



RIC-2

Repeater Interoperability Controller

Manual Revision: 2010-04-21

Covers Loader Firmware Revisions:

1.6 & Higher

Covers Application Firmware Revisions:

1.0 & Higher

Covers PCB Revisions:

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TABLE OF CONTENTS

Specifications	3
General Information	4
Hardware Installation	5
Hardware Alignment	7
Jumper Settings	9
Controls & Indicators	10
Operation	11
Product Programming	12
Theory of Operation	13
Technical Notes	15
Contact Information	15

SPECIFICATIONS

Voltage/Current:

Operating Voltage:	13-18 VDC
Operating Current (standby):	125 mA
LED Current:	4 mA
Fuse Protection Auto Resettable with surge suppression:	300 mA

RX Input from Radio:

Compression Range:	Not more than 3 db change for 30 db increase above threshold
Frequency Range:	300-3000 Hz
Notch Filter Depth:	45 db relative to 1 KHz
Dynamic Range	30 dB
COR Input	0-5 V

TX Outputs to Radio:

Compression Range:	Not more than 3 db change for 30 db increase above threshold
Notch Filter Depth:	45 db relative to 1 KHz
Output Impedance (TX):	600 Ohms or 22 K Ohms
Output Tone Level:	2/3 System deviation
PTT Out:	Open-Collector

Dedicated Phone Line:

Input Level	+10 to -25 dB
Input Impedance	600 Ohm Balanced
Output Level	-20 to 0 dB pot adjustable
Output Impedance	600 Ohm
Fuse Protection Auto Resettable with surge suppression:	300 mA

Mechanical:

Dimensions:	1.45" H x 6" W x 7.6" L
Operating Temp:	-30° to +60° C

Default Control Tone Frequencies & Timing:

Function Tone	Frequency	Level & Duration
High-Level Guard	2175 Hz	+10 dBm for 120 msec
Low-Level Guard	2175 Hz	-20 dBm continuous
F1	1950 Hz	0 dBm for 40 msec
F2	1850 Hz	0 dBm for 40 msec
F3	1750 Hz	0 dBm for 40 msec
F4	1650 Hz	0 dBm for 40 msec
F5	1550 Hz	0 dBm for 40 msec

GENERAL INFORMATION

The RIC-2 is a tone remote adaptor that allows repeaters connected by dedicated phone line, telemetry link or microwave to key one another. For instance when Repeater A receives a signal from a portable or mobile radio, the repeater will give a COR signal to the RIC-2. The RIC-2 will generate 2175 Hz high-level guard tone, function tone and low-level guard tone to key Repeater B and re-transmit the audio coming from Repeater A. F4 is used to have Repeater A key Repeater B and F5 is used to have Repeater B key Repeater A.

Additionally, a tone remote controller can be connected with two RIC-2 units for steering control mode. In addition to a Repeater A and Repeater B scenario above (interoperability mode), the tone remote controller can transmit to Repeater A using F1 or Repeater B using F2 or using F3 the tone remote controller can simulcast on both Repeater A and Repeater B simultaneously.

Be certain to follow standard anti-static procedures when handling any of Midian's products.

Getting Started:

The RIC-2 has a number of adjustment potentiometers and configuration jumpers. These have been adjusted and configured at the factory for a typical installation. However, audio levels should be verified and adjusted (if necessary) at the time of installation. Also, the configuration jumpers should be inspected prior to installation to verify that they are in the right configuration. Jumper descriptions appear in the jumper settings section with a quick reference table.

Line Interface

The line interface connector CON7 is a 10-pin RJ-45 style connector on the left side of the back panel.

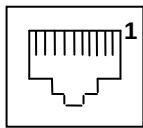


Diagram 3.1

2-Wire Operation: For a 2-wire installation, simply connect pins 5 and 6 (red and green) to the dedicated line. A standard 4 conductor phone cable will function properly in connector CON7. This is the standard configuration for the RIC-2. See table 3.1.

