UNIVERSIDAD RICARDO PALMA

FACULTAD DE INGENIERIA

ESCUELA ACADEMICO PROFESIONAL DE INGENIERÍA ELECTRÓNICA

“IMPLEMENTACIÓN DE SISTEMA DE MEDICION DE TEMPERATURA EN LINEA, EN CHUMACERAS DE POLEAS Y REDUCTOR DE FAJA 1300-CV-12001, USANDO TECNOLOGIA WIRELESS EN GOLD MILL MINERA YANACOCHA”

INFORME TÉCNICO POR EXPERIENCIA LABORAL PARA OPTAR EL TÍTULO PROFESIONAL DE INGENIERO ELECTRÓNICO

PRESENTADO POR:

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DEDICATORIA.

A mi familia y a Dios por ser motor y motivo de mi vida.

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INTRODUCCIÓN

El crecimiento minero en nuestro país ha sufrido cambios significativos con respecto a la producción de metales preciosos tales como cobre, oro y plata, lo cual ha significado que empresas de gran envergadura inviertan en proyectos mineros que han dejado bien posicionado el nombre de nuestro país logrando que se convierta en uno de los principales proveedores de oro y cobre en el mundo, actualmente ocupa el sexto lugar en la lista de proveedores de este metal a nivel mundial.

Si hablamos de Cajamarca, en esta ciudad se concentra la mayor producción de oro en el Perú ver figura.1; haciendo tentativa cualquier tipo de inversión extranjera referida a este rubro. A todo esto se le debe agregar la subida lineal que ha experimentado el precio del oro en los últimos años (ver *Tabla 1*), manteniendo ganancias muy por encima de los capitales invertidos, pero esto trae consigo que las grandes plantas de procesamiento de mineral demanden altos costos de mantención y por otro lado las normativas vigentes en nuestro país hacen que el cuidado del medio ambiente y la operación minera se hallan convertido en aliados, ya que se ha establecido desde mi punto de vista una relación ganar-ganar donde se debe invertir no solo en la extracción del metal precioso si no en mantener y preservar el medio ambiente a fin de poder mantener relaciones estratégicas con las comunidades y gobiernos locales. Minera Yanacocha gracias a su poder de adquisición facilita el desarrollo e implementación de proyectos tecnológicos de mejoramiento técnico en cualquiera de sus distintos procesos productivos, generando así iniciativa y desarrollo profesional entre sus empleados haciendo atractivo el uso de cualquier tecnología de vanguardia para obtener mayor rentabilidad y mayores utilidades. Finalmente reflejará una buena gestión de los recursos y preservación de los activos de la compañía.

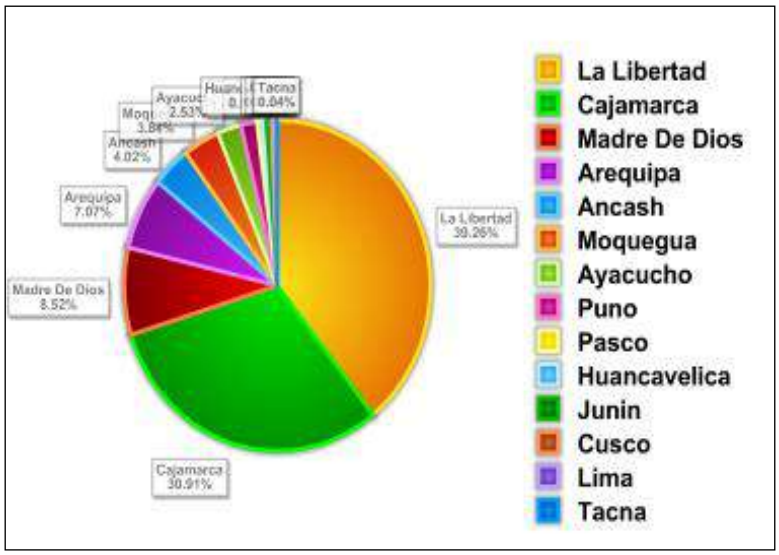


Figura 1. Participación Regional en la Producción de Oro

Nota. De “Estadísticas”, por el Ministerio de Energía y Minas (MINEM). Recuperado el 02 de Diciembre de 2010, del sitio web del MINEM:

Tabla 1 Evolución del precio del Oro 2000-2011

AÑO	COBRE	ORO	ZINC	PLATA	PLOMO	ESTAÑO
	Ctvs.US$/ lb	US$/OzTr	Ctvs.US$/lb	US$/OzTr	Ctvs.US$/lb	Ctvs.US$/lb
2000	82.24	279.37	51.16	5.00	20.59	246.57
2001	71.60	271.23	40.17	4.39	21.60	203.40
2002	70.74	310.13	35.32	4.63	20.53	184.18
2003	80.70	363.62	37.54	4.91	23.36	222.03
2004	129.99	409.85	47.53	6.69	40.21	383.13
2005	166.87	445.47	62.68	7.34	44.29	334.84
2006	304.91	604.58	148.56	11.57	58.50	398.29
2007	322.93	697.41	147.07	13.42	117.03	659.47
2008	315.51	872.72	85.04	15.01	94.83	839.60
2009	233.52	973.62	75.05	14.68	77.91	615.83
2010	342.28	1225.29	98.18	20.19	97.61	926.63
2011	400.20	1569.53	99.50	35.17	108.97	1183.96

Fuente:http://www.minem.gob.pe/descripcion.php?idSector=1&idTitular=2309&idMenu=sub151&idCateg=639

CAPITULO I. PLANTEAMIENTO DEL PROBLEMA

I.1. Descripción del proceso de producción de la empresa

I.1.1. Ubicación Geográfica

La empresa Minera Yanacocha está ubicada a 45 km de la ciudad de Cajamarca a una altura de 3800 m.s.n.m, es una empresa minera extractiva de cielo abierto, cuenta con cuatros locaciones geográficas importantes: (a) La Quinua, (b) Yanacocha Norte, (c) Pampa Larga y (d) China Linda en cada una de estas unidades productivas existen distintos procesos productivos siendo la base de todos estos el proceso de Lixiviación y Merril Crowe. Por otro lado cuenta con procesos secundarios con los cuales asegura el cuidado del agua y del medio ambiente como son los procesos de tratamiento de aguas ácidas (AWTP), y el tratamiento de aguas en exceso (EWTP). En el año 2008 se inauguró el primer proceso de molienda con el cual se marcó un hito en el procesamiento de mineral en Cajamarca siendo la pionera en tener un Molino semi-autógeno (SAG) con el cual incremento la producción significativamente haciendo que este sea un proyecto rentable.

I.1.2. Exploración

La exploración es la primera parte de un largo proceso. Consiste en ubicar zonas donde exista la presencia de minerales cuya explotación sea económicamente rentable. Inicialmente se utilizan reportes satelitales para determinar zonas mineralizadas en los lugares a explorar. Después, los geólogos recogen muestras (rocas) del suelo para conocer los elementos y minerales que las conforman. Si los análisis dan resultados positivos se procede con la perforación: se sacan muestras de diferentes profundidades (testigos) para determinar tipo, cantidad, profundidad y otras características del mineral. Finalmente se investiga y determina cuánto mineral existe en la zona. (Ver figura 2).

Figura 2. Exploración

Fuente. Procesos Minera Yanacocha 2010.Obtenido de http://www.yanacocha.com.pe/operaciones/proceso-de-producción/

Todas estas investigaciones se realizan siempre con previa autorización de la autoridad competente y de los pobladores de las zonas a explorar.

I.1.3. Pre-Minado

Antes de iniciar el trabajo de explotación en sí, fue necesario retirar del terreno la capa superficial de tierra orgánica (top soil) que permitió el crecimiento de vegetación en la superficie. Esto se hizo con equipos pequeños, y así dejar las condiciones necesarias para que en la etapa de minado se pueda explotar con equipos gigantes. En esta etapa la tierra orgánica se almacenó en áreas especiales para ser utilizada posteriormente en los trabajos de restauración del terreno o cierre de mina, este cierre de mina es el que se ejecuta en aquellas zonas donde ya se dejó de explotar. El trabajo fue realizado con equipos y mano de obra local. (Ver figura 3).

Figura 3. Pre minado

Fuente. Procesos Minera Yanacocha 2010.Obtenido de http://www.yanacocha.com.pe/operaciones/proceso-de-producción/

I.1.4. Minado

Consistió en la extracción del material que contiene oro y plata. Se inició con la perforación del terreno, para hacer unos agujeros que luego son llenados con material explosivo. Estos al ser detonados, fragmentan la roca y remueven subterráneamente el material exponiéndolo a la superficie. En esta etapa se aplicó el más alto estándar de cuidado en seguridad. (Ver figura 4).

Figura 4. Minado

Fuente. Procesos Minera Yanacocha 2010.Obtenido de http://www.yanacocha.com.pe/operaciones/proceso-de-producción/

I.1.5. Carguío y acarreo

Las explosiones que se realizan y la posterior remoción de tierra empiezan a formar grandes huecos en la tierra llamados tajos. Camiones gigantes (que pueden cargar hasta 250 toneladas de tierra) llevan el mineral extraído del tajo a la pila de lixiviación o PAD, que es la estructura donde se acumula el mineral extraído del cerro para ser lixiviado y así recuperar el oro existente. (Ver figura *5).*

Figura 5.Carguío y Acarreo

Fuente. Procesos Minera Yanacocha 2010.Obtenido de

http://www.yanacocha.com.pe/operaciones/proceso-de-producción/

Todos los camiones y las palas son controlados a través de un sistema computarizado "Dispatch" que permite conocer por satélite su ubicación exacta en todo momento.

I.1.6. Proceso de lixiviación en pilas

La pila o PAD de lixiviación es una estructura a manera de pirámide escalonada donde se acumula el mineral extraído. A este material se le aplicó, a través de un sistema de goteo, una solución cianurada de 50 miligramos por litro de agua, la cual disuelve el oro. Mediante un sistema de tuberías colocadas en la base del PAD, la solución disuelta de oro y cianuro – llamada solución rica – pasa a una poza de lixiviación o procesos, desde donde se bombea hacia la planta de procesos. (Ver figura 6).

Figura 6. Proceso de lixiviación en pilas

Fuente. Procesos Minera Yanacocha 2010.Obtenido de http://www.yanacocha.com.pe/operaciones/proceso-de-producción/

La base del PAD fue recubierta por una geo membrana, que es un material plástico de alta resistencia que impide el contacto de los químicos con el suelo, cuidando la calidad del agua.

I.1.7. Columnas de Carbón

Proceso que permite concentrar la cantidad de oro que hay en la solución rica, para luego recuperarlo en el proceso Merrill Crowe, el cual se da en dos etapas. La primera es la etapa de desorción, en la que haciendo circular una solución cianurada, se saca el oro atrapado en la superficie del carbón activado. La segunda etapa es la de adsorción; en ella se pasa la solución rica (con el oro en estado líquido) a través de columnas cargadas con carbón activado, para que el oro sea atrapado en los poros del carbón. (Ver Figura 7).

Figura 7. Planta de Columnas de Carbón

Fuente. Procesos Minera Yanacocha 2010.Obtenido de http://www.yanacocha.com.pe/operaciones/proceso-de-producción/

La solución rica en Oro y Plata es filtrada y limpiada. Luego se le elimina el oxígeno y se añade polvo de Zinc para precipitar el metal y hacerlo sólido. El producto del Merril Crowe es el que luego pasa al proceso de refinería.

I.1.8. Merrill Crowe

La solución pobre, sin oro, es llamada también Barren. Esta es enviada de nuevo al PAD, pasando antes por un tanque para agregarle el cianuro que se consumió durante el proceso. De esta manera se completa un circuito cerrado donde la solución utilizada no sale al medio ambiente, sino que se reutiliza constantemente. (Ver figura 8).

Figura 8. Merril Crowe

Fuente. Procesos Minera Yanacocha 2010.Obtenido de http://www.yanacocha.com.pe/operaciones/proceso-de-producción/

I.1.9.Refineria

El oro obtenido en el proceso Merrill Crowe es sometido a operaciones de secado en hornos de retortas a 650º C. Finalmente, el producto obtenido pasa por un proceso de fundición en horno de arco eléctrico a 1,200º C para obtener el Doré, que es una barra hecha de una mezcla de oro y plata. (Ver figura 9).

Figura 9. Refinería

Fuente. Procesos Minera Yanacocha 2010.Obtenido de http://www.yanacocha.com.pe/operaciones/proceso-de-producción/

I.1.10. Proceso Gold Mill

Mediante la planta de procesamiento de minerales “Gold Mill” (Molino de Oro) se busca procesar el metal que no puede ser obtenido mediante la lixiviación en pilas. El oro se recupera en 24 horas, a diferencia del proceso de lixiviación en pilas que dura casi 60 días. (Ver figura 10).

Figura 10. Proceso “Gold Mill”

Fuente. Procesos Minera Yanacocha 2010.Obtenido de http://www.yanacocha.com.pe/operaciones/proceso-de-producción/

La construcción del Gold Mill se inició a mediados del 2006 y concluyó a principios del 2008, con una inversión de 270 millones de dólares y un plan de producción de 9 años. 1500 trabajadores participaron en la construcción de esta importante obra que tiene una capacidad de procesamiento de 5, 000,000 ton/año.

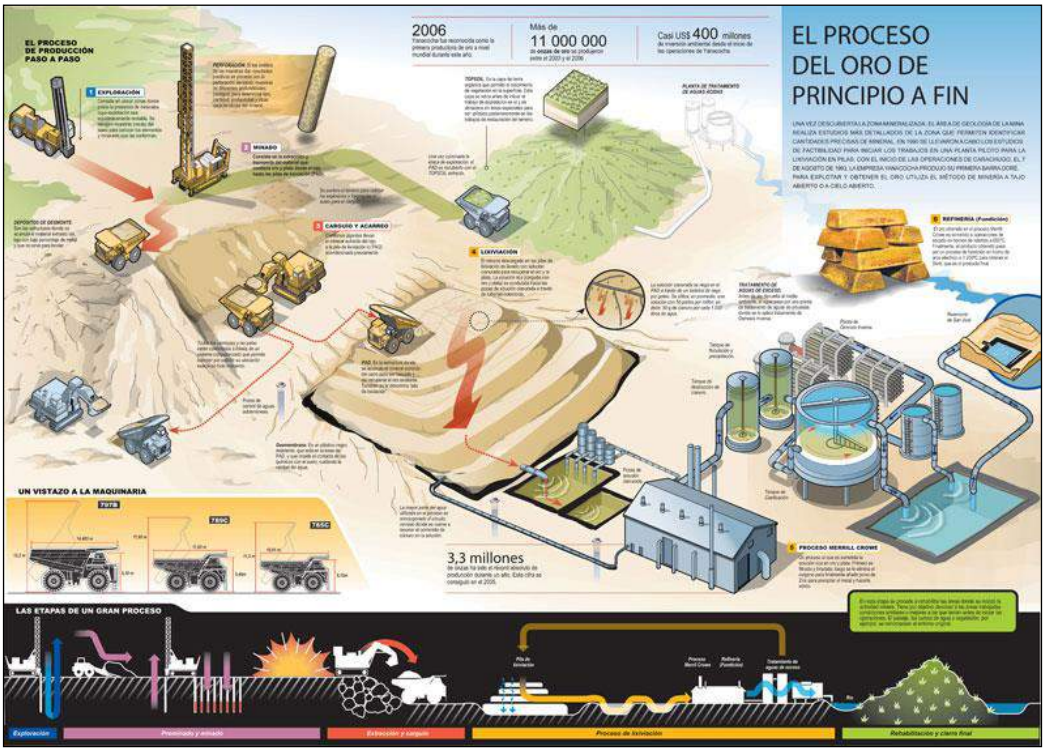


Figura 11. Proceso productivo de principio a fin.

Fuente. Procesos Minera Yanacocha 2010. Obtenido de http://www.yanacocha.com.pe/operaciones/proceso-de-producción/

I.1.11. Circuito de chancado

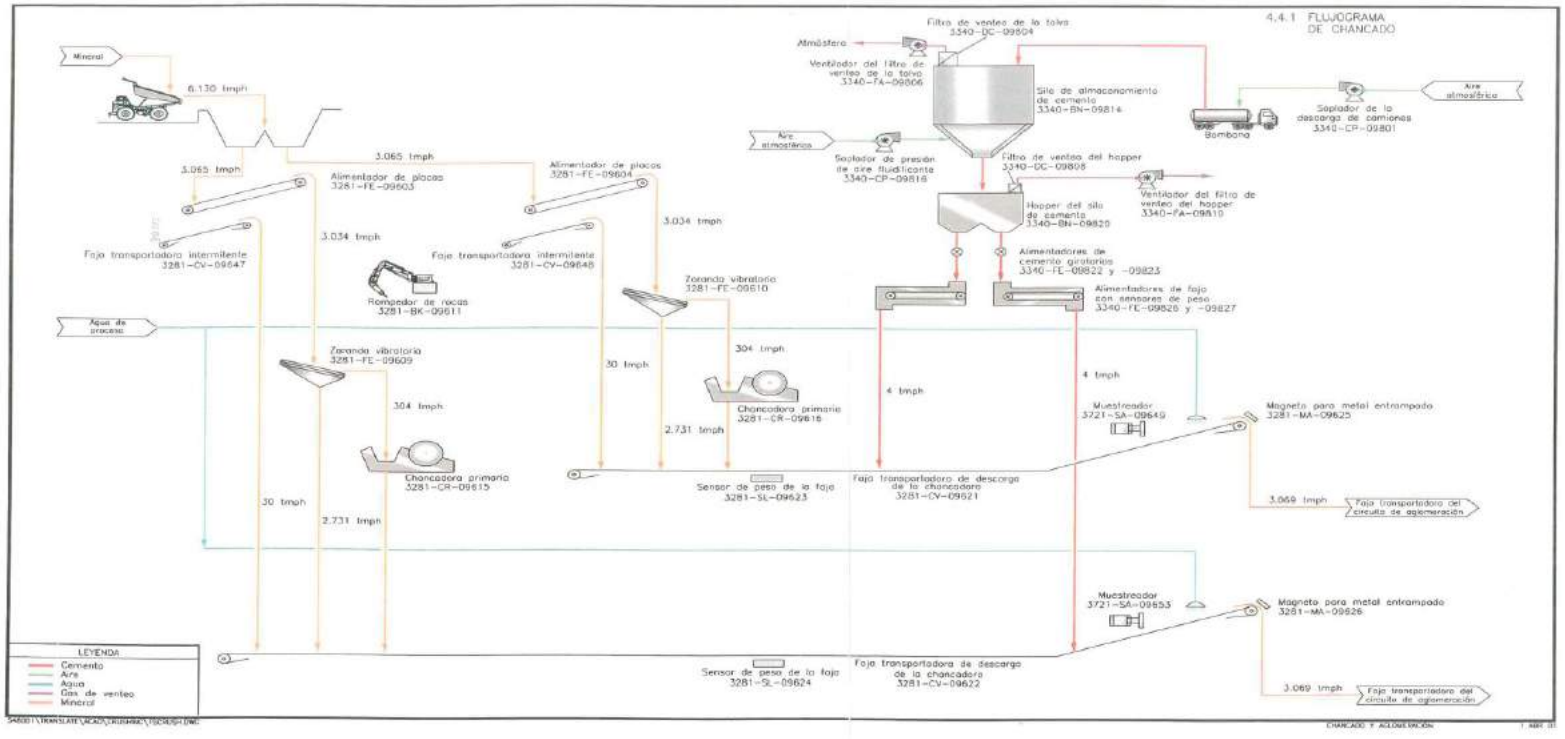


Figura 12. Circuito de chancado

Fuente. “Turn Over Package” circuito de Chancado (2002).

I.1.12. Circuito de Molienda

El circuito de molienda tiene el propósito de reducir el tamaño del mineral recibido desde el circuito de chancado hasta tener 80 por ciento pasando por 75 µm. La reducción de tamaño es necesaria para liberar el oro contenido dentro del mineral y hacerlo accesible a la lixiviación con cianuro.

El circuito de molienda fue diseñado para procesar 620 toneladas por hora, 24 horas al día, 365 días al año con un 92 por ciento de disponibilidad y una producción anual de aproximadamente cinco millones de toneladas. El único tiempo de parada programado es para las actividades de mantenimiento planificado.

La reducción de tamaño del mineral tiene lugar a través de la alimentación, molienda, clasificación y recirculación de "pebbles". Primero, el mineral es recuperado desde el "stockpile" de mineral chancado mediante tres alimentadores de placas y alimentado al molino semi-autógeno (SAG) donde es molido contra sí mismo y bolas de molienda en una acción de tamboreo. La descarga del molino pasa a través de un "trommel" donde los finos son clasificados en una batería de ciclones. El material grueso (pulpa de gruesos) de la batería de ciclones recircula hacia el molino SAG y los finos ("overflow" de los ciclones) fluyen por gravedad hacia el circuito de lixiviación y CCD. El material grueso del "trommel" del molino recircula hacia el molino SAG vía las fajas transportadoras del circuito de "pebbles".

Se usa agua de proceso conteniendo cianuro a través del área de molienda como agua de dilución y agua de rociado. El área de molienda está equipada con monitores y alarmas para cianuro de modo que cualquier situación peligrosa pueda ser identificada inmediatamente. Hay duchas de seguridad y estaciones de emergencia para el lavado de ojos instaladas en las áreas de proceso donde hay presencia de soluciones peligrosas.

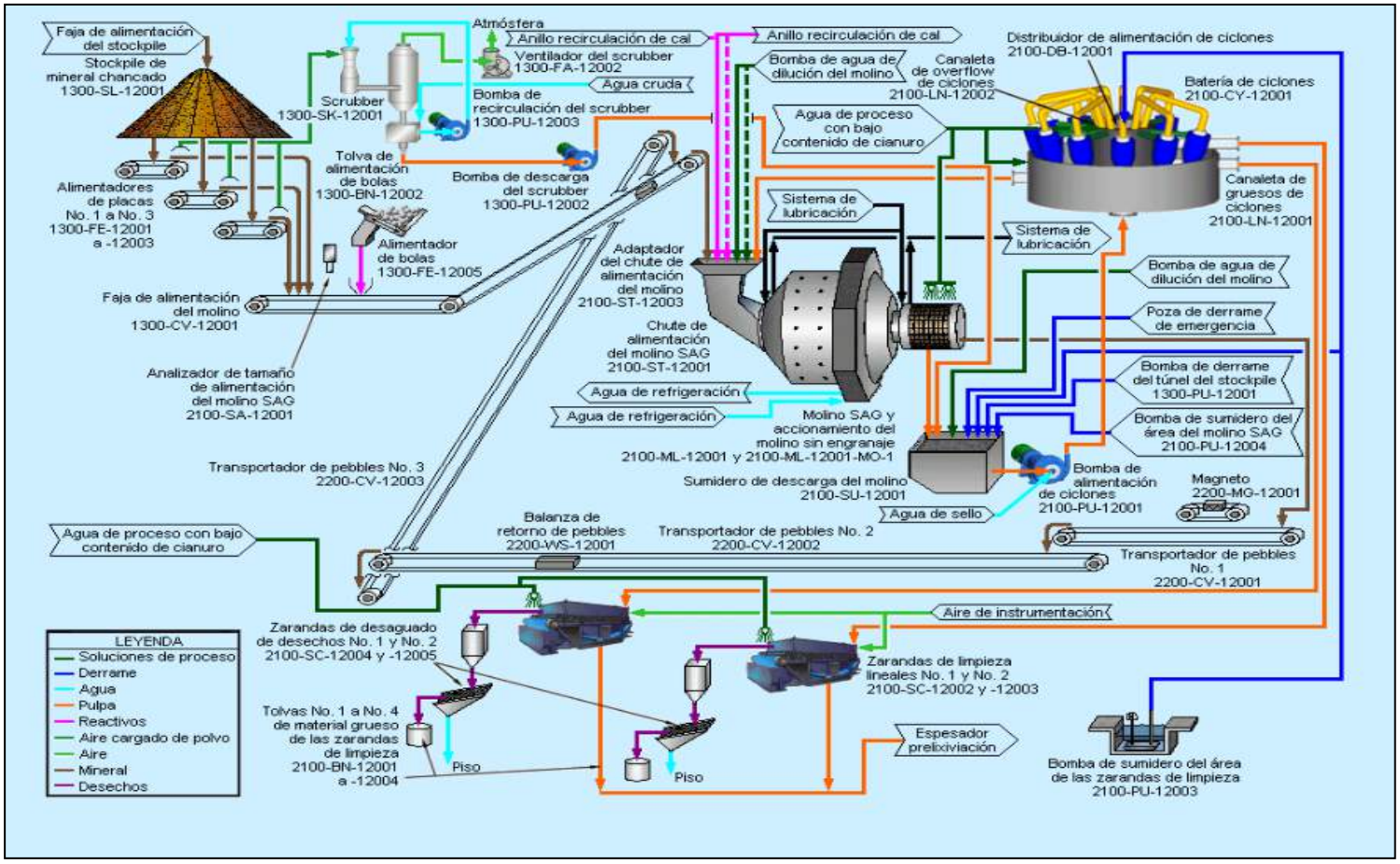


Figura 13. Circuito de Molienda

Fuente. Minera Yanacocha CBT. Operación planta “Gold Mill” (2007).

I.2. Formulación del Problema

La faja transportadora 1300-CV-1201 de la planta concentradora “Gold Mill”, presentó constantes incrementos de temperatura en los elementos rodantes de las chumaceras de su polea de cola, cabeza y contrapeso, así como en el motor y reductor, debido a la mala operación y sobre carga de mineral que transporta.

El incremento de temperatura se originó debido a los siguientes factores no condicionales:

- Arranques intempestivos con carga (presencia de mineral en la línea) por paradas de mantenimiento no programado, estos arranques intempestivos generan mayor torque y fricción sobre los elementos rodantes de la polea de cola, cabeza, motor y reductor de la faja transportadora 1300-CV-1201.

- Sobre carga de mineral en faja debido al ahorro de tiempo y aumento de tonelaje para el procesamiento de mineral.

- Frecuencia de lubricación no adecuada, ya que al estar la faja sub dimensionada esta ejerce mayor carga axial y radial sobre los rodamientos, generando desgaste prematuro sobre los elementos rodantes.

I.3. Justificación e Importancia

Dentro de los beneficios técnicos y justificaciones que hicieron que este proyecto sea de alto impacto se encontraron las siguientes:

- Obtención de valores de temperatura en línea para cada uno de los componentes monitoreados.

- Reducción de horas-hombre (h-h), por mantenimiento asignadas a tareas correctivas de mantenimiento, ya que al aumentar la vida útil de los componentes monitoreados estos no requieren ser reparados por fallas inesperadas o aleatorias, aumentando así la confiabilidad de la faja 1300-CV-1201.

- Eliminación de tareas relacionadas al monitoreo basado en condición y el uso de pirómetros en sitio con presencia y exposición de personal a riesgos involucrados por trabajar cerca de objetos en movimiento.

Anticipación de fallas en componentes monitoreados y que están sometidos a cambios e incrementos de temperatura inesperados, tales como polea de cola , cabeza, motor y reductor

- Generación de históricos de eventos por cambios de temperatura, con lo cual se puede estimar el nuevo ciclo de vida de cada componente y el intervalo P-F (Probabilidad Vs Falla) reduciendo las horas hombre por mantenimientos correctivos y preventivos.

Control de eventos por mala operación debido a sobre carga de mineral en faja, con esto logramos que los operadores puedan recibir una adecuada retroalimentación sobre la manera correcta de operar la faja transportadora 1300-CV-1201.

Aumentar el tiempo medio entre fallas (MTBF: Mean Time Between Failures).

CAPITULO II. OBJETIVOS

II.1. Objetivos Generales

El presente informe técnico tiene como finalidad exponer la mejora realizada en el monitoreo en línea de temperatura en las chumaceras de la polea de cola, cabeza, contrapeso y rodamientos de reductor de velocidad de la faja 1300-CV-1201, a través del uso de transmisores de temperatura con conexión "Wireless" y sensores tipo RTD (detector de temperatura resistivo), en la planta concentradora "Gold Mill" de Minera Yanacocha.

II.2. Objetivos Específicos

En esta parte del informe definiremos lo objetivos específicos del presente informe siendo estos:

- Se Instalaron cuatro transmisores de campo tipo "Wireless" y diez sensores del tipo RTD (detector de temperatura resistivo), en la polea de cola, cabeza, contrapeso y reductor de velocidad de la faja 1300-CV-1201.
- Medir valores de temperatura en línea a través del uso de sensores del tipo RTD (detector de temperatura resistivo), en las chumaceras de la polea de cola, cabeza, contrapeso y rodamientos del reductor de velocidad de la faja 1300-CV-1201, usando comunicación analógica 4-20 mA.
- Se Implementó una red de campo del tipo "Modbus", con la cual se transmite los valores de temperatura en línea medidos de cada uno de los componentes sometidos a cambios inesperados de temperatura.
- Se creó un enlace del tipo "Wireless", entre la red de campo "Modbus" y el Gateway 1420A existente en planta "Gold Mill".

- Obtener valores de temperatura en línea de las chumaceras de la polea de cola, cabeza, contrapeso y rodamientos de reductor de velocidad de la faja 1300-CV-1201.
- Se crearon pantallas de supervisión en sistema “Delta V”, para cada uno de los sensores tipo RTD (detector de temperatura resistivo).
- Se crearon alarmas lógicas de acuerdo a los valores de temperatura máximos y mínimos permisibles, en sistema “Delta V” de la faja 1300-CV-1201.

