GE Motors & Industrial Systems

NTB/3TB TERMINAL BOARD

531X305NTB_ _G1

These instructions do not purport to cover all details or variations in equipment, nor to provide every possible contingency to be met during installation, operation, and maintenance. If further information is desired or if particular problems arise that are not covered sufficiently for the purchaser's purpose, the matter should be referred to GE Motors & Industrial Systems.

CONTENTS

SAFETY SYMBOL LEGEND

WARNING — Indicates a procedure, practice, condition, or statement that, if not strictly observed, could result in personal injury or death.

CAUTION — Indicates a procedure, practice, condition, or statement that, if not strictly observed, could result in damage to or destruction of equipment

NOTE Indicates an essential or important procedure, practice, condition, or statement.

FUNCTIONAL DESCRIPTION

WARNING

This equipment contains a potential hazard of electric shock or burn. Only adequately trained persons who are thoroughly familiar with the equipment and the instructions should install or maintain this equipment.

INTRODUCTION

The 531X305NTB (NTB/3TB) board is located within the drive (or exciter) cabinet. The board contains passive interface circuitry and the drive's (or exciter's) connection terminals for most external signal-level I/O. Figure 1 shows the NTB/3TB layout.

The NTB/3TB connects to the drive control board via plugs 6PL and 8PL, to the power supply board via plugs 2PL and 4PL, and to external equipment via plug COMPL and terminal board 3TB. Refer to Tables 5 through 10 for I/O definitions.

The NTB/3TB provides the following interfaces:

- Power supply
- Encoder
- RS-232C and RS422
- Relay Outputs
- Analog Tach and Reference coarse scaling
- Low-level analog I/O
- Digital control inputs

POWER SUPPLY

The NTB/3TB supplies the following power outputs for external use:

- Regulated +5 V dc and ±15 V dc, each with a current capacity of 300 mA
- Unregulated ±24 V dc, with a current capacity of 500 mA
- 120 V ac, with a current capacity of 0.5 A

Baluns (line chokes) provide two noise-filtered power supply outputs for driving digital encoders. Hardware jumpers allow distribution of the encoder loads among the +5 V dc and ±15 V dc supplies to balance loading.

ENCODER INTERFACE

The NTB/3TB includes a differential A-quad-B encoder interface, including a marker channel, that can be connected to the drive. This circuit is optically isolated on the drive control board. The NTB/3TB includes jumpers to configure the interface for +5 V or ±15 V encoders.

RS-232C AND RS-422 INTERFACES

Connector COMPL provides an RS-232C serial link (see Table 11).

The NTB/3TB includes line termination resistors for a half-duplex, RS-422 compatible, serial interface to the drive control board's motor control processor (MCP).

RELAY OUTPUTS

The NTB/3TB provides the following outputs from seven relays with a 120 V ac, 1 A contact rating:

- Form C output from five relays controlled by the drive control board.
- One form A output and one side of the coil from a sixth relay controlled by the drive control board. This enables the coil to be controlled by the drive control board or an external ±24 V dc signal. External signals can also access the drive control board's coil driver output for applications that cannot tolerate the time delay associated with the relay pickup.
- Two form C contacts and both sides of the coil of a seventh relay for general purpose use. A hardware jumper selects whether this coil is driven by ±24 V dc or 120 V ac (see Table 2).

The board also supplies form C contacts from the MA contactor pilot relay on the Power Supply/Interface Board. These contacts are rated at 120 V ac, 2 A.

ANALOG TACH AND REFERENCE COARSE SCALING

The NTB/3TB's DIP switches allow coarse scaling of analog tachometer inputs from 25 to 380 V, and of analog references from 9 to 29 V (see Table 3). The drive control board provides fine scaling of these signals.

LOW-LEVEL ANALOG I/O

The NTB/3TB includes four potentiometers (pots) for scaling (5 to 50 V) 10-bit, general-purpose, medium-resolution inputs to the drive control board (see Table 4 for pot settings). The NTB/3TB transfers two high-resolution analog inputs to the drive control board, and receives four 8-bit, ±10 V analog outputs from it. These outputs drive functions such as other drives, analog meters, and diagnostics.

DIGITAL CONTROL INPUTS

Various control inputs pass through the NTB/3TB to the drive control board. These include special-purpose digital inputs, such as RESET and CONTROL ON, and 12 general-purpose control inputs (up to ±24 V dc). Hardware jumpers are used to bias unconnected inputs to +24 or –24 V dc, depending upon whether positive or negative logic is used (see Table 2).

APPLICATION DATA

TESTPOINTS

The NTB/3TB onboard testpoints permit access to critical signal paths for test purposes. Table 1 shows information on the use of each testpoint. Figure 1 shows testpoint locations.

Table 1. NTB/3TB Testpoints

Name	Description
DA1	± 10 V dc analog output, same as 3TB pin 53.
DA2	± 10 V dc analog output, same as 3TB pin 55.
MET1	± 10 V dc analog output, same as 3TB pin 54.
MET2	± 10 V dc analog output, same as 3TB pin 56.
DVM	Digital voltmeter (Test 03) input, range ± 50 V dc, same as 3TB pin 49.
COM	0 volt common reference point for test signals, same as 3TB pin 66.

CONFIGURABLE HARDWARE

The NTB/3TB includes configurable hardware that must be set correctly for the application:

- Berg-type (manually movable) hardware jumpers, identified by a *JP* nomenclature (see Table 2)
- DIP switches, identified by an *SW* nomenclature (see Table 3)
- Pots, identified by a *P* nomenclature (see Table 4)

Most of the jumper selections have been factory set. The test data sheets supplied with each controller (in the drive/exciter door pocket) indicate these factory set positions. Table 2 lists the jumper descriptions,showing the default setting first.