Table 3.1

Pin	Color	2-Wire
CON7-4	Black	Not Used
CON7-5	Red	Line 1
CON7-6	Green	Line 1
CON7-7	Yellow	Not Used

4-Wire Operation: For a single line 4-wire installation, connect pins 4 and 7 (black and yellow) for transmit audio to the base station (Line In) and pins 5 and 6 (red and green) for receive audio from the base station (Line Out). For this feature RIC Option J must be ordered and installed in the RIC-2. JP27 should be moved to the 2-3 position. See table 3.2.

Table 3.2

Pin	Color	4-Wire
CON7-4	Black	TX (Line In)
CON7-5	Red	RX (Line Out)
CON7-6	Green	RX (Line Out)
CON7-7	Yellow	TX (Line In)

Telemetry Radio: Rather than connecting the RIC-2 to a dedicated line to communicate with other RIC-2 units, telemetry radios can be used for communication. To use the RIC-2 with a telemetry radio, the RIC-2 must be ordered for use with the telemetry radio. If connecting to a telemetry radio connect CON7 as follows to the radio:

CON7-1: +VIN:

CON7-2: TX Audio Output: Connect to the mic-hi input of the radio.

CON7-8: PTT Output: Connect to the PTT of the radio.

CON7-9: RX Audio Input: Connect to a point in the radio providing flat receive audio.

CON7-10: Ground: Connect to the ground of the radio.

Microwave: To use the RIC-2 with a microwave system, the RIC-2 must be ordered for use with the microwave system. Connect the 4-wire audio to the TX and RX sides of the microwave. Connect the microwave's M lead to CON7-8 for an open collector to ground.

Radio Interface:

CON6 is located in the middle of the back panel and is used to connect the RIC-2 to the base station radio or repeater. The following are the connection points:

CON6:

CON6-2 (Orange): COR: Connect this lead to the busy detect of the radio. This input is to generate tone remote tones to cause other connected RIC-2 to key their repeaters or to control whether audio should be passed down the line to the tone remote controllers. A logic low from the radio's busy circuit will activate Q6.

CON6-5 (Green): TX Output: Connect to the microphone input of the base station/repeater.

CON6-6 (Red): Battery (13-18 VDC): Connect this lead to 13-18 VDC from the base station/repeater.

CON6-7 (Black): Ground: Connect this lead to the base station's or repeater's ground.

CON6-8 (White): RX Input: Connect the receive audio in the base station after the sub-audible hi-pass filter and at some point that gives flat audio to the RIC-2. Speaker audio is fine if it is single ended, but make certain the volume control cannot be turned down accidentally.

CON6-9 (Blue): PTT Output: Connect this lead to the PTT on the radio. This output is an open-collector to ground.

HARDWARE ALIGNMENT

The alignments are preset at the factory and should not need to be adjusted during installation. However, if an adjustment is needed please follow the procedures below.

TX Input Line Level Adjustment:

1. With the dedicated line connected to the RIC-2, connect a line level meter to the red and green (2-wire) or yellow and black (4-wire option) in bridging mode.
2. Configure the line level meter to generate continuous low-level guard tone (2175 Hz at -20 dBm).
3. Adjust RP13 while monitoring TP10 with an oscilloscope, so that TP10 shows 1.2 V p-p. Also verify that JP26 Pin 2 shows 220 mV p-p.

TX Notch Filter Alignment:

1. Continue generating the low-level guard tone from the line level meter in the previous step.
2. Monitor TP8 with a Sinadder. The audio level of the Sinadder should be adjusted to hear the tone.
3. Adjust RP9 until the tone is at it's most diminished point.
4. Adjust RP10 until the tone fully diminishes. If this step does not get rid of the tone go to step 5.
5. Repeat steps 3 and 4 until no tone is heard.

TX Bandpass Filter Alignment:

1. Reconfigure the line level meter to generate a continuous high-level guard tone (2175 Hz at +10 dBm).
2. Adjust RP7 while monitoring TP6 with an oscilloscope, so that TP6 is approximately 5.8 V p-p.