CAPITULO III. ANTECEDENTES

III.1. Planta concentradora Gold Mill y su problemática

III.1.1. Operación de la faja transportadora 1300-CV-12001

La faja transportadora es uno de los equipos de uso común para mover material relativamente seco, como mineral concentrado y filtrado. Los diseños y configuraciones de fajas transportadoras pueden variar de manera significativa.

El mineral es transportado sobre una faja fabricada de capas de tela y caucho unidas entre sí. La capa superior e inferior son de caucho. La capa superior generalmente es más gruesa para resistir el daño causado por las rocas. La faja es impulsada y guiada mediante grandes poleas cilíndricas en cada extremo, e incluye poleas adicionales ubicadas donde se hace necesario un cambio de dirección. Las poleas a menudo están revestidas o forradas con caucho, para mejorar el contacto con la faja lo cual mejora la tracción en las poleas motrices y reduce el deslizamiento, y consecuentemente el desgaste, en las otras poleas. La faja transportadora no puede funcionar cuando una faja transportadora aguas abajo no está operando,

La faja 1300-CV-1201 cuenta con un plano de control e instrumentación detallado. (Ver figura 14*).*

Las poleas están bombeadas, tienen un diámetro mayor en el centro que en los extremos, esto ayuda a mantener la faja en el centro. Las fajas de alta tensión, como las largas fajas transportadoras de mineral grueso o los alimentadores de faja, normalmente no tienen poleas bombeadas.

Las fajas transportadoras están invariablemente dispuestas de modo que las fajas transportadoras aguas arriba paran tan pronto como paran las fajas transportadoras o equipos aguas abajo, esto es para impedir que el material se desprenda.

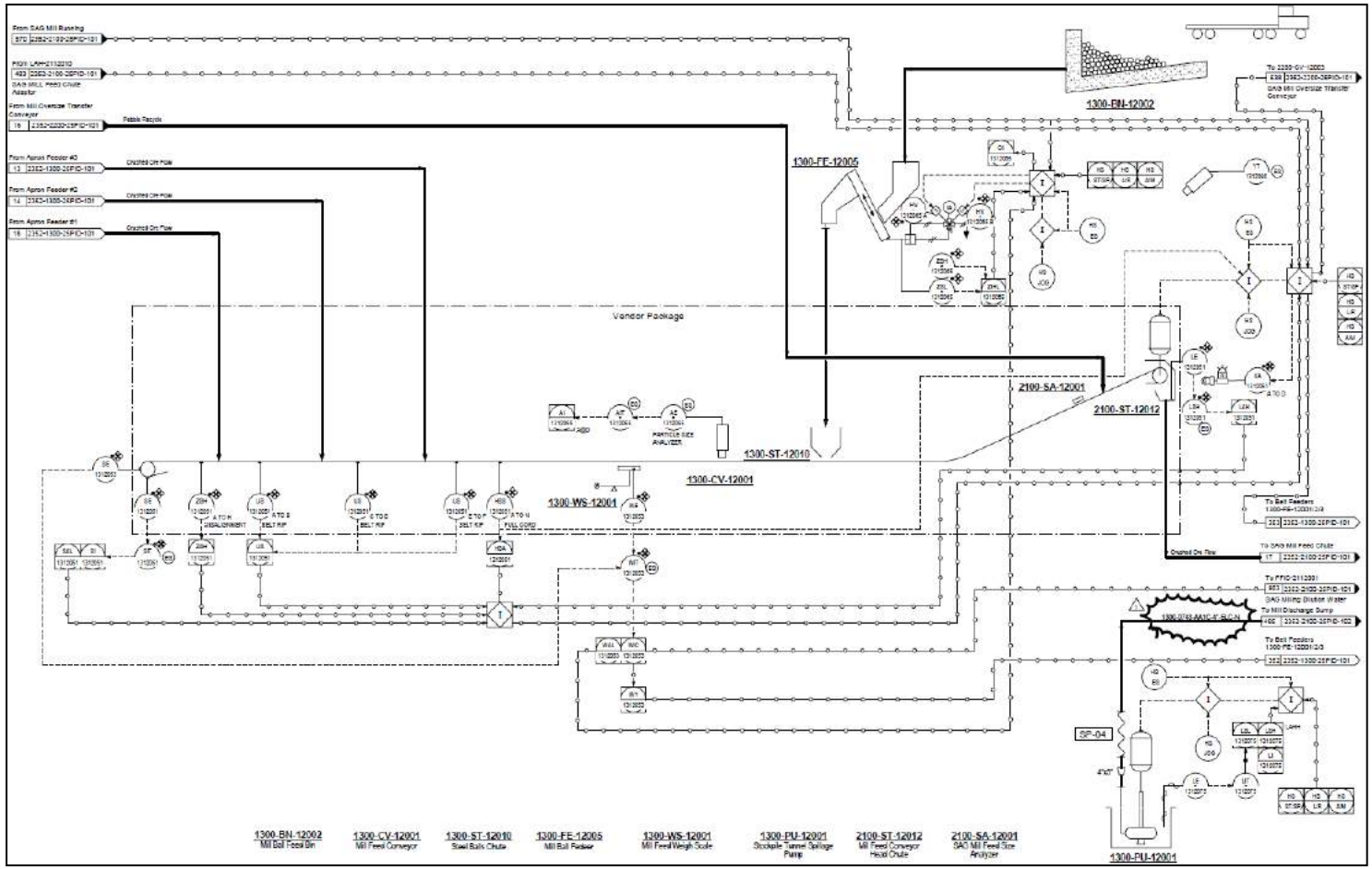


Figura 14. Circuito de Molienda

Fuente. Biblioteca Minera Yanacocha PI'D. Operación planta "Gold Mill" (2007).

Resumen de datos técnicos de la faja 1300-CV-1201:

- Capacidad de Diseño, Dry t/h 992.
- Capacidad de Diseño, Wet t/h 1,066.
- Máximo CEMA (“Cross section”), porcentage Máximo. 80%.
- Ancho de la Faja, mm 1066 (42”).

La faja transportadora 1300-CV-1201 dentro de sus componentes críticos cuenta con una polea de cola, cabeza, contrapeso, un motor eléctrico y un reductor de velocidad. (Ver figura 15). Estos componentes tiene un alto costo de reparación (Ver tabla 2). Una falla en cualquiera de estos componentes puede ocasionar una parada de la faja y por ende una parada de planta.

Tabla 2. Costo de repuestos de faja según cotización referencial enviada por empresa SKF 2013Q24686.

Item	Componente	Part Number	Precio Unitario	Cantidad	Total
POLEA DE CABEZA 12	Chumacera	SDAFS 3164 KATX12	62000	2	124000
	Rodamiento de Rodillos	23164 CACK/W33	6548,43	2	13096,86
	Manguito para Rodamiento	OSNP 3164X12.	9839,72	2	19679,44
	Anillo Guiador	A 8970	2021,24	2	4042,48
	Grasa	LGGB 2/180	3483,03	1	3483,03
	Sub Total				164301,81
POLEA DE COLA 12	Chumacera	SDAFS 3164 KATX12	62000	2	124000
	Rodamiento de Rodillos	23164 CACK/W33	6548,43	2	13096,86
	Manguito para Rodamiento	OSNP 3164X12.	9839,72	2	19679,44
	Anillo Guiador	A 8970	2021,24	2	4042,48
	Grasa	LGGB 2/180	3483,03	1	3483,03
	Sub Total				164301,81
POLEA CONTRAPESO6	Chumacera	SAF 538	3126,39	2	6252,78
	Rodamiento de Rodillos	22238 CCK/W33	1286,26	2	2572,52
	Manguito para Rodamiento	OSNW 38X6.15/16	2061,9	2	4123,8
	Anillo Guiador	TER 155	1130,95	2	2261,9
	Grasa	NLGB 2/180	3483,03	1	3483,03
	Sub Total				18694,03
MOTOR	Rodamiento de Rodillos	NU318 C3	941	1	941
	Rodamiento de Bolas	6318 C3	623,5	1	623,5
	Sub Total				1564,5
REDUCTOR	Rodamiento de Rodillos	NU400 C3	1100	1	1100
	Rodamiento de Bolas	6318 C3	623,5	1	623,5
	Sub Total				1723,5

Fuente. Cotización SKF del Perú. Actualizada al 23 de Marzo del 2013

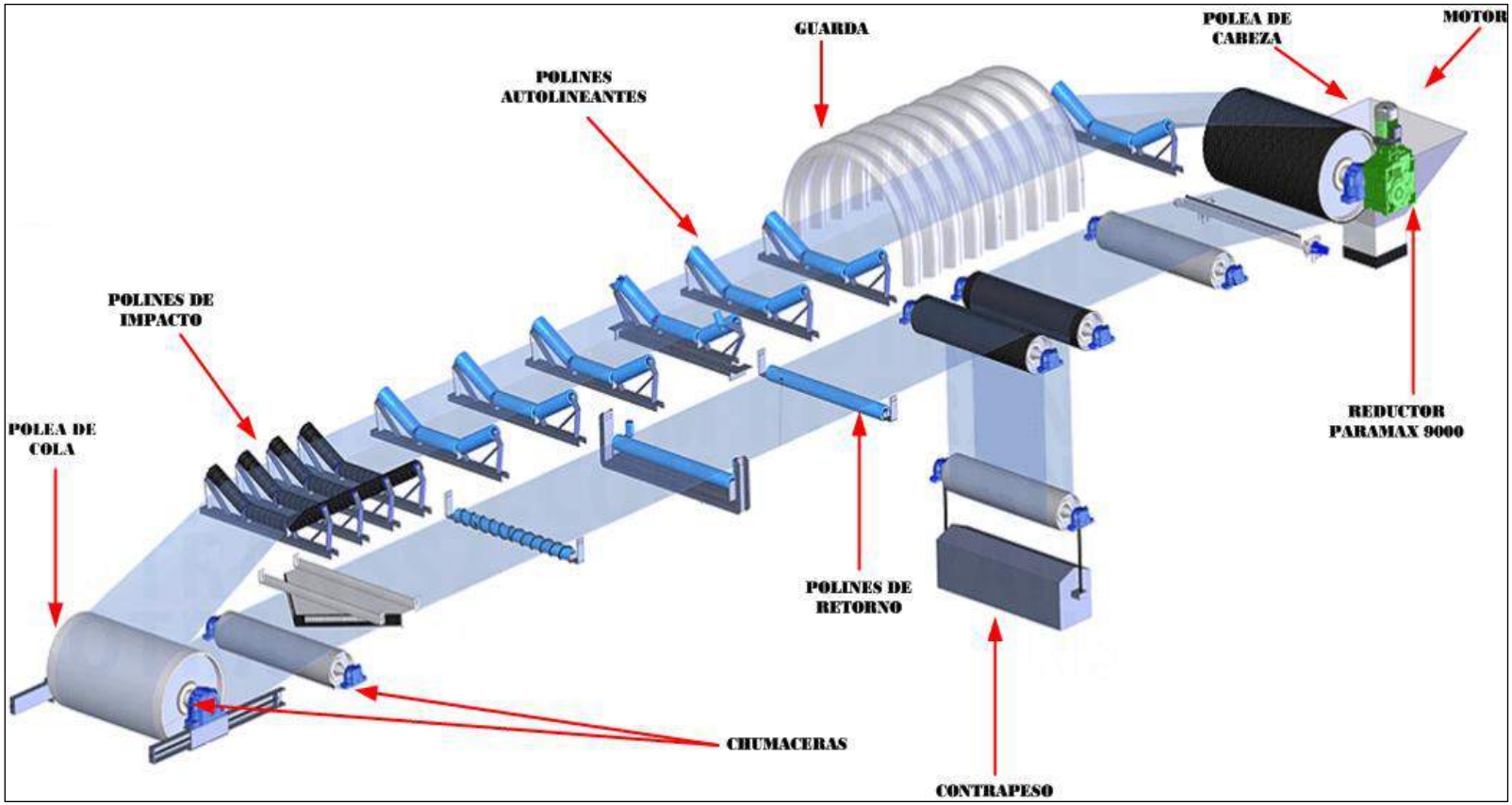
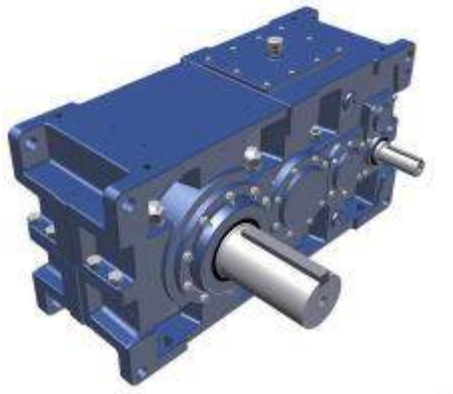


Figura 15. Composición de la faja 1300-CV-1201

Fuente. Diseño propio.

La faja 1300-CV-12001, dentro de los componentes más importantes que la conforman se encuentran: una polea de cola, una polea de cabeza una polea de contrapeso, un motor y un reductor de velocidad, los cuales tienen los siguientes datos técnico y rangos de operación de temperatura de trabajo. (Ver figura 16).

	
Reductor Paramax Serie 9000 Modelo:PHD9065R3-LRF-28 Rodamientos : (1) NU400 C3 , (1) 6318 C3 Rango de Temperatura:-10º - 40º Rpm: 1788 , Potencia: 380 HP Rango de Conversión: 1/24.7	Motor de 100HP- Toshiba Severe Duty Modelo: 4K41100L1A4AGD01 Premium Frame: 445T Rodamientos: (1) NU318 C3 , (1) 6318 C3 Rango de Temperatura: -10 - 40º C Rpm: 1800

	
Poleas: De Cola: Diámetro: 12” De Cabeza: Diámetro 12” De Contrapeso: Diámetro 6” Rango de Temperatura: -12.2 - 37.7 º Tipo de Grasa: NLGI	Chumaceras Tipo SAF: Rango de Operación T º : – 12 º - 50 º

Figura 16. Componentes críticos de faja 1300-CV-1201.
Fuente. Diseño propio.

III.1.1.1. Situación actual de faja 1300-CV-1201

La faja 1300-CV-1201 fue operada en condiciones sub estándares, esta mala operación originó fallas aleatorias en componentes críticos, debido al incremento de temperatura en los elementos rodantes de las chumaceras de la polea de cola, cabeza, contrapeso y rodamientos de reductor de velocidad. Este incremento de temperatura obedece a las siguientes causas no condicionales:

- - Arranques intempestivos con carga (Presencia de mineral en la línea), por paradas de mantenimiento no programado, lo cual genera mayor torque y fricción sobre los elementos rodantes de los rodamientos.
- - Sobre carga de mineral en faja, lo cual origina que la faja trabaje fuera de su rango máximo permisible, por encima de los 1,066 t/h, originando un aumento de la carga axial y radial sobre los elementos rodantes, este sobre dimensionamiento busca

ahorrar tiempo en el procesamiento de mineral y aumentar el tonelaje transportado de alimentación al molino de bolas.

- - Frecuencia de lubricación no adecuada, ya que al estar la faja sub dimensionada con respecto al tonelaje de mineral transportado, la grasa aplicada en las chumaceras y rodamientos se degrada en menor tiempo, haciendo que la fricción en los elementos rodantes se incremente, dando como consecuencia un incremento de temperatura y desgaste prematuro de las chumaceras y rodamientos. Con esto la faja debe parar con carga y ser reparada aleatoriamente. (Ver Figura 17).

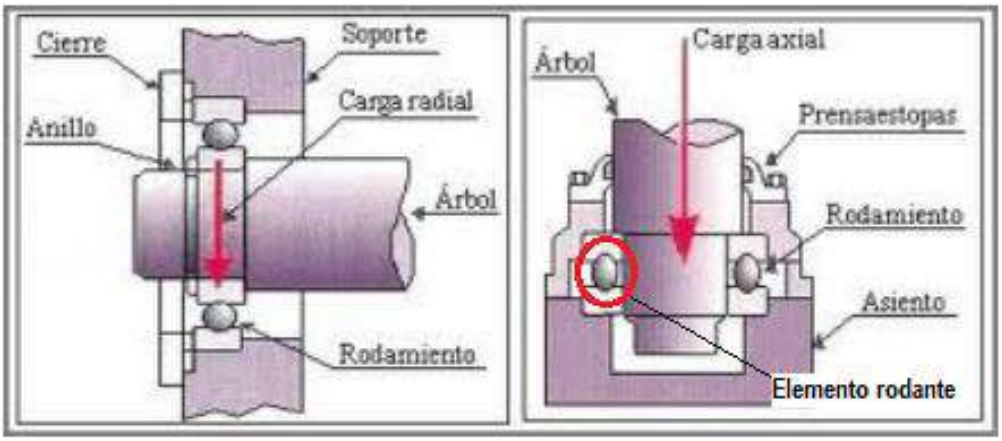
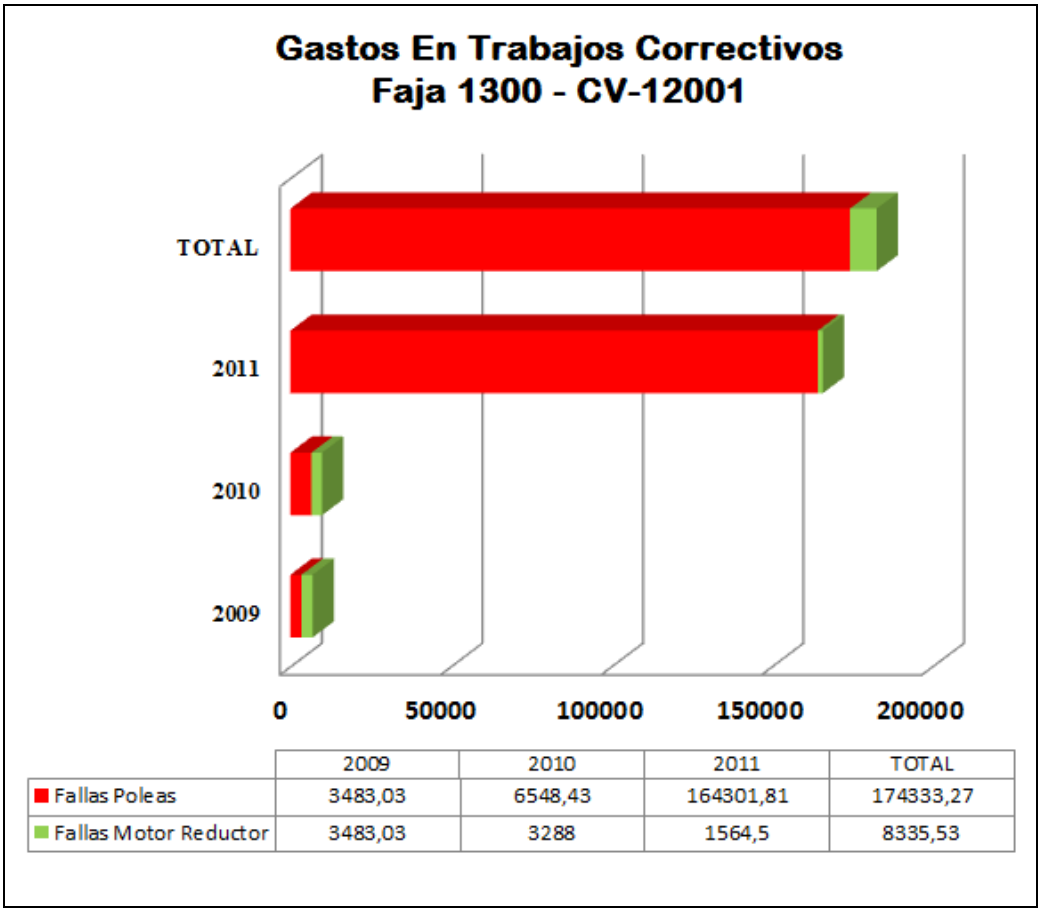


Figura 17. Carga Axial y Radial ejercida sobre elementos rodantes

Fuente.http://www.portaleso.com/portaleso/trabajos/tecnologia/mecanica/elementos_de_maquinas/rodadura

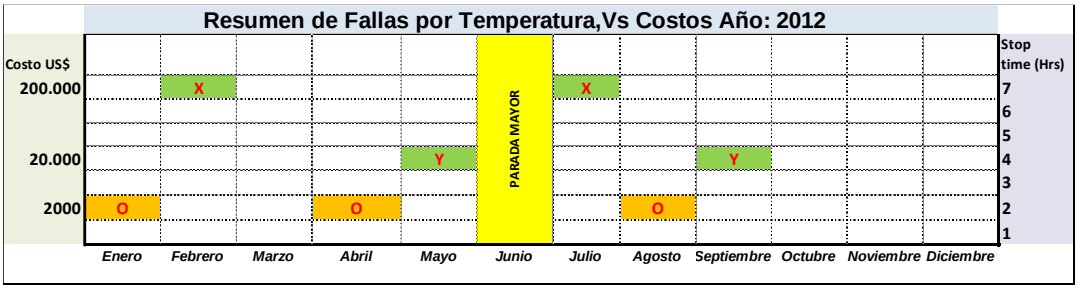
Actualmente la faja 1300-CV-1201 cuenta con un reductor de velocidad “Paramax 9000”, y chumaceras de la serie “SAF”, ubicadas en la polea de cola, cabeza y contrapeso, en todas las situaciones se presentan fallas aleatorias por incremento de temperatura, estos incrementos de temperatura originan paradas de planta por mantenimiento correctivo (reparaciones no programadas), generando altos costos de mantención por cambio de repuestos como rodamientos, chumaceras y hasta componentes completos como el reductor.

Reductores. (Ver figura 18).



	2009	2010	2011	TOTAL
Fallas Poleas	3483,03	6548,43	164301,81	174333,27
Fallas Motor Reductor	3483,03	3288	1564,5	8335,53

Figura 18. Gastos por mantenimientos correctivos en USD
Fuente. Diseño Propio



		Febrero	Marzo	Julio	Total
X	Falla Chumacera de Polea	164301,81		164301,81	328603,62
		Mayo	Setiembre		
Y	Falla Chumacera Contrapeso	18694,03	18694,03		37388,06
		Enero	Abril	Setiembre	
O	Falla en Rodamients Motor / Reductor	1564,5	1723,5	1564,5	4852,5
				TOTAL	**370844,18**

Figura 19. Fallas por incremento de Temperatura Chumaceras/Reductor 2012.
Fuente. Resumen de gastos y fallas ERP Elipse falla 1300-CV-1201. Obtenido en Marzo del 2013

En el Año 2012 se tuvo un gasto acumulado total por reparaciones no programadas de US$ 328,603.00, el cual involucra cambio de repuestos por mantenimiento correctivo y fallas aleatorias por desgaste prematuro en chumaceras de polea de cola, cabeza, contrapeso y rodamientos de reductor de velocidad de la faja 1300-CV-1201.Este alto gasto de mantenimiento sumado a costo de horas hombre de personal técnico involucrado en las reparaciones (alrededor de USD $ 20.00 por hora), disminuyen la disponibilidad y rentabilidad operativa de la planta de procesos de “Gold Mill” de minera Yanacocha.

CAPITULO IV. DESCRIPCIÓN DEL PROYECTO PROPUESTO

IV.1. Solución propuesta

La solución propuesta se detalla como sigue:

- Se instalaron 02 sensores de temperatura tipo RTD (detector de temperatura resistivo), en las chumaceras de la polea de cola de la faja 1300-CV-1201, y además, la instalación de un transmisor de temperatura tipo "Wireless".(A)
- Se instalaron 04 sensores de temperatura tipo RTD (detector de temperatura resistivo), en las chumaceras de la polea de contrapeso de la faja 1201-CV-1300; y además, la instalación de un transmisor de temperatura tipo "Wireless". (C)
- Se instalaron 02 sensores de temperatura RTD (detector de temperatura resistivo) en las chumaceras de la polea de cabeza, de la faja 1300-CV-1201 (D)
- Se instalaron 02 sensores de temperatura tipo RTD (detector de temperatura resistivo), en el reductor de la polea de cabeza; y además, la instalación de 01 transmisor de temperatura tipo "Wireless". (D)
- Se instaló 01 transmisor de temperatura tipo "Wireless" en la entrada del túnel de la faja 1300-CV-1201 que solo servirá de repetidor (B).
- Se Implementó un enlace de comunicación entre la red de campo tipo "Modbus" y la red Ethernet a través del uso de un "Gateway ya existente en planta.
- Se crearon códigos "Tags" de instrumentos y pantallas de supervisión en sistema SCADA -"Delta V", (Sistema de control y adquisición de datos).
- Se crearon comparadores lógicos de acuerdo a rango e temperatura máximos y mínimos permisibles en sistema "Delta V".
- Se desarrolló solución grafica de ubicación y disposición de equipos instalados. (Ver figura 20).

- Se Desarrolló plano PID (Piping and Instrumentation Diagram) con “Tags” creados en sistema de supervisión “Delta V”. (Ver figura 33).

La cantidad de sensores por componentes (ver Tabla 3).

Tabla 3. Resumen de instrumentos instalados en faja 1300-CV-1201

Equipo	**Polea de Cola**	**Polea de Cabeza**	**Polea de Contrapeso**	**Reductor**	**Total**
Sensor Temperatura	2	2	4	2	10
Transmisor WIFI	1	1	1	1	4

Fuente. Diseño propio.

IV.2. Descripción técnica de la solución

IV.2.1. Filosofía de Control

Podemos ver la figura 20. Los sensores del tipo RTD (detector de temperatura resistivo), miden el incremento de temperatura en cada una de las chumaceras de las poleas de cola, cabeza y contrapeso de la faja 1300-CV-12001 usando una conexión analógica de dos hilos y un nivel de corriente de 4-20mA, esta faja transportadora alimenta de mineral al molino de bolas de planta de Gold Mill. La faja está ubicada debajo del túnel , (Stockpile) lo que hace que la comunicación sea de la siguiente manera : el transmisor remoto tipo “Wireless” ubicado en la polea de cola busca la ruta más cercana de comunicación a fin de establecer una transmisión lo más limpia y nítida posible, el repetidor “Wireless” 648 , sirve de bridge entre en transmisor de la polea de cola y los transmisores ubicados en la polea de contrapeso y polea de cabeza, en cada caso se ha creado un comparador lógico usando el valor medido y el valor del comparador según: Very High: 100º C , High: 95ºC , Low: 5ºC cada valor medido es comparado (Valor nominal 0-50º C) en condiciones normales, esta señal es transmitida en una red del tipo “Modbus” y la señal es enlazada a través de un Gateway del tipo 1420A y transmitido por la red de datos “Ethernet” de

comunicación , el valor medido de cada sensor es monitoreado en la pantalla de supervisión, una vez que este valor supere los límites máximos permisibles activa una alarma lógica sonora con la cual se alerta al departamento de lubricación o de análisis predictivo para determinar la acción correctiva inmediata las cuales pueden ser :

- -Lubricación de componentes, chumaceras de polea de cola, cabeza, contrapeso y rodamientos de reductor de velocidad de faja 1300-CV-1201.
- -Inspección visual de componentes afectados por incremento de temperatura.
- -Decremento del tonelaje transportado hasta el límite máximo de 1,066 t/h según data técnica de diseño de la faja transportadora.
- -Generación de histórico de eventos a fin de poder determinar el intervalo P-F (Probabilidad Vs falla) o análisis causa raíz (ACR).

