in the Load Control Module or utilize a pre-landed wire harness that connects all of the power relays to the distribution panel and the respective branch circuit breakers.

The pre-wired harness contains seventeen #8 AWG stranded wires inserted into a two foot section of liquid-tight flexible conduit. Each wire is 90 inches long and has one end terminated in a ring terminal. Wires are marked per the designations shown in Figure 9. The ground wire is green. Appropriate elbows and fittings connect the conduit to the Load Control Module enclosure and the customer's electrical distribution enclosure.

2.2 HVAC Connections

The air conditioner control scheme involves splicing into the existing building low voltage wiring from the thermostat to the air conditioner/furnace. In a typical four wire scheme, connect the cooling wire (Y) in series to the respective terminal block on the LCM. See the wiring diagrams in Section 7. Connect the more important air conditioner to HVAC A. Connect the less important air conditioner, if applicable, to HVAC B.

Use 18-14 AWG solid or stranded wires from the thermostat/HVAC system to the 6-position terminal block on the LCM circuit board. See the wiring diagrams in Section 7 for connections.

2.3 120 VAC Power Supply

Connect 120 VAC power to the terminal block labeled 120 VAC in the lower left corner of the LCM enclosure. The circuit must be protected by a 15 amp fuse or circuit breaker (not provided). See Figure 28 and the wiring diagrams in Section 7.

2.4 Generator Controller Interface Connection

Connect a twisted-pair communication line from P10 on the LCM circuit board to the DC2/RDC2 controller. One pair carries the communication signal, the other pair supplies DC voltage to the board.

Use Belden cable #9402 or equivalent 20 AWG shielded, twisted-pair cable from the generator controller to the four-position terminal block on the LCM. The terminal block is rated for 5 A at 300 VAC. See Figure 12 for cable specifications.

Controller Communication Interconnection		
Pin	**Designation**	**Description**
1	A	RBUS Communication +
2	B	RBUS Communication -
3	PWR	12VDC Power +
4	COM	12VDC Power -
RBUS: RS-485 proprietary communication.		

Figure 11 Controller Interface Connections

If a transfer switch other than the Model RXT is used, the transfer switch does not connect to the RBUS communication circuit. See Figure 14. Connect engine start leads 3 and 4 as shown, and be sure to install the current transformer on the emergency source lines and connect it to the LCM.

See Figure 13 through Figure 18 for connection options with up to three accessory modules. Accessory modules can include one Model RXT transfer switch, one programmable interface module (PIM), and/or one load control module (LCM).

See Figure 12 for the maximum total cable length with 1, 2, or 3 accessory modules per cable run.

- Use Belden #9402 (4-conductor) or equivalent 20 AWG shielded, twisted-pair cable. Note the shield connections shown in Figure 13.
- If longer cable runs are required, #12–14 AWG wire can be used for the COM and PWR connections. The maximum total cable length is the value shown for #12 or #14 AWG wire in Figure 12.

Cable (TB1-PWR and COM)	Maximum length per run, meters (ft.)		
	Number of Modules (ATS, PIM, and LCM) per Run		
	1 Module	2 Modules	3 Modules
Belden #9402 or equivalent 20AWG	61 (200)	31 (100)	21 (67)
14 AWG	152 (500)	152 (500)	122 (400)
12 AWG	152 (500)	152 (500)	152 (500)

Figure 12 Total Cable Lengths with Accessory Modules Connected

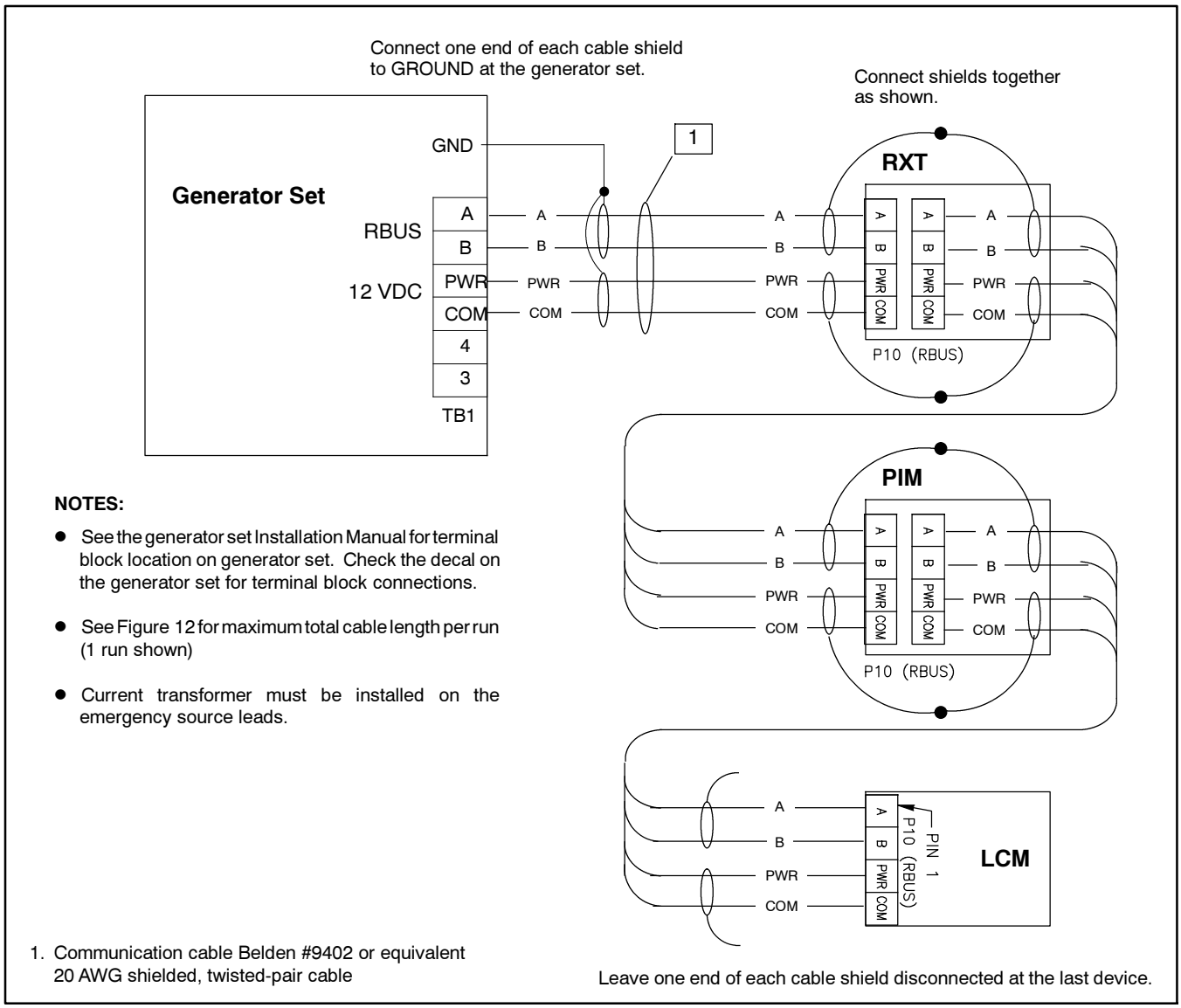


Figure 13 Communication Connection Details with Model RXT Transfer Switch, Daisy-Chain Connection