Figure 1 is a layout diagram of the NTB/3TB board, showing the locations of the configurable items.

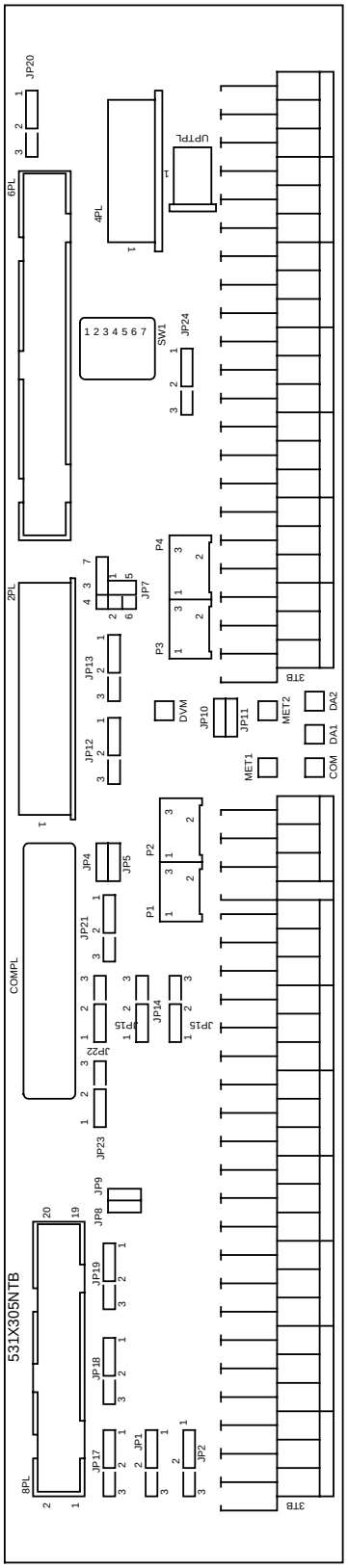

Figure 1. NTB/3TB Board Layout

Table 2. Jumpers

Revision	Name	Description
AA–Pres	JP1, JP2	Termination resistors for the drive control board's motor control processor (MCP) RS-422 interface (see also JP2) RS-422 termination resistors should only be installed at the physical first and last drops (ends of the cable runs). 1.2 Not installed 2.3 Installed (Must also put JP2 2.3)
AA–Pres	JP4	Swap RS-232C RxD and TxD data lines, COMPL pins 2 and 3 (see also JP5) Note many PCs can be jumpered to either the DCE or DTE configuration, and many cables are wired with pins 2 and 3 interchanged. If communication is not established with JP4 and JP5 in the default position, the alternate position may be necessary. 1.2 DCE mode for PC/term interface. drive transmits on pin 3. 1.3 DTE mode for modem interface. drive transmits on pin 2.
AA–Pres	JP5	Swap RS-232C RxD and TxD data lines, COMPL pins 2 and 3 (see also JP4) 3.4 DCE mode for PC/term interface. drive transmits on pin 3. 2.4 DTE mode for modem interface. drive transmits on pin 2.
AA–Pres	JP6	RS-232C RTS (COMPL-4)/CTS (COMPL-5) handshake line options (see also JP7) 3.7 DCE mode forced true handshaking 3.4 DCE mode full handshaking 2.4 DTE mode full handshaking 2.6 DTE mode forced true handshaking
AA-–res	JP7	RS-232C RTS (COMPL-4)/CTS (COMPL-5) handshake line options (see also JP6) The default position bypasses handshaking, generally allowing satisfactory serial communication independent of whether COMPL pins 4 and 5 are connected to a DTE or DCE port, or not connected at all. 1.5 DCE or DTE forced true handshaking 1.2 DCE mode full handshaking 1.3 DTE mode full handshaking
AA–Pres	JP8	RS-232C DSR (COMPL-6) and DTR (COMPL-20) handshake options (see JP9) The default position bypasses handshaking, generally allowing satisfactory serial communication, independent of whether COMPL pins 6 and 20 are connected to a DTE or DCE port, or not connected at all. 1.2 DSR and DTR both tied to +15 V dc (forced true) 1.3 DSR connected to DTR (loopback)
AA–Pres	JP9	RS-232C DSR (COMPL-6) and DTR (COMPL-20) handshake options (see JP8) 3.4 DSR and DTR both tied to +15 V dc (forced true) 2.4 DSR connected to DTR (loopback)
AD–Pres	JP10	RF24 polarity for digital control inputs (see also JP11) Note that on early prototypes of this board, JP10 and JP11 were identified as JP3A and JP3B. 1.2 RF24 = –24 V (negative logic) 1.3 RF24 = +24 V (positive logic)
AD–Pres	JP11	RF24 polarity for digital control inputs (see also JP10) 3.4 RF24 = –24 V (negative logic) 2.4 RF24 = +24 V (positive logic)
AA–Pres	JP12	Voltage to encoder supply (E0V1, E0V2) 1.2 E0V1 = +15 V dc 2.3 E0V1 = +5 V dc
AA–Pres	JP13	Voltage to encoder supply (E1V1, E1V2) 1.2 E1V1 = E0V1 per JP12 2.3 E1V1 = –15 V dc