IV.2.2. Data técnica de los instrumentos

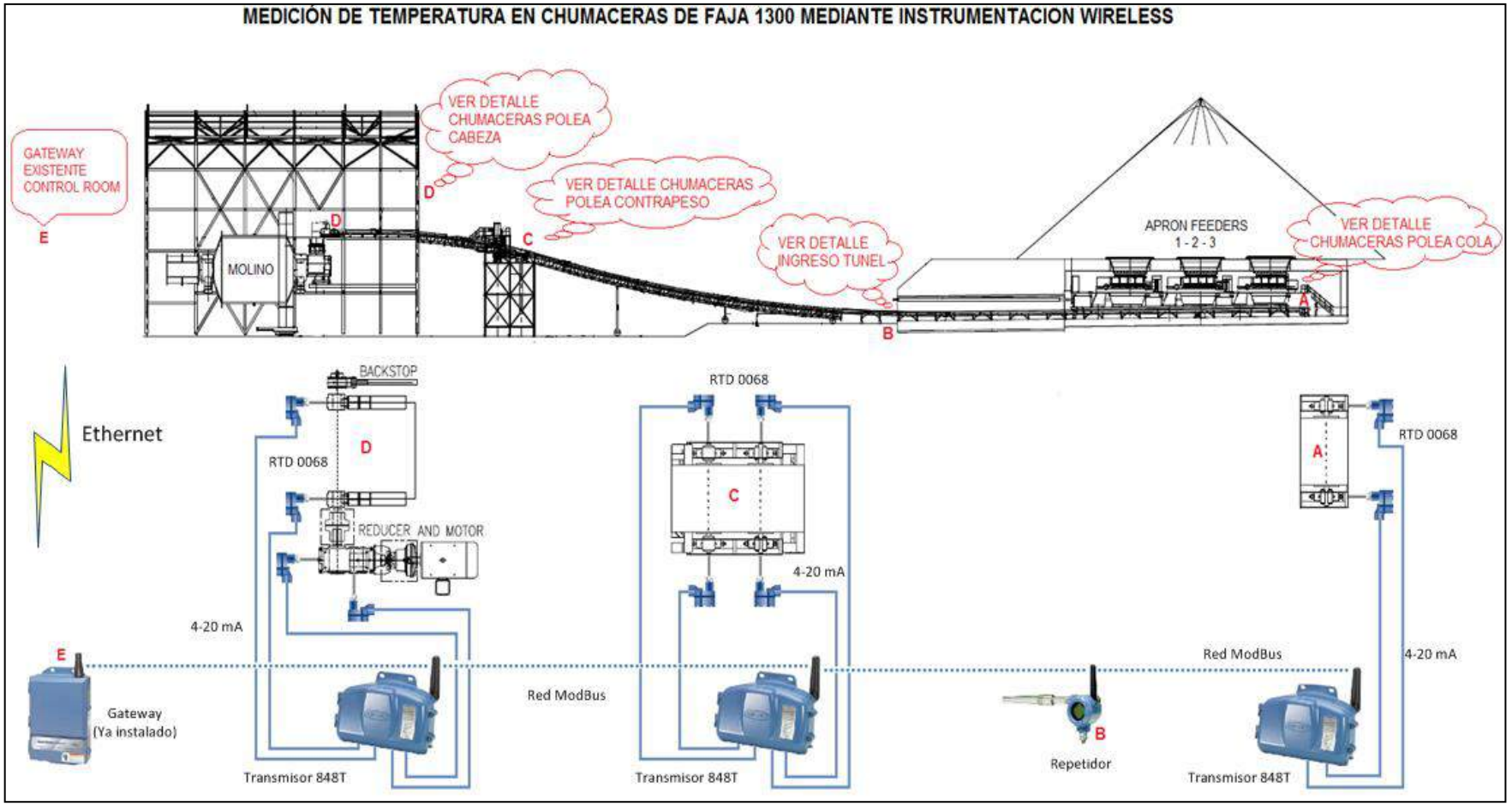


Figura 20. Disposición grafica de equipos instalados / Filosofía de control.

Fuente. Diseño propio.

IV.2.2.1. Rosemount 848T High Density Temperature

Figura 21. Transmisor 848T 648DX1D1NAWA3WK1B5Q4XA)

http://www2.emersonprocess.com/en-us/brands/rosemount/Pages/index.aspx

Tabla 4. Resumen técnico de TX Wireless 848T - Rosemount

Entrada	Ocho canales configurables independientemente incluyendo combinaciones de 2 - ohm y 3 hilos - 3 hilos y RTDs, termopares, mV y 2 entradas de 4-20 mA,
Salida	Manchester a codificar la señal digital que se ajusta a la norma IEC 61158 y ISA 50,02.
Estado	Si el autodiagnóstico detecta una rotura de sensor o un fallo del transmisor, el estado de la medición se actualiza en consecuencia.
	-40 A 185 ° F (-40 a 85 ° C)

Límites de temperatura ambiente	
Precisión	(Pt 100 @ condición de referencia: 20 ° C) ± 0,30 ° C (± 0,54 ° F)
Aislamiento	600 Vdc canal de aislamiento de canal (1). 10 Vdc Aislamiento de canal a canal para todas las condiciones de funcionamiento con un máximo de 150 metros (500 pies) de longitud del cable del sensor 18 AWG
Fuente de alimentación	Desarrollado a través de bus de campo FOUNDATION Fieldbus con El estándar de potencia. El transmisor funciona entre 9,0 y 32,0 Vcc, 2 mA máximo. (Terminales de alimentación del 2 transmisor se clasifican a 42,4 Vcc.)
Protección contra transitorios	El protector contra transitorios (opción código T1) ayuda a prevenir el daño para el transmisor de los transitorios inducidos en el cableado del bucle por relámpagos, soldaduras, equipos eléctricos pesados, o cambiar de marcha. Esta opción está instalada en la fábrica para el modelo 848T de Rosemount y

	no está diseñado para instalación en campo.
Tiempo de actualización **Límites de humedad**	Aproximadamente 1,5 segundos para leer las 8 entradas. 0-99% sin condensación de humedad relativa.
Tiempo de actualización	El funcionamiento dentro de las especificaciones se alcanza en menos de 30 Segundos después de aplicar alimentación al transmisor.
Alarmas	La AI y bloques de función ISEL permiten al usuario configurar el alarmas a HI-HI, HI, LO o LO-LO con una variedad de niveles de prioridad y la configuración de histéresis.
Compatibilidad electromagnética pruebas de cumplimiento	Cumple con los criterios establecidos en la Directiva Europea Unión 2004/108/CE, Cumple con los criterios establecidos en la norma IEC 61326: 2006
Estabilidad	± 0,1% de la lectura o 0,1 ° C (0,18 ° F), lo que sea mayor, para 2 años para los RTDs.

	± 0,1% de la lectura o 0,1 ° C (0,18 ° F), lo que sea mayor, para 1 año para termopares

Fuente. Diseño Propio

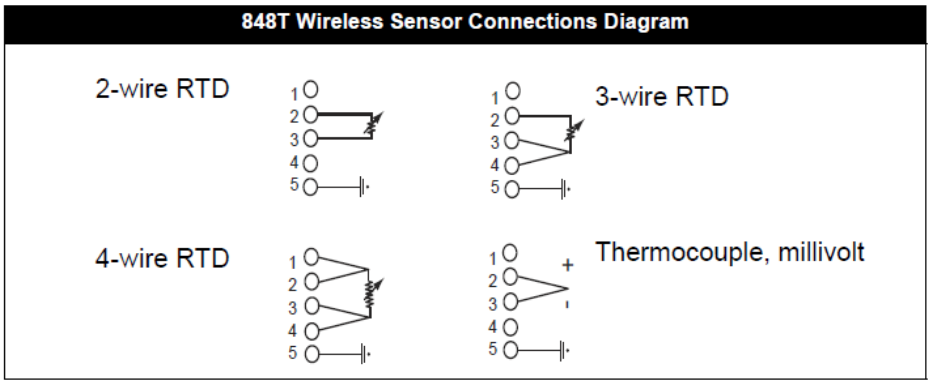


Figura 22. Diagrama de conexiones

http://www2.emersonprocess.com/en-us/brands/rosemount/Pages/index.aspx

IV.2.2.2. Transmisor de Temperatura

Figura 23. Transmisor 648 (648DX1D1NAWA3WK1B5Q4XA)

http://www2.emersonprocess.com/en-us/brands/rosemount/Pages/index.aspx

Tabla 5. Resumen técnico de TX Wireless 648 - Rosemount

Entradas	Compatible con Termopar, RTD, mV, y los tipos de ohm de entrada
	"Transmisor Precisión" en la página 8 para las opciones del sensor
Salidas	IEC 62591 (Wireless HART), 2,4 GHz DSSS
Límites de humedad	0-99% sin condensación de humedad relativa.
Precisión	(Pt 100 @ condición de referencia: 20 ° C)
	± 0,225 ° C (± 0,405 ° F)
Antena	PBT / policarbonato (PC) integrado omnidireccional antena
Potencia de salida de radiofrecuencia de la antena	Antena Externa (WK1 opcional): Máximo de 10 mW (10 dBm)
Frecuencia de actualización	Wireless HART, seleccionable por el usuario 1 segundo a 60 minutos

Fuente. Diseño Propio

IV.2.2.3. Sensor de Temperatura RTD

Figura24. Sensor 0068 068N21N00N040V1XA)

http://www2.emersonprocess.com/en-us/brands/rosemount/Pages/index.aspx

Tabla 6. Resumen técnico de RTD 0068 – Rosemount

Rango de Temperatura	-50 a 400 ºC
Estabilidad	± 0.08%
Límites de humedad	100%
Histéresis	± 0.09% del rango de operación de temperatura
Auto Calentamiento	200 mW mínimo poder requerido para alcanzar 63.2% respuesta del sensor en flujo de agua 3 ft/s
Enclosure	Nema 4x
Material	Platinum

Fuente. Diseño Propio

IV.2.2.4. Transmisor de Temperatura

Figura 25. Gateway 420A1A1A0J)
http://www2.emersonprocess.com/en-us/brands/rosemount/Pages/index.aspx

Tabla 7. Resumen técnico de Gateway 1420 - Rosemount

Voltaje de Alimentación	24 Vdc 500 milliamps required to power the 1420 Wireless Gateway.
Estabilidad	-40 a 60°C (-40 to 158°F)
Límites de humedad	0-95% humedad relativa (sin-condensación)
Histéresis	± 0.09% del rango de operación de temperatura
Comunicación	**RS485** 2-hilos comunicación enlazado con multilazos Modbus Baudios: 57600, 38400, 19200, o 9600 Protocolo: Modbus RTU Cableado: Par trenzado blindado, 18 AWG. Distancia máxima de cableado 5,000 ft. (1,524 m) **Ethernet** Servidor Web y Modbus TCP/IP OPC con , Servidor Web y Modbus TCPIP HSE para AMS con , Servidor Web y Modbus TCPIP HSE para AMS con OPC, Servidor Web y Modbus TCPIP --- **Modbus** Soporta RTU y TCP/IP con 32 bit
Enclosure	Nema 4x
Material	Aluminio con Bajo % de Cobre

Fuente. Diseño Propio

IV.2.2.5. Configuración de Transmisor “Wireless”

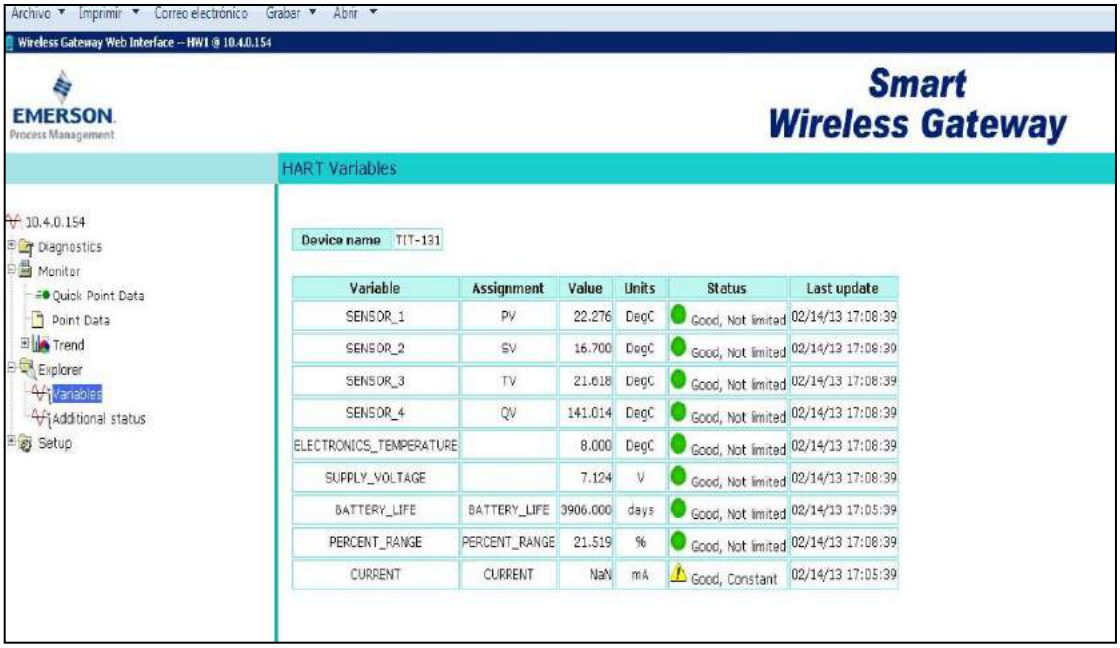


Figura 26. Creación de Tags y Sets

http://www2.emersonprocess.com/en-us/brands/rosemount/Pages/index.aspx

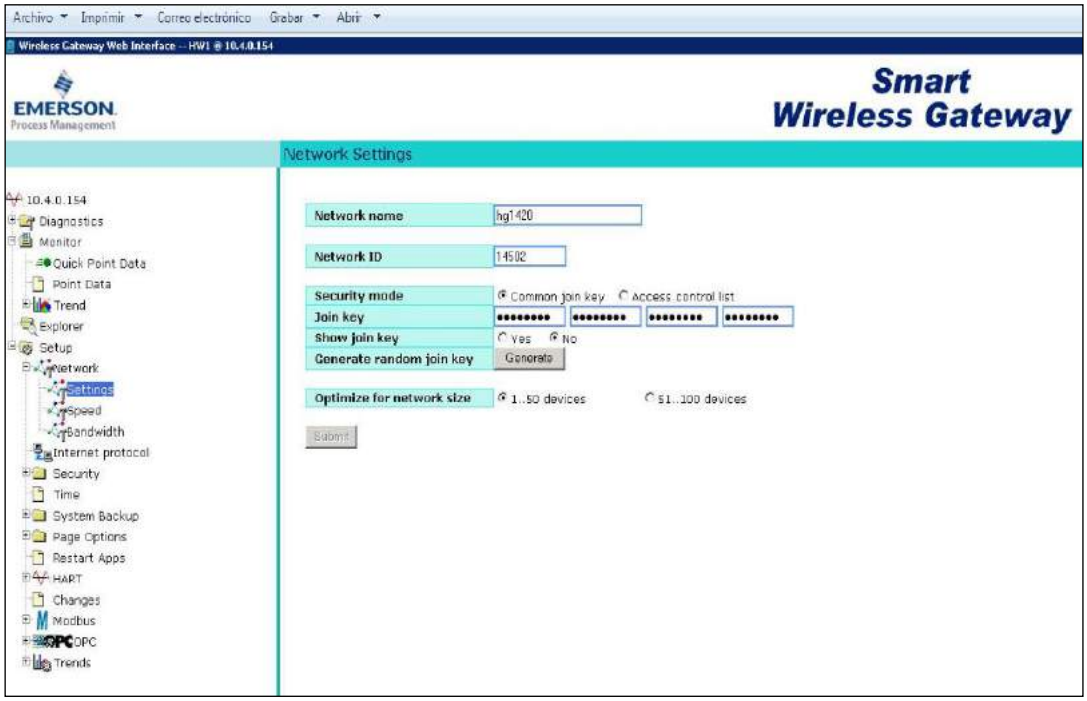


Figura 27. Configuración de Identificador “Net working”

http://www2.emersonprocess.com/en-us/brands/rosemount/Pages/dex.aspx

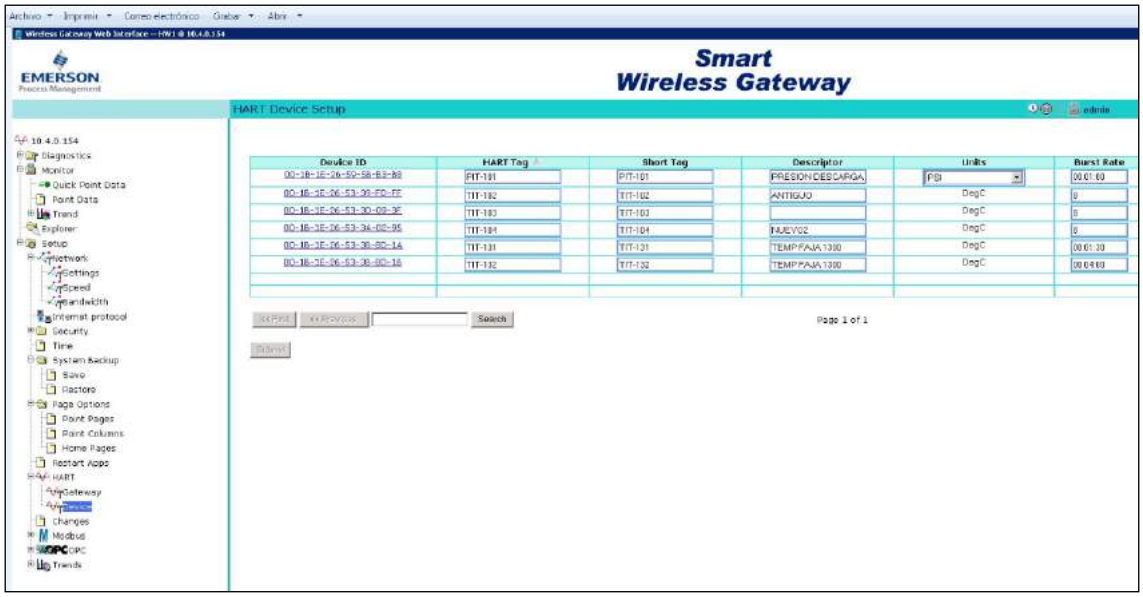


Figura 28. Configuración de parámetros HART

http://www2.emersonprocess.com/en-/brands/rosemount/Pages/index.aspx

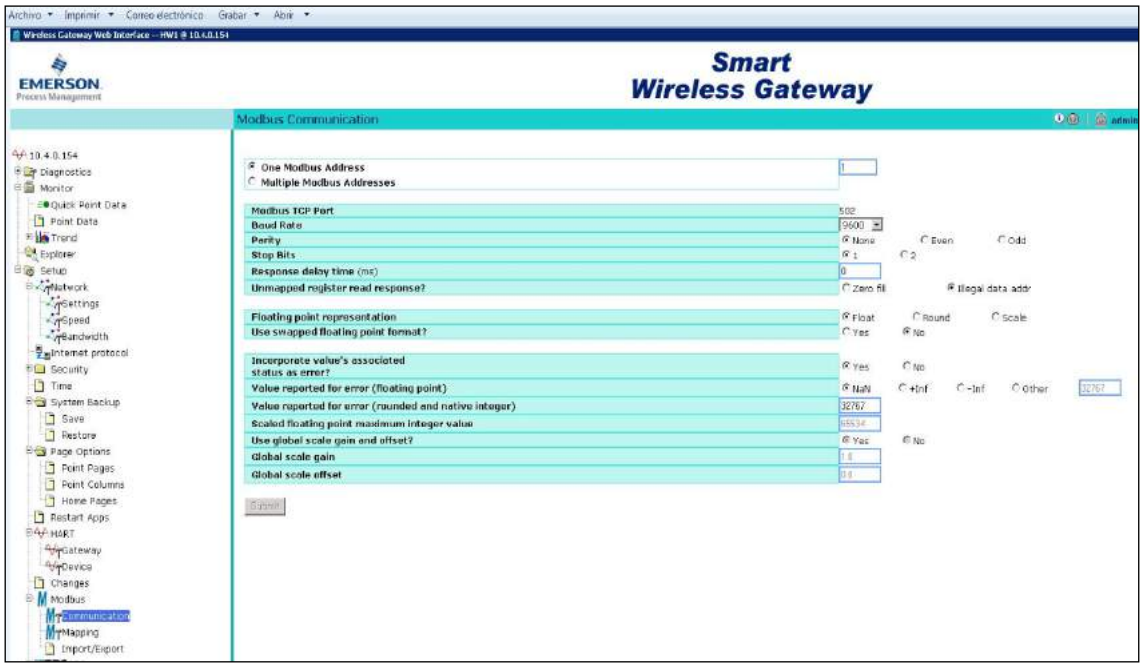


Figura 29. Configuración parámetros de Red “Modbus”

http://www2.emersonprocess.com/en-us/brands/rosemount/Pages/index.aspx

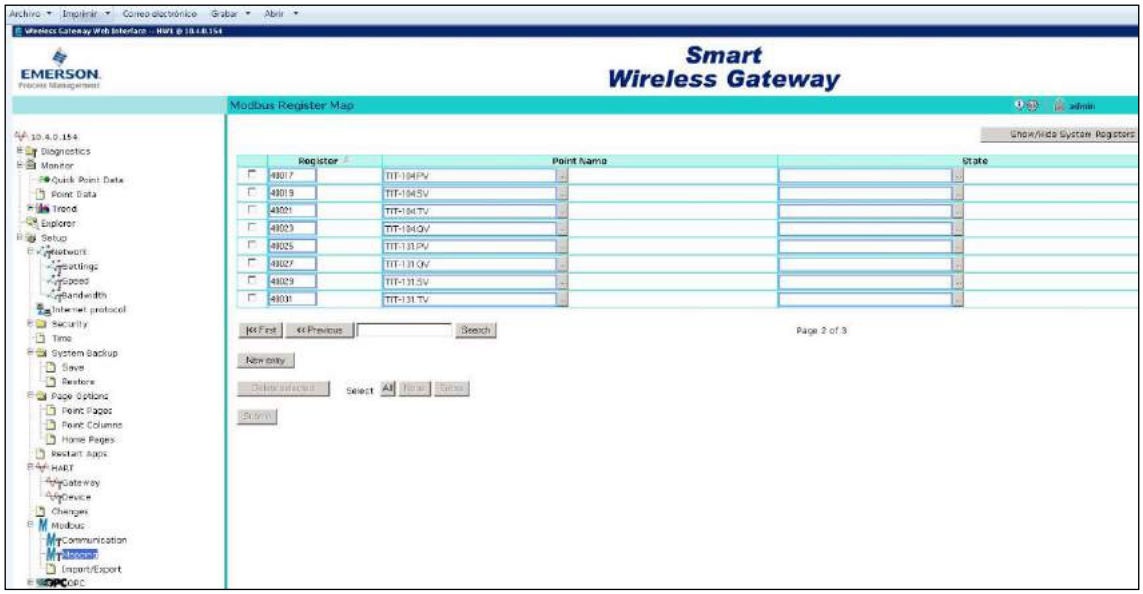


Figura 30. Mapeo de direcciones "Modbus"

http://www2.emersonprocess.com/en-us/brands/rosemount/Pages/index.aspx

IV.2.3. Montaje de los instrumentos

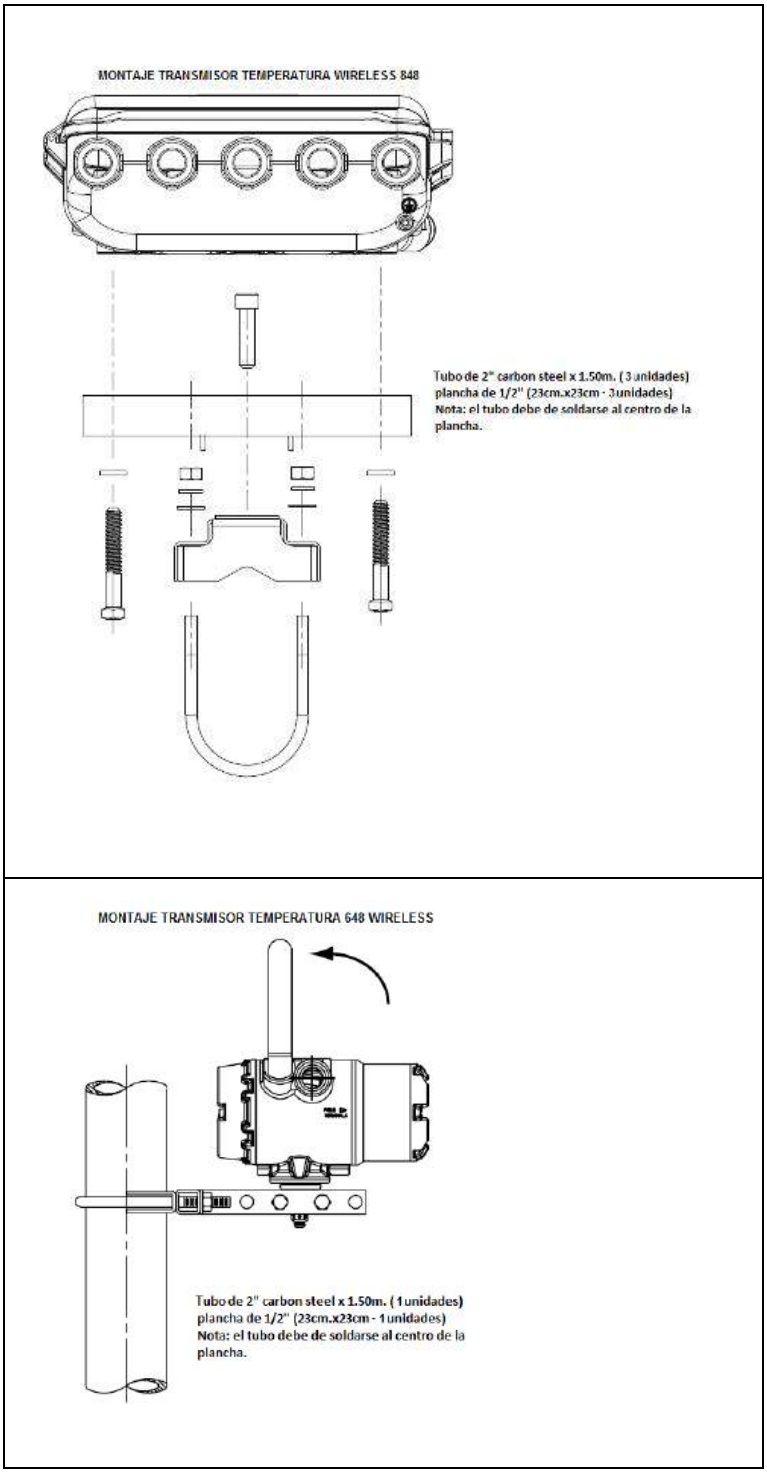


Figura 30. Montaje de Transmisores "Wireless" *8*48/648

http://www2.emersonprocess.com/en-us/brands/rosemount/Pages/index.aspx

IV.2.4. Creación de Pantallas de supervisión y Alarmas

Se han creado 10 pantallas de supervisión una para sensor RTD (detector de temperatura resistivo), asignando los respectivos “Tags” creados según punto anterior mostrado en Figura 26. Ver Figura 31.

Figura 31. Ejemplo pantalla de Supervisión creada en sistema “Delta V”

Fuente. Diseño propio.

IV.2.5. Creación de TAGS en sistema Delta V

Se generaron 16 códigos “Tags” los cuales se aprecian en la figura 33.

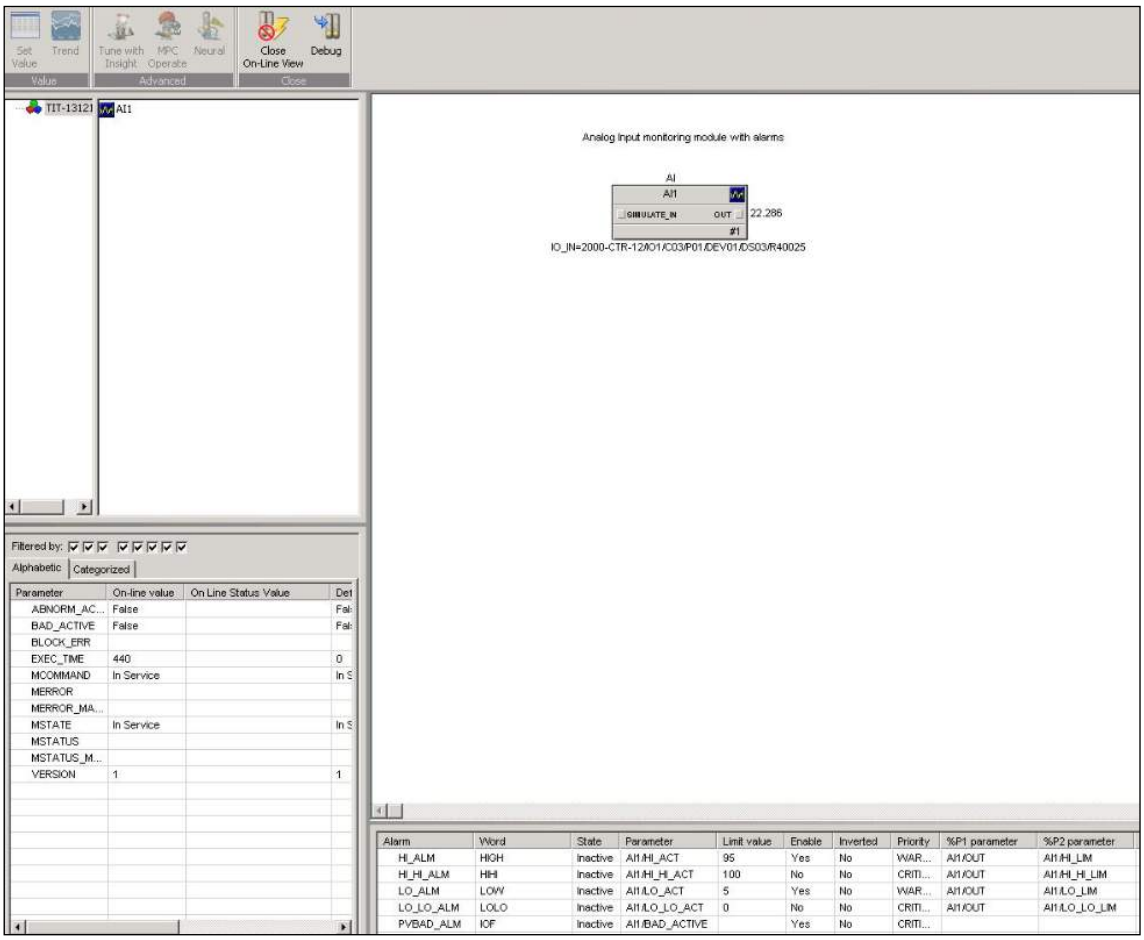


Figura *32.* Creación de TAGS en sistema “Delta V”

Fuente. Diseño propio.

