QTG-900 & QTG-910

Quad-Tach Generator

Installation & Operation Manual
QTG001b

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GENERAL DESCRIPTION

ORMEC has two models of Quad-Tach Generators. Both units are stand-alone printed circuit assemblies designed to interface to digital quadrature signals such as produced by optical incremental encoders. They generate an analog output signal proportional to the "speed" of the encoder, as determined by the frequency of the quadrature input signals.

1.1 QTG-900 Overview

The QTG-900 is used primarily in PMC-900 series servomotor control systems to provide analog velocity feedback from the quadrature signals of the position encoder. This eliminates the need for an analog tachometer. The QTG-900 produces a bipolar analog output voltage which is proportional to the frequency of the quadrature inputs, and whose polarity is dependent on the direction of encoder travel, as determined by the phase relationship of the quadrature signals.

1.2 QTG-910 Overview

The QTG-910 is used primarily in "Electronic Lineshaft" applications to interface an optical incremental encoder to the "Motion Reference Bus" of the PMC-900 series Programmable Motion Controllers. It provides an effective method for interfacing positioning systems with machine motion which is not under servo control. It accepts quadrature signals directly from an incremental position encoder mounted to the equipment whose motion the PMC is to follow. The QTG-910 processes the encoder quadrature, decoding each transition of the quadrature signals (4x multiplication) and provides a single pulse train which can be used by PMCs as an external motion reference for the "Motion Reference Bus".

Should the equipment whose motion is being monitored by the QTG-910 back up, the QTG-910 measures the amount of the reversal, up to 65,535 encoder transitions. Motion Reference Bus pulses are not transmitted by the QTG-910 until the equipment has gone forward to the point where it started to back up. This capability allows the PMC based positioning system to accurately track external equipment during start-stop and machine vibration conditions.

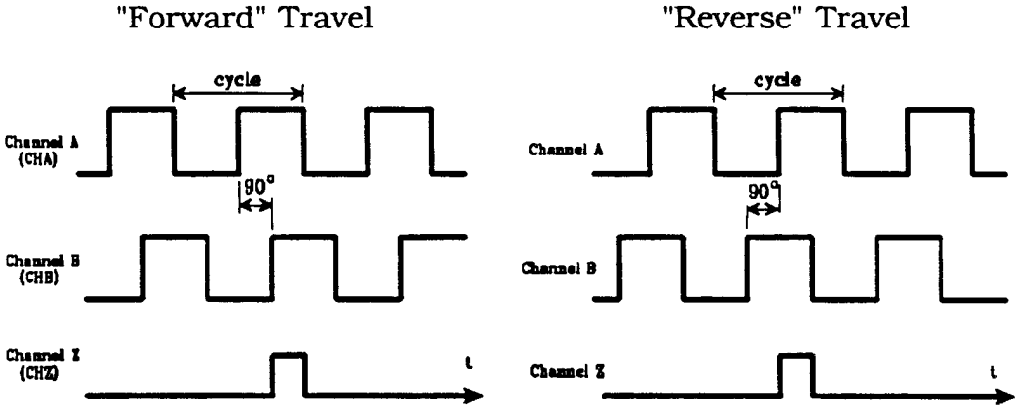
The QTG-910 also provides a unipolar analog output voltage which is proportional to the frequency of the quadrature inputs for forward travel only. This voltage used for "velocity feedforward" for PMC-900 Series Motion Control Systems to minimize position following error for slave servomotors in electronically lineshafted systems.

The QTG-910 processes the quadrature output signals from an encoder monitoring machine motion and transmits "net forward distance" to be used on the Motion Reference Bus. This feature is useful for electronically lineshafted machines that are not supposed to have their PMC based systems tracking the machine under back-up conditions.

OPERATION

The input to the Quad-Tach Generator is from a digital position encoder or other source of "phase quadrature" signals. These signals are two "RS-485 compatible" differentially driven square wave signals, which are displaced in phase by 90 degrees providing both travel and direction information. "Phase quadrature" signals for "Forward" and "Reverse" travel are illustrated below. The encoder resolution "linecount" specification specifies the number of "cycles" of the encoder per revolution of the motor (or per inch for a linear encoder). The QTGs use each transition of both of the quadrature signals ("4x multiplication") for maximum position information.