Table 2. Jumpers — Continued

Revision	Name	Description
AL–Pres	JP14, JP15	Coarse voltage range select for VCO #3, V3VCO JP14 & JP15 settings determine the gain of the first stage of the analog interface circuitry for the (VC3P, VC3N) analog inputs to the V3VCO channel, per the following table. JP14 JP15 Maximum Input Voltage Nominal Input Voltage 2.3 2.3 16.9 10.0 1.2 2.3 23.3 13.8 2.3 1.2 34.9 20.6 1.2 1.2 41.3 24.4 Maximum and Nominal values represent differential input voltages at the 3TB inputs with the following significances: Second max: max voltage for which the first stage will provide linear transfer function independent of the V3SCLE setting. Nominal: Voltage which will produce 20000 counts in V3VCOVAR (VAR.184) with the EE.V3SCLE (EE.484) programmed to 10000. This is the optimum "rated reference" voltage, allowing 25% overrange. Note that VCO #3 is only available on drives having DS200 series drive control boards, not 531X series drive control boards. 2.3 10.0 V Nom (with JP15 2.3); or 20.6 V Nom (JP15 1.2) 1.2 13.8 V Nom (with JP15 2.3); or 24.4 V Nom (JP15 1.2)
AA–Pres	JP17	Encoder 0 optically isolated receiver voltage drive level (E0A) 1.2 15 V dc 2.3 5 V dc
AA–Pres	JP18	Encoder 0 optically isolated receiver voltage drive level (E0B) 1.2 15 V dc 2.3 5 V dc
AA–Pres	JP19	Encoder 0 optically isolated receiver voltage drive level (E0M) 1.2 15 V dc 2.3 5 V dc
AA–Pres	JP20	Voltage level of external drive for general purpose relay (GR+ and GR–) 1.2 120 volts 2.3 24 volts
AA–Pres	JP21	Supply –24 volts on COMPL-25 1.2 COMPL-25 is open 2.3 COMPL-25 is connected to –24 V dc
AL–Pres	JP22, JP23	Coarse voltage range select for VCO #4, V4VCO JP22 & JP23 settings determine the gain of the first stage of the analog interface circuitry for the (VC4P, VC4N) analog inputs to the V4VCO channel, per the following table. JP22 JP23 Maximum Input Voltage Nominal Input Voltage 2.3 2.3 16.9 10.0 1.2 2.3 23.3 13.8 2.3 1.2 34.9 20.6 1.2 1.2 41.3 24.4 Maximum and Nominal values represent differential input voltages at the 3TB inputs with the following significances: Second max: maximum voltage for which the first stage will provide linear transfer function independent of the V4SCLE setting. Nominal: Voltage which will produce 20000 counts in V4VCOVAR (VAR.185) with the EE.V4SCLE (EE.488) programmed to 10000. This is the optimum "rated reference" voltage, allowing 25% overrange. Note that VCO #4 is only available on drives having DS200 series drive control boards, not 531X series drive control boards. 2.3 10.0 V Nom (with JP23 2.3); or 20.6 V Nom (JP22 1.2) 1.2 13.8 V Nom (with JP23 2.3); or 24.4 V Nom (JP22 1.2)

Table 2. Jumpers — Continued

Revision	Name	Description
AL–Pres	JP24	Enable 4–20 mA current loop input to the feedback VCO (FDBP, FDBN) When the current loop mode is enabled (2.3), a 500-ohm burden resistor is inserted, yielding 10 volts at 20 mA. 1.2 Voltage input mode, scaled via SW1-5 2.3 Current loop input mode, SW1-5 should be open
AA–AC	JP3A	RF24 polarity for digital control inputs (see also JP3B) Note that JP3A and JP3B were renamed JP10 and JP11 on subsequent revisions. 1.2 RF24 = –24V (negative logic) 1.3 RF24 = +24V (positive logic)
AA–AC	JP3B	RF24 polarity for digital control inputs. (See also JP3A). 3.4 RF24 = –24V (negative logic) 2.4 RF24 = +24V (positive logic)

Table 3. Switches

Name	Description
SW1-5	Feedback VCO Channel/Analog Tach Feedback (FDBP, FDBN) Voltage Range Select These switch settings determine the gain of the first stage of the analog interface circuitry for the (FDBP, FDBN) analog inputs to the FBVCO channel. Maximum and Nominal values represent differential input voltages at the 3TB inputs with the following significances: First max: Voltage for which the VCO stage will saturate with the FBSCL (drive control P6, if present) scaling potentiometer set to the maximum gain (full CCW) position. Second max: maximum voltage for which the first stage will provide linear transfer function independent of the FBSCL setting. Nominal: Voltage which will produce 20000 counts in FBVCOVAR (VAR.183) with the FBSCL scaling pot set to maximum gain (full CCW) and the EE.FVSCL# (EE.1386m) programmed to 10000. This is the optimum "rated feedback" voltage, allowing 25% overrange. Note that the software scaling function on the VCO channels is only available on DCP Rev 1.24 & later. ALSO NOTE: When JP7 on the drive control board is in the 2.3 position, each voltage range in the chart should be divided by 6. For use with 4–20 mA current inputs, set all switches off and see JP24 (REV AL and later). 0 (all off) 25-33 volts maximum, 20.0 volts nominal or 4-20 mA 1 (1 on) 32-42 volts maximum, 25.1 volts nominal 2 (2 on) 39-52 volts maximum, 30.9 volts nominal 3 (1,2 on) 45-60 volts maximum, 35.9 volts nominal 4 (3 on) 55-74 volts maximum, 44.0 volts nominal 6 (2,3 on) 69-92 volts maximum, 54.9 volts nominal 8 (4 on) 89-119 volts maximum, 70.5 volts nominal 12 (3, 4 on) 118-159 volts maximum, 94.5 volts nominal 14 (2-4 on) 132-177 volts maximum, 105.0 volts nominal 16 (5 on) 175-236 volts maximum, 140.0 volts nominal 20 (3, 5 on) 205-276 volts maximum, 164.0 volts nominal 24 (4, 5 on) 239-321 volts maximum, 191.0 volts nominal 28 (3-5 on) 268-362 volts maximum, 215.0 volts nominal 31 (all on) 300-390 volts maximum, 231.0 volts nominal
SW6-7	Reference VCO Channel/Analog Reference (REFP, REFN) Voltage Range Select These switch settings determine the gain of the first stage of the analog interface circuitry for the (REFP, REFN) analog inputs to the RFVCO channel. Maximum and Nominal values represent differential input voltages at the 3TB inputs with the following significances: First max: Voltage for which the VCO stage will saturate with the RFSCL (drive control P5, if present) scaling potentiometer set to the maximum gain (full CW) position. Second max: maximum voltage for which the first stage will provide linear transfer function independent of the RFSCL setting. Nominal: Voltage which will produce 20000 counts in RFVCOVAR (VAR.182) with the RFSCL scaling pot set to maximum gain (full CW) and the EE.RVSCL# (EE.1281m) programmed to 10000. This is the optimum "rated reference" voltage, allowing 25% overrange. Note that the software scaling function on the VCO channels is only available on DCP Rev 1.24 & later. 0 (all off) 12.5–16.9 volts maximum, 10.0 volts nominal 2 (7 on) 17.3–23.3 volts maximum, 13.8 volts nominal 1 (6 on) 25.8–34.9 volts maximum, 20.6 volts nominal 3 (all on) 30.6–41.3 volts maximum, 24.4 volts nominal