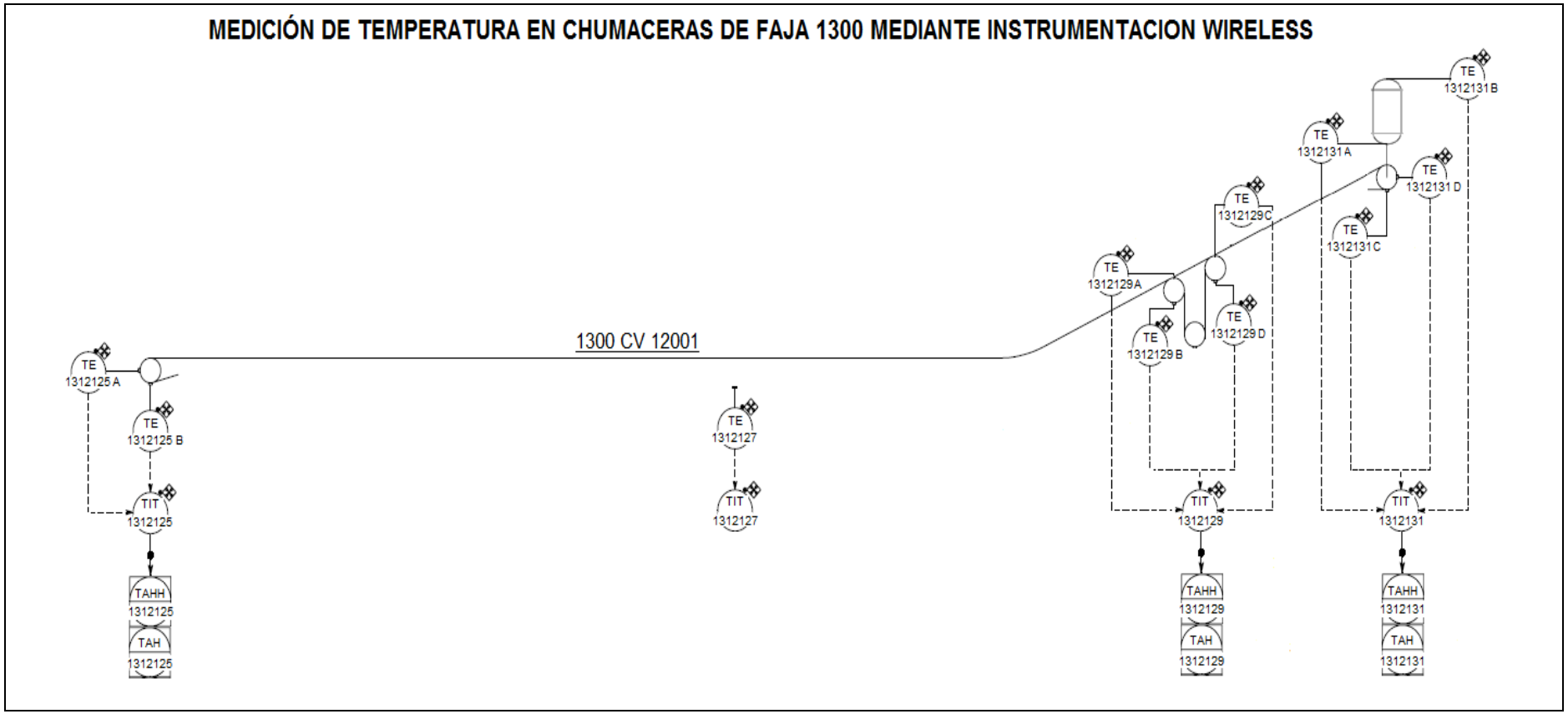


Figura 33. Plano PID de solución implementada con Tags "Delta V"

Fuente. Diseño propio

CAPITULO V. ANÁLISIS ECONÓMICO

V.1. Análisis Económico de propuesta implementada

	Costos por Reparaciones correctivas por Incremento de Temperatura						Gastos de Inversión por implementación de solución					
Reparación de Polea Cola	Tarea	Costo Materiales (US$)	Duración Tarea (H-H)	Personas	Duración Total	Costo promedio (HH US$ 20)	Instalación de Instrumentos	Materiales (US$)	Duración Tarea (H-H)	Personas	Duración Total	Costo promedio (HH US$ 30)
	Cambiar una chumacera	62000	6	3	18	360	Instalación de Sensor 0068	526	2	3	6	180
	Cambiar un Rodamiento	6548,43	4	3	12	240	Instalación de Transmisor 848T	7549,6	8	3	24	720
	Lubricación	3483,03	1	2	2	40	Configuración y montaje	1000	4	2	8	240
	Sub Total	72031,46				640	Sub Total	9075,6	14			1140
	Total					72671,46	Total					10229,6
Reparación de Polea Cabeza	Tarea	Costo Materiales (US$)	Duración Tarea (H-H)	Personas	Duración Total	Costo promedio (HH US$ 20)	Instalación de Instrumentos	Materiales (US$)	Duración Tarea (H-H)	Personas	Duración Total	Costo promedio (HH US$ 20)
	Cambiar una chumacera	62000	6	3	18	360	Instalación de Sensor 0068	526	2	3	6	180
	Cambiar un Rodamiento	6548,43	4	3	12	240	Instalación de Transmisor 848T	7549,6	8	3	24	720
	Lubricación	3483,03	1	2	2	40	Configuración y montaje	1000	4	2	8	240
	Sub Total	72031,46				640	Sub Total	9075,6	14			1140
	Total					72671,46	Total					10229,6
Reparación de Polea Contrapeso	Tarea	Costo Materiales (US$)	Duración Tarea (H-H)	Personas	Duración Total	Costo promedio (HH US$ 20)	Instalación de Instrumentos	Materiales (US$)	Duración Tarea (H-H)	Personas	Duración Total	Costo promedio (HH US$ 20)
	Cambiar una chumacera	3126,39	6	3	18	360	Instalación de Sensor 0068	526	6	3	18	540
	Cambiar un Rodamiento	1286,26	4	3	12	240	Instalación de Transmisor 848T	7549,6	4	3	12	360
	Lubricación	3483,03	1	2	2	40	Configuración y montaje	1000	1	6	6	180
	Sub Total	7895,68				640	Sub Total	9075,6	11			1080
	Total					8535,68	Total					10166,6
Reparación de reductor	Tarea	Costo Materiales (US$)	Duración Tarea (H-H)	Personas	Duración Total	Costo promedio (HH US$ 20)	Instalación de Repetidor 648	Materiales (US$)	Duración Tarea (H-H)	Personas	Duración Total	Costo promedio (HH US$ 20)
	Cambiar Rodamientos	1723,5	2	3	6	120	Instalación de Tranmisor	3912	4	3	12	360
	Lubricación	1741,5	1	2	2	40	Configuración y montaje	1000	1	2	2	60
	Sub Total	1723,5				120	Sub Total	4912	5			420
	Total					1843,5	Total					5337
	Resumen	Reparación	Cantidad	Veces x Año	Sub Total	Total		Instalación	Cantidad	Veces x Año	Sub Total	Total
	Reparación de Polea Cola	72671,46	2	2	145342,92	290685,84	Instalación de RTD	706	10	1	7060	7060
	Reparación de Polea Cabeza	72671,46	2	2	145342,92	290685,84	Instalación de Tx 848 T	8269,6	3	1	24808,8	24808,8
	Reparación de Polea Contrapeso	8535,68	2	2	17071,36	34142,72	Instalación de Tx 648 T	4272	1	1	4272	4272
	Reparación de reductor	1843,5	2	2	3687	7374	Configuración y montaje	1240	1	1	1240	1240

Figura 34. Resumen de Gastos por Correctivos y Costo de Implementación

Fuente. Diseño propio

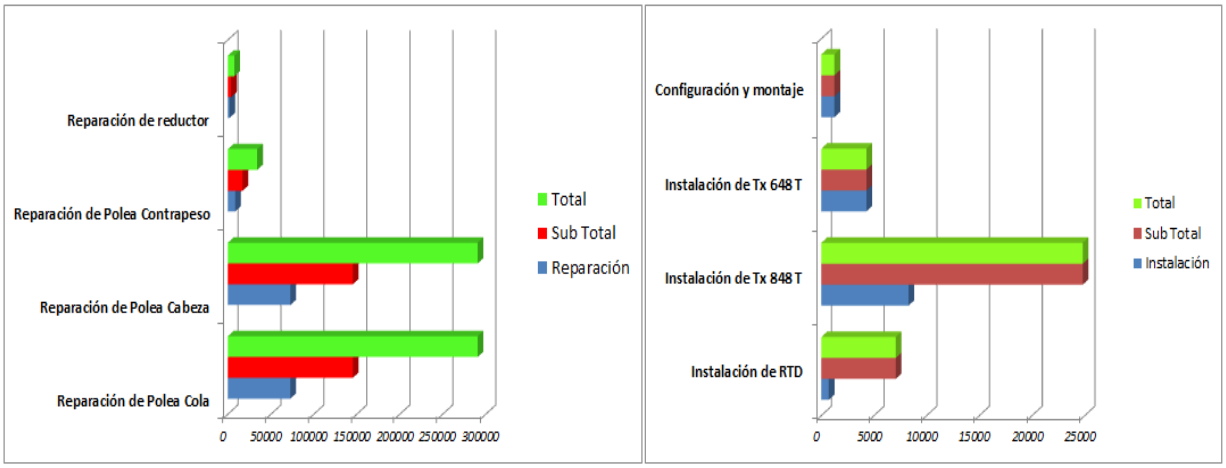


Figura 35. Comparación de Gastos por Reparar Vs Implementar solución

Fuente. Diseño propio.

Si comparamos los gastos figura 35, Se observa que el costo de haber implementado la propuesta es menor con respecto al costo unitario de reparación y/o reemplazo de cada chumacera y reparación del reductor de velocidad por falla en rodamientos ya que según la figura 19, estos gastos en el 2012 se han realizado en promedio dos veces por año, lo cual duplica el costo unitario de reparación, siendo este último más de 10 veces mayor que el costo de implementar la propuesta técnica, haciendo fiable la implementación de este sistema de monitorio en línea.

CONCLUSIONES

- El gasto de la implementación y montaje de Gateway 1420A no fue considerado ya que este equipo se encontraba ya disponible en el alcance inicial del montaje de la faja transportadora.
- Siempre existirán este tipo de problemas debido a que unos de los objetivos principales de cada operación minera es producir más en el menor tiempo posible y aunque se sobre dimensione la faja o cualquier equipo de planta está siempre trabajara sobre el tope de su capacidad nominal haciendo que este tipo de eventos y daños en componentes por sobre carga den como consecuencia incremento de temperatura, siendo al final un evento común y repetitivo.
- Al aumentar el tiempo de vida de cada componente como chumaceras y rodamientos de la faja 1300-CV-1201 debido a la anticipación de su posible falla por incremento de temperatura, también se asegura disponibilidad de planta y un tiempo mayor de operación minimizando detenciones por posibles paradas intempestivas lo cual hace menor el valor del lucro cesante. Este no fue analizado ya que no fue necesario, debido a que la rentabilidad del proyecto es directa gracias a los altos costos de reparación de componentes (chumaceras y rodamientos en los que se incurre por ser la faja un activo crítico para la operación de la planta de procesos de “Gold Mill” de minera Yanacocha.

RECOMENDACIONES

- En lo sucesivo cada nuevo proyecto de implementación minero donde se incluyan fajas transportadoras deben venir con sistemas de monitoreo de temperatura en línea a fin de tener los beneficios de esta implementación desde el arranque de planta.
- Una acción correctiva inmediata al incremento de temperatura es un engrase de chumaceras y rodamientos, esta tarea preventiva es más barata que el reemplazo de componentes, pero los más recomendable como acción correctiva es colocar un sistema de lubricación en línea con lo cual se reduce el gasto por horas hombre de personal técnico lubricador asimismo se puede generar un enclavamiento sobre algunos de los valores comparados según el "Set Point" o los rangos de temperatura nominales.
- Es recomendable generar un histórico de eventos por incremento de temperatura ya que la data tomada de cada sensor puede ser comparada con valores de temperatura de otras fajas que posean los mismos tipos de componentes con parámetros de operación similar , pero que se diferencien en el modelo de chumacera y rodamientos de reductor a fin de poder establecer un comparativo de vida útil y modelo de chumacera rodamiento utilizado, ya que se puede mejorar la calidad de estos componentes tomando como referencia otras operaciones.
- Se debe realizar una lección punto a punto, para poder actualizar el método y modo de operación de la faja, generar un plan de interiorización con los operadores a fin de que sean conscientes del costo y el riesgo involucrado que existe de sobre cargar de mineral la faja y operarla sobre el máximo de su límite permisible.

GLOSARIO

Molino Semi-Autógeno (SAG): Es un equipo usado en plantas mineras para moler rocas de mineral para reducir su tamaño y hacerlo apto para las etapas siguientes de procesamiento de dicho mineral.

PAD: Es una estructura a manera de pirámide escalonada donde se acumula el mineral extraído usado en lixiviación minera.

Stockpile: Es una pila de almacenamiento de mineral.

Trommel: Es un cilindro formado por mallas que sirve para clasificar el mineral a la salida de un molino de mineral ya sea bolas o semi autógeno.

Intervalo P-F: El intervalo P-F rige la frecuencia con que debe ser realizada la tarea predictiva.

RTD: Detector de temperatura resistivo. Es decir, un **sensor** de **temperatura** basado en la variación de la resistencia de un conductor con la temperatura.

Modbus: Es un protocolo de comunicaciones situado en el nivel 2 del Modelo OSI, basado en la arquitectura maestro/esclavo o cliente/servidor.

Delta V: Sistema de control y adquisición de datos desarrollado por la empresa Emerson.

Tags: Es la nomenclatura usada en proyectos para nombrar un equipo o instrumento dentro de un plano de ingeniería de diseño.

ACR: Análisis causa raíz. Es un método de resolución de problemas dirigido a identificar sus causas o acontecimientos.

Setpoint: Es la salida deseada cuando se realiza control automático de procesos.

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ANEXOS

ANEXO “A”

Rosemount 848T Wireless Temperature Transmitter

CE

WirelessHART
Expanding the Possibilities

DEFAULT SETTINGS

The 848T default configuration is shown below:

Sensor 1	Type J Thermocouple
Sensor 2	Type J Thermocouple
Sensor 3	Type J Thermocouple
Sensor 4	Type J Thermocouple
Engineering Units	°C
Number of Lead Wires	2
Sensor Alerts	Disabled
Network ID	Factory Generated Network Parameters
Join Key	Factory Generated Network Parameters
Update Rate	1 Minute

Use the C1 option code to have the factory configure each sensor individually. This option also enables factory configuration of process alerts, update rate, and channel tag. This option code is not required to configure the self-organizing network parameters, or to set all of the sensors identically.

DEVICE NETWORK CONFIGURATION

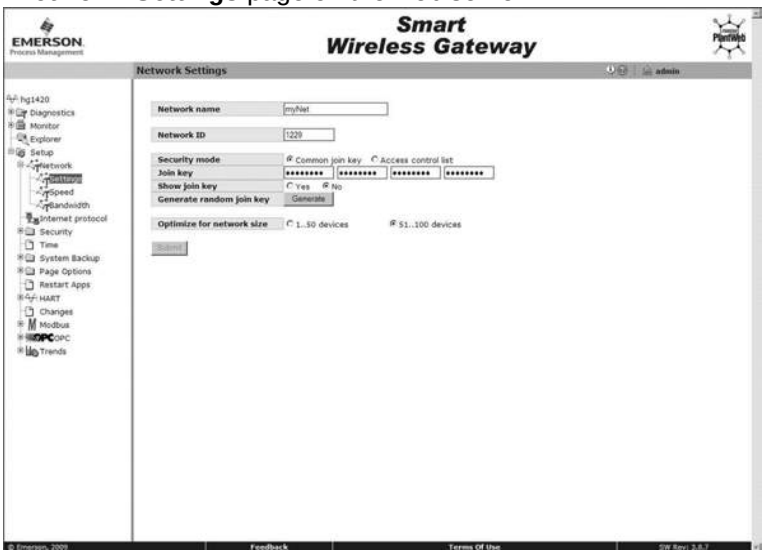
Join Device to Network

Fast Key	2, 1, 1

The transmitter must be configured in order to communicate with the Smart Wireless Gateway, and ultimately with the host system. This step is the wireless equivalent of connecting wires from the transmitter to the host system.

1. From the *Home* screen, select 2: **Configure.**
2. Select 1: **Guided Setup**.
3. Select 1: **Join Device to Network**.

Using a Field Communicator or AMS, enter the Network ID and Join Key so they match the Network ID and Join Key of the Smart Wireless Gateway, and other devices in the network. If the Network ID and Join Key do not match the Gateway, the transmitter will not communicate with the network. The Network ID and Join Key can be obtained from the Smart Wireless Gateway on the **Setup>Network>Settings** page on the web server.



Configure Update Rate

Fast Key	2, 1, 2

The Update Rate is the frequency a new measurement is taken and transmitted over the wireless network, is by default one minute. This may be changed at commissioning, or at any time using AMS Wireless Configurator. The Update Rate is from 8 seconds to 60 minutes and is user selectable.

1. From the *Home* screen, select 2: **Configure.**
2. Select 1: **Guided Setup**.
3. Select 2: **Configure Update Rate.**

If using an Emerson gateway, select **Yes** to enable optimizations. If using another vendors WirelessHART gateway, select **No** to disable optimizations and consult manufacturer's gateway manual.

SENSOR CONFIGURATION

Configure Sensor Type

Fast Key	2, 1, 3, 1

Every temperature sensor has unique characteristics, to achieve the most accurate measurement, configure the input channels of the 848T to match the specific sensor type.

1. From the *Home* screen, select 2: **Configure.**
2. Select 1: **Guided Setup**.
3. Select 3: **Configure Sensors.**
4. Select 1: **Configure Sensor Type/Connection**.

Each input can be configured on the 848T for different sensor types. Select the desired sensor type and lead wires for each sensor input. If an input is not being used, "Not Used" should be selected for the sensor type. Refer to the Sensor Wiring Diagram Figure 3-4 on page 3-4.

Configure Engineering Units

Fast Key	2, 1, 3, 3

Each input can be configured on the 848T for different engineering units. The supported units are ° C, ° F, ° R, K, millivolts, ohms, and milliamps.

1. From the *Home* screen, select 2: **Configure.**
2. Select 1: **Guided Setup**.
3. Select 3: **Configure Sensors.**
4. Select 3: **Configure Device Engineering Units**.

Removing the Power Module

After the sensor and network parameters have been configured, remove the power module and close the housing cover. The power module should only be inserted when the device is ready for commissioning.

Use caution when handling the power module, it may be damaged if dropped from heights in excess of 20 ft. (6.1 m).

ADVANCED CONFIGURATION (OPTIONAL)

Configure Process Alerts

Fast Key	2, 1, 5

Alerts allow the user to set the transmitter to provide a notification when the measurement readings exceed the specified temperature range. A high and low alert may be established for each sensor input. A process alert is transmitted if the trigger points are exceeded and alert mode is “on”. An alert is displayed on a Field Communicator or on the AMS status screen, and will reset when the value is once again within the user-configured range.

NOTE
The High Alert value must be set higher than the Low Alert value, and both values must be within the temperature sensor limits.

1. From the *Home* screen, select 2: **Configure.**
2. Select 1: **Guided Setup**.
3. Select 5: **Configure Alerts**, then follow the on-screen instructions to complete the configuration process**.**

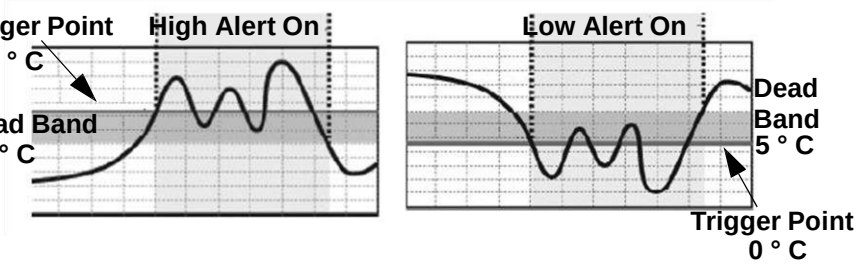
The user configures the Trigger Point and Dead Band for each High and Low alert and when the measurement value exceeds the Trigger Point it activates the alert. The alert deactivates when the measurement value falls outside the Dead Band range.

Example:

For the following illustration, the alert is active when the value rises above 100 ° C or falls below 0 ° C. The alert turns off when the value falls below 95 ° C or rises above 5 ° C. Dead Band is a buffer so the alerts do not toggle on and off when the temperature measurement is close to the Trigger Point.

High Alert Configuration
Trigger Point = 100 ° C
Dead Band = 5 ° C

Low Alert Configuration
Trigger Point = 0 ° C
Dead Band = 5 ° C



Device Temperature Engineering Units

Fast Key	2, 2, 6, 3

The Device Temperature reported can be configured for different engineering units.

To select the sensor temperature unit:

1. From the *Home* screen, select 2: **Configure.**
2. Select 2: **Manual Setup**.
3. Select 6: **Device Temperature.**
4. Select 3: **Unit**.

Write Protect

Fast Key	2, 2, 8, 1

The 848T Wireless has a software write protect security feature.

To view write protect security settings:

1. From the *Home* screen, select 2: **Configure.**
2. Select 2: **Manual Setup**.
3. Select 8: **Other.**
4. Select 1: **Write Protect**.

AC Power FIlter

Fast Key	2, 2, 8, 2

The AC Power Filter can be set to reject line power noise at either 50 or 60 Hz:

1. From the *Home* screen, select 2: **Configure.**
2. Select 2: **Manual Setup**.
3. Select 8: **Other.**
4. Select 2: **AC Power Filter**.

HART Tag

Fast Key	2, 2, 7, 1

The 848T HART Tag (8 characters) can be configured to identify the device:

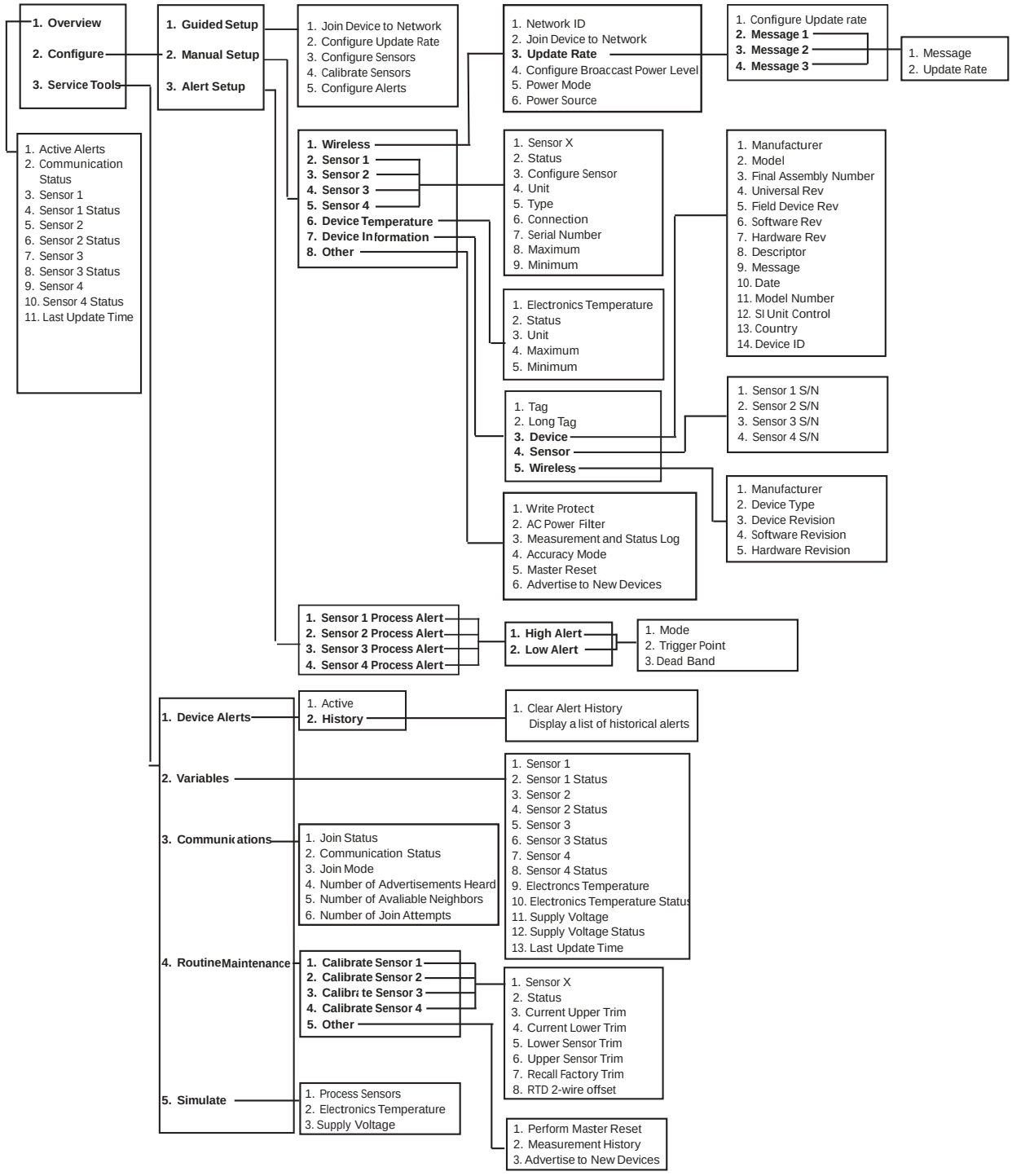
1. From the *Home* screen, select 2: **Configure.**
2. Select 2: **Manual Setup**. Select
3. 7: **Device Information.** Select
4. 1: **Tag***.

*A long tag (consisting of 32 characters) can be configured using the fast key sequence by selecting 2: Long Tag

HART® Menu Tree

Options listed in bold type indicate that a selection provides other options. For ease of operation, changing calibration and setup, such as sensor type, number of wires, and range values, can be completed in several locations.

Figure 2-3. Field Communicator Menu Tree



Section 3 Installation

Safety Messages . . . . . page 3-1
Wireless Considerations . . . . . page 3-2
Sensor Connections . . . . . page 3-3
Physical Installation . . . . . page 3-7
4–20 Milliamp Inputs . . . . . page 3-8

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Before connecting a 375 Field Communicator in an explosive atmosphere, make sure the instruments are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Process leaks could result in death or serious injury.

- Do not remove the thermowell while in operation.
- Install and tighten thermowells and sensors before applying pressure

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

Device cover is on a hinge and in certain installation configurations, the cover could swing open. Use caution when opening transmitter cover.

WIRELESS CONSIDERATIONS

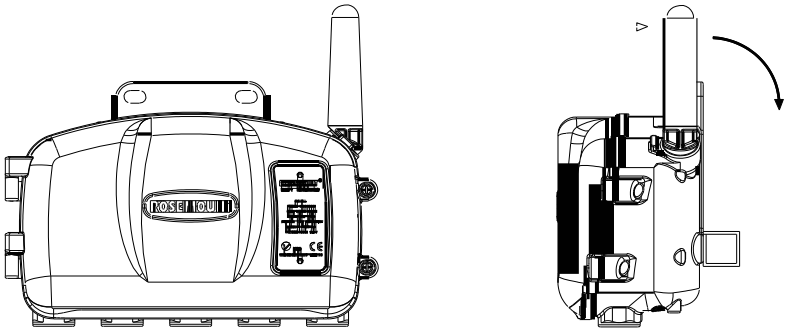
Power Up Sequence

The Power Module should not be installed on any wireless device until the Smart Wireless Gateway (“Gateway”) is installed and functioning properly. Wireless devices should also be powered up in order of proximity from the Gateway, beginning with the closest. This will result in a simpler and faster network installation. Enable Active Advertising on the Gateway to ensure that new devices join the network faster. For more information, see the Smart Wireless Gateway Manual (Document No. 00809-0200-4420).

Antenna Position

The antenna should be positioned vertically and it should be approximately 3 ft. (1 m) from any large structure, building, or conductive surface to allow for clear communication to other devices.

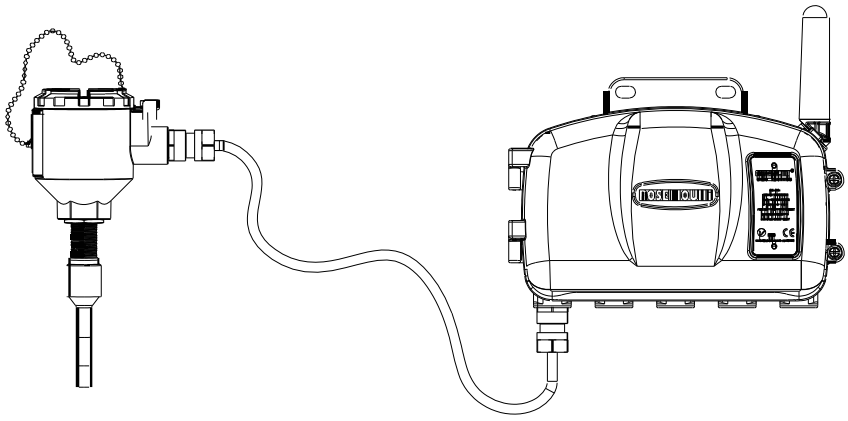
Figure 3-1.