Phase Quadrature Position Encoder Signals



Note: Channel Z is a once per revolution marker channel.

Both QTGs use a Programmable Logic Device (EPLD) and a Voltage-to-Frequency Converter (VFC). The EPLD performs the functions of Noise Filtering, Quadrature Decoder, and Clock Generation for the VFC. The VFC generates a unipolar analog reference proportional to the frequency of the quadrature signals. In addition, the EPLD provides polarity selection for the analog pseudo-tach output signal, TACHOUT. The QTG-910 also has a 16-bit binary counter used to assist in the "Encoder Backup Compensation" function.

The maximum possible frequency range of the QTG-900 is 125 kHz for each of the quadrature signals. By moving the "maximum quadrature frequency" range configuration jumper on header JM1, the maximum quadrature frequency can be changed from the standard 125 kHz to 62.5 kHz, 31 kHz, or 16 kHz. The TACHOUT analog output is directly proportional to the actual input quadrature frequency, such that it will be 10 volts at the selected maximum quadrature frequency.

2.1 QTG-900 Bipolar Operation

The QTG-900 uses bipolar operation to generate a "pseudo-tachometer" signal for use as feedback for closing the velocity loop in a PMC-900 series Programmable Motion Controller.

For this bipolar operation, the "OPT5'" jumper must be in place on header JM1. In this case, the TACHOUT output signal will be negative when the encoder travels in the "forward" direction, and positive when the encoder travels in the "reverse" direction. LED displays are provided for the decoded Channel A and Channel B signals to assist in installation.

2.2 QTG-910 Operation

The QTG-910 operates only in unipolar mode as explained in the General Description Section. Since it is designed to operate with the encoder moving in the "forward" direction, the LED displays on the QTG-910 indicate CHA (Channel A) and FWD (forward). FWD "on" indicates that the position encoder is rotating in the forward direction. Should FWD not light when the position encoder is rotated in the "forward" direction of the machine, interchange the wires on CHA and CHB (also CHA' and CHB').

The QTG-910 has only one frequency range which is detailed below:

QTG-910 Maximum Encoder Quadrature Rates

Quadrature Symmetry	Quadrature Rate	Composite (4x) Frequency
90° ± 0°	87.5 kHz	350 kHz
90° ±10°	87.5 kHz	350 kHz
90° ±20°	87.5 kHz	350 kHz
90° ±30°	87.5 kHz	350 kHz
90° ±40°	87.5 kHz	350 kHz
90° ±45°	80.0 kHz	320 kHz
90° ±50°	74.0 kHz	296 kHz

The QTG-910 provides "RS-485 compatible" differentially driven outputs (EXTREF and EXTREF') which transmit the "net forward distance" of the position encoder to the Motion Reference Bus.

2.3 QTG-900 Unipolar Operation

It is possible to select unipolar operation with the QTG-900 to generate digital position and analog velocity reference signals for slave mode PMC-900s which are following a remote position reference such as a digital position encoder. However, since the QTG-900 does not perform encoder backup compensation, **it is not recommended that the QTG-900 be used for this purpose** unless an ORMEC EBC-900 is used to perform the encoder backup function and provide the interface to the Motion Reference Bus.

For unipolar operation with the QTG-900, the "OPT5'" jumper **must be removed** from header JM1. In this case, the TACHOUT output signal will be positive

when the encoder travels in the "forward" direction, and at zero volts when the encoder travels in the "reverse" direction.

In addition to providing an analog voltage for speed reference by slave PMCs, the QTG-900 also provides a digital pulse train (EXTREF and EXTREF') for encoder position information. This pulse train is a result of "4x multiplication" encoder quadrature decode circuitry, meaning that a pulse is generated for each transition of either quadrature channel.