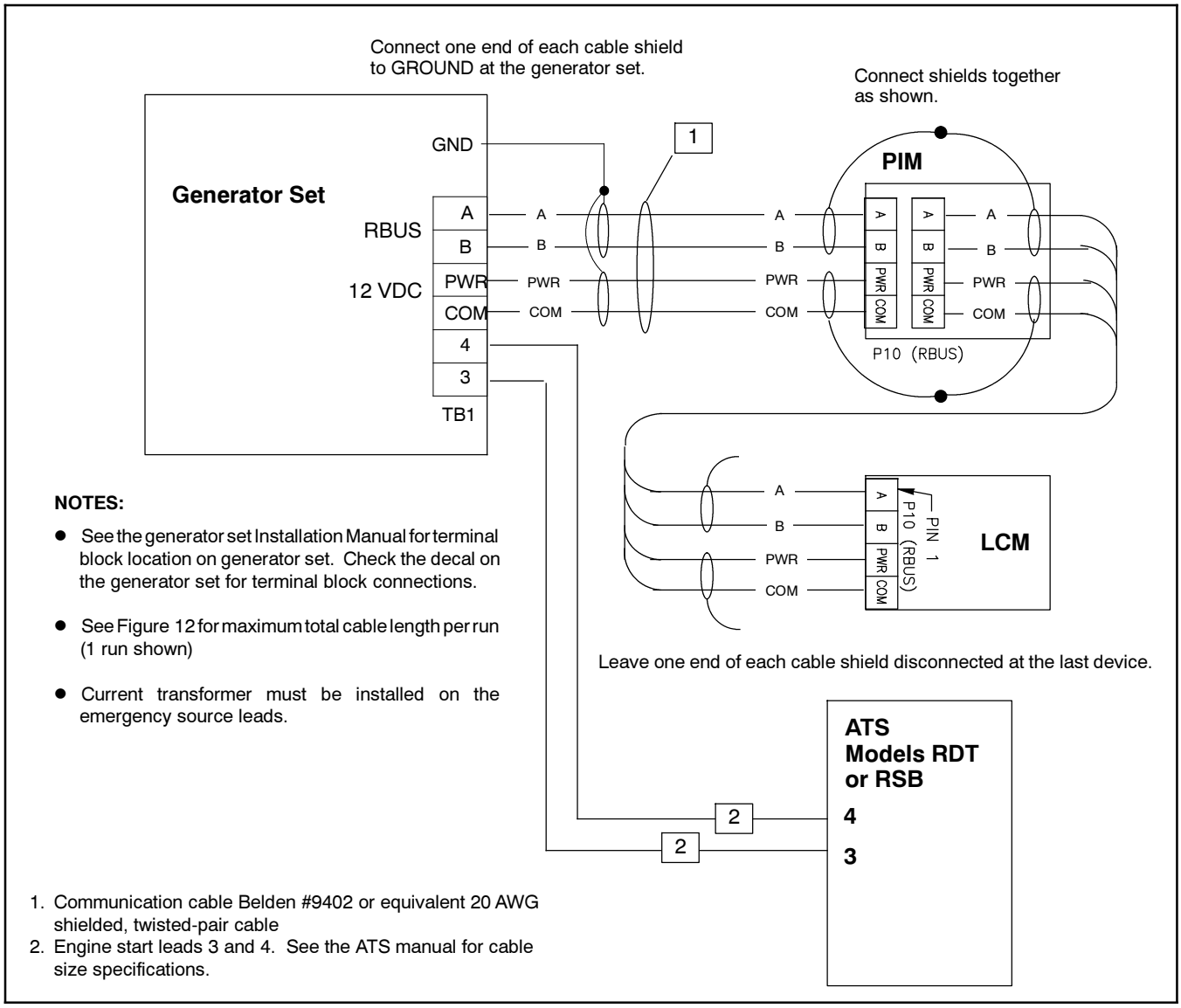
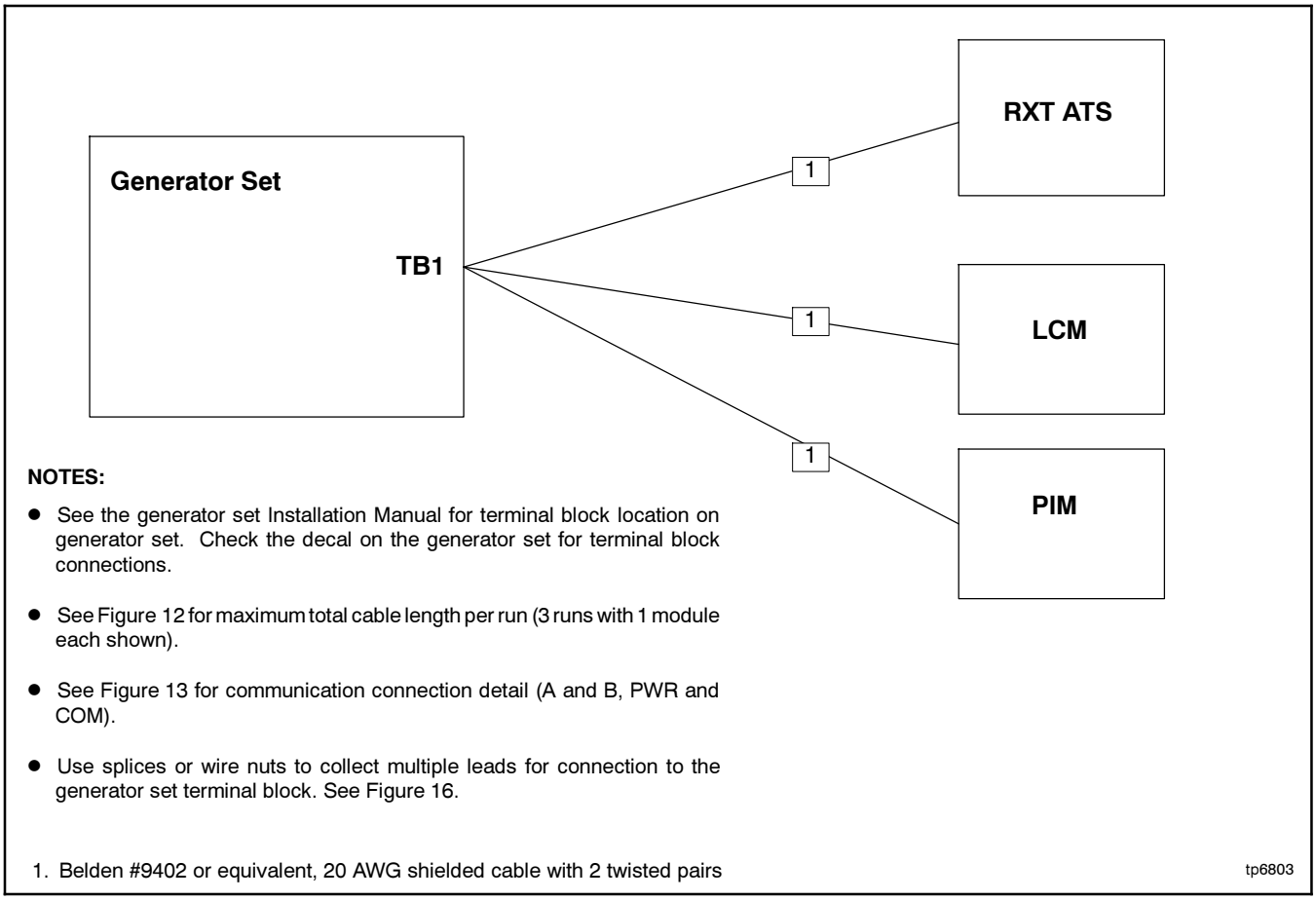


Figure 14 Connection Details with Model RDT or RSB Transfer Switch



NOTES:

- See the generator set Installation Manual for terminal block location on generator set. Check the decal on the generator set for terminal block connections.
- See Figure 12 for maximum total cable length per run (3 runs with 1 module each shown).
- See Figure 13 for communication connection detail (A and B, PWR and COM).
- Use splices or wire nuts to collect multiple leads for connection to the generator set terminal block. See Figure 16.