Conduit Plug

The temporary orange plugs should be replaced with the included conduit plugs using approved thread sealant.

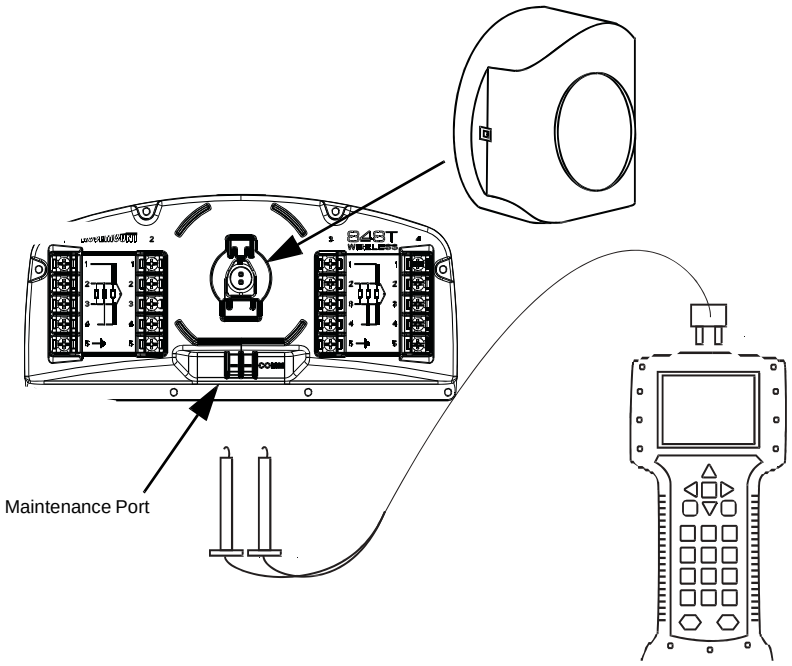
Figure 3-2.



375 Field Communicator Connections

The Power Module needs to be connected for the 375 Field Communicator to interface with the 848T Wireless.

Figure 3-3. Field Communicator Connection Diagram



SENSOR CONNECTIONS

The 848T Wireless is compatible with a number of RTD and thermocouple sensor types. Figure 3-4 on page 3-4 shows the correct input connections to the sensor terminals on the transmitter. To ensure a proper sensor connection, anchor the sensor lead wires into the appropriate compression terminals and tighten the screws.

Thermocouple or Millivolt Inputs

Use appropriate thermocouple extension wire to remote mount the transmitter from the sensor. Make millivolt input connections with copper wire. Use shielding for long runs of wire.

RTD or Ohm Inputs

There are various RTD configurations, including the 2-, 3-, and 4-wire, used in industrial applications. A 3- or 4-wire RTD operates within specification, without recalibration, for lead wire resistances up to 60 ohms per lead. This is the equivalent of 6,000 ft of 20 AWG wire. For a 2-wire RTD, both RTD leads are in series with the sensor element, so an error can occur in lead lengths that exceed one foot of 20 AWG wire. This error can be eliminated by using a 3- or 4-wire RTD.

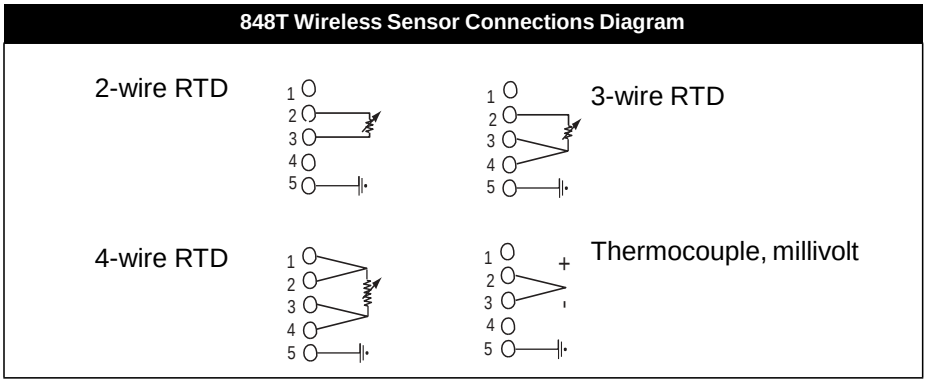
Sensor Lead Wire Resistance Effect—RTD Input

When using a 4-wire RTD, the effect of lead resistance is eliminated and has no impact on accuracy. A 3-wire sensor will not fully cancel lead resistance error because it cannot compensate for imbalances in resistance. Using the same type and length of wire on all three lead wires will make a 3-wire RTD installation as accurate as possible. A 2-wire sensor will produce the largest error because it directly adds the lead wire resistance to the sensor resistance. For 2- and 3-wire RTDs, an additional lead wire resistance error is induced with ambient temperature variations. The table and the examples shown below help quantify these errors.

Table 3-1. Examples of Approximate Basic Error

Sensor Input	Approximate Basic Error
4-wire RTD	Negligible (independent of lead wire resistance up to 60 Ω per lead)
3-wire RTD	± 1.0 Ω in reading per ohm of unbalanced lead wire resistance (Unbalanced lead wire resistance = maximum imbalance between any two leads.)
2-wire RTD	1.0 Ω in reading per ohm of lead wire resistance

Figure 3-4. Sensor Wiring Diagrams



Refer to “Grounding Practices” on page 3-10 for more information on sensor grounding practices.

Figure 3-5. Rosemount 68Q, 78 Standard Temperature Range, and 58C RTD Sensor Lead Wire Configurations

Figure 3-6. Rosemount 65, 78 High Temp, 68 RTD Lead Wire Configurations

Figure 3-7. Rosemount 183 Thermocouple Lead Wire Configuration

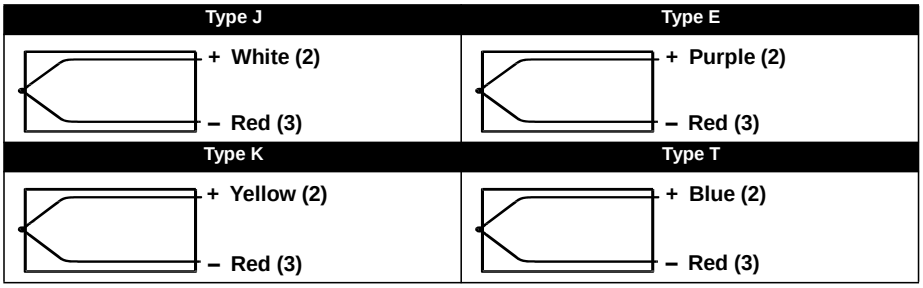
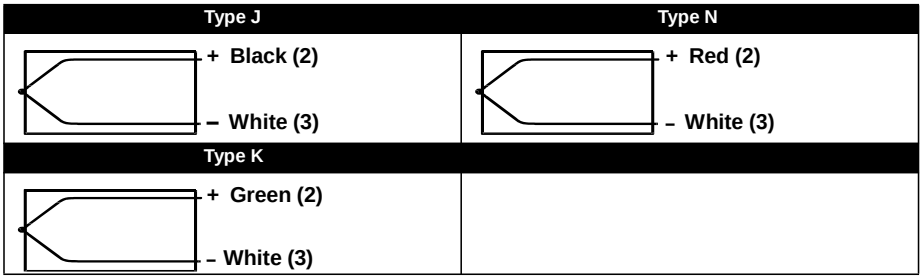


Figure 3-8. Rosemount 185 Thermocouple Lead Wire Configurations



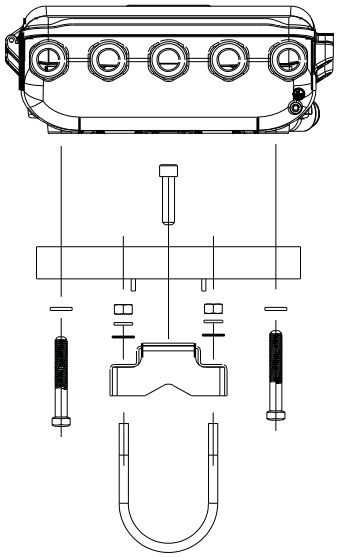
Note:
Wire color examples apply to Rosemount sensors, but will vary by manufacturer.

PHYSICAL INSTALLATION

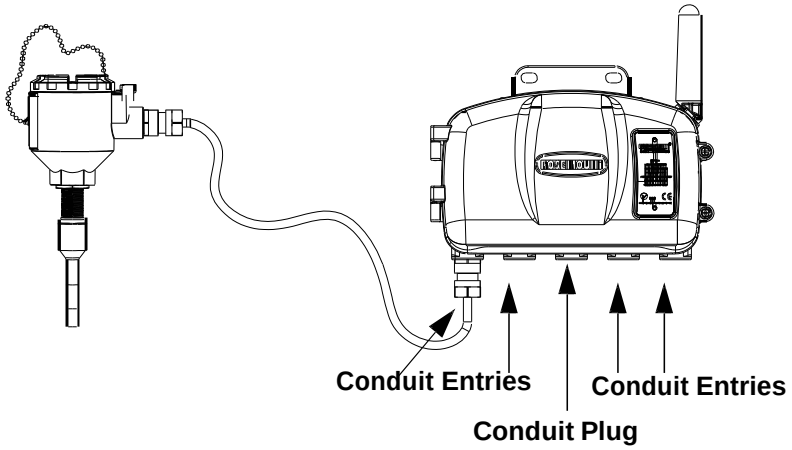
Remote Mount

The Rosemount 848T Wireless can only be installed in the Remote Mount configuration where the sensor is mounted separate from the 848T housing, then connected to the 848T using conduit or cable glands.

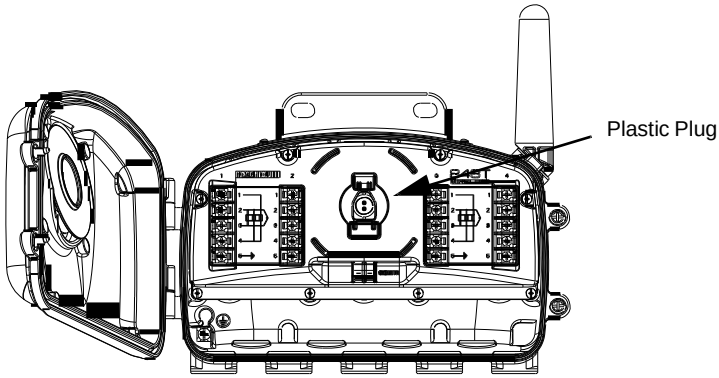
1. Install the sensor according to standard installation practices. Be sure to use thread sealant on all connections.
2. To reduce sensor wiring length, mount the Rosemount 848T Wireless transmitter central to all of the measurements. When installing the 848T wireless, the conduit entries need to be facing downward. If using the mounting bracket (Option Code B6), mount to a 2-in. pipe.



3. Run wiring (and conduit, if necessary) from the sensor to the 848T. For an easier installation, use the outside conduit entries, as shown below. Any unused conduit entries should be sealed with an approved sealant using the included threaded conduit plug.



4. Pull the wiring through the threaded conduit entry of the 848T.
5. Attach the sensor wiring to the terminals as indicated on the wiring diagram Figure 3-4 on page 3-4. Note that Terminal Screw 5 is for attaching the shield wire of the sensor to the device. See “Grounding Practices” on page 3-10 for more information.
6. To connect the power module, remove the plastic plug from the receptacle and discard.



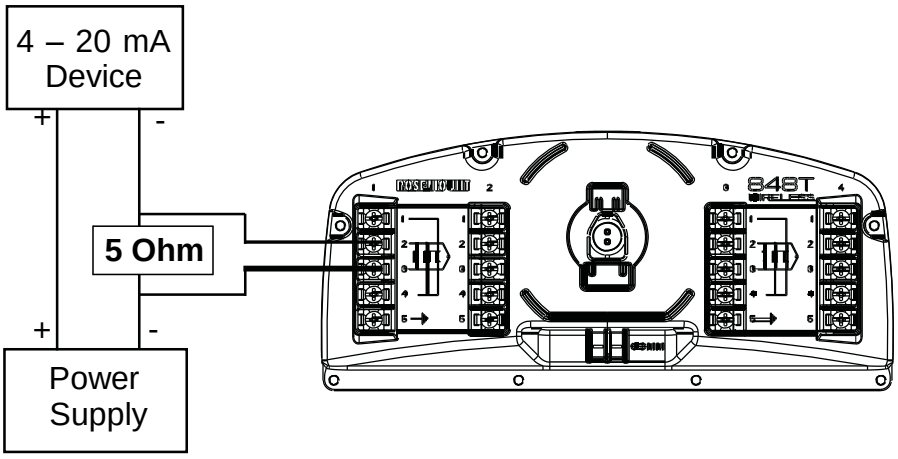
7. After initial installation, close the housing cover securely. Always ensure a proper seal by installing the electronics housing cover so that metal touches metal, but do not over tighten.
8. Position the antenna **vertically**. The antenna should be approximately three feet (1 m) from any large structures or buildings to allow clear communication to other devices.

4–20 Milliamp Inputs

This section details the wiring and configuration of the Rosemount 848T Wireless transmitter to monitor a 4 – 20 mA signal using the S002 option code. This technique is used to capture data from a 4 – 20 mA device that does not have a connection to traditional loop control or monitoring system.

The 848T measures millivolt signals, to monitor a 4 – 20 mA signal there must be a conversion to millivolt using a 5 Ohm resistor to create a 20 -100 mV signal. It is optimal to use a 5 Ohm resistor with stable operation over the ambient temperature range where the 848T is located. See Figure 3-9 below for information on wiring.

Figure 3-9. 848T Wireless Terminal Diagram



NOTICE

For a device to be Intrinsically Safe, it must operate on only one power source. By converting a 4 – 20 mA signal to a measurable millivolt signal, it is considered as a second power source in the terminal block of the 848T, and voids the Intrinsically Safe approval. This does not affect the division 2, non-incendive approvals so this configuration can still be installed and operated in division 2 areas. Also, this technique should not be applied to a 4 – 20 mA device currently connected to a loop control.

The mA signal should not be directly applied to the transmitter's millivolt terminals. Doing this without the resistor may damage the electronics. The voltage applied across the terminals should not exceed 100 mV. Excessive voltage could damage the transmitter.

Using the 375 Communicator or AMS, reconfigure the 848T sensor type to either 4 – 20 mA (Rosemount), 4 –20 mA (NAMUR), or mV. The engineering units are user-selectable and can be either mA or mV. Table 3-2 shows the saturation and alarm thresholds for 4–20 mA (Rosemount) sensor type and Table 3-3 shows the saturation and alarm thresholds for 4– 20 mA (NAMUR) sensor type.

Table 3-2. 4-20 mA (Rosemount) Saturation and Alarm

Transmitter Status	Analog Input (mA)	Measured Voltage (mV)	Analog Region
Sensor Saturation	>21.71	>108.55	Upper Alarm
Sensor Out of Limits	20.8 – 21.71	104 – 108.55	Upper Saturation
Good	3.9 – 20.8	19.5 – 104	Normal Region
Sensor Out of Limits	3.79 – 3.9	18.95 – 19.5	Lower Saturation
Sensor Saturation	<3.79	<18.95	Lower Alarm

Table 3-3. 4-20 mA (Namur) Saturation and Alarm

Transmitter Status	Analog Input (mA)	Measured Voltage (mV)	Analog Region
Sensor Saturation	>20.96	>104.8	Upper Alarm
Sensor Out of Limits	20.5 – 20.96	102.5 – 104.8	Upper Saturation
Good	3.8 – 20.5	19 – 102.5	Normal Region
Sensor Out of Limits	3.64 – 3.8	18.2 – 19	Lower Saturation
Sensor Saturation	<3.64	<18.2	Lower Alarm

Because of resistor variances, the input must be calibrated with the resistor installed to meet the accuracy specifications located on page A-3. For more information on lower and upper trim procedures, see “Calibration” on page 5-2.

Grounding Practices

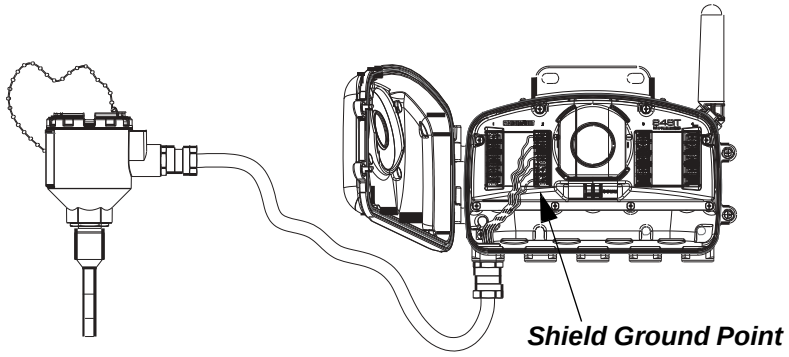
The transmitter operates with the housing floating or grounded. However, the extra noise in floating systems may impact many types of readout devices. If the signal appears noisy or erratic, grounding the transmitter at a single point may solve the problem.

The electronics enclosure should be grounded according to local and national installation codes. This can be accomplished via the process connection, internal case grounding terminal, or the external grounding terminal.

Each process installation has different requirements for grounding, use the options recommended by the facility for the specific sensor type, or begin with the recommendations below.

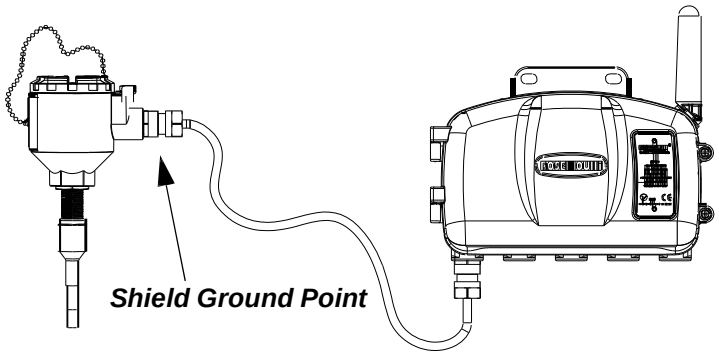
Ungrounded Thermocouple, mV, and RTD/Ohm Inputs Option:

1. Connect sensor wiring shield to Terminal Screw 5 at the terminal block. Terminal Screw 5 is internally connected to the housing.
2. Ensure the sensor wiring is electrically isolated from the transmitter housing.



Grounded Thermocouple Option:

1. Ground the sensor wiring shield at the sensor.
2. Ensure the sensor wiring and shield is electrically isolated from the transmitter housing and Terminal Screw 5.



Section 4 Commissioning

Safety Messages . . . . . page 4-1
Insert Power Module . . . . . page 4-2
Network Status . . . . . page 4-2
Verify Operation . . . . . page 4-2

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Before connecting a 375 Field Communicator in an explosive atmosphere, make sure the instruments are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Process leaks could result in death or serious injury.

- Do not remove the thermowell while in operation.
- Install and tighten thermowells and sensors before applying pressure

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

NOTE

All wireless devices should be installed only after the Smart Wireless Gateway has been installed and is functioning properly. Wireless devices should also be powered up in order of proximity from the Smart Wireless Gateway, beginning with the closest. This will result in a simpler and faster network installation. For more information see Smart Wireless Gateway Reference Manual (00809-0200-4420).

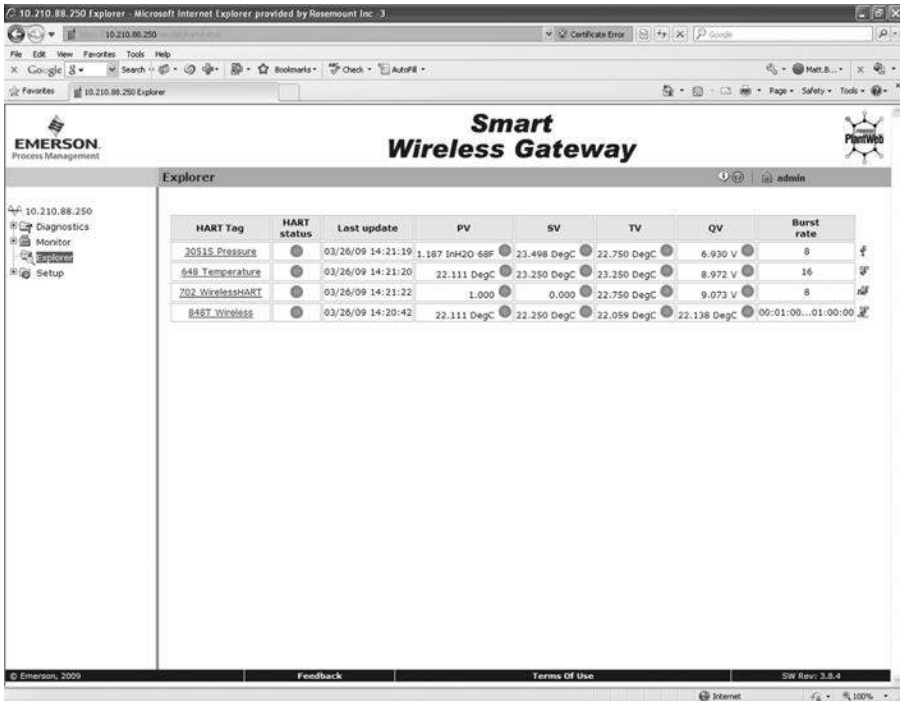
INSERT POWER MODULE

At commissioning, the Power Module needs to be inserted. If present, remove the plastic plug from the receptacle and insert the Power Module. Then close the housing cover, making sure to tighten the cover so that metal touches metal but do not over tighten.

NETWORK STATUS

If the Rosemount 848T Wireless was configured with the Network ID and Join Key and sufficient time has taken place for network polling, the transmitter should be connected to the network. To verify connectivity, open the Smart Wireless Gateway's integral web interface and navigate to the explorer page.

Figure 4-1. Smart Wireless Gateway Explorer Page



This page displays the transmitter's HART tag, PV, SV, TV, QV, and Update Rate. If the device and sensors are working properly, a green status indicator is present for HART status. A red indicator means there is a problem with either the device, a sensor, or the communication path. If "Not Used" has been selected for a sensor, a yellow indicator is shown. For more information on a specific device, click on the tag name.

VERIFY OPERATION

Operation can be verified using one of three methods: 375 Field Communicator, the Smart Wireless gateway's integrated web interface, or using AMS™ Wireless Configurator.

375 Field Communicator

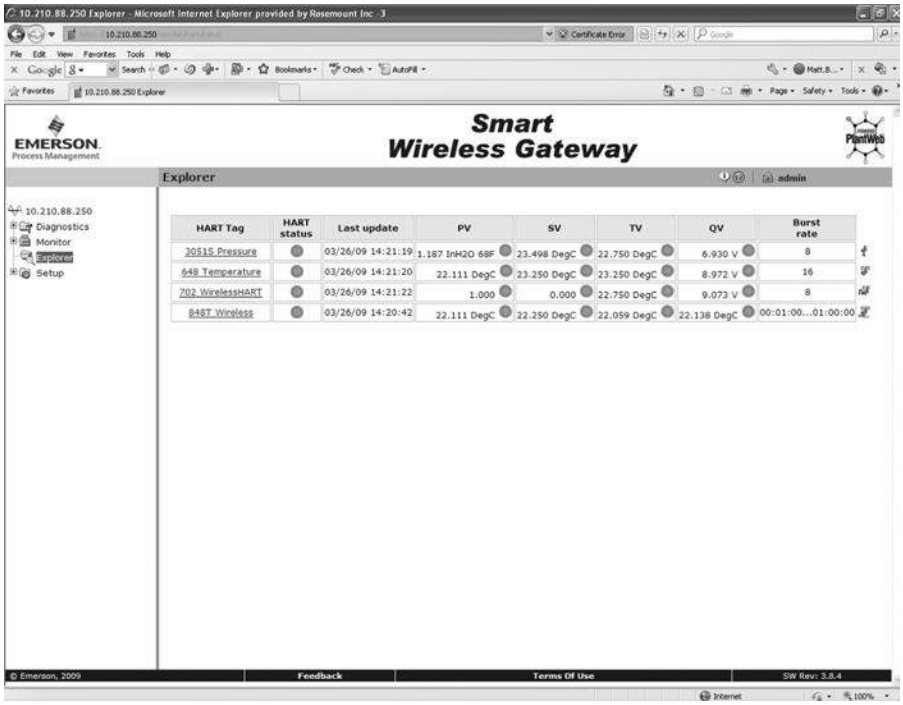
For HART communication, an 848T Wireless DD is required. For connecting with a 375 Field Communicator, refer to Figure 3-3 on page 3-3.

Function	Key Sequence	Menu Items
Communications	3, 3	Join Status, Communications Status, Join Mode, Number of Advertisements Heard, Number of Available Neighbors, Number of Join Attempt

Smart Wireless Gateway

In the Gateway's integrated web interface, navigate to the **Explorer** page. This page shows whether the device has joined the network, and if it is communicating properly.

Figure 4-2. Smart Wireless Gateway Explorer Page



NOTE
It may take several minutes for the device to join the network.

NOTE
If the device joins the network and immediately has an alarm present, it is likely due to sensor configuration. Check the sensor wiring (see Rosemount 848T Terminal Diagram Figure 4-2 on page 4-3) and the sensor configuration (see 848T Fast Key Sequence for handheld communicator on page 2-8).

Section 5 Operation and Maintenance

Safety Messages . . . . . page 5-1
Calibration . . . . . page 5-2
Power Module Replacement . . . . . page 5-3

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

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- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Before connecting a 375 Field Communicator in an explosive atmosphere, make sure the instruments are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Process leaks could result in death or serious injury.

- Do not remove the thermowell while in operation.
- Install and tighten thermowells and sensors before applying pressure

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

CALIBRATION

Calibrating the transmitter increases the measurement precision by allowing corrections to be made to the factory stored characterization curve by digitally altering the transmitter's interpretation of the sensor input.

To understand calibration, it is necessary to understand that smart transmitters operate differently from analog transmitters. An important difference is that smart transmitters are factory characterized, meaning that they are shipped with a standard sensor curve stored in the transmitter firmware. In operation, the transmitter uses this information to produce a process variable output, in engineering units, dependent on the sensor input.

Perform a sensor trim if the transmitter's digital value for the sensor measurement variables does not match the plant's standard calibration equipment. The sensor trim function calibrates the sensor to the transmitter in temperature units or raw units. Unless the site-standard input source is NIST-traceable, the trim functions will not maintain the NIST-traceability of the system.

Sensor Trim

Fast Key	3, 4, 1-4,

To calibrate the transmitter using the sensor trim function:

1. Assemble and power the calibration system including the 848T, Field Communicator/AMS, power supply, and temperature input source.
2. From the Home Screen, select 3: Service Tools.
3. Select 4: Routine Maintenance.
4. Select 1 - 4: Calibrate Sensor 1, 2, 3, or 4.
5. Select 5: Lower Sensor Trim.
6. Follow the on-screen instructions to complete the adjustment of the lower value.
7. Repeat the procedure for the upper value. Select 6: Upper Sensor Trim and follow the on-screen instructions to complete the adjustment of the upper value.
8. Verify calibration.

Recall Factory Trim

Fast Key	3, 4, 1-4, 7

Recalling factory trim recalls the factory-characterization of the standard sensor curve stored in the transmitter firmware

1. From the Home Screen, select 3: Service Tools.
2. Select 4: Routine Maintenance.
3. Select 1 - 4: Calibrate Sensor 1, 2, 3, or 4 depending on what selection is made.
4. Select 7: Recall Factory Trim.

POWER MODULE REPLACEMENT

Expected power module life is six years at reference conditions.(1)

When power module replacement is required, open the cover and then remove the power module. Replace the power module (part number 00753-9220-0001) and close the cover making sure to tighten so that metal touches metal but do not over tighten.

Handling Considerations

The power module with the wireless unit contains 2 “C” size primary lithium/thionyl chloride batteries. Each battery contains approximately 2.5 grams of lithium, for a total of 5 grams in each pack. Under normal conditions, the battery materials are self-contained and are not reactive as long as the batteries and the power module integrity are maintained. Care should be taken to prevent thermal, electrical or mechanical damage. Contacts should be protected to prevent premature discharge.

Use caution when handling the power module. The power module may be damaged if dropped from heights in excess of 20 feet.

⚠ Battery hazards remain when cells are discharged.

Environmental Considerations

As with any battery, local environmental rules and regulations should be consulted for proper management of spent batteries. If no specific requirements exist, recycling through a qualified recycler is encouraged. Consult the materials safety data sheet for battery specific information.

Shipping Considerations

The unit is shipped to you without the power module installed. Please remove the power module from the unit prior to shipping.

Primary lithium batteries are regulated in transportation by the U.S. Department of Transportation, and are also covered by International Air Transport Association (IATA), International Civil Aviation Organization (ICAO), and European Ground Transportation of Dangerous Goods (ARD). It is the responsibility of the shipper to ensure compliance with these or any other local requirements. Please consult current regulations and requirements before shipping.