SPECIFICATIONS

3.1 Mechanical

The Quad-Tach-Generator is a PCB with dimensions 4.5" x 4.5" mounted on an 1/8" aluminum "L" bracket with a footprint of 1.25" x 4.5". This bracket has two key-hole mounting points to mount the assembly to a panel. See Appendix 5.1 for a layout diagram of the QTG-900 and Appendix 5.3 for a layout diagram of the QTG-910. The schematic diagrams for the QTG-900 and QTG-910 are in Appendixes 5.2 and 5.4 respectively.

3.2 Power Requirements

Power is provided to the QTG at the TB1 terminal block connector as described below:

Power	TB1 Pin	Voltage	Max. Current
Digital	1	+5 vdc ±5%	200 ma
Digital Common	2	+5 vdc common	
Analog	3	+12 or +15 vdc ±5%	20 ma
Analog Common	4	±12 vdc common	
Analog	5	-12 or -15 vdc ±5%	20 ma

INSTALLATION

4.1 Main Connector - TB1

This connector is a Phoenix 21-pin removable terminal block which plugs into terminal block header TM1, located on the front of the board. It provides termination points for all power and signals for the QTG operation. The connector is split up into three logical sections: Power, Quadrature Inputs, and Reference Outputs.

Pin	Name	Description
TB1-1	+5V	Main connection for +5 VDC Power Supply
TB1-2	DGND	Digital Ground
TB1-3	+12V	+12 VDC or +15 VDC Power Supply
TB1-4	AGND	Analog Ground (tied to DGND on board)
TB1-5	-12V	-12 VDC or -15 VDC Power Supply
TB1-6	SHIELD	EMI Isolated Shield Connection Point
TB1-7	KEY	Location for a polarizing key (no pin)
TB1-8	CHA	Quadrature Channel A
TB1-9	CHA'	Logical Complement of CHA
TB1-10	CHB	Quadrature Channel B
TB1-11	CHB'	Logical Complement of CHB
TB1-12	CHZ	Quadrature Zero Reference
TB1-13	CHZ'	Logical Complement of CHZ
TB1-14	SHIELD	EMI Isolated Shield Connection Point
TB1-15	DGND	Digital Ground
TB1-16	+5V	+5 VDC connection to power an Encoder
TB1-17	EXTREF	A reference pulse train providing one output pulse for each transition of the quadrature signals. This signal is compatible with the Motion Reference Bus on PMC-900 series Programmable Motion Controllers.
TB1-18	EXTREF'	Logical Complement of EXTREF
TB1-19	SHIELD	EMI Isolated Shield Connection Point
TB1-20	AGND	Analog Ground
TB1-21	TACHOUT	The analog voltage signal providing a speed reference.

4.2 Configuration Header - JM1

4.2.1 QTG-900 Configuration Header - JM1

This dual-row 10-pin 0.1" header located on the bottom edge of the unit provides two kinds of configurability to the QTG-900.

1) Configuration of the maximum quadrature input frequency of the board.
2) Configuration of the analog output.