1. Belden #9402 or equivalent, 20 AWG shielded cable with 2 twisted pairs

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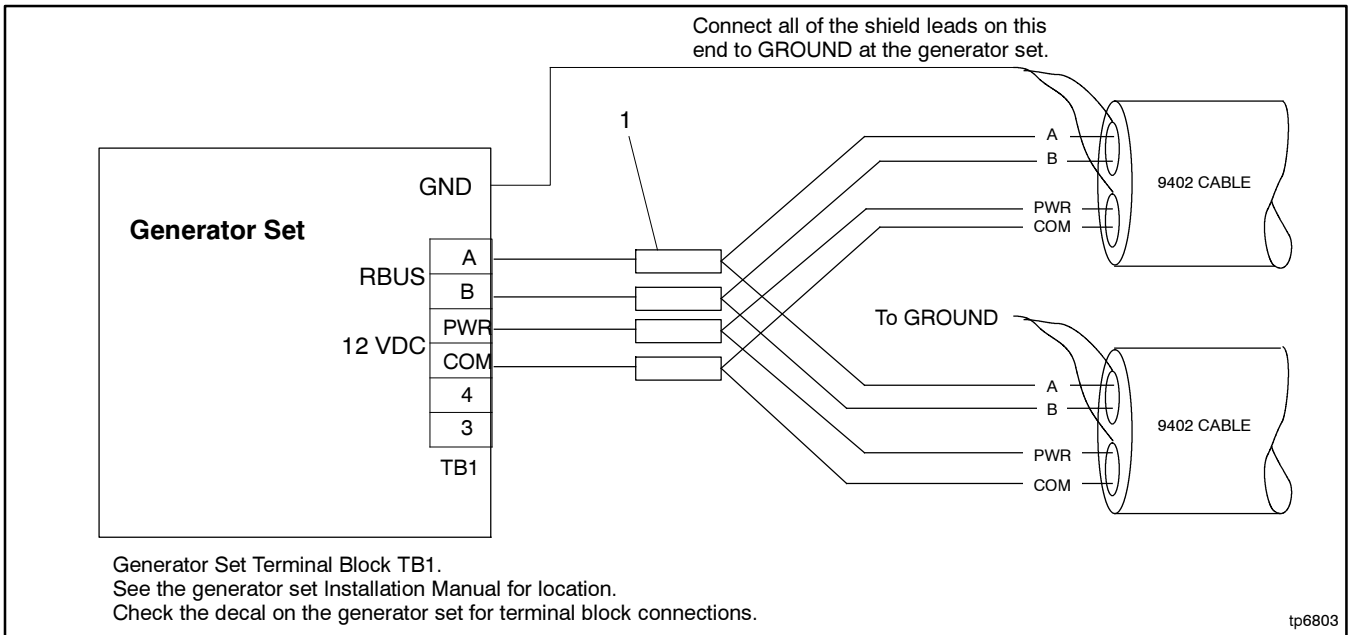
Figure 15 Accessory Module Connections, Star Configuration (three cable runs with one module each)



Generator Set Terminal Block TB1.
See the generator set Installation Manual for location.
Check the decal on the generator set for terminal block connections.

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1. Splice

Figure 16 Multiple Connections to the Generator Set

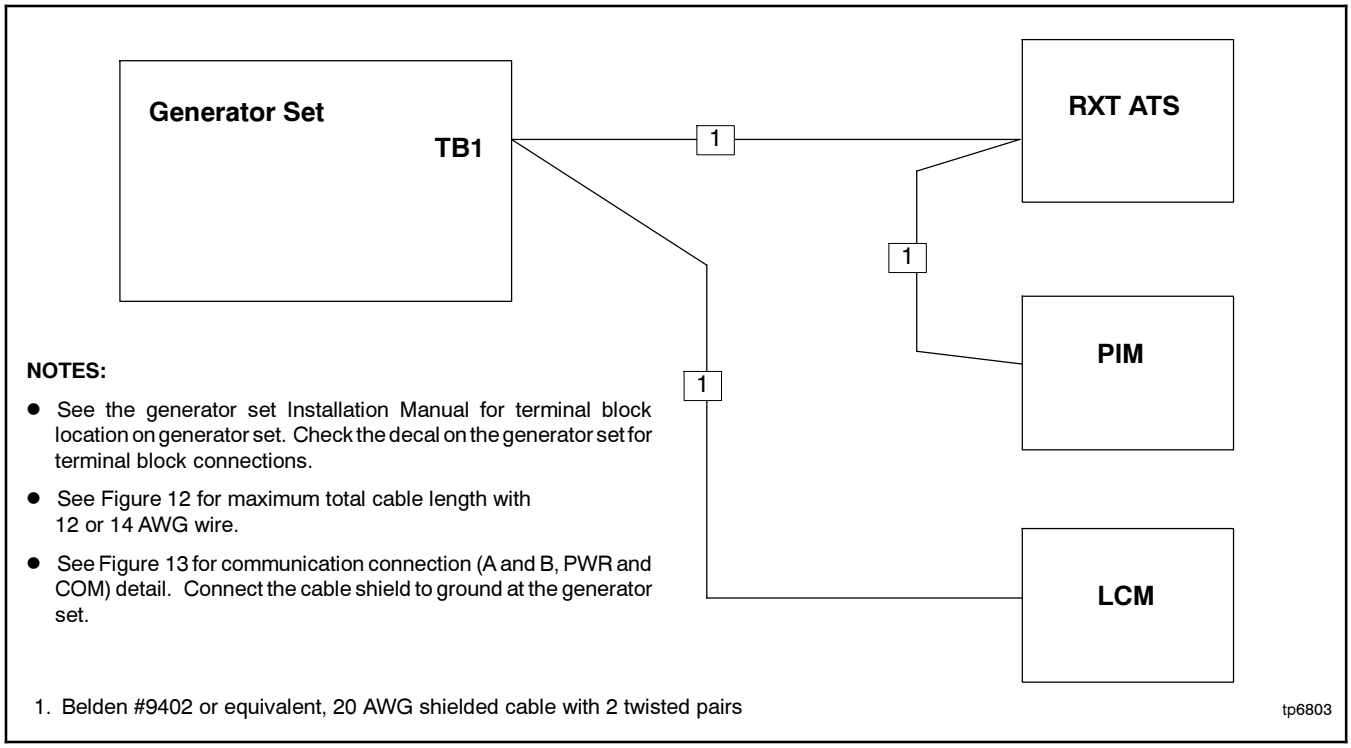


Figure 17 Accessory Module Connections (two cable runs with one and two modules shown)