SPARE PARTS

Table 5-1. Spare Parts List

Part Description	Part Number
Long-life Power Module, Intrinsically Safe	00753-9220-0001
O-ring for aluminum housing cover	00849-1603-0001
Captive screws for aluminum housing cover	00849-1602-0001
Aluminum housing cover and captive screws (o-ring included)	00849-1601-0001
Electronics module	00849-1600-0001
Kit, Spare Cable gland, 1/2-NPT, 7.5mm - 11.9mm (qty 1)	00648-9010-0001
Kit, Spare Cable gland, 1/2-NPT, thin wire, 3mm - 8mm (qty 1)	00648-9010-0003
Mounting bracket for 2-in. pipe mount - SST bracket and bolts	00848-4350-2001
M20 cable gland adapter (qty 4)	00849-1605-0001

(1) Reference conditions are 70° F (21° C), transmit rate of once per minute, and routing data for three additional network devices.

Section 6 Troubleshooting

Safety Messages . . . . . page 6-1
General Information . . . . . page 6-2

SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Failure to follow these installation guidelines could result in death or serious injury.

- Make sure only qualified personnel perform the installation.

Explosions could result in death or serious injury.

- Before connecting a 375 Field Communicator in an explosive atmosphere, make sure the instruments are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Process leaks could result in death or serious injury.

- Do not remove the thermowell while in operation.
- Install and tighten thermowells and sensors before applying pressure

Electrical shock could cause death or serious injury.

- Use extreme caution when making contact with the leads and terminals.

Table 6-1. Device Status with Recommended Actions

Device Status	Description	Recommended Actions
Electronics Failure	**An electronics error has occurred that could impact the device measurement reading.**	1. Reset the device. 2. Reconfirm all of the configuration items in the device. 3. Contact a service center if the condition persists.
Sensor Failure	**The process temperature sensor cannot be read.**	1. Check the sensor wiring connections and configuration. 2. Replace the temperature sensor. 3. Contact a service center if the condition persists.
Process Sensor Out of Limits	**The process temperature sensor is out of the allowed operating range.**	1. Verify that the appropriate sensor is selected for the application. 2. Replace the temperature sensor with an appropriate sensor type for the process temperature range. 3. Contact a service center if the condition persists.
Process Sensor Saturated	**The process temperature value has saturated and can no longer track the actual process temperature measurement.**	1. Verify that the process temperature is within the valid operating limits of the temperature sensor and device. 2. Replace the temperature sensor. 3. Contact a service center if the condition persists.
Sensor High Alert	**The temperature measurement has gone above the high alert configured by the user. The alert is active.**	1. Check the process sensors and process conditions. 2. Check the user configured alerts.
Sensor Low Alert	**The temperature measurement has dropped below the low alert configured by the user. The alert is active.**	1. Check the process sensors and process conditions. 2. Check the user configured alerts.
Process Sensor Excessive EMF	**There is excess voltage on the process temperature sensors.**	1. Check the sensor wiring and connections. 2. Replace the process sensor. 3. Contact a service center if the condition persists.
Junction Temperature Out of Limits	**The cold junction compensation temperature is outside of the allowed operating limits.**	1. Verify that the electronics Cold temperature is within the device operating range. 2. Contact a service center if the condition persists.
Electronics Temperature Out of Limits	**The electronics temperature is outside of the operating range of the transmitter.**	1. Make sure the device is installed in an environment within the device operating temperature range. 2. Contact a service center if the condition persists.
Electronics Temperature Failure	**The electronics temperature is beyond the failure limits of the transmitter.**	1. Make sure the device is installed in an environment within the device operating temperature range. 2. Contact a service center if the condition persists.
Simulation Active	**The device is in simulation mode and may not report actual information.**	1. Disable any simulation values. 2. Contact a service center if the condition persists.

Device Status	Description	Recommended Actions
Supply Voltage Failure	**The supply voltage is too low for the device to function properly.**	1. Replace the Power Module.
Supply Voltage Out of Range	**Low supply voltage may affect the operation of the device.**	1. Replace the Power Module.
High Power Active	**The device is operating in a high power mode ideal for configuration situations. If the device is self-powered, using the high power mode for long periods of time will significantly reduce the life of the Power Module.**	1. When configuring the device, activate high power mode. 2. Upon completion of configuration, disable high power mode.

Table 6-2. Wireless Network Troubleshooting

Symptom	Recommended Actions
Device not joining the network	**Verify Network ID and Join Key** **Wait longer (30 min.)** **Enable High Speed Operation on Smart Wireless Gateway** **Check the Power Module** **Verify the device is within range of at least one other device** **Verify network is in active network advertise** **Power Cycle device to try again** **Verify device is configured to join. Send the "Force Join" command to the device** **See the Troubleshooting section of the Smart Wireless Gateway manual for more information.**
Short Battery Life	**Check that "Power Always On" mode is off** **Verify the device is not installed in extreme temperatures** **Verify that the device is not a network pinch point** **Check for excessive network rejoins from poor connectivity**
Limited Bandwidth Error	**Reduce the Update Rate on the transmitter** **Increase communication paths by adding more wireless points**

Appendix A Specifications and Reference Data

Specifications . . . . . page A-1
Dimensional Drawings . . . . . page A-5
Ordering Information . . . . . page A-6

SPECIFICATIONS

Functional Specifications

Input
Supports Thermocouple, RTD, millivolt, ohm, and milliamp input types. See Accuracy on page A-3 for sensor options.

Output
WirelessHART™, linear with temperature or input.

Humidity Limits
0 – 99% non-condensing relative humidity.

Transmit Rate
User selectable, 8 sec. to 60 min.

Accuracy
(PT 100 @ reference conditions: 20 °C)
±0.30 °C (±0.54 °F)

Physical Specifications

Electrical Connections/Power Module

- Replaceable, non-rechargeable, Intrinsically Safe Lithium-Thionyl Chloride power module with polybutadine terephthalate (PBT) enclosure.
- Six year life at reference conditions.(1)
- 5-Screw Terminals for sensor connection.

Field Communicator Connections
Clips permanently fixed to terminal block

Materials of Construction
Housing

- Low-copper aluminum

Paint

- Polyurethane

(1) Reference conditions are 70° F (21° C), transmit rate of once per minute, and routing data for three additional network devices.

Cover O-ring

- Silicon

Terminal Block and Power Module

- PBT

Antenna

- PBT/Polycarbonate (PC) integrated omnidirectional antenna

Mounting

Transmitters may be panel mounted or mounted to a 2-in. pipe stand using optional mounting brackets. See “Dimensional Drawings” on page A-5.

Weight

848T Wireless - 4.75 lbs. (2.15 kg)

Enclosure Ratings (848T Wireless)

Housing option codes HA1 or HA2 are Type 4X and IP66 rated.

Performance Specifications

EMC (ElectroMagnetic Compatibility)

Meets all relevant requirements of EN 61326.

Transmitter Stability

±0.15% of output reading or 0.15 °C (0.27 °F), whichever is greater, for 2 years for RTDs.

±0.15% of output reading or 0.15 °C (0.27 °F), whichever is greater, for 1 year for thermocouples.

Self Calibration

The analog-to-digital measurement circuitry automatically self-calibrates for each temperature update by comparing the dynamic measurement to extremely stable and accurate internal reference elements.

Vibration Effect

Minimal effect when tested per the requirements of IEC60770-1: High Vibration Level - field or pipeline (10-60 Hz 0.21 mm displacement peak amplitude/60-2000 Hz 3g).

Accuracy

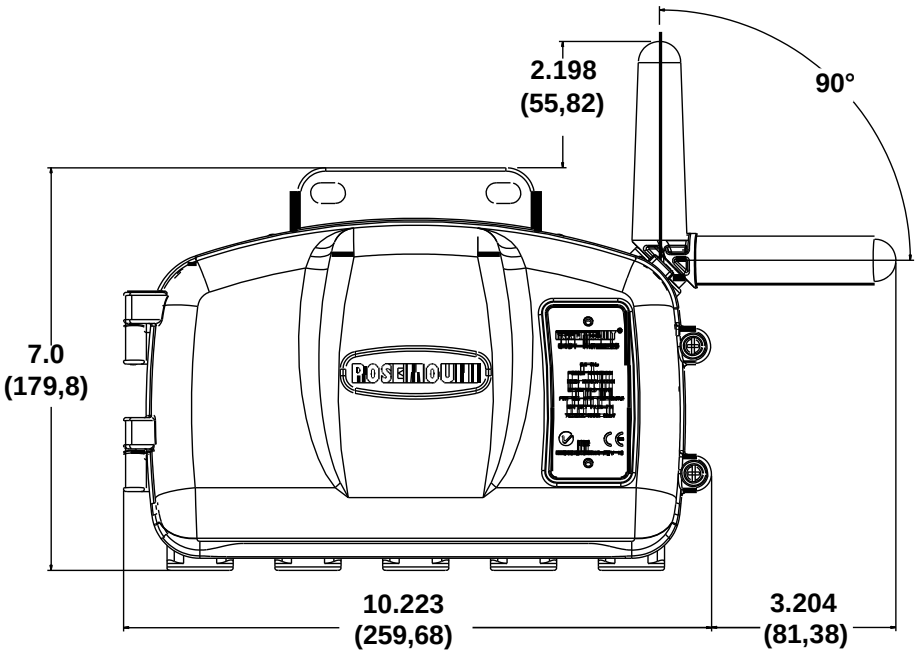
TABLE 1. Input Options/Accuracy

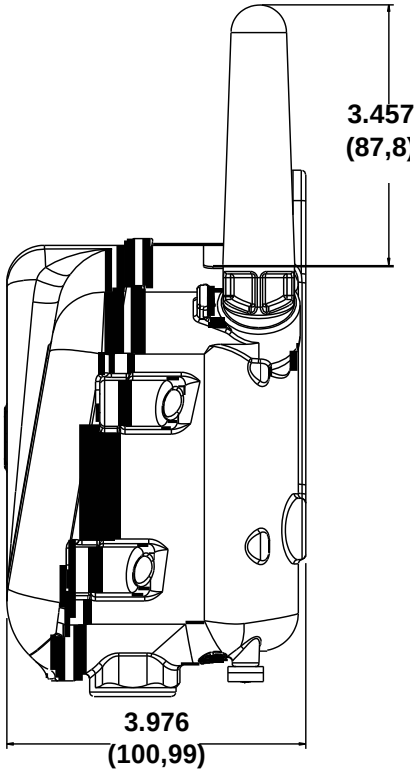
Sensor Option	Sensor Reference	Input Ranges °C	Input Ranges °F	Accuracy Over Range(s) °C	Accuracy Over Range(s) °F
2-, 3-, and 4-Wire RTDs					
Pt50 (a = 0.003910)	GOST 6651-94	–200 to 550	–328 to 990	± 0.57	± 1.03
Pt 100 (a = 0.00391)	GOST 6651-94	–200 to 550	–328 to 990	± 0.28	± 0.50
Pt 100 (a = 0.00385)	IEC 751; a = 0.00385, 1995	–200 to 850	–328 to 1562	± 0.30	± 0.54
Pt 100 (a = 0.003916)	JIS 1604, 1981	–200 to 645	–328 to 1193	± 0.30	± 0.54
Pt 200 (a = 0.00385)	IEC 751; a = 0.00385, 1995	–200 to 850	–328 to 1562	± 0.54	± 0.98
PT 200 (a = 0.003916)	JIS 1604, 1981 (a = 0.003916)	–200 to 645	–328 to 1193	± 0.54	± 1.03
Pt 500 (a = 0.00385)	IEC 751; a = 0.00385, 1995	–200 to 850	–328 to 1562	± 0.38	± 0.68
Pt 1000 (a = 0.00385)	IEC 751; a = 0.00385, 1995	–200 to 300	–328 to 572	± 0.40	± 0.72
Ni 120	Edison Curve No. 7	–70 to 300	–94 to 572	± 0.30	± 0.54
Cu 10	Edison Copper Winding No. 15	–50 to 250	–58 to 482	± 3.20	± 5.76
Cu 100 (a=428)	GOST 6651-94	-185 to 200	-365 to 392	± 0.48	±0.86
Cu 50 (a=428)	GOST 6651-94	-185 to 200	-365 to 392	± 0.96	±1.73
Cu 100 (a=426)	GOST 6651-94	-50 to 200	-122 to 392	± 0.48	±0.86
Cu 50 (a=426)	GOST 6651-94	-50 to 200	-122 to 392	± 0.96	±1.73
Thermocouples—Cold Junction Adds + 0.5 °C to Listed Accuracy					
NIST Type B (Accuracy varies according to input range)	NIST Monograph 175	100 to 300 301 to 1820	212 to 572 573 to 3308	± 6.00 ± 1.54	± 10.80 ± 2.78
NIST Type E	NIST Monograph 175	–200 to 1000	–328 to 1832	± 0.40	± 0.72
NIST Type J	NIST Monograph 175	–180 to 760	–292 to 1400	± 0.70	± 1.26
NIST Type K	NIST Monograph 175	–180 to 1372	–292 to 2502	± 1.00	± 1.80
NIST Type N	NIST Monograph 175	–200 to 1300	–328 to 2372	± 1.00	± 1.80
NIST Type R	NIST Monograph 175	0 to 1768	32 to 3214	± 1.50	± 2.70
NIST Type S	NIST Monograph 175	0 to 1768	32 to 3214	± 1.40	± 2.52
NIST Type T	NIST Monograph 175	–200 to 400	–328 to 752	± 0.70	± 1.26
DIN L	DIN 43710	–200 to 900	–328 to 1652	± 0.70	± 1.26
DIN U	DIN 43710	–200 to 600	–328 to 1112	± 0.70	± 1.26
w5Re/W26Re	ASTME 988-96	0 to 2000	32 to 3632	± 1.60	± 2.88
Type L	GOST R.8.585-2001	–200 to 800	–328 to 1472	±0.71	±1.28
Body Temperature of Transmitter		-50 to 85	-58 to 185	±3.50	±6.30
Input Units					
Ohm Input		0 to 2000 ohms		±0.90 ohms	
Millivolt Input		-10 to 100 mV		±0.05 mV	
4–20 mA (Rosemount)(1)		4–20 mA		±0.01 mA	
4–20 mA (NAMUR)[1]		4–20 mA		±0.01 mA	

(1) Requires the S002 option code.

DIMENSIONAL DRAWINGS

848T Wireless Remote Mount





Dimensions are in inches (millimeters)

ORDERING INFORMATION

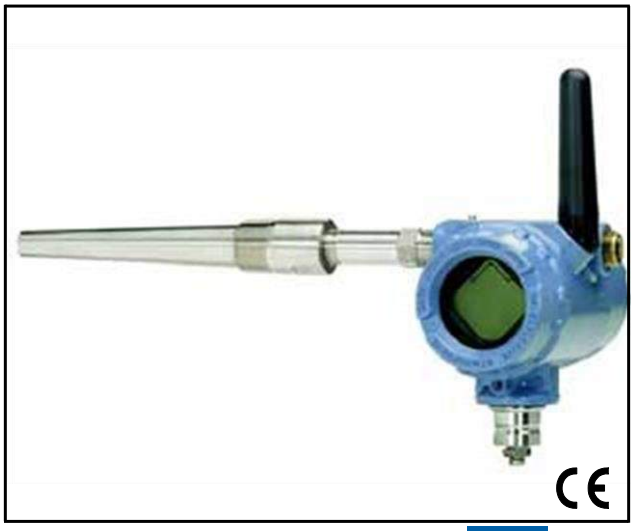
Model	Product Description
848T	High Density Temperature Measurement Family
Code	**Communications Protocol**
X	Wireless
Code	**Certifications**
I5	FM Intrinsically Safe, Division 2
N5	FM Class I, Division 2, and Dust Ignition-Proof (enclosure required)
I6	CSA Intrinsically Safe, Division 2
N6	CSA Class I, Division 2
I1	ATEX Intrinsic Safety
I7	IECEx Intrinsic Safety
NA	No Approval
Code	**Input Types**
S001	Resistance Temperature Detectors and Thermocouples
S002(1)	RTDs, Thermocouples, and 4–20 mA
Code	**Options**
Wireless Burst Rate	
WA3(2)	User Configurable Burst Rate, 2.4 GHz DSSS WirelessHART™
Omnidirectional Wireless Antenna	
WK(2)	Long Range, Integral Antenna
SmartPower™	
1(2)	Long Life Power Module Adapter, Intrinsically Safe
	Note: Long-Life Power Module must be shipped separately, order Part #00753-9220-0001
Mounting Kit Options	
B6	Mounting Bracket for 2-in. pipe mount - SST brackets and bolts
Housing Options	
HA1(3)	Aluminum with Cable Glands (5 x 1/2 inch NPT for 7.5 - 11.9 mm)
HA2(3)	Aluminum with Conduit Entries (5 plugged holes, suitable for installing 1/2-inch NPT fittings)
Custom Software Configuration Request	
C1	Factory configuration of date, descriptor, and message fields (CDS required)
Configuration Options	
F5	50 Hz Line Voltage Filter
5-Point Calibration	
C4	5-Point Calibration (requires Q4 option code to generate a calibration certificate)
Calibration Certificate	
Q4	Calibration Certificate (3-Point Calibration with Certificate)
Typical Model Number: 848T X I5 S001 WA3 WK1 B6 HA1	

(1) Only available with product certification N5 or NA. Stable resistors are included.
(2) Required for wireless
(3) HA1 or HA2 required for wireless

ANEXO “B”

Rosemount 648 Wireless Temperature Transmitter

- *Industry-leading temperature transmitter delivers field reliability as a wireless measurement solution*
- *Achieve optimal efficiency with Best-in-Class product specifications and capabilities*
- *Smart Wireless delivers innovative wireless solutions for temperature measurement and overall transmitter*



Rosemount 648 Wireless Temperature Transmitter

Industry-leading temperature transmitter delivers field reliability as a wireless measurement solution

- Superior accuracy and stability
- Single sensor capability with universal sensor inputs (RTD, T/C, mV, ohms)
- Transmitter-Sensor Matching with Callendar-Van Dusen
- IEC-approved WirelessHART® protocol
- Dual-compartment housing, available in aluminum or stainless steel
- Large LCD display
- Extended Range Antenna options available

Achieve optimal efficiency with Best-in-Class product specifications and capabilities

- Two-year stability rating reduces maintenance costs
- Transmitter-Sensor Matching eliminates the interchangeability error of sensors, improving measurement point accuracy by 75%
- User-centric Device Dashboards communicate important diagnostics and ensure process health
- Compensation for ambient temperature enhances transmitter performance
- Dual-compartment housing provides the highest reliability in harsh industrial environments

A standard diagnostic offering increases measurement reliability and provides visibility into process conditions

- Four user-configurable alerts provide increased process information and measurement point insight
- Open/short sensor diagnostics assist with detecting issues in sensor loops
- The terminal temperature feature verifies the installation location temperature conditions to ensure optimal transmitter operation

Smart Wireless delivers innovative wireless solutions for temperature measurement and overall transmitter performance

- Self-organizing network delivers information rich data with >99% data reliability and establishes a highly stable network
- Smart Wireless capabilities extend the full benefits of PlantWeb® to previously inaccessible temperature measurement locations
- Emerson SmartPower™ Solutions provide an intrinsically safe Power Module, allowing field replacements without removing the transmitter from the process, keeping personnel safe, and reducing maintenance costs
- Emerson Process Management's layered approach to wireless network security ensures that data transmissions are secure

Explore the benefits of a Complete Point Solution from Rosemount Temperature Measurement

- An "Assemble To Sensor" option enables Emerson to provide a complete point temperature solution, delivering an installation-ready transmitter and sensor assembly
- Emerson offers a selection of RTDs, thermocouples, and thermowells that bring superior durability and Rosemount reliability to temperature sensing, complementing the Rosemount Transmitter portfolio

Experience global consistency and local support from numerous worldwide Rosemount Temperature manufacturing sites

- World-class manufacturing provides globally consistent product from every factory and the capacity to fulfill the needs of any project, large or small
- Experienced Instrumentation Consultants help select the right product for any temperature application and advise on best installation practices
- An extensive global network of Emerson service and support personnel can be on-site when and where they are needed

Rosemount 648 Temperature Transmitter

The Rosemount 648 Wireless Temperature transmitter delivers industry-leading temperature field reliability as a wireless process measurement with Best-in-Class specifications and capabilities.

Transmitter features include:

- IEC-approved WirelessHART protocol (Option Code WA3)
- External Antenna (Option Code WK1)
- Extended Range, External Antenna (Option Code WM1)
- Large LCD Display (Option Code M5)
- Transmitter-Sensor Matching (Option Code C2)
- 3-Point Calibration Certificate (Option Code Q4)
- Assemble to Sensor (Option Code XA)

Table 1. Rosemount 648 Temperature Transmitter Ordering Information

 The Standard offering represents the most common options. The starred options ( ) should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

Model	Product Description		
648	Temperature Transmitter		
Transmitter Type			
Standard			**Standard**
D	Wireless Field Mount		
Transmitter Output			
Standard			**Standard**
X	Wireless		
Measurement Configuration			
1	Single-Sensor Input		
Housing Style		**Material**	
Standard			**Standard**
D	Dual Compartment Housing	Aluminum	
E	Dual Compartment Housing	SST	
Conduit Entry Size			
Standard			**Standard**
1	1/2-14 NPT		
Product Certifications			
Standard			**Standard**
NA	No Approval		
I5	FM Intrinsically Safe, Non-Incendive, and Dust Ignition-proof		
N5	FM Non-Incendive and Dust Ignition-proof		
I6	CSA Intrinsically Safe		
I1	ATEX Intrinsic Safety		
I7	IECEx Intrinsic Safety		
I4	TIIS Intrinsic Safety		
I3	China Intrinsic Safety		

Table 1. Rosemount 648 Temperature Transmitter Ordering Information

 The Standard offering represents the most common options. The starred options ( ) should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

Wireless Options (Include with selected model number)

Wireless Update Rate, Operating Frequency, and Protocol		
Standard		**Standard**
WA3	User Configurable Update Rate, 2.4 GHz DSSS, IEC 62591 (WirelessHART)	
Omnidirectional Wireless Antenna and SmartPower™		
Standard		**Standard**
WK1	External Antenna, Adapter for Black Power Module (I.S. Power Module Sold Separately)	
WM1	Extended Range, External Antenna, Adapter for Black Power Module (I.S. Power Module Sold Separately)	
	NOTE: Black Power Module must be shipped separately, order Model 701PBKKF or Part #00753-9220-0001.	
Mounting Bracket		
Standard		**Standard**
B5(1)	“L” Mounting Bracket for 2-in. pipe and panel mounting - All SST	
Display		
Standard		**Standard**
M5	LCD Display	
Software Configuration		
Standard		**Standard**
C1	Custom Configuration of Date, Descriptor, Message, and Wireless Parameters (Requires CDS with order)	
Line Filter		
Standard		**Standard**
F5	50 Hz Line Voltage Filter	
F6	60 Hz Line Voltage Filter	
Sensor Trim		
Standard		**Standard**
C2	Transmitter-Sensor Matching - Trim to Specific Rosemount RTD Calibration Schedule (CVD Constants)	
5-Point Calibration		
Standard		**Standard**
C4	5-Point Calibration (Requires Q4 option code to generate a Calibration Certificate)	
Calibration Certificate		
Standard		**Standard**
Q4	Calibration Certificate (3-Point Calibration)	
Cable Gland Option		
Standard		**Standard**
G2	Cable Gland (7.5 mm - 11.9 mm)	
G4	Thin Wire Cable Gland (3 mm - 8 mm)	
Assemble To Options		
Standard		**Standard**
XA (1)	Sensor Specified Separately and Assembled to Transmitter	
Typical Model Number: 648 D X 1 D 1 NA WA 3 WK 1 M5 C1 F6		

(1) When ordering a Rosemount 648 with the XA option, a mounting bracket is not included. If a bracket is required, please order option code B5.

Transmitter Specifications

Functional Specifications

Input

Supports Thermocouple, RTD, millivolt, and ohm input types. See "Transmitter Accuracy" on page 8 for sensor options.

Output

IEC 62591 (WirelessHART), 2.4 GHz DSSS

Local Display

The optional five-digit integral LCD Display can display sensor temperature in engineering units (°F, °C, °R, K, Ω, and millivolts) and percent of range. The display updates based on the Wireless Update Rate.

Humidity Limits

0–99% Non-condensing Relative Humidity

Update Rate

WirelessHART, user-selectable 1 second to 60 minutes

Accuracy

(Pt 100 @ reference condition: 20 °C)
±0.225 °C (±0.405 °F)

Radio Frequency Power Output from Antenna

External Antenna (WK1 option): Maximum of 10 mW (10dBm) EIRP

Physical Specifications

Electrical Connections

Power Module

The Emerson SmartPower™ Power Module is field replaceable, featuring keyed connections that eliminate the risk of incorrect installation.

The Power Module is an Intrinsically Safe solution, containing Lithium-thionyl chloride with a polybutadine terephthalate (PBT) enclosure.

The 648 Wireless has Power Module life time rating of 10 years with a one-minute update rate, at reference conditions.(1)

Sensor Terminals

Sensor terminals permanently fixed to terminal block

Field Communicator Connections

Communication Terminals

Clips permanently fixed to terminal block, designated by the text "COMM."

Materials of Construction

Enclosure

Housing - Low-copper aluminum or stainless steel

Paint - Polyurethane

Cover O-ring - Buna-N

Terminal Block and Power Module

PBT

Antenna

PBT/Polycarbonate (PC) integrated omnidirectional antenna

Mounting

Transmitters may be attached directly to the sensor. Mounting brackets also permit remote mounting. See "Dimensional Drawings" on page 12.

Weight

Low-copper Aluminum:
- 648 without LCD - 4.1 lb. (1.9 kg)
- 648 with M5 LCD - 4.2 lb. (2.0 kg)

Stainless Steel:
- 648 without LCD - 8.0 lb. (3.5 kg)
- 648 with M5 LCD - 8.1 lb. (3.6 kg)

Enclosure Ratings (648)

Housing Style option codes D and E are Type 4X and IP66/67 rated dual-compartment housings.

Performance Specifications

ElectroMagnetic Compatibility (EMC)

All Models:

Meets all relevant requirements of EN 61326-1; 2006; EN 61326-2-3; 2006

Transmitter Stability

The 648 has a stability of ±0.15% of output reading or 0.15 °C (whichever is greater) for 24 months.

Self Calibration

The analog-to-digital measurement circuitry automatically self-calibrates for each temperature update by comparing the dynamic measurement to extremely stable and accurate internal reference elements.

Vibration Effect

No effect when tested per the requirements of IEC60770-1 (1999):

High Vibration Level - field or pipeline (10-60 Hz 0.21 mm displacement peak amplitude / 60-2000 Hz 3g).

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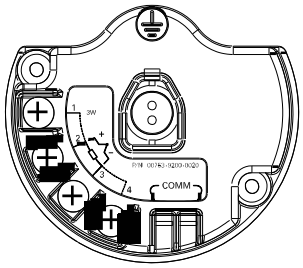
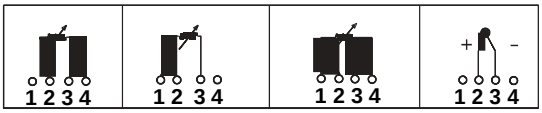
(1) Reference conditions are 70 °F (21 °C), and routing data for three additional network devices.
NOTE: Continuous exposure to ambient temperature limits (-40 °F or 185 °F; -40 °C or 85 °C) may reduce specified life by less than 20 percent.

Sensor Connections



648 Wireless Sensor Connections Diagram



2-wire RTD and K * **3-wire RTD and** K * **4-wire RTD and** K **T/C and mV**

* *Rosemount Inc. provides 4-wire sensors for all single element RTDs. You can use these RTDs in 3-wire or 2-wire configurations by leaving the unneeded leads disconnected and insulated with electrical tape.*

Temperature Limits

Description	Operating Limit	Storage Limit
Without LCD Display	–40 to 185 °F –40 to 85 °C	–40 to 185 °F –40 to 85 °C
With LCD Display	–4 to 175 °F –20 to 80 °C	–40 to 185 °F –40 to 85 °C

Transmitter Accuracy

Table 2. Rosemount 648 Input Options and Accuracy

Sensor Options	Sensor Reference	Input Ranges		Digital Accuracy(1)	
2-, 3-, 4-wire RTDs		°C	°F	°C	°F
Pt 100 (α = 0.00385)	IEC 751	–200 to 850	–328 to 1562	± 0.225	± 0.405
Pt 200 (α = 0.00385)	IEC 751	–200 to 850	–328 to 1562	± 0.405	± 0.729
Pt 500 (α = 0.00385)	IEC 751	–200 to 850	–328 to 1562	± 0.285	± 0.513
Pt 1000 (α = 0.00385)	IEC 751	–200 to 300	–328 to 572	± 0.285	± 0.513
Pt 100 (α = 0.003916)	JIS 1604	–200 to 645	–328 to 1193	± 0.225	± 0.405
Pt 200 (α = 0.003916)	JIS 1604	–200 to 645	–328 to 1193	± 0.405	± 0.729
Ni 120	Edison Curve No. 7	–70 to 300	–94 to 572	± 0.225	± 0.405
Cu 10	Edison Copper Winding No. 15	–50 to 250	–58 to 482	± 2.1	± 3.78
Pt 50 (α = 0.00391)	GOST 6651-94	–200 to 550	–328 to 990	± 0.45	± 0.81
Pt 100 (α = 0.00391)	GOST 6651-94	–200 to 550	–328 to 990	± 0.225	± 0.405
Cu 50 (α = 0.00426)	GOST 6651-94	–50 to 200	–58 to 392	± 0.72	± 1.296
Cu 50 (α = 0.00428)	GOST 6651-94	–185 to 200	–301 to 392	± 0.72	± 1.296
Cu 100 (α = 0.00426)	GOST 6651-94	–50 to 200	–58 to 392	± 0.36	± 0.648
Cu 100 (α = 0.00428)	GOST 6651-94	–185 to 200	–301 to 392	± 0.36	± 0.648
Thermocouples(2)					
Type B(3)	NIST Monograph 175, IEC 584	100 to 1820	212 to 3308	± 1.155	± 2.079
Type E	NIST Monograph 175, IEC 584	–50 to 1000	–58 to 1832	± 0.30	± 0.54
Type J	NIST Monograph 175, IEC 584	–180 to 760	–292 to 1400	± 0.525	± 0.945
Type K(4)	NIST Monograph 175, IEC 584	–180 to 1372	–292 to 2501	± 0.75	± 1.35
Type N	NIST Monograph 175, IEC 584	–200 to 1300	–328 to 2372	± 0.75	± 1.35
Type R	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	± 1.125	± 2.025
Type S	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	± 1.05	± 1.89
Type T	NIST Monograph 175, IEC 584	–200 to 400	–328 to 752	± 0.525	± 0.945
DIN Type L	DIN 43710	–200 to 900	–328 to 1652	± 0.525	± 0.945
DIN Type U	DIN 43710	–200 to 600	–328 to 1112	± 0.525	± 0.945
Type W5Re/W26Re	ASTM E 988-96	0 to 2000	32 to 3632	± 1.05	± 1.89
GOST L	GOST R 8.585-2001	–200 to 800	–328 to 1472	± 0.525	± 0.945
Other Input Types					
Millivolt Input		–10 to 100 mV		± 0.0225 mV	
2-, 3-, 4-wire Ohm Input		0 to 2000 ohms		± 0.675 ohm	

(1) The published digital accuracy applies over the entire sensor input range. Digital output can be accessed by HART Communications or WirelessHART.