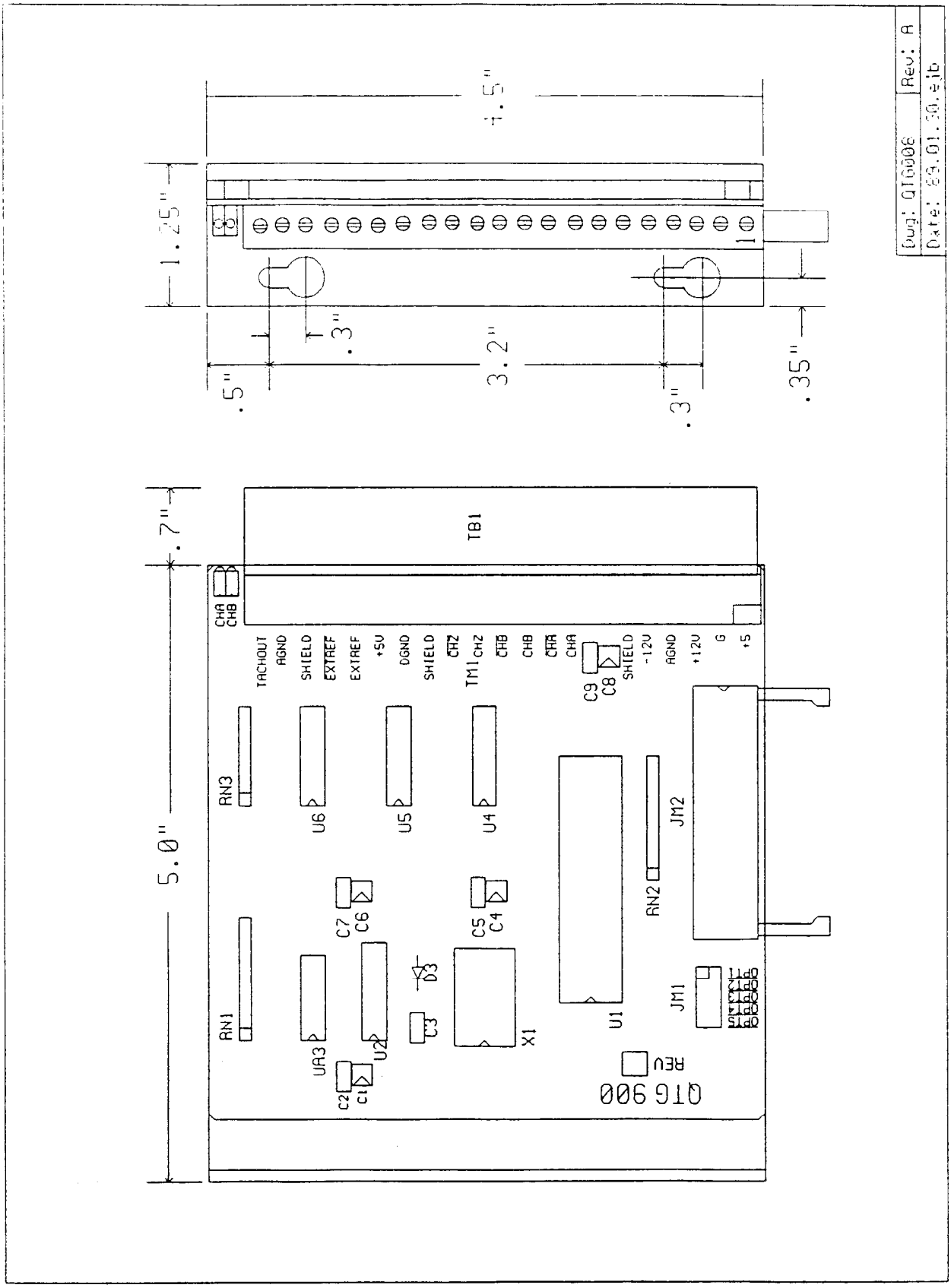
To enable an option, a jumper block must connect the desired odd pin of the jumper block to the even side. All even pins are grounded to the Digital Ground.

Pin	Name	Description
JM1-1	OPT1'	Select 125 kHz maximum quadrature frequency (factory default position)
JM1-3	OPT2'	Select 62.5 kHz maximum quadrature frequency
JM1-5	OPT3'	Select 31 kHz maximum quadrature frequency
JM1-7	OPT4'	Select 16 kHz maximum quadrature frequency
JM1-9	OPT5'	Select BIPOLAR analog output. (factory default position) When this jumper is removed, the analog output will be positive when CHA leads CHB and zero when CHB leads CHA.
JM1-Even	DGND	Digital Ground