Table 4. Potentiometers

Name	Description
P1	Provides scaling of analog input P1 from 8 volts to 50 volts maximum.
P2	Provides scaling of analog input P2 from 8 volts to 50 volts maximum.
P3	Provides scaling of analog input P3 from 8 volts to 50 volts maximum.
P4	Provides scaling of analog input P4 from 8 volts to 50 volts maximum.

Table 5. Connector 2PL,
I/O Between the NTB/3TB and Power Supply

Pin No.	Nomenclature	Description
1	/PSEN	Power supply enable (active low).
2	–15V	–15 V dc, ±5%
3	+15V	+15 V dc, ±5%
4	DCOM	Digital common
5, 6	+5V	+5 V dc, ±5%
7	DCOM	Digital common
8	–24V	–24 V dc, ±20%
9	+24V	+24 V dc, ±20%

Table 6. Connector 4PL,
I/O Between NTB/3TB and Drive Control Boards

Pin No.	NTB/3TB Terminal	Nomenclature	Description
1	85	X2	115 V ac output (unfused side).
2	83	FX1	115 V ac output (fused side).
3	81	MANC	Form C normally closed contact from the MA pilot relay (K2).
4	79	MANO	Form C normally open contact from the MA pilot relay (K2).
5	77	MACM	Form C common contact from the MA pilot relay (K2).

Table 7. Connector OPTPL,
I/O Between LAN Terminal and NTB/3TB Boards

Pin No.	Nomenclature	Description
1	X2	Return for CFX1 120 V ac loads (isolated from COM). Same as NTB/3TB pin 85.
2	CFX1	120 V ac, ±15%, from NTB/3TB board, fused at 500 mA, including internal fans (isolated from COM). Same as NTB/3TB pin 83.

Table 8. Connector 8PL,
Input from Drive Control and LAN Terminal Boards

Pin No.	3TB Terminal	Nomenclature	Description
1	6	FA	Non-inverting RS-422 half-duplex serial data line from the drive control board's Motor Control Processor (MCP) UART.
2	8	FB	Inverting RS-422 half-duplex serial data line from MCP UART.
3	10	DCOM	Signal return for EXSY (at COM potential).
4	12	EXSY	External sync input to MCP.
5	—	——	Not connected.
6	1	E0AB	Encoder interface Channel A non-inverted differential input.
7	3	/E0AB	Encoder interface Channel A inverted differential input. (Tie to COM for single-ended encoders.)
8	5	E0BB	Encoder interface Channel B non-inverted differential input.
9	7	/E0BB	Encoder interface Channel B inverted differential input. (Tie to COM for single-ended encoders.)
10	9	E0MB	Encoder interface marker channel non-inverted differential input.
11	11	/E0B	Encoder interface marker channel inverted differential input. (Tie to COM for single-ended encoders.)
12	—	——	Not connected.
13	14	CL1	CL1 – CL8 are general-purpose control inputs, ±24 V dc maximum with 27 kΩ input impedance.
14	16	CL2	See CL1 (pin 13).
15	18	CL3	See CL1 (pin 13).
16	20	CL4	See CL1 (pin 13).
17	22	CL5	See CL1 (pin 13).
18	24	CL6	See CL1 (pin 13).
19	26	CL7	See CL1 (pin 13).
20	28	CL8	See CL1 (pin 13).

NOTE

The NTB/3TB terminal board provides 95 connector points arranged in two rows of screw-type terminals. The terminals are numbered sequentially, with odd numbers in the top row and even numbers in the bottom row.

CAUTION

The NTB/3TB board DACn and METn outputs are not controlled during power-up or power-down. If these outputs are being used to control processes that might respond inappropriately to these transient outputs, steps should be taken to disable the process during these times. One solution is to pass the output through one of the NTB/3TB relays, which are always dropped out during power-up and power-down. The relay can be easily configured to pick up after power-up by pointing it at a drive variable such as TRUEREG, VAR.10.