(2) Total digital accuracy for thermocouple measurement: sum of digital accuracy +0.8 °C. (cold junction accuracy).

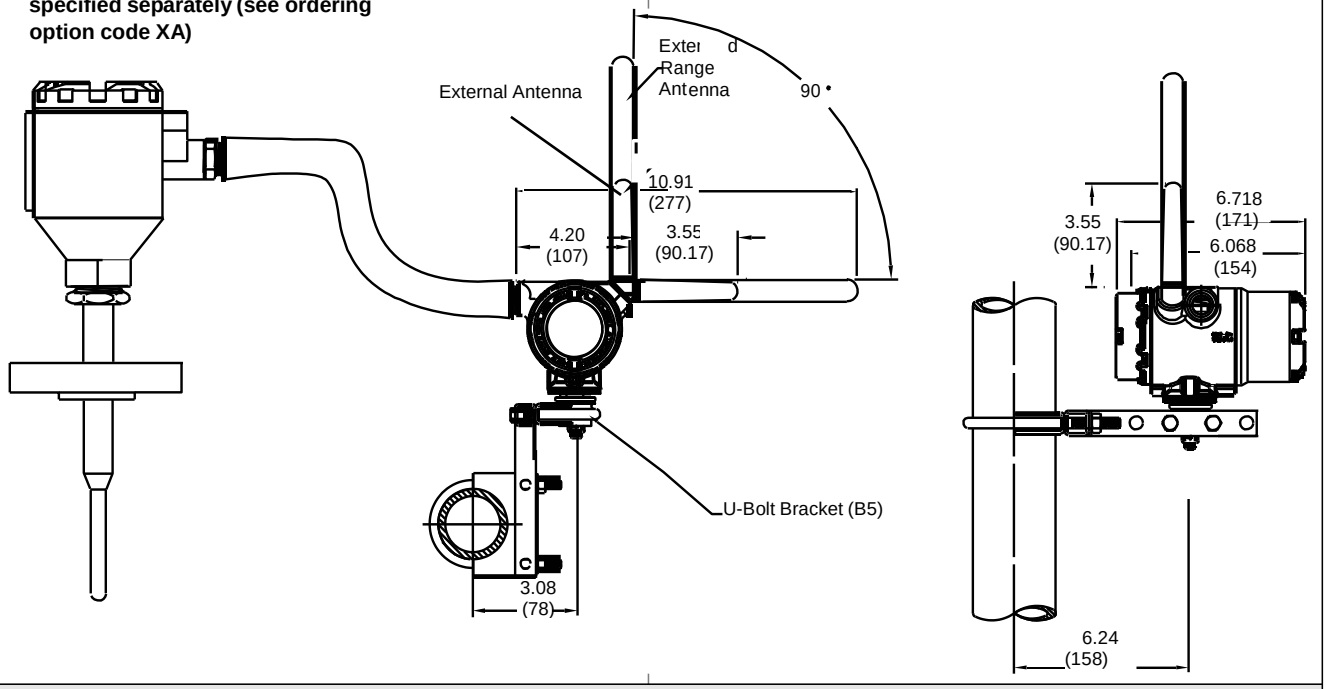
(3) Digital accuracy for NIST Type B T/C is ±4.5 °C (±8.1 °F) from 100 to 300 °C (212 to 572 °F).

(4) Digital accuracy for NIST Type K T/C is ±1.05 °C (±1.895 °F) from –180 to –90 °C (–292 to –130 °F).

Dimensional Drawings

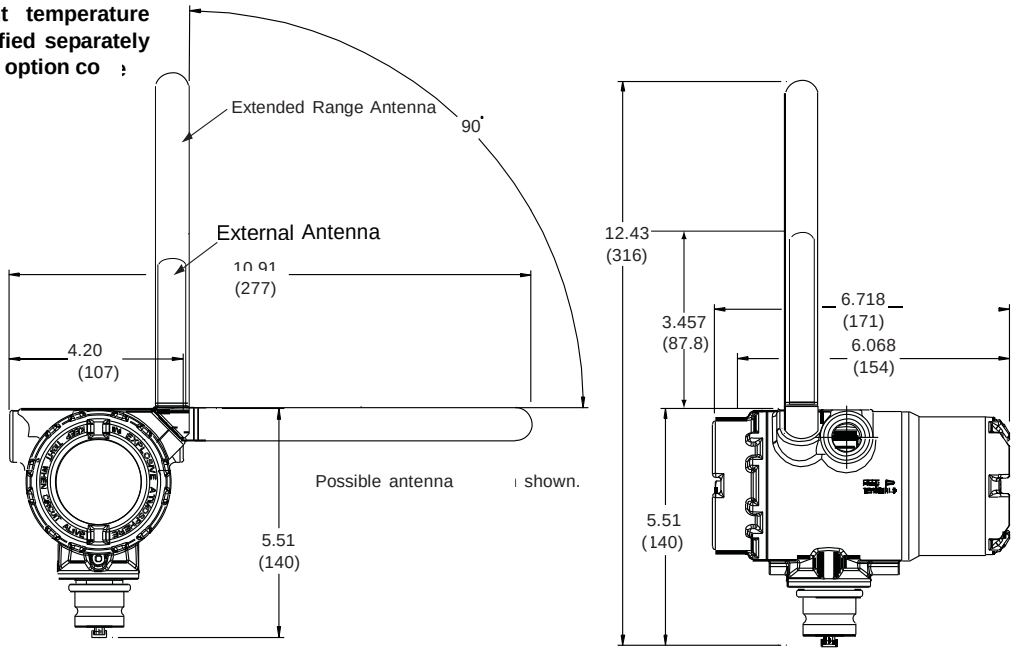
648 Remote Mount

Remote mount temperature sensor specified separately (see ordering option code XA)



648 Direct Mount

Direct mount temperature sensor specified separately (see ordering option co e XA)



Dimensions are in inches (millimeters)

ANEXO “C”

Volume 1 Temperature Sensors and Accessories (English)

- *RTD and Thermocouple offering in single and*
- *dual sensor models*
- *Barstock Thermowell offering in wide range of materials and process connections*
- *Calibration capabilities for increasing measurement accuracy*

Rosemount Volume 1 Temperature Sensor and Thermowells

Optimize plant efficiency and increase measurement reliability with industry-proven design and specifications

- Available in a wide variety of sensing technologies – RTD and Thermocouples
- All sensor styles and lengths are available in ¼-in. diameter
- State of the art manufacturing procedures provide robust element packaging, increasing reliability
- Industry-leading calibration capabilities allow for Callendar-van-Dusen values to give increased accuracy when paired with Rosemount transmitters
- Optional Class A accuracy for critical temperature measurement points
- Sanitary offering provides sensor assemblies approved for hygienic applications

Streamline operations and maintenance with sensor and thermowell design

- Spring loaded threaded adapter, General-purpose welded, capsule, and bayonet styles offer remote or integral transmitter mounting configuration

Explore the benefits of a Complete Point Solution from Rosemount Temperature Measurement

- An “Assemble Sensor to Specific Transmitter” option enables Emerson to provide a complete point temperature solution, delivering an installation-ready transmitter and sensor assembly
- Emerson has a complete portfolio of Single Point and High Density Temperature Measurement solutions, allowing you to effectively measure and control your processes with the reliability you trust from Rosemount products

Experience global consistency and local support from numerous worldwide Rosemount Temperature manufacturing sites

- World-class manufacturing provides globally consistent product from every factory and the capacity to fulfill the needs of any project, large or small.
- Experienced Instrumentation Consultants help select the right product for any temperature application and advise on best installation practices.
- An extensive global network of Emerson service and support personnel can be on-site when and where they are needed.

Rosemount 68 Sensor and Thermowell

The Rosemount 68 Sensor and Thermowell have designs that provide flexible and reliable temperature measurements in process environments.

Features include:

- Industry-standard Pt-100 RTD
- Variety of enclosure and connection head options
- Global hazardous-location approvals (Option Codes E5, E6, E7)
- Calibration services to give you insight to sensor performance (Option Codes V1-V8, X8, X9)
- Calibration certification documentation to accompany sensor (Option Code Q4)
- Assemble to Transmitter option (Option Code XA)

Table 1. Series 68 RTD Sensor Assemblies WITHOUT Thermowell

★ The Standard offering represents the most common options. The starred options (★) should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

Model	Product Description	Available Safety Approvals					
0068	Platinum Temperature Sensor WITHOUT thermowell		FM	ATEX	CSA	IECEx	
Sensor Lead Wire Termination							
Standard							**Standard**
R	Aluminum Connection Head, Six Terminals, Flat Cover, Unpainted		Y				★
T	Aluminum Connection Head, Six Terminals, Extended Cover, Unpainted		Y				★
P	Aluminum Connection Head, Six Terminals, Flat Cover, Painted		Y				★
L	Aluminum Connection Head, Six Terminals, Extended Cover, Painted		Y				★
N	Sensor only with 6-in. PTFE-insulated, 22-gauge lead wires		Y				★
D	Rosemount Aluminum Connection Head with 1/2-in. Entries		Y				★
Expanded							
C	Polypropylene Connection Head		N				
G	Rosemount SST Connection Head with 1/2-in. Entries		Y				
Sensor Type (single element -50 to 400 °C (-58 to 752 °F))							
Standard							**Standard**
01(1)(2)	Capsule Style						★
11(3)	General-purpose style						★
21(4)	Spring-loaded style						★
Expanded							
31(5)	Bayonet spring-loaded style (not available in (X) lengths over 21 inches)						
Extension Type							
Standard							**Standard**
A	Nipple Coupling						★
C	Nipple Union						★
N	None						★
Extension Length (E)							
Standard							**Standard**
00	0.0 in.						★
30	3.0 in.						★
60	6.0 in.						★

Table 1. Series 68 RTD Sensor Assemblies WITHOUT Thermowell
 The Standard offering represents the most common options. The starred options () should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

Thermowell Material		
Standard		**Standard**
N	No thermowell required	
Immersion Length (L)		
Standard		**Standard**
010[1][6]	1.0-in.	
015	1.5-in.	
020	2.0-in.	
025	2.5-in.	
030	3.0-in.	
035	3.5-in.	
040	4.0-in.	
045	4.5-in.	
050	5.0-in.	
055	5.5-in.	
060	6.0-in.	
065	6.5-in.	
070	7.0-in.	
075	7.5-in.	
080	8.0-in.	
085	8.5-in.	
090	9.0-in.	
095	9.5-in.	
100	10.0-in.	
105	10.5-in.	
110	11.0-in.	
115	11.5-in.	
120	12.0-in.	
125	12.5-in.	
130	13.0-in.	
135	13.5-in.	
140	14.0-in.	
145	14.5-in.	
150	15.0-in.	
155	15.5-in.	
160	16.0-in.	
165	16.5-in.	
170	17.0-in.	
175	17.5-in.	
180	18.0-in.	
185	18.5-in.	
190	19.0-in.	
195	19.5-in.	
200	20.0-in.	
205	20.5-in.	
210	21.0-in.	
210	21.5-in.	
220	22.0-in.	
225	22.5-in.	
230	23.0-in.	
235	23.5-in.	
240	24.0-in.	
245	15.5-in.	
250	25.0-in.	

Table 1. Series 68 RTD Sensor Assemblies WITHOUT Thermowell
 The Standard offering represents the most common options. The starred options () should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

Standard		Standard
260	26.0-in.	
270	27.0-in.	
280	28.0-in.	
290	29.0-in.	
300	30.0-in.	
310	31.0-in.	
320	32.0-in.	
330	33.0-in.	
340	34.0-in.	
350	35.0-in.	
360	36.0-in.	
370	37.0-in.	
380	38.0-in.	
390	39.0-in.	
400	40.0-in.	
410	41.0-in.	
420	42.0-in.	
430	43.0-in.	
440	44.0-in.	
450	45.0-in.	
460	46.0-in.	
470	47.0-in.	
480	48.0-in.	

Options (Include with selected model number)

Approval Options		
Standard		**Standard**
E5	FM Explosion-proof approval (See Figure 24)	
E6	CSA Explosion-proof approval (See Figure 25)	
E7[7]	IECEx Flameproof approval (See Figure 28)	
E1	KEMA/CENELEC Flameproof approval	
Callendar-Van Dussen Constants		
Standard		**Standard**
V1-V8	V-Callendar-van Dussen Constant (V4 not available with series 68 sensors)	
Calibration Schedule		
Standard		**Standard**
X8	Customer-Specified Temperature Range Calibration	
X9	Customer-Specified Single Temperature Point Calibration	
Calibration Certification		
Standard		**Standard**
Q4	Calibration Certification, Customer-Specified Temperature	
Mounting Adapters		
Standard		**Standard**
M5-M7	Mounting adapter: Sensor Compression Fitting: M5= 1/8 - 27 NPT, M6 = 1/4 - 18 NPT, M7 = 1/2 - 14 NPT	
A Leadkit		
Standard		**Standard**
A1-A8	Twisted lead wire extension: A1 = 1.5 ft, A2 = 3.0 ft, A3 = 6.0 ft, A4 = 12 ft, A5 = 24 ft, A6 = 50 ft, A7 = 75 ft, A8 = 100 ft	
B Leadkit		
Standard		**Standard**
B1-B8[8]	Shielded cable lead wire extension: B1 = 1.5 ft, B2 = 3.0 ft, B3 = 6.0 ft, B4 = 12 ft, B5 = 24 ft, B6 = 50 ft, B7 = 75 ft, B8 = 100 ft	
C Leadkit		
Standard		**Standard**
C1-C8[8]	Armored cable lead wire extension: C1 = 1.5 ft, C2 = 3.0 ft, C3 = 6.0 ft, C4 = 12 ft, C5 = 24 ft, C6 = 50 ft, C7 = 75 ft, C8 = 100 ft	

Table 1. Series 68 RTD Sensor Assemblies WITHOUT Thermowell

 The Standard offering represents the most common options. The starred options ( ) should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

D Leadkit		
Standard		**Standard**
D1-D8[8]	Armored cable lead wire extensions with electrical plug: D1 = 1.5 ft, D2 = 3.0 ft, D3 = 6.0 ft, D4 = 12 ft, D5 = 24 ft, D6 = 50 ft, D7 = 75 ft, D8 = 100 ft	
L Leadkit		
Standard		**Standard**
L1-L8	Armored cable mating plugs with lead wire extension: L1 = 1.5 ft, L2 = 3.0 ft, L3 = 6.0 ft, L4 = 12 ft, L5 = 24 ft, L6 = 50 ft, L7 = 75 ft, L8 = 100 ft	
F Leadkit		
Standard		**Standard**
F1	4-pin bayonet connector	
H Leadkit		
Standard		**Standard**
H1-H8	4-pin connector mating plugs with lead wire extension: H1 = 1.5 ft, H2 = 3.0 ft, H3 = 6.0 ft, H4 = 12 ft, H5 = 24 ft, H6 = 50 ft, H7 = 75 ft, H8 = 100 ft	
J Leadkit		
Standard		**Standard**
J1	Moisture-proof seal assembly for armored cables	
Assemble to Options		
Standard		**Standard**
XA[9]	Assemble connection head or transmitter to a sensor assembly	

(1) Capsule style available in 1-in. increments only, starting at 1-in. (i.e. 1, 2, 3-inches, etc.) See “Mounting Adapters for Series 58, 68, 78, and 183” on page 72.

(2) This option must be used with Sensor Lead Wire Termination code N and is not available with assembly code XA or with Approval codes E1, E5, E6, and E7.

(3) General-purpose sensors are only available in (L) lengths of 2.5-in. or greater.

(4) Spring loaded sensors must be installed in a thermowell assembly to meet the requirements of explosion-proof approvals code E6.

(5) Not available with Sensor Lead Wire Termination codes R, P, or C or with approval codes E1, E5, E6, or E7.

(6) 1-in. length without extension is only available in capsule style.

(7) IECEx Flame-proof Approval is only applicable if installed with Rosemount 248, 644, or 3144P transmitters.

(8) These options are not available with Sensor Lead Wire Termination codes R, P, or W.

(9) If ordering code XA with a transmitter, specify the same option on the transmitter model code.

Ordering Example

	Model	Lead Wire Termination	Sensor Type	Extension Type	Extension Length	Thermowell Material	Immersion Length	Additional Options
Typical Model Number	0068	N	11	N	00	N	045	E5

Table 2. Series 68 RTD Sensor Assemblies WITH Thermowell

 The Standard offering represents the most common options. The starred options () should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

Model	Product Description	Available Safety Approvals						
0068	Platinum Temperature Sensors WITH Thermowell		FM	ATEX	CSA	IECEx		
Sensor Lead Wire Termination								
Standard								**Standard**
R	Aluminum Connection Head, Six Terminals, Flat Cover, Unpainted		Y	Y	Y	N		
T	Aluminum Connection Head, Six Terminals, Extended Cover, Unpainted		Y	Y	Y	N		
P	Aluminum Connection Head, Six Terminals, Flat Cover, Painted		Y	Y	Y	N		
L	Aluminum Connection Head, Six Terminals, Extended Cover, Painted		Y	Y	Y	N		
N	Sensor only with 6-in. PTFE-insulated, 22-gauge lead wires		Y	Y	Y	N		
D	Rosemount Aluminum Connection Head with 1/2-in. Entries		Y	Y	Y	Y		
Expanded								
C	Polypropylene Connection Head		N	N		N		
G	Rosemount SST Connection Head with 1/2-in. Entries		Y	Y	Y	Y		
Sensor Type (single element -50 to 400 °C (-58 to 752 °F))								
Standard								**Standard**
11	General-purpose style							
21	Spring-loaded style							
Expanded								
31(1)(2)	Bayonet spring-loaded style (available in (X) lengths of 1 to 21-in., increments of 1-in.)							
Extension Type								
Standard								**Standard**
A(3)	Nipple Coupling							
C(3)	Nipple Union							
N	None							
Extension Length (E)								
Standard								**Standard**
00	0.0 in.							
30	3.0 in.							
60	6.0 in.							
Thermowell Material								
Standard								**Standard**
A	Type 316 SST(4)							
B	Type 304 SST							
C	Carbon Steel							
D	316L SST							
E	304L SST							
Expanded								
F	Alloy 20							
G	Alloy 400							
H	Alloy 600							
J	Alloy C-276							
L	Alloy B							
M	304 SST with PTFE coating							
P	Chrome Molybdenum F22							
R	Nickel 200							
T	Titanium							
U(5)	316 SST with Tantalum Sheath							
V	310 SST							
W	321 SST							
Z	Chrome Molybdenum F11							

Table 2. Series 68 RTD Sensor Assemblies WITH Thermowell
 The Standard offering represents the most common options. The starred options ( ) should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

Standard				**Standard**
290	29.0-in.	33.0-in.	2.5-in.	
300	30.0-in.	33.0-in.	1.5-in.	
310	31.0-in.	33.0-in.	0.5-in.	
320	32.0-in.	36.0-in.	2.5-in.	
330	33.0-in.	36.0-in.	1.5-in.	
340	34.0-in.	36.0-in.	0.5-in.	
350	35.0-in.	39.0-in.	2.5-in.	
360	36.0-in.	39.0-in.	1.5-in.	
370	37.0-in.	39.0-in.	0.5-in.	
380	38.0-in.	42.0-in.	2.5-in.	
390	39.0-in.	42.0-in.	1.5-in.	
400	40.0-in.	42.0-in.	0.5-in.	
410	41.0-in.	45.0-in.	2.5-in.	
420	42.0-in.	45.0-in.	1.5-in.	
430	43.0-in.	45.0-in.	0.5-in.	
440	44.0-in.	48.0-in.	2.5-in.	
450	45.0-in.	48.0-in.	1.5-in.	
460	46.0-in.	48.0-in.	0.5-in.	
470	47.0-in.	51.0-in.	2.5-in.	
480	48.0-in.	51.0-in.	1.5-in.	

Thermowell Style		**Mounting**	**Stem**	
Standard				**Standard**
T20(4)	Threaded	1/2-14 ANPT	Stepped	
T22(4)(12)	Threaded	3/4-14 ANPT	Stepped	
T24(4)(12)	Threaded	1-11.5 ANPT	Stepped	
T26(12)	Threaded	3/4-14 ANPT	Tapered	
T28(12)	Threaded	1-11.5 ANPT	Tapered	
T30(12)	Threaded	1 1/2-11 ANPT	Tapered	
T32(12)	Threaded	1/2-14 ANPT	Straight	
T34(12)(13)	Threaded	3/4-14 ANPT	Straight	
T36(12)(13)	Threaded	1-11.5 ANPT	Straight	
T38(12)(13)	Threaded	3/4-14 ANPT	Straight	
T44(12)	Threaded	1/2-14 ANPT	Tapered	
W38	Welded	3/4-in. pipe	Stepped	
W40	Welded	1-in. pipe	Stepped	
W42	Welded	3/4-in. pipe	Tapered	
W44	Welded	1-in. pipe	Tapered	
W46	Welded	1 1/4-in. pipe	Tapered	
W48(12)	Welded	3/4-in. pipe	Straight	
W50(12)	Welded	1-in. pipe	Straight	
F10(12)	Flanged	2-in., Class 150	Straight	
F12(12)	Flanged	3-in., Class 150	Straight	
F52(8)	Flanged	1-in., Class 150	Stepped	
F54	Flanged	1 1/2-in., Class 150	Stepped	
F56	Flanged	2-in., Class 150	Stepped	
F58(9)	Flanged	1-in., Class 150	Tapered	
F60	Flanged	1 1/2-in., Class 150	Tapered	
F62	Flanged	2-in. Class 150	Tapered	
F64(8)(12)	Flanged	1-in., Class 150	Straight	
F66(12)	Flanged	1 1/2-in., Class 150	Straight	
F70	Flanged	1-in., Class 300	Stepped	

Table 2. Series 68 RTD Sensor Assemblies WITH Thermowell
 The Standard offering represents the most common options. The starred options ( ) should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

A Leadkit		
Standard		**Standard**
A1-A8	Twisted lead wire extension: A1 = 1.5 ft, A2 = 3.0 ft, A3 = 6.0 ft, A4 = 12 ft, A5 = 24 ft, A6 = 50 ft, A7 = 75 ft, A8 = 100 ft	
B Leadkit		
Standard		**Standard**
B1-B8(1)	Shielded cable lead wire extension: B1 = 1.5 ft, B2 = 3.0 ft, B3 = 6.0 ft, B4 = 12 ft, B5 = 24 ft, B6 = 50 ft, B7 = 75 ft, B8 = 100 ft	
C Leadkit		
Standard		**Standard**
C1-C8(1)	Armored cable lead wire extension: C1 = 1.5 ft, C2 = 3.0 ft, C3 = 6.0 ft, C4 = 12 ft, C5 = 24 ft, C6 = 50 ft, C7 = 75 ft, C8 = 100 ft	
D Leadkit		
Standard		**Standard**
D1-D8(1)	Armored cable lead wire extensions with electrical plug: D1 = 1.5 ft, D2 = 3.0 ft, D3 = 6.0 ft, D4 = 12 ft, D5 = 24 ft, D6 = 50 ft, D7 = 75 ft, D8 = 100 ft	
L Leadkit		
Standard		**Standard**
L1-L8	Armored cable mating plugs with lead wire extension: L1 = 1.5 ft, L2 = 3.0 ft, L3 = 6.0 ft, L4 = 12 ft, L5 = 24 ft, L6 = 50 ft, L7 = 75 ft, L8 = 100 ft	
F Leadkit		
Standard		**Standard**
F1(1)	4-pin bayonet connector	
H Leadkit		
Standard		**Standard**
H1-H8	4-pin connector mating plugs with lead wire extension: H1 = 1.5 ft, H2 = 3.0 ft, H3 = 6.0 ft, H4 = 12 ft, H5 = 24 ft, H6 = 50 ft, H7 = 75 ft, H8 = 100 ft	
J Leadkit		
Standard		**Standard**
J1	Moisture-proof seal assembly for armored cables	
Special External Pressure Test		
Standard		**Standard**
R01	Special External Pressure Test	
Material Certification		
Standard		**Standard**
Q8	Material Certification	
Surface Finish Certification		
Standard		**Standard**
Q16	Surface Finish Certification	
Dye Penetration Test		
Standard		**Standard**
R03	Dye Penetration Test	
Thermowell Special Cleaning		
Standard		**Standard**
R04	Thermowell Special Cleaning	
NACE Approval		
Standard		**Standard**
R05	NACE Approval	
SST Plug and Chain		
Standard		**Standard**
R06	Stainless steel plug and chain	
Full Penetration Weld		
Standard		**Standard**
R07(13)	Full penetration weld	
Thermowell Concentric Serrations		
Standard		**Standard**
R09(13)(14)	Concentric serrations of thermowell flange face	

Table 2. Series 68 RTD Sensor Assemblies WITH Thermowell
 The Standard offering represents the most common options. The starred options () should be selected for best delivery.
The Expanded offering is subject to additional delivery lead time.

Flat Faced Flange		
Standard		**Standard**
R10 (13)(14)	Flat Faced Flange	
Vent Hole		
Standard		**Standard**
R11	Vent Hole	
Thermowell Xray		
Standard		**Standard**
R12	Thermowell Xray	
Special Surface Finish		
Standard		**Standard**
R14	Special Surface Finish (12 Ra Maximum “U” length = 22.5-in.)	
Ring Joint Flange		
Standard		**Standard**
R16(13)(14)	Ring joint flange (Not available with 0-in. (T) length)	
Electropolish		
Standard		**Standard**
R20	Electropolish	
Wake Frequency		
Standard		**Standard**
R21	Wake Frequency-Thermowell Strength Calculation	
Internal Pressure Test		
Standard		**Standard**
R22	Internal pressure test	
Brass Plug & Chain		
Standard		**Standard**
R23	Brass plug & chain	
Canadian Registration No.		
Expanded		
R24	CRN Marking for British Columbia	
R25	CRN Marking for Alberta	
R26	CRN Marking for Saskatchewan	
R27	CRN Marking for Manitoba	
R28	CRN Marking for Ontario	
R29	CRN Marking for Quebec	
R30	CRN Marking for New Brunswick	
R31	CRN Marking for Nova Scotia	
R32	CRN Marking for Prince Edward Island	
R33	CRN Marking for Yukon Territory	
R34	CRN Marking for Northwest Territory	
R35	CRN Marking for Nunavut	
R36	CRN Marking for Newfoundland and Labrador	
Twell From Hex Stock		
Expanded		
R37	Thermowell from Hex stock	
Assemble to Options		
Standard		**Standard**
XA(15)	Assemble connection head or transmitter to a sensor assembly	

ANEXO “D”

1420 Wireless Gateway

Section 1 Introduction

Basic Functionality and General Considerations . . . . . page 1-1
System Requirements . . . . . page 1-1
Guide to the 1420 Wireless Gateway . . . . . page 1-2
Guide to the 1420 Wireless Gateway Manual . . . . . page 1-3

BASIC FUNCTIONALITY AND GENERAL CONSIDERATIONS

The 1420 Wireless Gateway enables wireless, self-organizing devices to communicate with each other, and manages security and connectivity. The gateway is the entry point for wireless device data that is then converted to a format that is compatible with other systems. System integration is possible with Modbus, OPC, TCP/IP via Ethernet or serial connections. The 1420 Wireless Gateway enables users to monitor points that were previously out of reach.