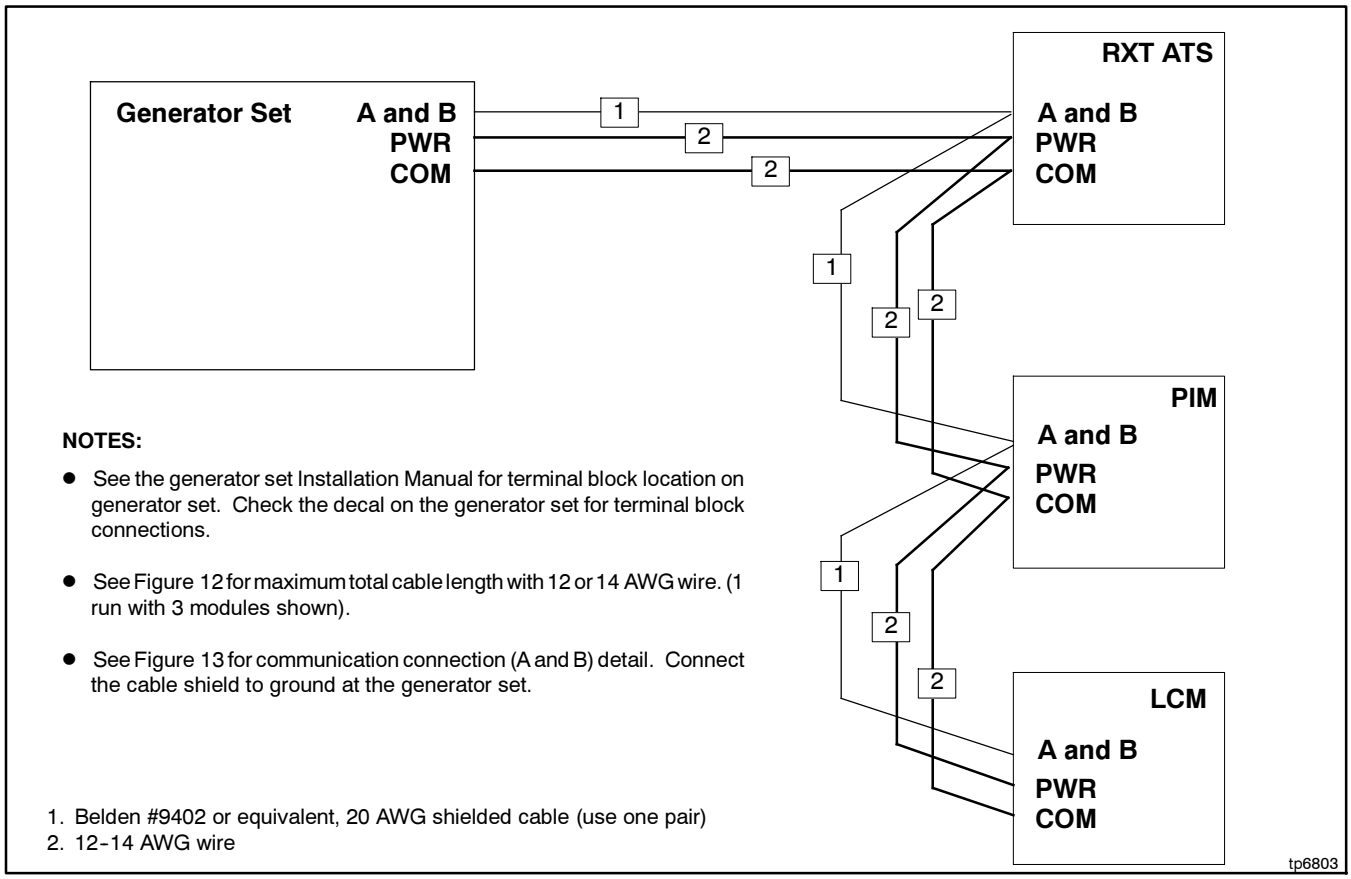


Figure 18 Accessory Module Connections with 12-14 AWG Power Leads (one cable run with three modules shown)

3 Operation

Many appliances do not run continuously. Air conditioners and furnaces, refrigerators, sump pumps, and other appliances cycle on and off as needed. With the Load Control Module (LCM), less critical appliances can be powered by the generator set when the more important appliances are not running, allowing the use of a smaller generator set than would be needed to run all of the building's electrical equipment at the same time.

The RDC2/DC2 generator controller receives input from current transformer (located in the ATS or generator) and determines whether load shedding or adding shall occur. The LCM receives commands from the generator controller and energizes or de-energizes the appropriate load relays.

The LCM is activated by the ATS transferring from the utility (normal) source to the generator. When activated, the LCM sheds all connected loads. After transfer to the generator set, loads are added according to their priority.

If the ATS fails to transfer from the utility source to the generator, the LCM will re-add all loads. When the ATS transfers to utility, the LCM adds all loads that have been previously shed.

For more information about the load add and load shed timing, see Section 4, Theory of Operation.

3.1 Power Loads

Four power relays are provided for management of non-essential secondary loads. Two (2) 120 VAC loads (shed simultaneously) or a single 240 VAC load can be wired to each relay. Limitations on loads selected are 40 A @ 240 VAC.

3.2 HVAC Loads

There are two (2) relays available to control two (2) independent heating, ventilation, and air conditioning (HVAC) loads. The relays are limited to 2 A @ 30 VAC.

A 5-minute time delay prevents HVAC loads from adding too quickly. Air conditioning compressors may be damaged if they start too soon after being stopped due to the necessity of starting the compressor against a large residual pressure. Five minutes is a typically accepted time required for an AC compressor to bleed off to a pressure level which the motor can successfully start against.

3.3 Load Add/Shed Priority

Loads are prioritized from priority 1 to priority 6. See Figure 8 on page 4. Priority 1 is considered the most critical and will add first and shed last. Priority 6 is considered the least critical and will add last and shed first.

4 Theory of Operation

4.1 Load Add

The load control module (LCM) adds and sheds loads based on the available capacity of the generator set. When the generator has ample available capacity, loads are added quickly. When the available capacity is low, loads are added more slowly to give the generator time to recover and to allow ample time to ensure that any switching loads will come on before adding more load than the generator can handle.

The load add time ranges from 15 seconds to 120 seconds depending on the loading of the generator set. Figure 19 shows an example of the load add timing for a 20 kW generator set with the maximum capacity set to the default setting of 70%. Figure 20 shows the HVAC load add timing for a 20 kW generator set.

Available Capacity (%)	Load (%)	Load (kW) for a 20 kW Generator	Time (Seconds)
70%	0%	0	15
50%	20%	4	23
37%	33%	6.6	34
30%	40%	8	40
20%	50%	10	48
5%	65%	13	60
<5%	>65%	>13 kW	Never Add

Figure 19 Example: Power Relay Load Add Timing for a 20 kW Generator

Available Capacity (%)	Load (%)	Load (kW) for a 20 kW Generator	Time (Seconds)
70%	0%	0	30
50%	20%	4	66
37%	33%	6.6	91
30%	40%	8	102
20%	50%	10	120
<20%	>50%	>10 kW	Never Add

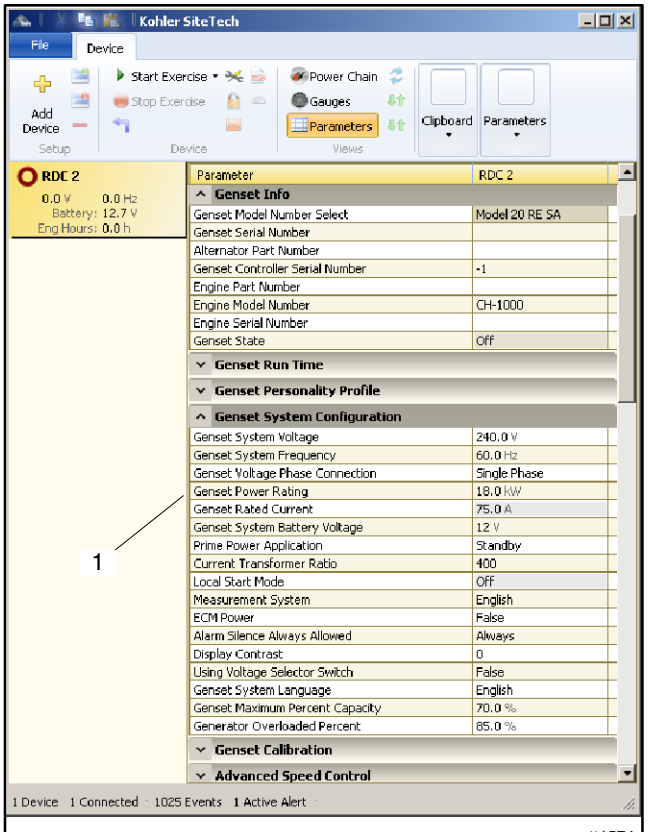
Figure 20 Example: HVAC Load Add Timing for a 20 kW Generator

Capacity

The Generator Maximum Percent Capacity setting dictates the maximum level that the load control module will automatically place on the generator. This setting is adjustable using a laptop computer connected to the RDC2 or DC2 controller and Kohler® SiteTech™ software. See Section 4.2.4.