Table 9. NTB/3TB Terminals, I/O Between NTB/3TB and External Connections

NTB/3TB Terminal	Nomenclature	Description
1	E0A	Encoder channel A non-inverted differential input. E0A, /E0A, E0B, E0M, and /E0M are optically coupled inputs. Either +5 V or +15 V A-quad-B or single channel encoders may be used, check JP17, JP18, and JP19. This interface can be steered to block ENCP1 in addition to ENCP0. Specifications for drive/exciter tach interface circuit: Only differential tachs (A, /A, B, /B) are recommended and are covered by this spec. However, a single ended 15 V tach will run if the unused input is tied to +5 V and circuit is configured for +V operation. Operation with a marker pulse will degrade maximum frequency and requires special consideration based on the marker pulse phasing. These frequency specifications apply to the frequency of either channel of the tach based on the rpm and pulses per rev, (this rate is multiplied by 4 internal to the drive); tach and circuit errors were taken into account. The maximum operating frequency is limited by a filter on the input to the receiver circuit drive control boards. For drive control board DS200LDCC (LDCC) applications, the maximum operating frequency is increased approximately 50% from what is shown below for drive control board DS200SDCC (SDCC) applications. Care has to be taken with the line capacitance and frequency when using low impedance line driver because it can cause significant additional current consumption and power dissipation in the tach and the power supply. Low impedance driver (15 V supply and 15 V receiver configuration): Lakeshore or BEI 7406M15; an 88C30 interface is not recommended UNLESS tachometer has clamping diodes installed on its output. Maximum frequency: 102 Hz (150 kHz with LDCC) Current consumption: I = 23 mA + 60 * C(line) * freq, per channel Lakeshore tach (5 V supply and receiver configuration – may be desirable for high capacitance line to limit power dissipation in tach driver circuitry): Maximum frequency: 51 Hz (75 kHz with LDCC) Current consumption: I = 15 mA + 20 * C(line) * freq, per channel DS8830 differential driver (5 V supply and receiver configurations): Maximum frequency: 34 Hz (Tach driver must be above 0 °C) Current consumption: I = 10 mA + 16 * C(line) * freq, per channel 7406 open collector output with 1K pull-up resistors (15 V supply with 5 V receiver): Maximum frequency: 25 Hz (assumes line capacitance is < .01 μf) Current consumption: I = 11 mA, per channel NOTE: Current stated above is ONLY the current consumed by the receiver circuit and wiring. Total current consumption for a two channel tach is: Itotal = 2 * I + Tack internal current consumption.

Table 9. NTB/3TB Terminals — Continued,
I/O Between NTB/3TB and External Connections

NTB/3TB Terminal	Nomenclature	Description
2	E0V1	Positive side of power supply with balun choke for Encoder E0A/E0B. Either +5 or +15 V dc as set by NTB/3TB jumper JP12.
3	/E0A	Inverting differential input for Encoder #0, channel A.
4	E0V2	Return for E0V1, basically at COM potential.
5	E0B	Non-inverting differential input for Encoder #0, channel B.
6	FA	Non-inverting RS-422 half-duplex serial data line. Provides a serial channel into the drive control board's MCP (as opposed to the RS-232C channel into the drive control board's DCP). This provides a potential high speed channel for tight coupling of drives at the motor control loop level. EXSY provides an external synchronization input to MCP. Jumpers JP1 and JP2 are used to connect line termination resistors to FA and FB (needed at each end of an RS-422 network).
7	/E0B	Inverting differential input for Encoder #0, channel B.
8	FB	Inverting RS-422 half-duplex serial data line (see FA, 3TB point 6).
9	E0M	Encoder interface marker pulse channel non-inverted differential input.
10	FCOM	Signal return for EXSY (at COM potential).
11	/E0M	Encoder interface marker pulse channel inverted differential input.
12	EXSY	External sync output to drive control board's motor control processor.
13	R1C	Relay #1 common contact. These relay contacts are rated for 120 V ac, 0.5 A. EEPROM parameters allow these six relays to be driven by any bit of any variable in the Drive Control Processor of the drive control board. (See EE.216 and following). By default, these relays are updated 45 times per second. Beginning with DP revision 2.24, blocks RLYAL (373) and RLAYN (374), allow any or all of these relays to be updated 90 to 720 times per second. These relays have a typical mechanical delay of 3 to 4 ms.
14	CI1	General-purpose control input. RUN, JOG, POL, XSTP, and CI1 – CI8 are general-purpose control inputs, ±24 V dc maximum with 27 kΩ input impedance and a 2 ms hardware filter. Each is automatically sampled 45 times per second by default. Beginning with DP revision 2.24, CI1 – CI8 may be sampled faster, at 90 to 720 times per second by scheduling a foreground block, BLK.372, CIINS, at the appropriate rate.
15	R1NC	Relay #1 normally closed contact.
16	CI2	See CI1 (3TB point 14).
17	R1NO	Relay #1 normally open contact.
18	CI3	See CI1 (3TB point 14).
19	R2C	Relay #2 common contact.
20	CI4	See CI1 (3TB point 14).
21	R2NC	Relay #2 normally closed contact.
22	CI5	See CI1 (3TB point 14).
23	R2NO	Relay #2 normally open contact.
25	R3C	Relay #3 common contact.
26	CI7	See CI1 (3TB point 14).
27	R3NC	Relay #3 normally closed contact.
28	CI8	See CI1 (3TB point 14).
29	R3NO	Relay #3 normally open contact.
30	RF24(1)	Voltage reference for digital control inputs. Defaulted to –24 V dc; changes to +24 V dc via NTB/3TB's jumpers JP10 and JP11. Each digital control input is active when connected to RF24, inactive when open. Total ±24 V dc load includes loading on RF24.
31	R4C	Relay #4 common contact.