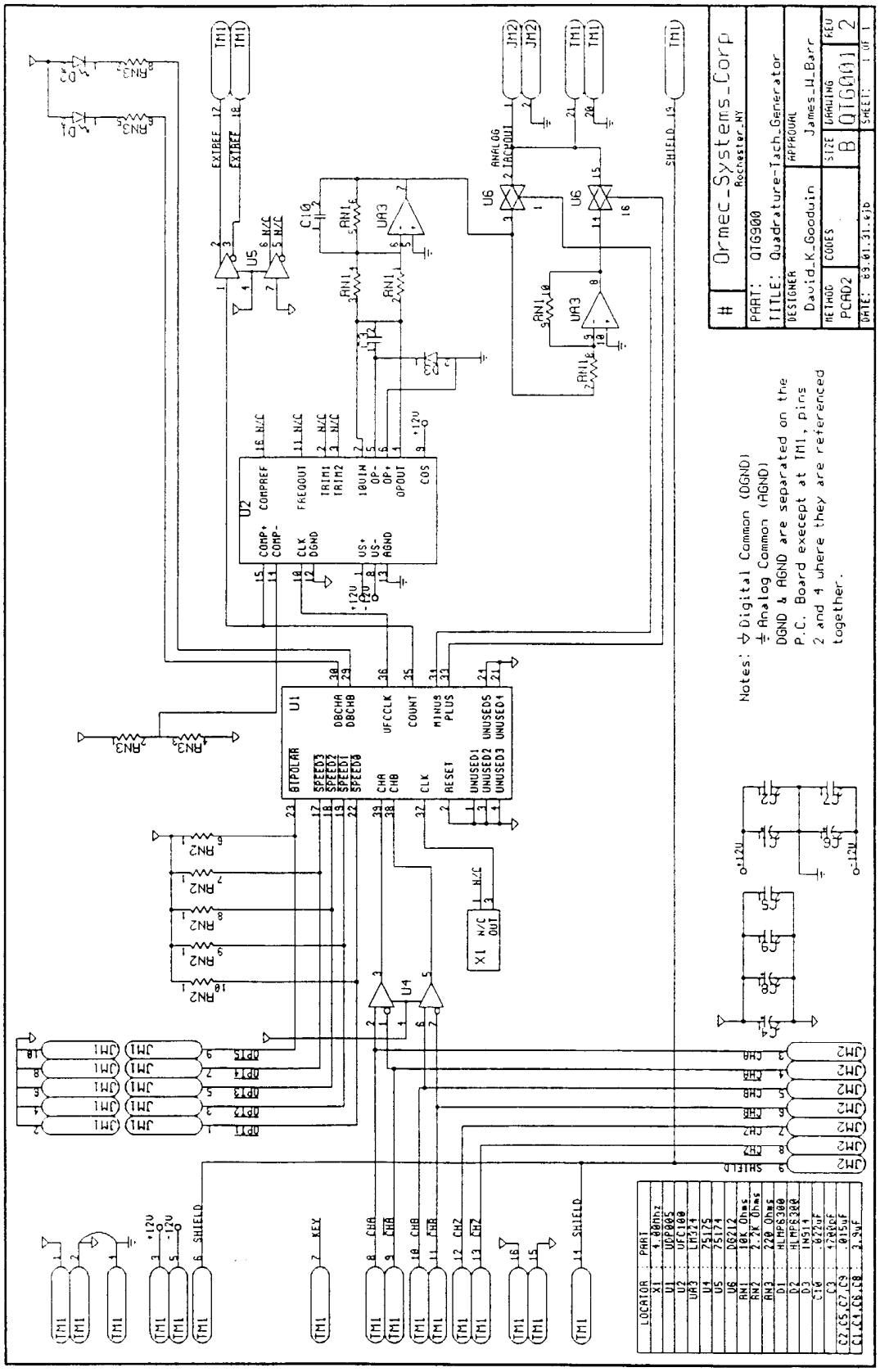
4.2.2 QTG-910 Configuration Header - JM1

This single-row 3-pin 0.1" header located on the top edge of the unit is used to select three possible analog output gains. The factory configuration is to set the maximum analog output at 2.5 volts for the maximum quadrature frequency of the QTG-910. This is accomplished by strapping JM1-2 to JM1-3 (G1). Strapping JM1-2 to JM1-1 (G4) will provide an analog gain of 4, raising the maximum analog output to 10 volts. Leaving this header unstrapped provides an analog gain of 2, with a corresponding maximum analog output of 5 volts.