The maximum load is calculated by multiplying the Generator Maximum Percent Capacity by the Genset Power Rating, which is a setting in the RDC2/DC2 controller. The Genset Power Rating, in kW, is factory-set to the natural gas rating. If the 14RESA or 20RESA has been converted to LP fuel, use SiteTech to change the Genset Power Rating on the controller. Refer to the generator set specification sheet for the new rating, and change the rating (kW) under the Genset System Configuration in SiteTech. See Figure 21 and TP-6701, SiteTech Software Operation Manual.

The LCM will operate if the rating setting is not changed, but loads will be shed at a kW level based on the factory default rating, rather than the rating of the reconfigured generator set.



1. Genset Power Rating setting

Figure 21 Genset Power Rating in SiteTech

4.2 Load Shed

Less important (higher priority number) loads are shed when the generator is unable to support them. This permits more important loads to continue to receive power from the generator. The less important loads are re-added after the generator loading has gone down enough to support them again. The LCM sheds less important loads before the power quality of the generator suffers from the overload.

Loads are shed in two ways – Overload and Under Frequency.

4.2.1 Overload Shed

Loads are shed on a time scale which is based on the total generator overload. The loads will shed slowly when the generator is not heavily overloaded. Loads are shed much more quickly when the overload is higher. The timing variation allows consistent overloads to be removed, instantaneous excessive overloads to be very quickly removed and normal overloads (such as motor inrush) to remain online until the transient overload condition is removed.

Figure 22 shows the overload shed timing for a 20 kW generator set with the generator overloaded percent set to the default setting of 85%. If the overload condition persists, the load shed timing can be affected by load shed acceleration. See Section 4.2.3.

The Generator Overload Percent setting is the maximum load that the LCM will accept without shedding. The setting is adjustable using a laptop computer connected to the RDC2 or DC2 controller and Kohler SiteTech software. See Section 4.2.4. Set the Generator Overload Percent at least 10% higher than the Generator Maximum Percent Capacity.

Generator Overload (%)	Load (%)	Load (kW) for a 20 kW Generator	Time (seconds)
0%	<85%	<17 kW	Never Shed
0%	85%	17	40
10%	95%	19	28
13%	98%	19.6	24
15%	100%	20	22
20%	105%	21	17
>35%	>120%	>24 kW	0.5

Figure 22 Overload Shed Timing for a 20 kW Generator

4.2.2 Under Frequency Shed

Loads are shed on a time scale which is based on the generator frequency droop. The loads will shed quickly when the frequency droop is high (output frequency is lower), and more slowly when the generator is running close to rated frequency. The timing variation allows large overloads to be shed very quickly, while allowing the generator to ride through normal transients (such as starting an AC compressor).

Figure 23 shows the under frequency shed timing for a 60 Hz generator set. If the underfrequency condition persists, the load shed timing can be affected by load shed acceleration. See Section 4.2.3.

Frequency (Hz)	Frequency Droop (Hz)	Time (seconds)
>59 Hz	<1 Hz	Never Shed
58.5	1.5	5.4
57	3	4.3
56	4	3.4
54	6	1.8
<52.5 Hz	>7.5 Hz	0.3

Figure 23 Under Frequency Shed Timing for a 60Hz Generator

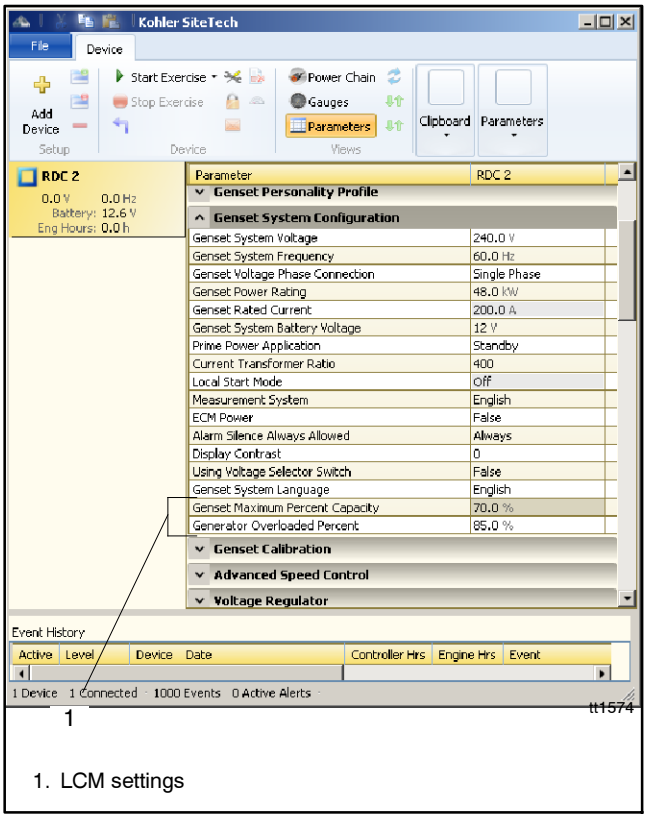
4.2.3 Load Shed Acceleration

The load control module uses load shed acceleration to shed loads more quickly if an overload or underfrequency condition persists. If an overload condition is not cleared by shedding a load, each subsequent load will shed more quickly. The acceleration is more pronounced for an underfrequency shed.

4.2.4 Changing Settings

The Generator Maximum Percent Capacity and Generator Overloaded Percent settings can be changed using a laptop computer connected to the RDC2 or DC2 controller and Kohler® SiteTech™ software. The load control settings are found in the Genset System Configuration group. See Figure 24 and TP-6701, SiteTech Software Operation Manual.

Set the Generator Overload Percent at least 10% higher than the Generator Maximum Percent Capacity.



1. LCM settings

Figure 24 SiteTech Screen

5 Status Indicators and Test Button

LEDs provide visual indication of the status of each load. See Figure 25 and Figure 26.

Use the TEST button to exercise the load shed relays in sequence according to the assigned priorities. The generator set must be running, but the ATS must not transfer to the generator set for this test.

Test Procedure

1. Press RUN on the RDC2 or DC2 generator set controller to start the generator set.
2. Press the TEST button on the LCM to exercise the first relay.
3. Press TEST again for the next relay, and repeat to cycle through all of the relays in order.

The test mode ends automatically after 15 minutes. To end the test manually, hold the TEST button for 5 seconds or press OFF or AUTO on the RDC2 or DC2 generator set controller.

The TEST button does not work when the generator set is OFF or in AUTO.