Table 9. NTB/3TB Terminals — Continued,
I/O Between NTB/3TB and External Connections

NTB/3TB Terminal	Nomenclature	Description
32	RF24(2)	Voltage reference for digital control inputs (see RF24[1], 3TB point 30).
33	R4NC	Relay #4 normally closed contact.
34	RUN	General-purpose input. Defaulted to, but not limited to, RUN function.
35	R4NO	Relay #4 normally open contact.
36	JOG	General-purpose input. Defaulted to JOG function.
37	R5NO	Relay #5 normally open contact.
38	POL	General-purpose input. Defaulted to the reference polarity function.
39	R5NC	Relay #5 normally closed contact.
40	XSTP	General-purpose input. Defaulted to the XSTOP function (normally closed).
41	R5C	Relay #5 common contact.
42	CTLN1	Control on input 1. CTLN1 and CTLN2 (3TB point 44) form part of the circuit that picks up the MA contactor pilot relay. They must be connected together for the drive (or drive (or exciter) to run. Can also be used to connect external interlocks, providing a fail-safe (microprocessor independent) way to stop the drive (or exciter).
43	R6NO	Relay #6 normally open contact.
44	CTLN2	Control on input 2 (see CTLN1, 3TB point 42).
45	R6C	Relay #6 common contact.
46	P1	Scaled 10-bit analog input. P1 through P4 are medium-resolution (10-bit) analog input channels for voltages from ±5 V dc to ±50 V dc, scaled via respective pots P1 through P4 on the NTB/3TB. Input impedance ≥ 10 kΩ, and input filtering is at most 1 ms.
47	MSRF	Relay #6 coil driver (Master Sync Reference output), open collector output. When inactive, MSRF is pulled up to +24 V dc through 1400 Ω maximum. When active, MSRF is pulled down to 1.5 V dc maximum through 200 Ω, not including a maximum drop of 3.4 V across the 200 Ω due to the relay #6 coil load. If internal control of this relay is not required, relay #6 may be picked up by an external driver capable of pulling MSRF down to 1.5 V dc maximum sinking 17 mA. See also 3TB point 13.
48	P2	Scaled 10-bit analog input. See P1 (3TB point 46).
49	DVM	Filtered fixed-scaled 10-bit analog input. DVM is a medium-resolution analog input channel, with fixed scaling for ± 51.0 V dc maximum (± 25.5 on early drive control boards). Input impedance and filtering is 511 kΩ and 100 ms. In conjunction with drive (or exciter) test 03, provides a digital voltmeter function with at least 0.5% accuracy for diagnostic functions.
58	RESET	Hard reset input to the drive (or exciter). Connecting RESET to +5 to +24 V dc resets all processors in the drive (or exciter). Leaving RESET open or connecting to COM allows drive (or exciter) operation. The drive control board provides a 20 ms noise filter on this input.
59	T0IN	Input to internal timer/counter 0 of the drive control board's DCP. Biased to +24 V dc through 27 kΩ, and must be pulled to COM (less than +1.5 V dc) to be recognized by the DCP.
60	+5VDC	+5 V dc source, ±10%, 300 mA (including load on E0V1 and E1V1).
61	T0OUT	TTL output through 200 Ω from DCP's timer/counter 0 (on drive control board). T0OUT is useful primarily as a pulse-train output.
62	+15VDC	+15 V dc source, ±10%, 300 mA (including load on E0V1 and E1V1).
63	REFP	Non-inverting differential analog reference input with REFN, 3TB point 65. Maximum reference can be 9 – 29 V dc, coarsely selected by NTB/3TB's switches SW1 – SW7. Fine scaling provided by EE.1281 (RVSCLn). This circuit uses a VCO similar to the one used by FDBP and FDBN. Input impedance is at least 60 kΩ with less than 1 ms of filtering. If this circuit is not needed for the drive (or exciter) speed reference, the digitalization of this input is available for other functions requiring high resolution.

Table 9. NTB/3TB Terminals — Continued,
I/O Between NTB/3TB and External Connections

NTB/3TB Terminal	Nomenclature	Description
64	–15VDC	–15 V dc source, ±10%, 300 mA (including load on E1V1).
65	REFN	Inverting differential analog reference input, with REFP, 3TB point 63.
66	COM(1)	0 V common reference for all drive (or exciter) I/O, same as 3TB point 68. COM should be used for signal level returns only.
67	RSVD(1)	Not used. Provides voltage clearance between signal-level points and points with potentials above 50 V.
68	COM(2)	0 V common reference for all drive/exciter I/O, same as 3TB point 66.
69	FDBP	Non-inverting differential analog tach input (with 3TB point 73). Either ac AN or dc tachometers with a top speed voltage from 25 to 390 V (6 to 65 V if jumper JP7 on the drive control board is in the 2-3 position) can be connected to these differential inputs. NTB/3TB's DIP switches SW1 through SW7 provide coarse scaling. drive control board's jumper JP8 and EE.1386 (FVSCLn) provide fine scaling and analog ac AN tach rectification. Input impedance of this circuit is at least 300 kΩ, with less than 1.5 ms of filtering. If this circuit is not needed for the drive (or exciter) speed feedback, the digitalization of this input is a available for other functions requiring high resolution.
70	+24VDC	+24 V dc source, ±25%, unregulated, 500 mA (including load on RF24).
71	RSVD(2)	Not used.
72	–24VDC	–24 V dc source, ±25%, unregulated, 500 mA (including load on RF24).
73	FDBN	Inverting differential analog tach input with 3TB point 69.
74	E1V1	Power supply with balun line choke for encoders on SPC board. Either –15 V dc or same voltage as E0V1 (+5 or +15 V dc) as selected using NTB/3TB jumper JP13.
75	RSVD(3)	Not used.
76	E1V2	Return for E1V1, basically at COM potential.
77	MACM	Form C common contact from MA pilot relay; auxiliary contact from the relay used to pilot the MA contactor. Rated for 125 V ac, 2A.
78	RSVD(4)	Not used. Provides voltage clearance between signal-level points and points with potentials above 50 V.
79	MAN0	Form C normally open contact from the MA pilot relay; auxiliary contact from the relay used to pilot the MA contactor. Rated for 125 V ac, 2A.
80	GRC1	General-purpose relay common contact of first form C. Rated for 120 V ac, 0.5 A.
81	MANC	Form C normally closed contact from the MA pilot relay; auxiliary contact from the relay used to pilot the MA contactor. Rated for 125 V ac, 2A.
82	GNC1	General-purpose relay normally closed contact.
83	CFX1	120 V ac, ±15%, fused at 500 mA total including internal fans (isolated from COM).
84	GNO1	General-purpose relay normally open contact.
85	X2	Return for CFX1 120 V ac loads (CFX1 and X2 isolated from COM).
86	GRC2	General-purpose relay common contact of second form C. Rated 120 V ac, 0.5 A).
87	GR+	GR+ and GR– (3TB point 89) are coil inputs to a general purpose relay. This relay is not internally connected to any drive (or exciter) circuitry, and may be used as required for customer applications. The coil may be driven by 24 V or 120 V, either ac or dc, as selected using jumper JP20.
88	GNC2	General-purpose relay normally closed contact. Rated 120 V ac, 0.5 A.
89	GR–	See GR+ (3TB point 87).
90	GNO2	General-purpose relay normally open contact. Rated 120 V ac, 0.5 A.