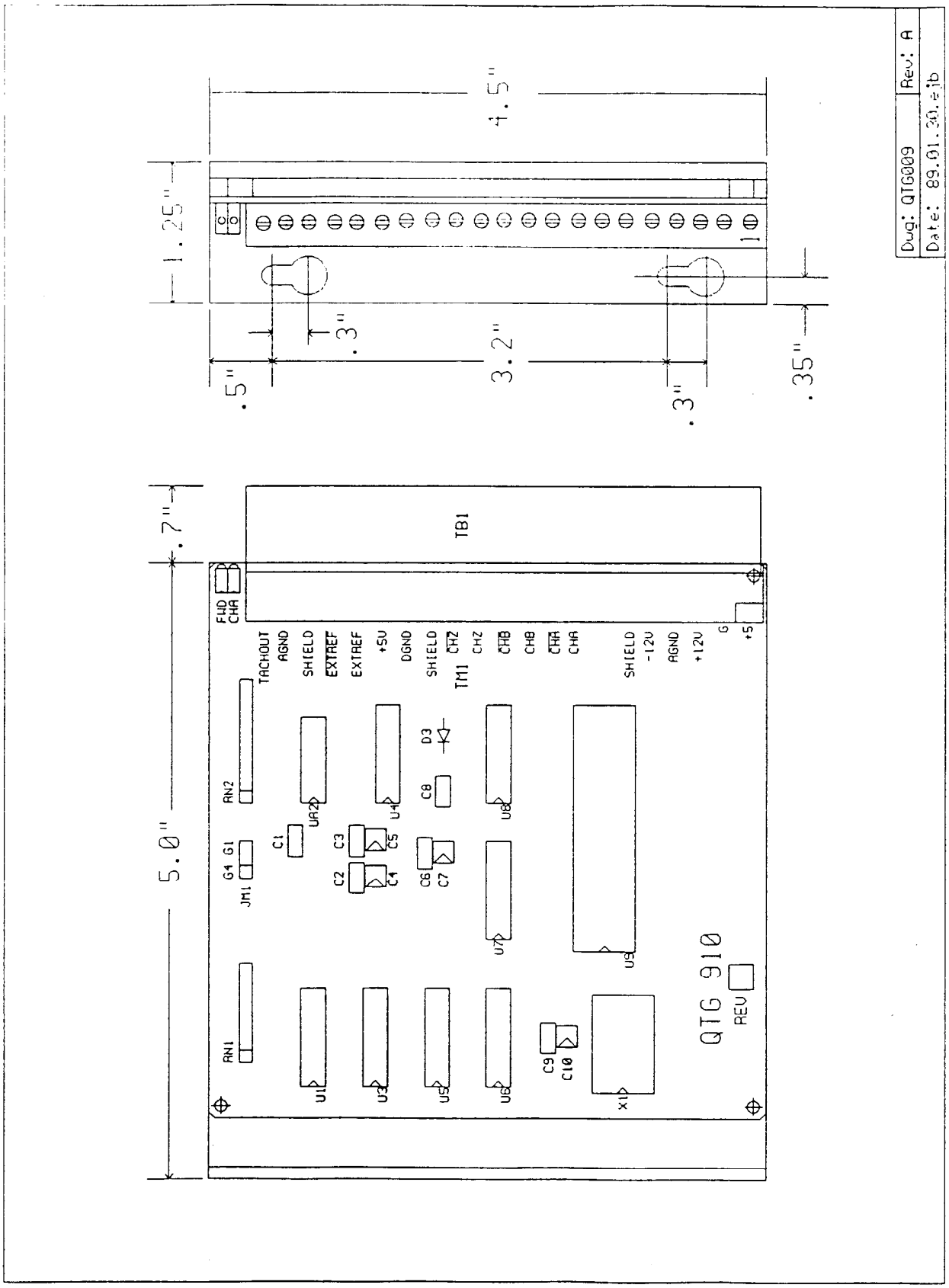
5.1 QTG-900 LAYOUT DRAWING



5.2 QTG-900 SCHEMATIC DRAWING



5.3 QTG-910 LAYOUT DRAWING



5.4 QTG-910 SCHEMATIC DRAWING