6 LEDs on the LCM circuit board

Local LEDs on the LCM circuit board include the following:

- Power available (green is on, flashing is problem, off is no power or booting up)
- Online (green when connected to the RDC2 or DC2 controller)

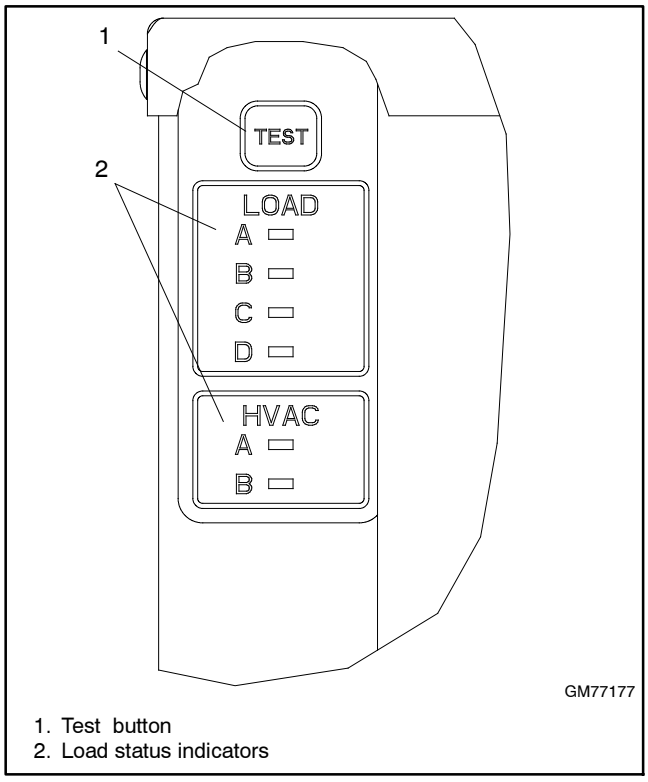
See Figure 27 for the LED locations.

7 Drawings and Diagrams

The dimension drawing, wiring diagrams, and schematics for LCMs with the pre-wired harness and with terminal blocks for customer connection are shown in Figure 28 through Figure 32.

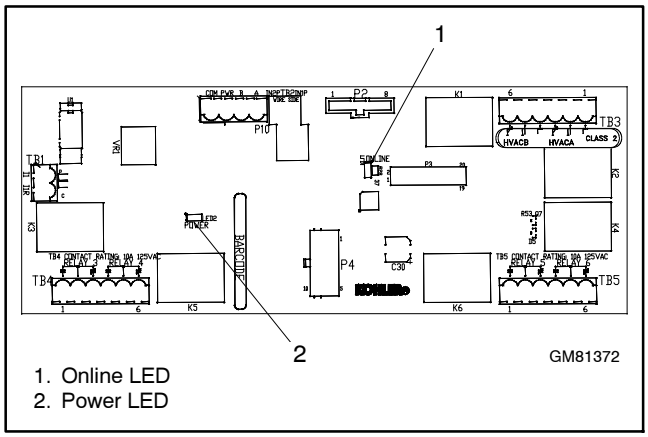
State	LED color	Duty Cycle
Disconnected (Shed)	Red	Full On
Connected (added)	Green	Full On
Disconnected (Test)	Red	1 sec on, 1 sec off