Table 9. NTB/3TB Terminals — Continued,
I/O Between NTB/3TB and External Connections

NTB/3TB Terminal	Nomenclature	Description
91	VC3N	Inverting differential analog input for auxiliary VCO #3. The top reference voltage may be 9 to 29 V dc. Jumpers JP14 and JP15 provide coarse scaling of the inputs. This circuit uses a VCO similar to the one used by REFP and REFN. Input impedance is at least 60 kΩ with less than 1 ms of filtering. The digitalization of this input is available at VAR.184 for functions requiring a high-resolution analog input by using BLK.263 (V3VCO). (VCO #3 is not available on the 531X301DCC Drive Control board.)
92	VC4N	Inverting differential analog input for auxiliary VCO #4. The top reference voltage may be 9 to 29 V dc. Jumpers JP22 and JP23 provide coarse scaling of the inputs. This circuit uses a VCO similar to the one used by REFP and REFN. Input impedance is at least 60 kΩ with less than 1 ms of filtering. The digitalization of this input is available at VAR.185 for functions requiring a high-resolution analog input by using BLK.264 (V4VCO). (VCO #4 is not available on the 531X301DCC Drive Control board.)
93	VC3P	Non-inverting differential analog input for auxiliary VCO #3.
94	VC4P	Non-inverting differential analog input for auxiliary VCO #4.
95	MET3	±10 V dc analog output from an 8-bit D/A converter (see 3TB point 54).

Table 10. Connector 6PL,
I/O Between NTB/3TB and Drive Control Board

Pin No.	NTB/3TB Terminal	Nomenclature	Description
1	42	CTLN1	Control ON input 1. CTLN1 and CTLN2 (3TB point 44) form part of the circuit that picks up the MA contactor pilot relay. They can also be used to connect external interlocks, providing a fail-safe (microprocessor independent) way to open the MA contactor, if used.
2	44	CTLN2	See CTLN1 (pin 1).
3	—	LBIAS	± 24 V dc bias for digital inputs from NTB/3TB (for + or – logic).
4	61	T0OUT	TTL output through 200 Ω from DCP's timer/counter 0 (on drive control board). T0OUT is useful primarily as a pulse-train output.
5	34	RUN	General-purpose input. Defaulted to, but not limited to, RUN function.
6	36	JOG	General-purpose input. Defaulted to JOG function.
7	38	POL	General-purpose input. Defaulted to the reference polarity function.
8	40	XSTP	General-purpose input. Defaulted to XSTP function (normally closed).
9	47	MSRF	Relay #6 coil driver (Master Sync Reference output), open collector output. When inactive, MSRF is pulled up to +24 V dc through 1400 Ω maximum. When active, MSRF is pulled down to 1.5 V dc maximum through 200 Ω, not including a maximum drop of 3.4 V across the 200 Ω due to the relay #6 coil load. If internal control of this relay is not required, relay #6 may be picked up by an external driver capable of pulling MSRF down to 1.5 V dc maximum sinking 17 mA. See also 3TB point 13.
10 – 14	—	RO1 – RO5	NTB/3TB relay coil output driver lines 1 through 5.
15, 16	—	P3B, P4B	Scaleable general-purpose analog input from NTB/3TB.