TX Mod Level Adjustment:

1. Reconfigure the line level meter to generate a continuous 1 KHz tone at -10 dBm.
2. With JP25 in the 1-2 position the output impedance is 22 K. For radios with a 600 Ohm impedance put JP25 in the 2-3 position.
3. Adjust RP8 for full system deviation.

RX Input Line Level Adjustment:

1. With voice being received from the base station adjust RP3 while monitoring TP1 with an oscilloscope, so that TP1 shows around 700 mV p-p. Also verify that JP22 Pin 2 shows around 180 mV p-p.

RX Notch Bandpass Alignment:

1. Generate the low-level guard tone (2175 Hz at -20 dBm) using the line level meter to the RX Input from the radio.
2. Monitor TP2 with a Sinadder. The audio level of the Sinadder should be adjusted to hear the tone.
3. Adjust RP5 until the tone is at it's most diminished point.
4. Adjust RP4 until the tone fully diminishes. If this step does not get rid of the tone go to step 5.
5. Repeat steps 3 and 4 until no tone is heard.

RX Output Line Level Adjustment:

1. With voice being received from the base station adjust RP6 while monitoring the line out with a line level meter and set for approximately -10 dBm on average voice or -5 dBm on peak voice.

Duplex Parallel Crossover Adjustment:

1. If the RIC-2 is ordered with the 4-Wire Option it may be necessary to program one of the RC-2's for parallel crossover. This allows audio from the TRC tone remote controller's TX line to be fed into the RX port of one RIC-2 and then crossed over to it's TX port to the other RIC-2's RX port. Set RP15 for a level adequate to activate the busy indication on the other tone remote(s) and to a level that is comfortable. This is not necessary if used only for interoperability between Repeater A and Repeater B. The simplest way to use the RIC-2 is with 2-wire mode.

JUMPER SETTINGS

The following tables shows the default jumper settings and their function:

Jumper Number	Default Position	Description
SJ15	Out	De-Emphasis jumper
JP22	1-2 Out – 2-3 In	AGC Compander Circuit bypass
JP25	1-2 In – 2-3 Out	22K versus 600 Ohm impedance selection
JP26	1-2 Out – 2-3 In	AGC Compander Circuit bypass
JP27	1-2 In – 2-3 Out	4-Wire Option
JP36	1-2 In	Termination jumper
JP37	1-2 In	Termination jumper – 4-Wire Option
JP38	1-2 In	Termination jumper – 4-Wire Option
JP40	1-2 In	Termination jumper
JP41	1-2 Out	Out = Unit 1 – In = Unit 2
JP44	1-2 Out	Install only in 4-Wire mode

CONTROLS & INDICATORS

Power LED: This red LED indicates that power is applied to the unit and that the switch is on.

Transmit LED: This red LED indicates that the unit is applying push to talk to the base station or repeater.

COR/MON LED: This red LED indicates when carrier is detected on the base station radio, thus causing the RIC-2 to generate 2175 Hz high and low level keying tones to other RIC-2 units.

Tone LED: This red LED indicates presence of low-level guard tone.

F1-F2 LEDs: The F1 or F2 LED indicates if the RIC-2 is Unit 1 or Unit 2 when used in control mode.

Interoperability Mode:

In the interoperability mode, two repeaters or base stations can be cross connected to allow portable and mobile radios on Repeater A to talk to portable and mobile radios on Repeater B and vice versa.

When connecting two RIC-2's together, set each RIC-2 to a different Unit ID number. By default, each unit comes with JP41 in the out position which defines the unit as Unit ID #1. To change to Unit ID #2, install the JP41.

Repeater A receives audio and issues a COR to the RIC-2 Unit ID #1. The RIC-2 sees the COR signal and then generates the High Level Guard Tone, followed by a F4 function tone, followed by a Low Level Guard Tone as long as Repeater A is generating a COR signal. This sequence of events will cause the second RIC-2 Unit ID #2 to decode the keying tones and key up Repeater B and transmit the audio received from Repeater A using the RIC-2 Unit ID #1. The reverse of this process from Repeater B going to Repeater A is the same except the RIC-2 Unit ID #2 will use a F5 function tone.