Figure 25 Status Indicators



1. Test button
2. Load status indicators

Figure 26 User Interface



1. Online LED
2. Power LED

Figure 27 LEDs on the LCM Circuit Board

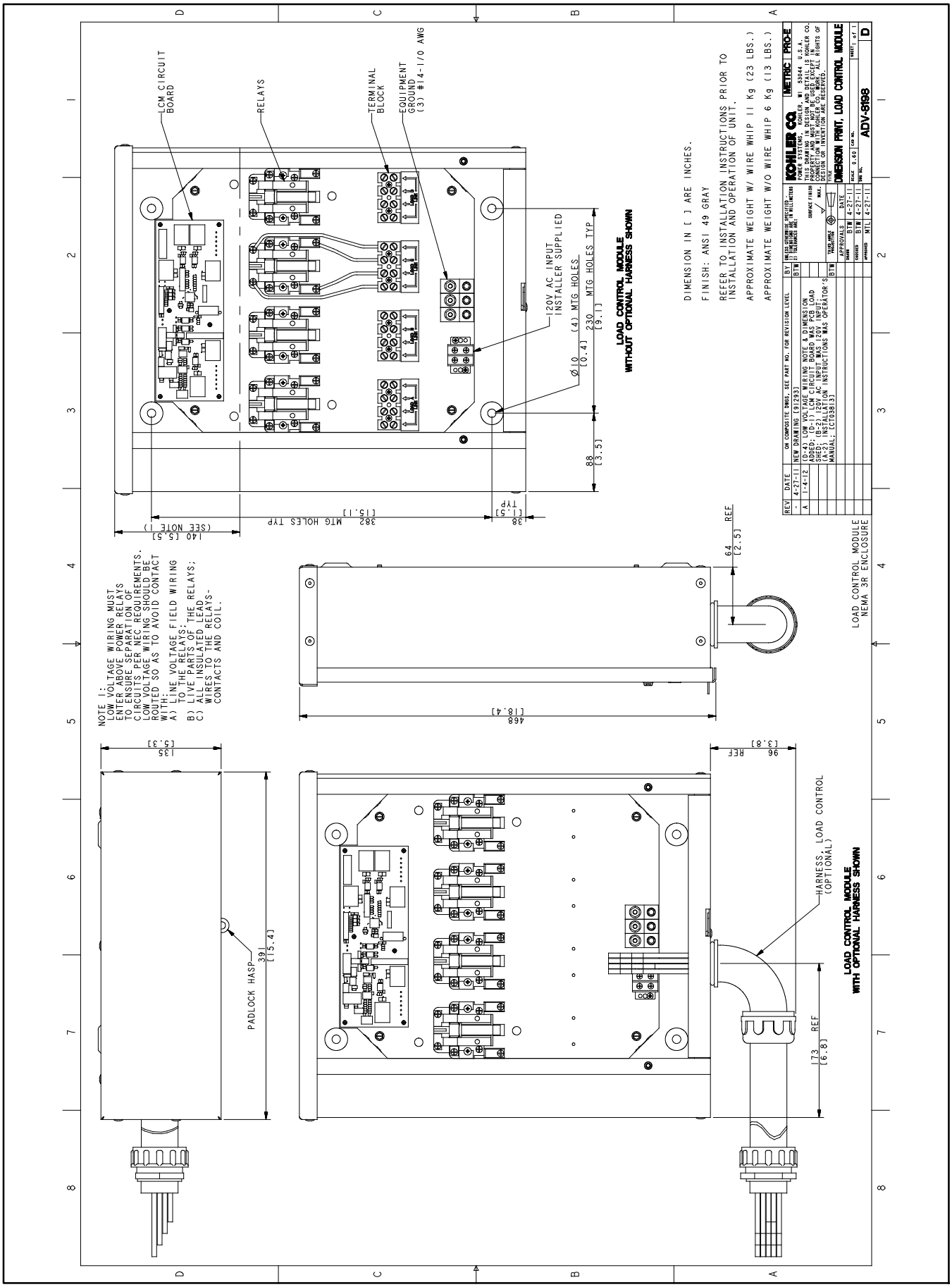


Figure 28 Dimension Drawing, Load Control Modules, ADV-8198-A

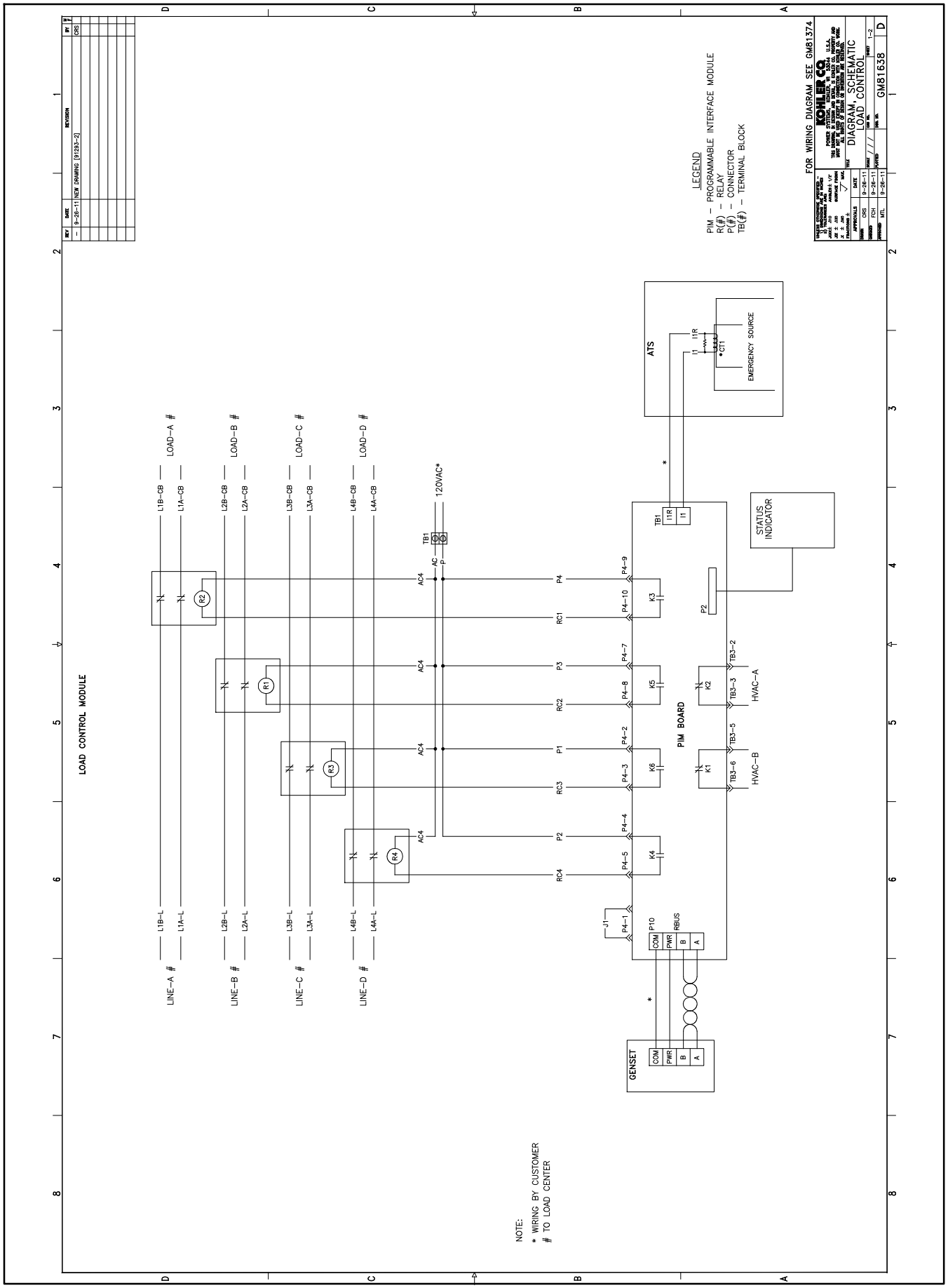


Figure 29 Schematic Diagram, LCM with Pre-wired Harness, GM81638 Sheet 1

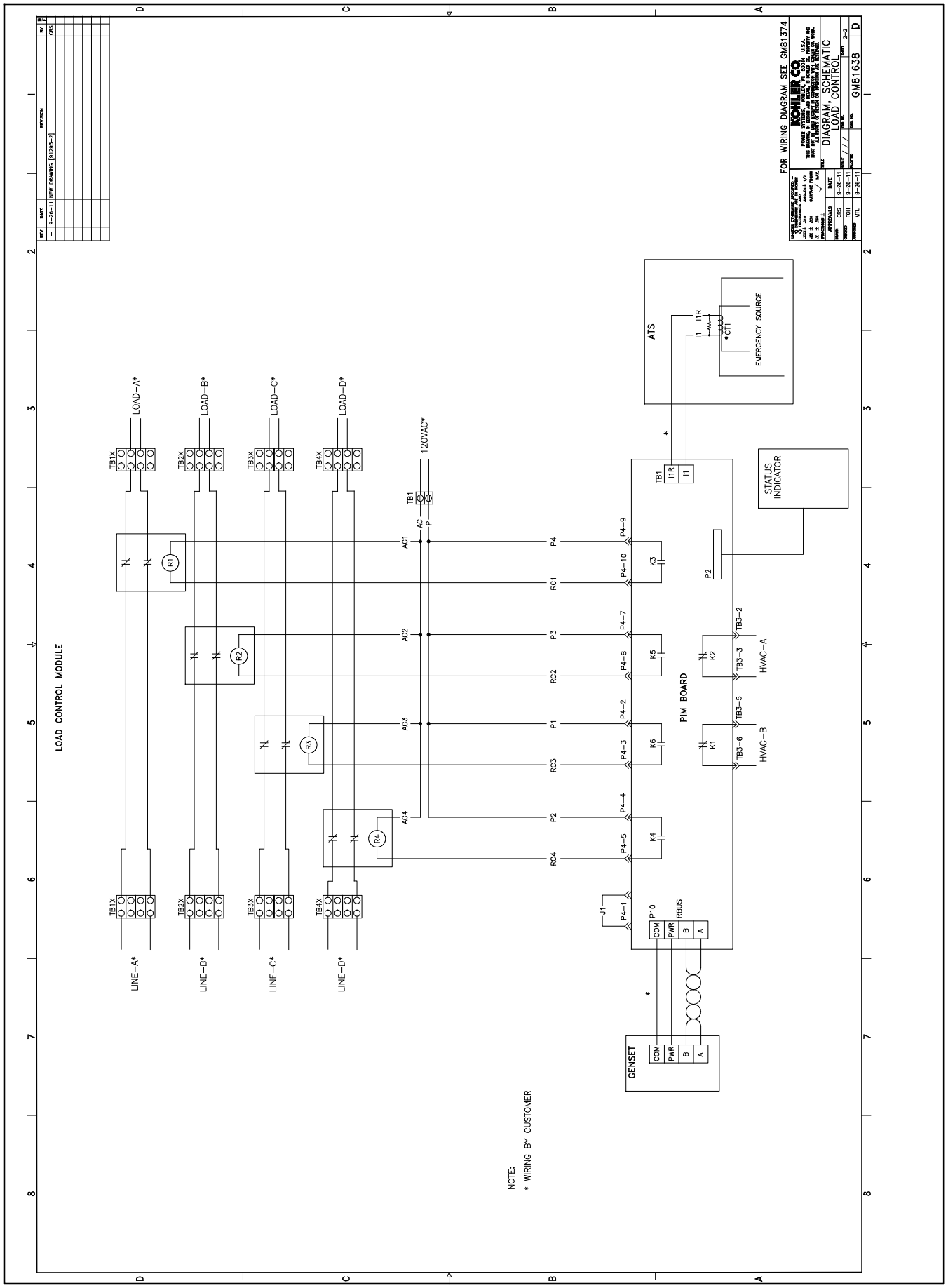


Figure 30 Schematic Diagram, LCM with Terminal Blocks for Customer Connection, GM81638 Sheet 2