Table 10. Connector 6PL — Continued,
I/O Between NTB/3TB and Drive Control Board

Pin No.	NTB/3TB Terminal	Nomenclature	Description
17	51	ASP0	Fixed scaled 10-bit analog input. ASP0 is a medium-resolution analog input channel, with fixed scaling (no trim pot). Input impedance and filtering is 10 kΩ and 1 ms.
18	—	VC3NB	Inverting differential analog input to drive control board auxiliary VCO #3.
19	—	VC3PB	Non-inverting differential analog input to drive control board auxiliary VCO #3.
20, 21	—	P1A, P1B	Scaleable general-purpose analog inputs from NTB/3TB.
22	95	MET3	See DA1 (pin 24).
23	49	DVM	Filtered fixed-scaled 10-bit analog input. DVM is a medium-resolution analog input channel, with fixed scaling for ± 51.0 V dc maximum (± 25.5 on early drive control boards). Input impedance and filtering is 511 kΩ and 100 ms. In conjunction with drive (or exciter) test 03, provides a digital voltmeter function with at least 0.5% accuracy for diagnostic functions.
24	53	DA1	± 10 V dc analog output from 8-bit or 12-bit D/A converter. DA1 and DA2 (8 bit resolution on the drive control board and 12 bits on the drive control board), and MET1, MET2, and MET3 (8 bit resolution), are outputs from D/A converters and can source ± 10 V dc at no load or ± 8 V dc at a 10 mA load (200 Ω series impedance). Any drive variable can be steered to these D/A outputs and can be scaled to set the value corresponding to 10 V dc output. If the variable attains a magnitude greater than this value, the D/A output is clamped to ± 10 volts rather than rolling over. DA1 and DA2, intended for diagnostics and system applications, are updated every 1.4 ms. MET1, MET2, and MET3, intended primarily for meter driver functions, are updated every 2.8 ms. Note MET3 is only present on boards of rev AM and later, and is only functional when used with DS200 series drive control boards --it is not provided on 531X series drive control boards.
25	55	DA2	See DA1 (pin 24).
26	54	MET1	See DA1 (pin 24).
27	56	MET2	See DA1 (pin 24).
28	57	MSSY	Input to internal interrupt INT0 of the drive control board's DCP. Biased to +24 V dc though 27 kΩ, must be pulled to COM (less than +1.5 V dc) to be recognized by the DCP.
29	59	T0IN	Input to internal timer/counter 0 of the drive control board's DCP. Biased to +24 V dc through 27 kΩ, and must be pulled to COM (less than +1.5 V dc) to be recognized by the DCP.
30	58	RESET	Hard reset input to the drive (or exciter). Connecting RESET to +5 to +24 V dc resets all processors in the drive (or exciter). Leaving RESET open or connecting to COM allows drive (or exciter) operation. The drive control board provides a 20 ms noise filter on this input.
31	—	TDB	RS-232C channel transmitted from DCP.
32	—	RDB	RS-232C channel received by the DCP.
33	—	CTSB	RS-232C channel clear-to-send handshake.
34	—	RTSB	RS-232C channel clear-to-receive handshake.
35	—	VC4NB	Inverting differential analog input for drive control board auxiliary VCO #4.
36	—	VC4PB	Non-inverting differential analog input for drive control board auxiliary VCO #4.
37	—	RFNB	Differential analog input from NTB/3TB to reference VCO, negative line.
38	—	RFPB	Same as pin 37, but positive line.
39	—	FBNB	Differential analog input NTB/3TB to feedback VCO, negative line.
40		FBPB	Same as pin 39, but positive line.

Table 11. Connector COMPL, RS-232C I/O Between NTB/3TB Board and User Interface

Pin No.	Nomenclature	Description
1 – 25	——	The drive (or exciter) includes an RS-232C connection only for use as a serial link with the drive (or exciter) configuration tools. These software packages are diagnostic and configuration programs used during installation, tuneup, and troubleshooting. GE does not intend this communications link to be used for any other purpose.

CAUTION

Do not connect pin 25 of COMPL directly to a PC (personal computer) unless jumper JP21 is in the 1-2 position, or damage may occur.

NOTE

Although the RS-232C interface should work correctly with all 25 pins of COMPL connected, using the minimum possible interface avoids incompatibility and noise problems.

RENEWAL/WARRANTY REPLACEMENT

BOARD IDENTIFICATION

A printed wiring board is identified by an alphanumeric part (catalog) number stamped on its edge. For example, the NTB/3TB drive terminal board is identified by part number 531X305NTBcrG1.

The *531X305NTB* portion is the base number that specifically identifies the printed wiring board. The *c* and *r* digits are alphabetic characters that indicate the board configuration and revision level, respectively. The *G#* identifies a group, which is a variation of a particular board. The NTB/3TB has one group, *G1*.

NOTE

All digits are important when ordering or replacing any board.

WARRANTY TERMS

The GE Motors & Industrial Systems Terms and Conditions brochure details product warranty information, including the **warranty period** and **parts and service** coverage.

The brochure is included with customer documentation. It may be obtained separately from the nearest GE Sales Office or authorized GE Sales Representative.

WARRANTY PARTS AND SERVICE

This board has no fuses or other end-user serviceable parts. If it fails, it needs to be replaced as a unit.

To obtain a replacement board, or service assistance, contact the nearest GE Service Office.

Please have the following information ready to exactly identify the **part** and **application**:

- GE requisition or shop order number
- Equipment serial number and model number
- Board number and description

PROCEDURE FOR REPLACING BOARDS

WARNING

To prevent electric shock, turn off power to the board, then test to verify that no power exists in the board before touching it or any connected circuits.

CAUTION

To prevent equipment damage, do not remove boards or connections, or re-insert them, while power is applied to the drive.

Treat all boards as static-sensitive. Use a grounding strap when changing boards and always store boards in anti-static bags or boxes they were shipped in.

To replace an NTB/3TB board:

1. **Turn off the power to the drive**, then wait several minutes for all the capacitors to discharge. Test any electrical circuits before touching them to ensure the power is off.

2. Open the drive's cabinet door to access the board. (The NTB/3TB is typically located below the drive's board rack.)

3. Carefully disconnect all cables from the NTB/3TB board as follows:

   – For ribbon cables, grasp each side of the cable connector that mates with the board connector and gently pull the cable connector loose.

   – For cables with pull tabs, carefully pull the tab.

   – For wires attached to connector 3TB, loosen the screw located at the top of each terminaland carefully pull each wire free. (Ensure that wires are labeled to simplify reconnection.)

4. Remove the four screws that secure the NTB/3TB to the four standoffs and remove the board.

CAUTION

Avoid dropping mounting hardware into the unit, which could cause damage.

5. Set all configurable items on the replacement (new) board in the exact position as those on the board being replaced (old board).

   If a board revision has added or eliminated a configurable component, or re-adjustment is needed, refer to *Configurable Hardware* paragraphs and Tables in this instruction book.

NOTE

Because of upgrades, boards of different revision levels may not contain identical hardware. However, GE Motors & Industrial Systems ensures backward compatibility of replacement boards.

6. Install the new board on the four standoffs with the four screws removed in step 4.

7. Reconnect all cables disconnected in step 3, ensuring that each connector is properly seated at both ends.

8. Reconnect all individual wires disconnected in step 3 (as labeled), ensuring that each wire is properly secured in the terminal.

Notes:

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