General operation of the two RIC-2 units are the same for both two wire and four wire interfacing with one minor difference that deals with looping a receive path back into the transmit path.

NOTE: If the receiving audio is longer than 2 minutes, the RIC-2 unit will disconnect the receiving audio path and will not allow any more receiving audio from the repeater until the COR signal has been non-active for 5 seconds.

Tone Remote Control Mode:

In the steering control mode, there would be two repeaters to be connected as well as a tone remote controller such as Midian's TRC series.

For example, the two RIC-2 units mentioned in Interoperability Mode will still operate in the same manner as described. In Tone Remote Control Mode the tone remote controller can control the RIC-2 units. The RIC-2 Unit #1 will key Repeater A if the tone remote controller uses the F1 function tone. The RIC-2 Unit #2 will key Repeater B if the tone remote controller uses the F2 function tone. If the tone remote controller uses the F3 function tone then both repeaters will simulcast.

Note: If you are using a TRC that has the capability of displaying/following the last function tone decoded, it is important to remember that only the F1 through F3 function tones will correctly steer the audio to the appropriate repeaters. This is because the RIC-2 units use the F4 and F5 function tones to talk to each other and some TRC's will decode and display this information. Additional operator training may be necessary to be certain that the transmitted audio from a TRC is steered in the correct direction.

Note: If the installation requires the two RIC-2 units and a TRC unit in a four wire configuration, you must configure one of the RIC-2 units with a looping receive audio path and leave the second RIC's looping receive audio path disconnected. Failure to do so will only allow the TRC to receive audio from one repeater or the other depending on how everything is wired.

Note: If the TRC that is planned for use employs a cross mute feature, it would be advisable to disable that feature in the TRC. Otherwise, you will most likely never hear any audio from either repeater.

PRODUCT PROGRAMMING

Unit # 1: With JP41 uninstalled the RIC-2 is configured for Unit # 1.

Unit # 2: With JP41 installed the RIC-2 is configured for Unit # 2.

Duplex Parallel Crossover: Installing JP44 enables the Duplex Parallel Crossover. If the RIC-2 is ordered with the 4-Wire Option and is being used in the tone remote control mode it may be necessary to program one of the RC-2's for parallel crossover. This allows audio from the TRC tone remote controller's TX line to be fed into the RX port of one RIC-2 and then crossed over to it's TX port to the other RIC-2's RX port. This is not necessary if used only for interoperability mode between Repeater A and Repeater B.

TX Voice Path:

Phone line audio from the tone remote controller is fed into the TX voice path in simplex mode through transformer T1. In 4-wire mode it is fed into transformer T2 and is selected by jumper JP27. Both transformer circuits have surge suppression and an auto-resettable polyswitch for lightning protection. They each have RF chokes and RF bypass caps to keep out any RF that may get into the phone lines. For best results an extra Earth ground connection is provided at J1.

Audio is input through Pin 2 of JP27 through a hi-pass filter C123 and RP13 to block any 60-cycle hum from an unbalanced phone line. Audio is then passed into TX amp low pass filter U14:3. The low pass filter rolls off noise above 3 KHz. Its output is about 1.2 V p-p with -20 dBm with low-level guard tone on the phone line. The output of this amp passes through compression amp circuit U14:4 and U7B. Its output is about 155 mV p.p. This is the threshold of compression. Jumper JP26 allows you to select the compressed audio or non-compressed audio. When using short phone lines with stable levels you may choose to use the non-compressed audio as the audio coming from the tone remote controller is already compressed. Several competing units do not employ the compression circuit.