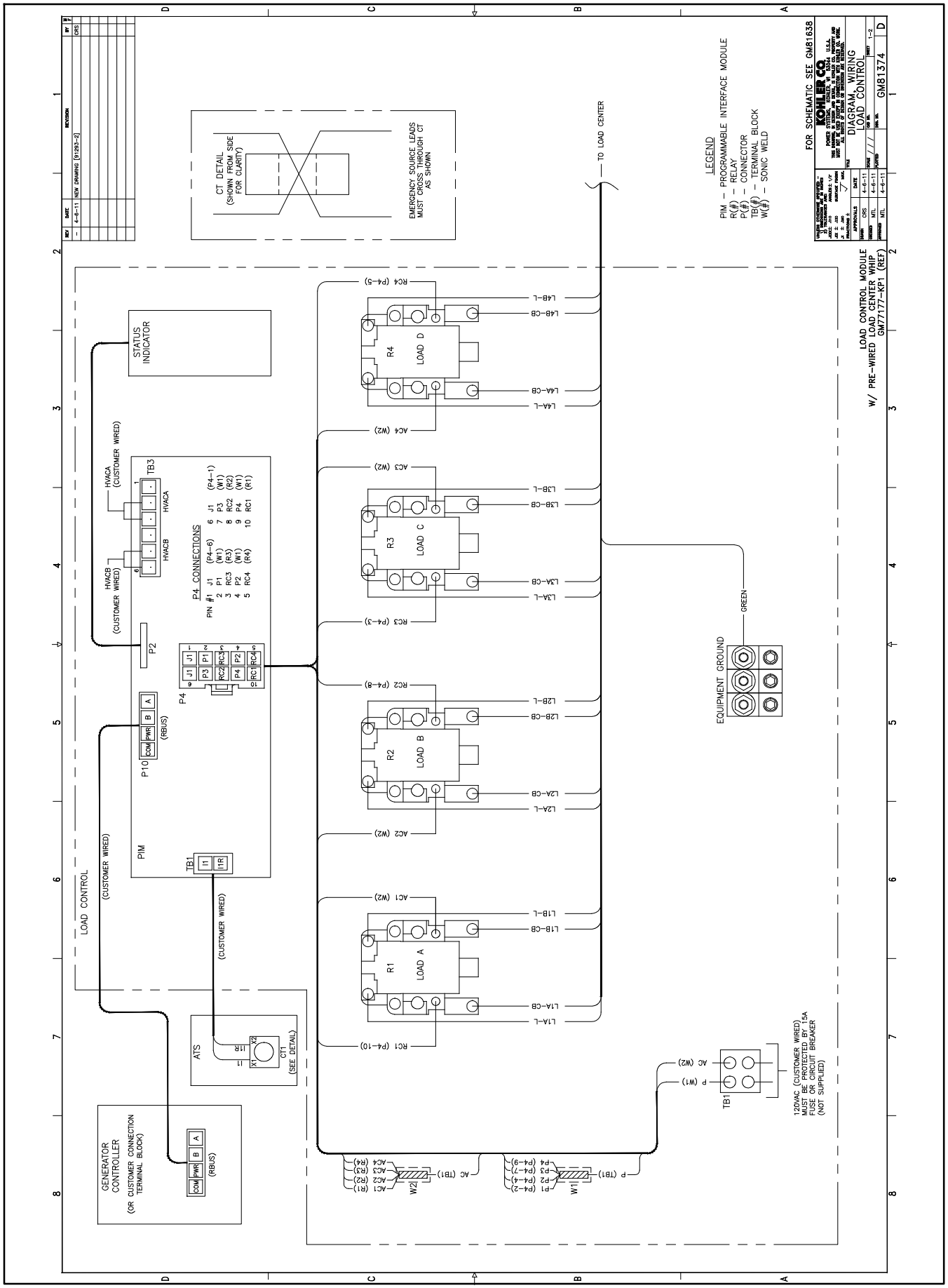


Figure 31 Wiring Diagram, LCM with Pre-wired Harness, GM81374 Sheet 1

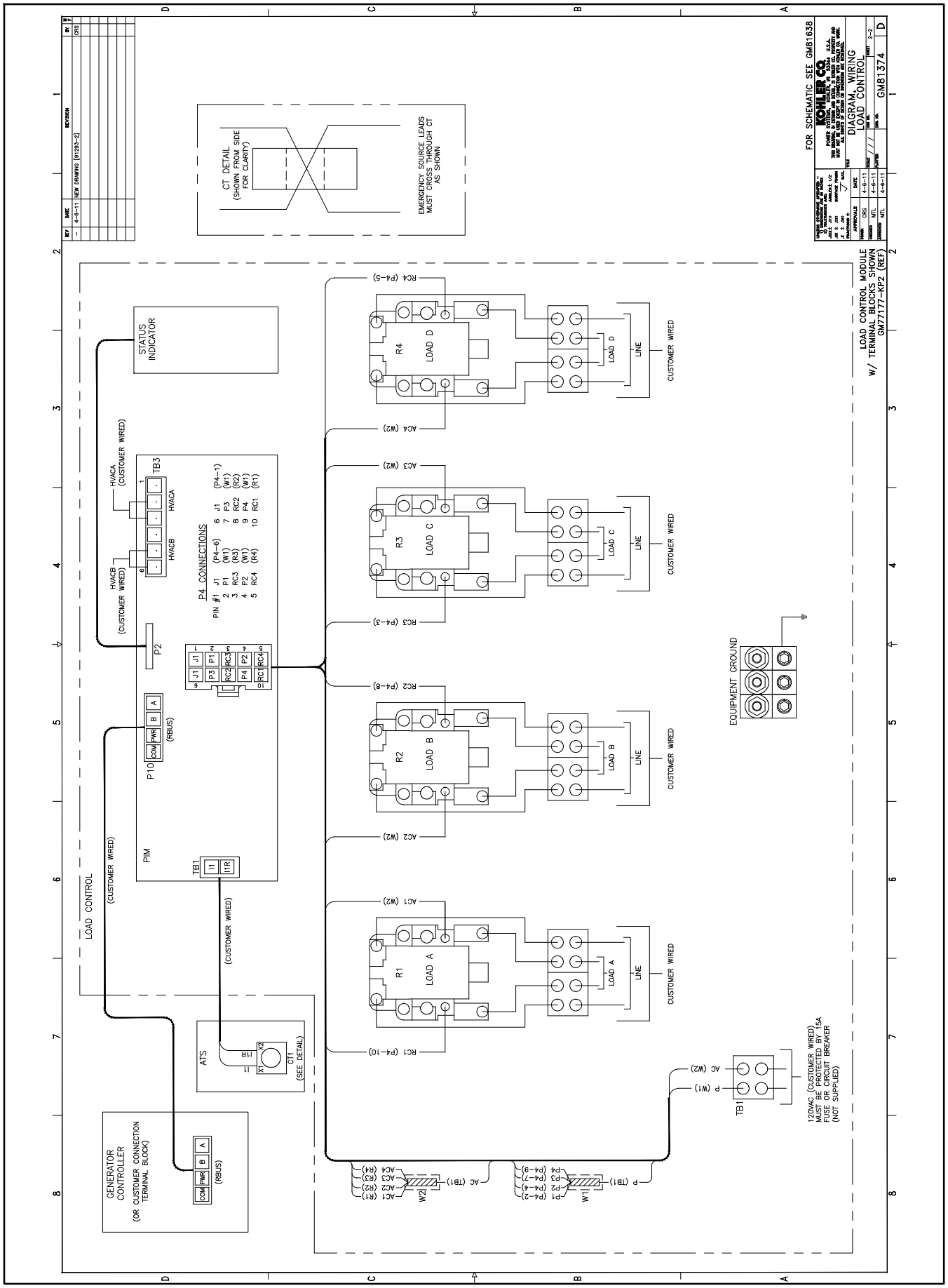


Figure 32 Wiring Diagram, LCM with Terminal Blocks for Customer Connection, GM81374 Sheet 2

8 Parts Lists

Load Control Module with Harness

Kit: GM77177-KP1-QS		
Qty.	**Description**	**Part Number**
1	LCM Assembly w/Harness	GM77177-1
1	Transformer, Current	GM83929
1	Installation Instructions	TT-1574
2	Insulink	X-367-1

Load Control Module with Terminal Blocks

Kit: GM77177-KP2-QS		
Qty.	**Description**	**Part Number**
1	LCM Assy w/Term	GM77177-2
1	Transformer, Current	GM83929
1	Installation Instructions	TT-1574
2	Insulink	X-367-1