Pin 2 of JP26 is the input into a bi-quadratic filter U15:2, U15:1, and U15:4. The band pass output is on Pin 7 and can be peaked using frequency tuning pot RP9. The frequency tuning 25-turn pot RP9 will tune over a range of 1 KHz from 2100 to 3100 Hz. The band pass output on Pin 7 is fed into notch null pot RP10 along with the voice and Guard Tone through R179 into RP10. The two Guard Tone frequencies are 180 degrees out of phase and cancel at the input of U15:3. From U15:3's output the remaining voice is fed into C89 where an optional voice scrambler may be installed. From the other side of C89 it is passed into mixer U14:1 and then output through a high Z or low Z circuit to the base station's modulator. This amplifier is also a mixer for the pulse width modulator encoder.

RX Voice Path:

RX audio from the base station goes through hipass filter C39 and RP3. RP3 also serves as the RX input level adjustment pot. This audio is then fed into amplifier U8:2 which acts as low pass filter for noise above 3 KHz and if jumper SJ15 is installed it can give a 6 dB per octave de-emphasis if desired.

Audio from U8:2 is fed into the compression amplifier U7A and U8:1 or it can be bypassed around the compressor using JP22. From JP22 it goes to C56 where an optional voice scrambler may be installed. From there it passes through the notch filter to remove 2175 Hz voice components. This circuit works in exactly the same way as the description for the TX Voice Path. Voice audio from the notch filter is input into the audio mixer U8:4. This mixer also receives duplex crossover audio and MSK encoded audio. Out of the mixer they are then input into the line amplifier (U20:1) which drives T1.

Signaling Path:

Signaling audio from T1 or T2 passes through the TX amp U14:3. Tone remote audio from input level pot RP13 is fed into the Guard Tone state variable band pass filter and into the broadband function tone detector circuit via U10:3. The Guard Tone frequency is normally 2175 Hz, and the high Q state variable filter has a 6 dB bandwidth of about + or - 70 Hz. It is then fed into the Guard Tone detector U11:3 and Schmitt Trigger U10:1 and level shifter Q23 to the microprocessor for frequency validation. Once it has been validated and checked for the proper timing, the microprocessor then looks at the function tone output from Q22 and performs the monitor or frequency function following the high-level Guard Tone command. U10:2 is a high gain amp for the function tone followed by Schmidt trigger U10:4.

Power Supply:

13-18 VDC is input on the red wire of the Radio Interface connector and then into a resettable polyswitch. D22 is a polarity protection diode that is designed to pop the resettable fuse if power is hooked up backwards. C31 and C34 act as RF bypass caps after the RF inductor L7. U6 acts as a 12 VDC regulator. Its output is fed to all of the analog circuitry and U14B acts as a pseudo-ground reference at approximately 6 VDC. The 12 VDC on the analog page schematic is also fed over to U4 which is a 5 VDC regulator shown on the digital page to run the

microprocessor and the optional encoders/decodes and serial chips. The relays on the digital page receive their 12 VDC from the 12 VDC regulator. They are driven by open-collector transistors to protect the microprocessor from the 12 VDC.

Microprocessor Schematic:

The microprocessor utilizes a 16 MHz clock and is a flashable part.

On the right hand side of the microprocessor page we have all of the LED functions shown. See the Control and Indicators section.

This product includes a pulse width modulator output from the microprocessor that is fed into emitter follower Q3 and output on level pot RP2. This is fed into the TX audio path for transmitting the 2175 Hz high level guard tone and the F4 or F5 functions tones followed by the 2175 Hz low level keying tone.

TECHNICAL NOTES

No technical notes are available at this time.

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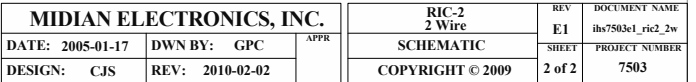
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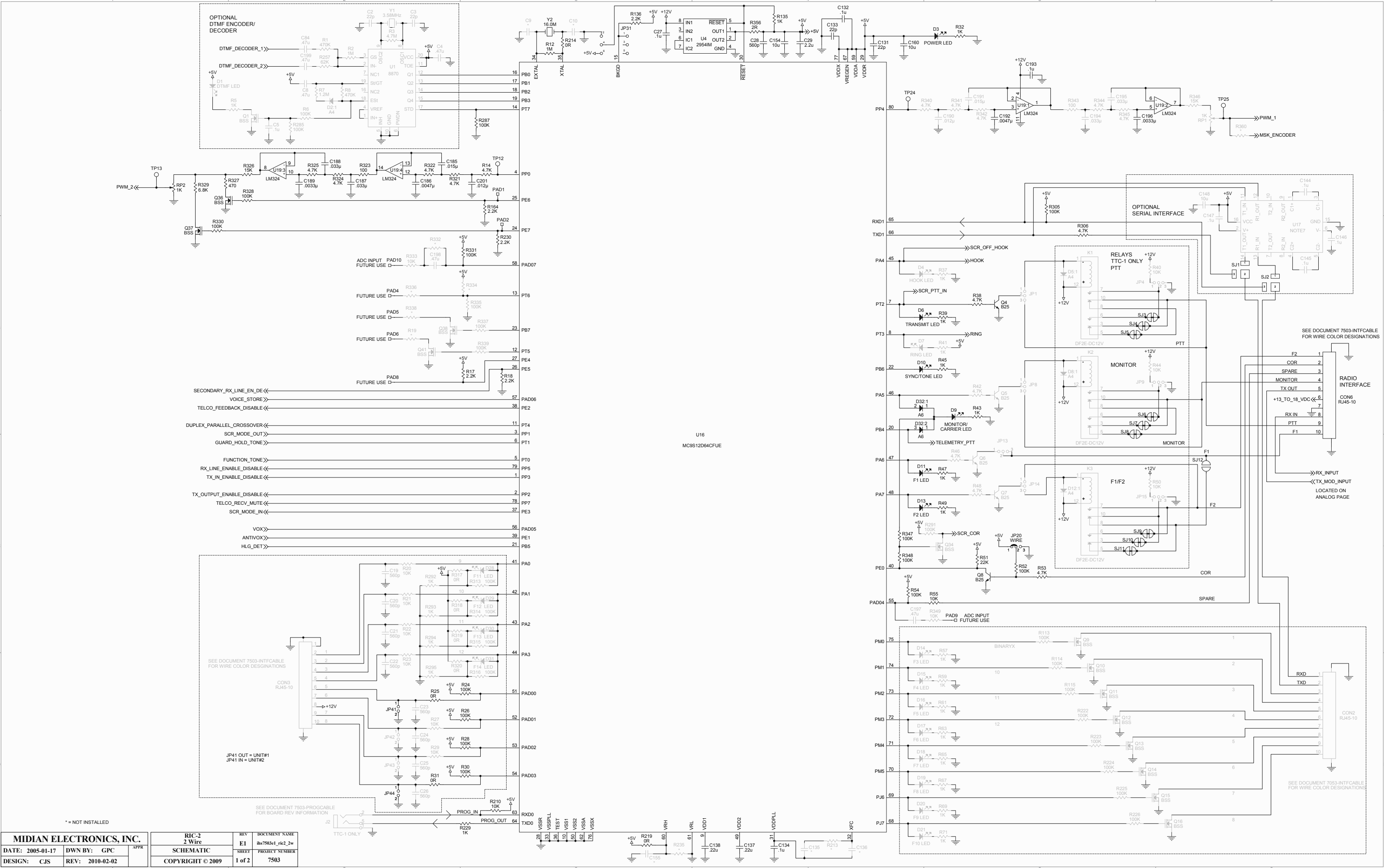
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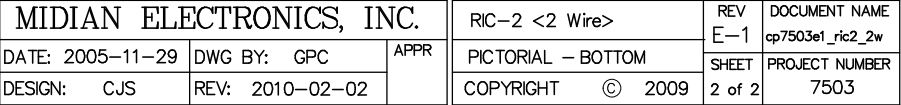
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DESIGN: CJS	REV: 2010-02-02		COPYRIGHT © 2009	SHEET	PROJECT NUMBER
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