The 1420 Wireless Gateway provides industry leading security, scalability, and functionality. Users can customize security levels to meet plant standards via a web-based interface. This interface also allows monitoring of points, simple trending, customized measuring point lists, basic configuration, and security management. The 1420 Wireless Gateway allows easy network expansion; simply set the Network ID and Join Key on the new device and it will become a part of the existing network.

SYSTEM REQUIREMENTS

In order to properly install and operate the 1420 Wireless Gateway, the Information System computer must meet or exceed the following criteria. For the initial configuration, a PC/Laptop must have an ethernet card and a web browser.

Operating System:

- Windows 2000, service pack 4
- Windows Server 2003
- Windows XP (Home or Professional), service pack 1 or higher

If the operating system requirement is not met, the setup will display a message and stop.

Applications:

- Internet Explorer 6.0 or higher
- Mozilla Firefox 1.5 or higher
- Sun Microsystems™ Java™ Runtime 1.4.1 (or newer)

If the user manual is being installed, the following application is also required:

- Adobe® Acrobat® 5.0 (or newer)

If the Network Assistant or OPC Proxy Setup utilities are being installed, the following application is also required:

- .NET Framework 2.0

If any of the above requirements are not met, the setup disc will install the following:

- Internet Explorer 6.0 service pack 1
- Sun Microsystems™ Java™ Runtime 1.5.0_10
- Adobe® Acrobat Reader® 8.0
- .NET Framework 2.0

Hard disk space:

- Maximum installation (including all upgrades performed by the setup disc): 250 mb

Typical installation (all features, but none of the above installed): 35 mb

Hardware:

Ethernet port

GUIDE TO THE 1420 WIRELESS GATEWAY

Common Terms and Definitions

The following terms and definitions are intended to define how the terms are used in this document. They may vary slightly from their common usage outside this document. See “Glossary” on page Glossary-1 for more terms and definitions.

Term	Definition
Connectivity	Refers to the connection between devices, specifically Path Statistics and Link Reliability in the devices.
Device	Refers to a wireless temperature or pressure transmitter.
Gateway	Refers to the 1420 Wireless Gateway. The interface between a network of devices and an information system. In this case, HART protocol in the devices and Modbus, Serial RS485, and Ethernet outputs.
Information System	network), Host System, or Control System. Typical systems include Distributed Control Systems (DCS), programmable logic controllers (PLC), data historians and asset management systems.
Private Network/LAN	A local connection between a 1420 Wireless Gateway and a PC/Laptop. This network is used for commissioning and configuration of the gateway.

Parts

The 1420 Wireless Gateway comes packaged with one Crossover Cable, four metal conduit entry plugs, and one Installation CD. If any of these are missing, please contact Rosemount Customer Central.

Conduit Entries

There are four ½” NPT Conduit entries. Any unused entries should be sealed using the metal plugs provided with the 1420 Wireless Gateway.

Upper Cover

The region of the 1420 Wireless Gateway behind the upper cover houses the gateway’s electronics, including the processor and the RS485 communication board. This area should not need to be opened at any time during installation or operation.

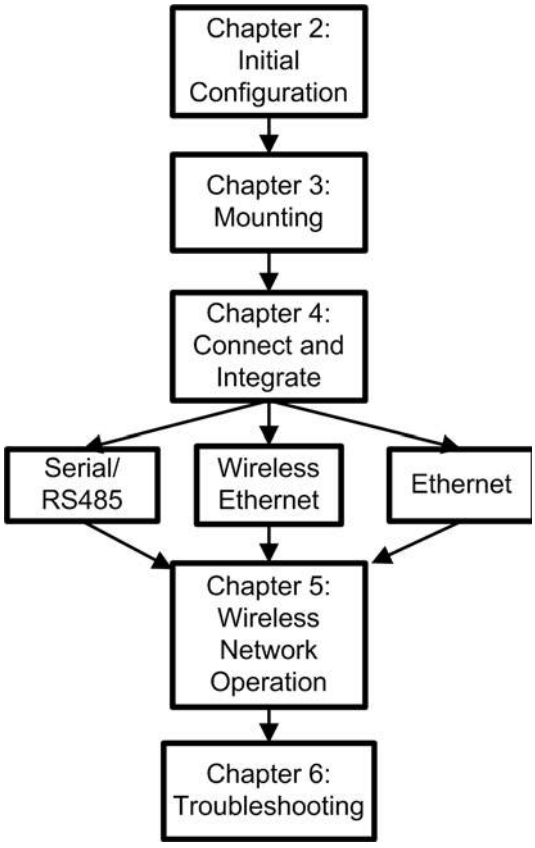
Lower Cover

The lower cover of the 1420 Wireless Gateway houses the junction box. The junction box houses the terminal block, which has connections for the power supply, Modbus output, Ethernet output, redundant Ethernet output and a Power Over Ethernet (POE) connection.

WARNING
Using the POE receptacle with a standard Ethernet or non-Rosemount wireless radio may result in equipment damage.

GUIDE TO THE 1420 WIRELESS GATEWAY MANUAL

This manual will guide you through the Initial Configuration, Mounting, Data Connection, Wireless Network Operation, and Troubleshooting of the 1420 Wireless Gateway. It also includes several Appendices for additional information including Reference Data, Approvals Information and Modbus Integer Scaling. At the end of the manual is a glossary of terms for your convenience.



Section 2: Initial Configuration

This chapter will describe how to connect directly to the 1420 Wireless Gateway for initial configuration using a PC/Laptop and the Crossover Cable. This process will prepare the 1420 Wireless Gateway to function properly when connected to the Information System.

Section 3: Mounting

This chapter will describe how to properly mount the 1420 Wireless Gateway. It will provide information for installing the gateway indoors versus outdoors, on a pipe or a bracket, and information about connecting an antenna.

Section 4: Data Integration

This chapter will describe how to establish a connection from the 1420 Wireless Gateway to the Information System and how to integrate the data collected by the gateway into the Information System. It will focus on the three primary interfacing methods: Serial/RS485, Ethernet, and Wireless Ethernet.

Section 5: Wireless Network Operation

This chapter will describe how to operate the wireless network after it is installed. Specifically it will cover fortification techniques and username/password management.

Section 6: Troubleshooting

This chapter will describe common problems and their solutions in three primary subjects: Physical Connections, Wireless Device Connectivity, and Application Integration Troubleshooting.

Glossary and Appendices

Included in this manual is a glossary of terms and definitions. The appendices will provide additional and more specific information on a variety of subjects.

WARNING
You will see warnings like this throughout the manual. They wil refer to specific hazards regarding safety of personnel and equipment.

BEST PRACTICES
You will see callouts like this throughout the manual. They will refe to best practices involved in installing, configuring and maintaining your wireless network.

HINT/TIP
You will see callouts like this throughout the manual. They will refe to hints and tips involved in installing, configuring and maintaining your wireless network.

SECURITY
You will see callouts like this throughout the manual. They will refe to specific important details about ways to secure your wireless network.

Section 2 Initial Configuration

Commissioning . . . . . page 2-1
Configuration . . . . . page 2-6
Return PC/Laptop to Original Settings . . . . . page 2-11

⚠WARNING

Explosions could result in death or serious injury:

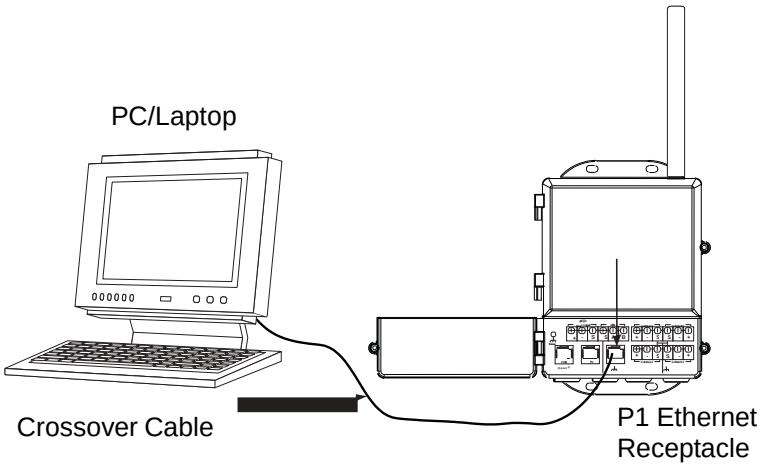
- In an Explosion-Proof and Flame-Proof environment, do not open the 1420 Wireless Gateway electronic housing in an explosive atmosphere.

COMMISSIONING

To configure the 1420 Wireless Gateway, a local connection between a PC/laptop and the 1420 Wireless Gateway must first be established. This can be done with the crossover cable and a PC/laptop dedicated to the 1420 Wireless Gateway, or a PC/laptop used for another purpose can be temporarily configured for the task.

HINT/TIP
If a PC/laptop from another network is used, carefully record the current IP address and other settings so the PC/laptop can be returned to its original network when configuration of the 1420 Wireless Gateway is finished.

If using a PC/laptop attached to another network, shut down the PC/laptop and remove it from the network before proceeding to set up the 1420 Wireless Gateway local connection.



Configure from the CD

The simplest way to configure the PC/laptop for use with the 1420 Wireless Gateway is to use the Network Assistant installed from the CD included with the 1420 Wireless Gateway.

Configuration of the gateway is done through its web interface. To access the device, you must create a private LAN with a subnet of 192.168.1.XX. The gateway will appear on this LAN at the IP address 192.168.1.10.

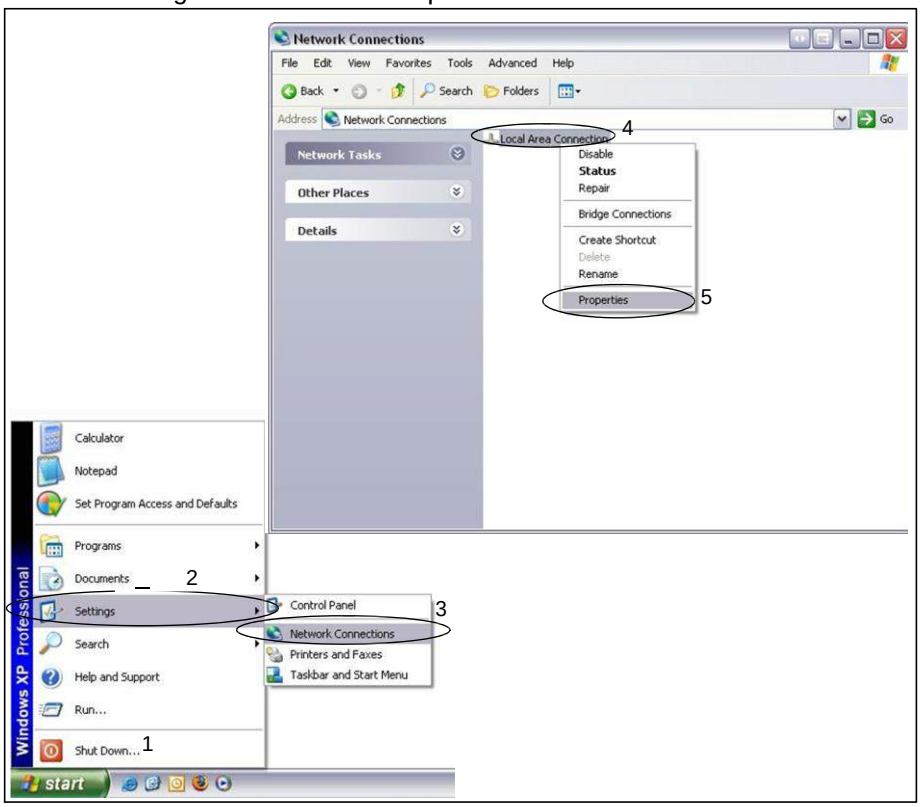
1. Using the supplied cross-over Ethernet cable, attach your PC to the 1420 Wireless Gateway's P1 receptacle.
2. Launch the Network Assistant on your PC/laptop by double-clicking on its desktop icon or by selecting it from the start menu.
3. If prompted, select the network adapter that you connected to the 1420 Wireless Gateway.
4. Click on the Direct button to establish a direct connection to the 1420.

When you are ready to remove the PC from the 1420 first open the Network Assistant and select Normal to return the settings of the PC/laptop to their original values. To check the connection, proceed to step 5 below.

Configure Manually

The PC/laptop address and host settings can also be changed manually using the following procedure for Internet Explorer on Windows XP. The procedure for other operating systems and web browsers may vary slightly:

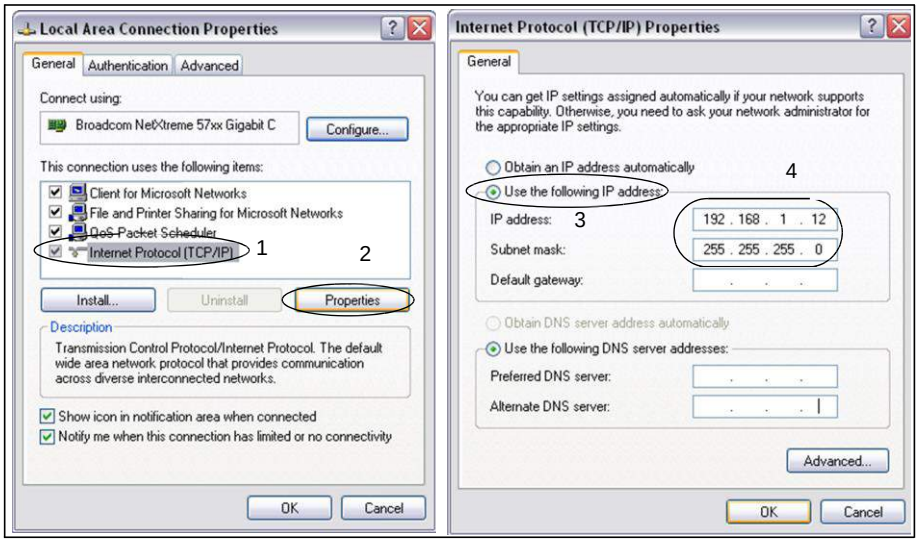
1. On the PC/laptop, install the Java Plug-in found on the CD provided with the 1420. The Plug-in can also be found at http://java.com/
2. Under Network Connections:
   a. Select Local Area Connection
   b. Right click to select Properties.



c. Select Internet Protocol (TCP/IP), then click the Properties button

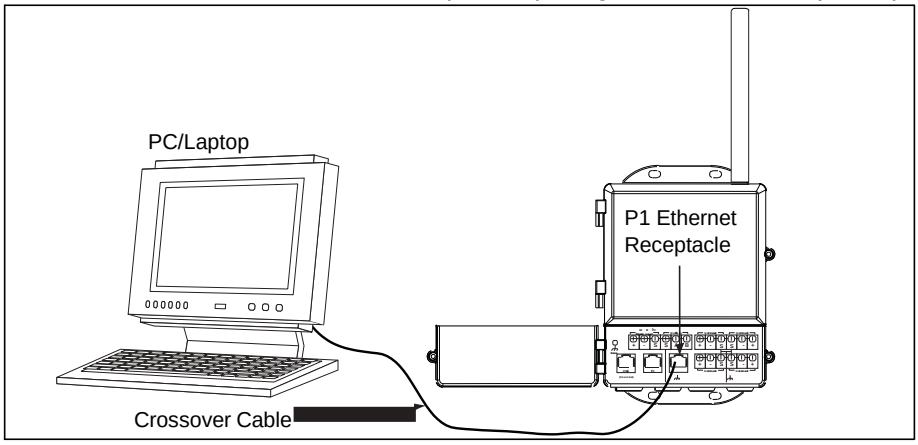
d. Select the Use the following IP address button and set the IP address to 192.168.1.12

e. Set the Subnet Mask to 255.255.255.0



f. Select OK for each of the settings windows that have opened.

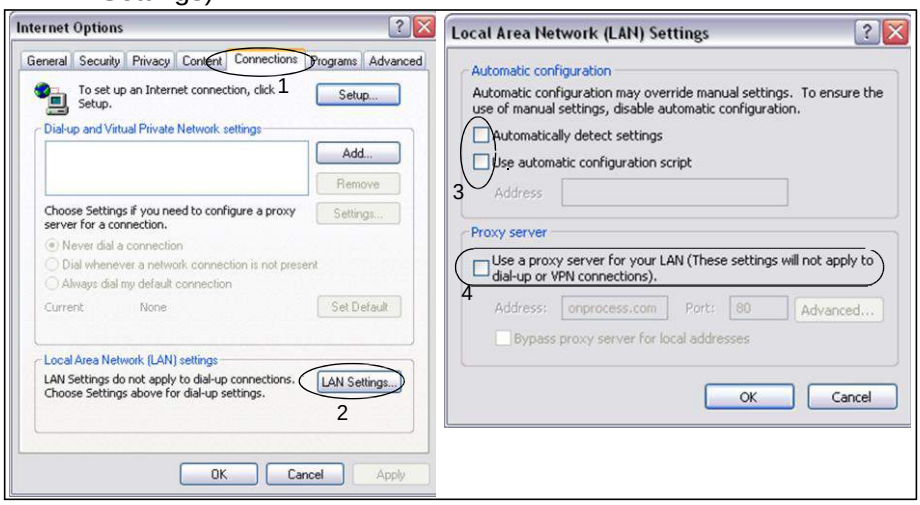
3. Using the supplied crossover Ethernet cable, attach your PC/laptop to the 1420's P1 Ethernet Receptacle (far right Ethernet receptacle).



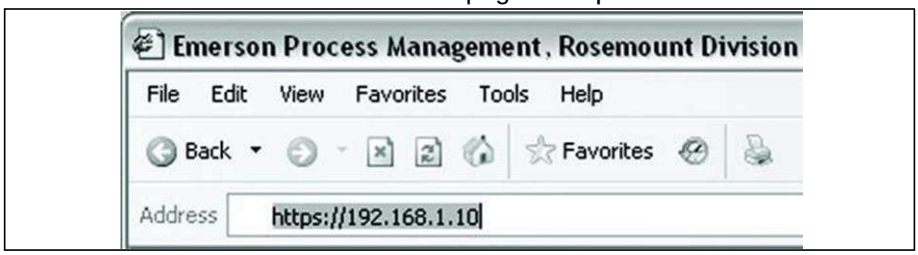
WARNING
Do not connect to the P3 Power Over Ethernet (POE) port. This port supplies power and could potentially damage the PC/laptop.

4. Open a standard web browser (Internet Explorer, Mozilla Firefox or similar).

5. Uncheck proxies (Tools>Internet Options>Connections>LAN Settings)



6. Access the 1420's default web page at https://192.168.1.10



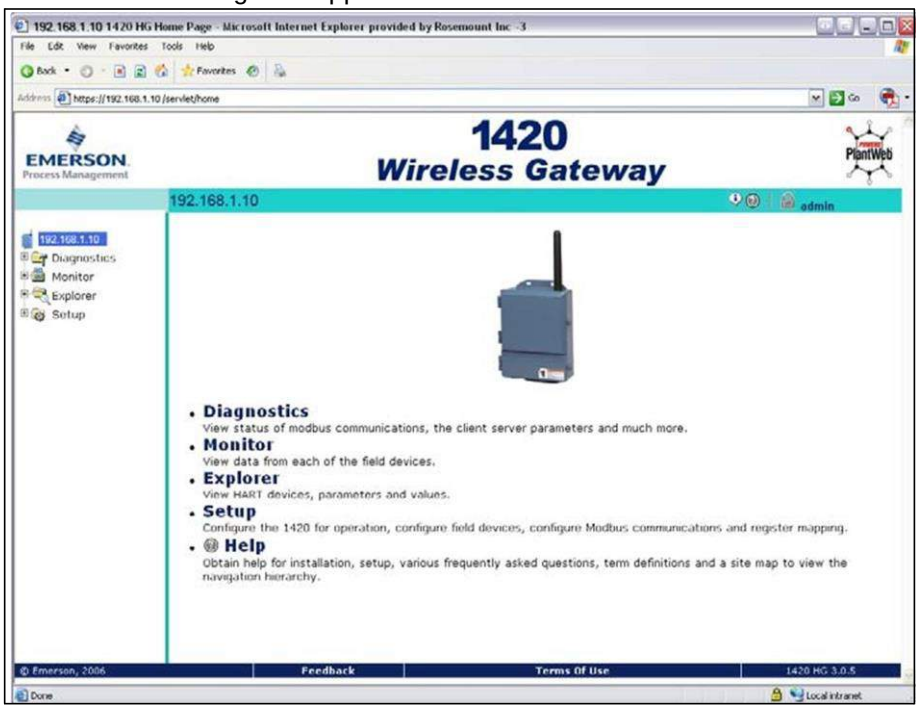
a. Log on as User: admin

b. Password: default

c. Click Yes to proceed through the Security Alert

To prevent future security warnings, navigate to Setup>Security>Certificates, then click the Import 1420 certificate into web browser button.

The 1420 Home Page will appear as shown below.



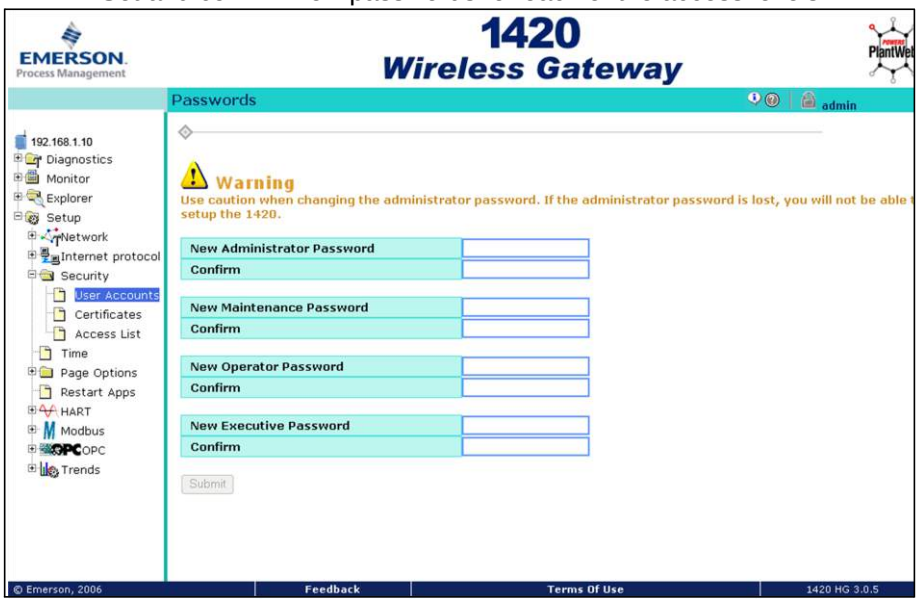
CONFIGURATION

Basic Security Configuration

Click Setup>Security>User Accounts to change the passwords. These passwords allow for varying levels of application access. The administrator can modify any system or field device setting. In contrast, the operator is only able to modify some parameters. Use caution when changing the administrator password. If the administrator password is lost, you will not be able to set up the 1420. The 1420 is shipped with the following default passwords:

To configure the basic security of the 1420 Wireless Gateway, perform the following steps.

1. Navigate to Setup>Security>User Accounts
2. Set and confirm new passwords for each of the access levels



3. Click Submit

Table 2-1. Default Passwords

ID	PASSWORD
Executive (exec)	default
Operator (oper)	default
Maintenance (maint)	default
Administrator (admin)	default

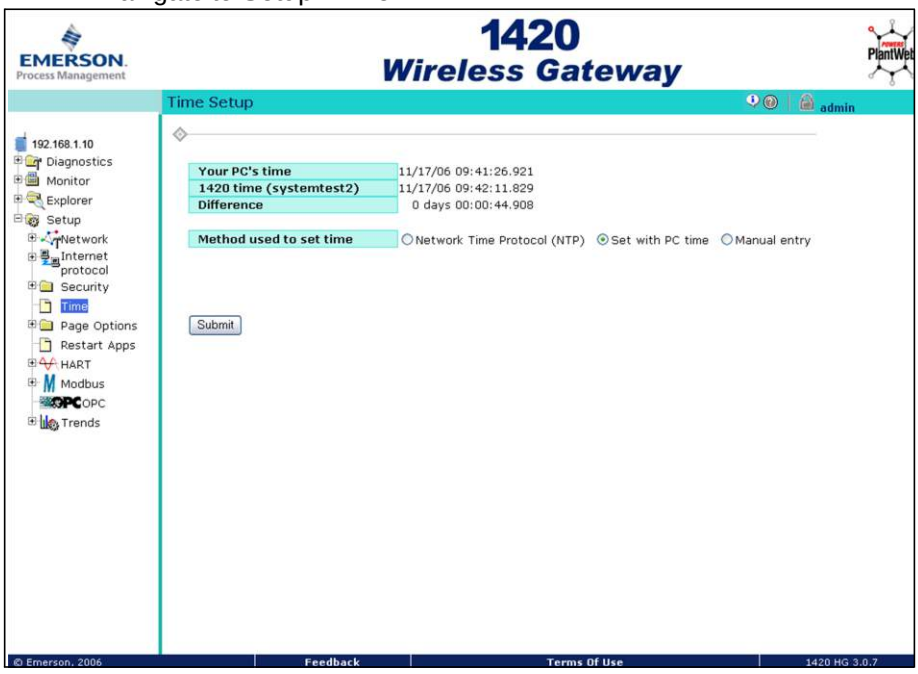
Table 2-2. Access Table

Role	HTML Access
Executive (exec)	With the exception of factory settings (Setup/factory.html), can get any page (Read-Only access).
Operator (oper)	No additional privileges
Maintenance (maint)	• Can set device tags • Can configure Modbus communications • Can configure Modbus register map
Administrator (admin)	• Can configure network settings (address, default). • Can set passwords • Can set time settings • Can set home page options • Can restart applications

BEST PRACTICES
It is recommended that passwords be changed for security purposes. Consult your Network Administrator for guidelines on setting passwords.

Time Configuration

1. Navigate to Setup>Time



2. Select method and click Submit

Ethernet Network Configuration:

Once a local connection with the 1420 Wireless Gateway is established, configuration can be performed using the Gateway's User Interface. The settings can be modified to ensure best performance when the 1420 Wireless Gateway is permanently installed and integrated into the Information System.

If the gateway is connected to a LAN or if more than one gateway will be used on a private network, the unit will need to be given a new IP address and a new hostname. A new entry will need to be added to your host file with the new IP address and Host name using the Network Assistant or the manual procedure described above.

Address

If you will be attaching the 1420 Wireless Gateway to an internal Intranet, you may select to have the device obtain an IP address via DHCP or be statically assigned an IP address (Figure 2-1). Contact your network administrator if you are not sure which selection is appropriate.

BEST PRACTICES
The 1420 should be assigned a static IP address.

1. Determine 1420 Ethernet Port for connecting to Ethernet Network

NOTE
If using a wired connection, use Port 1 (P1)

IT/Process Control Network Administrator or Technician can provide the following:

a. 1420 fixed IP Address or DHCP Host Name

b. Netmask (Subnet Mask)

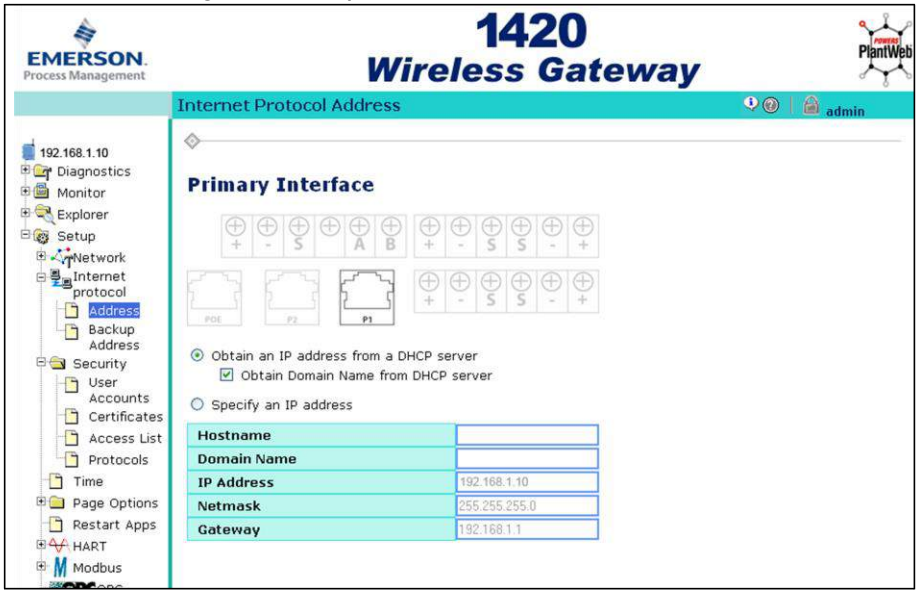
c. Gateway

BEST PRACTICES
Keep these values in a secure location not accessible by unauthorized personnel.

2. Configure 1420 Ethernet IP settings

a. Access the 1420 with Administrator access

b. Navigate to Setup>Internet Protocol>Address



c. Enter configuration information determined above

3. To complete configuration without a firewall, click Submit and proceed with 1420 Restart when prompted.

To configure the 1420 for an Ethernet Network with a firewall, perform the following steps:

1. Navigate to Setup>Security>Protocol
2. Click to enable or disable security in the various protocols
   The ports listed are the 1420 defaults. They may be changed to suit the specific installation requirements.

3. Click Submit and proceed with 1420 Restart when prompted

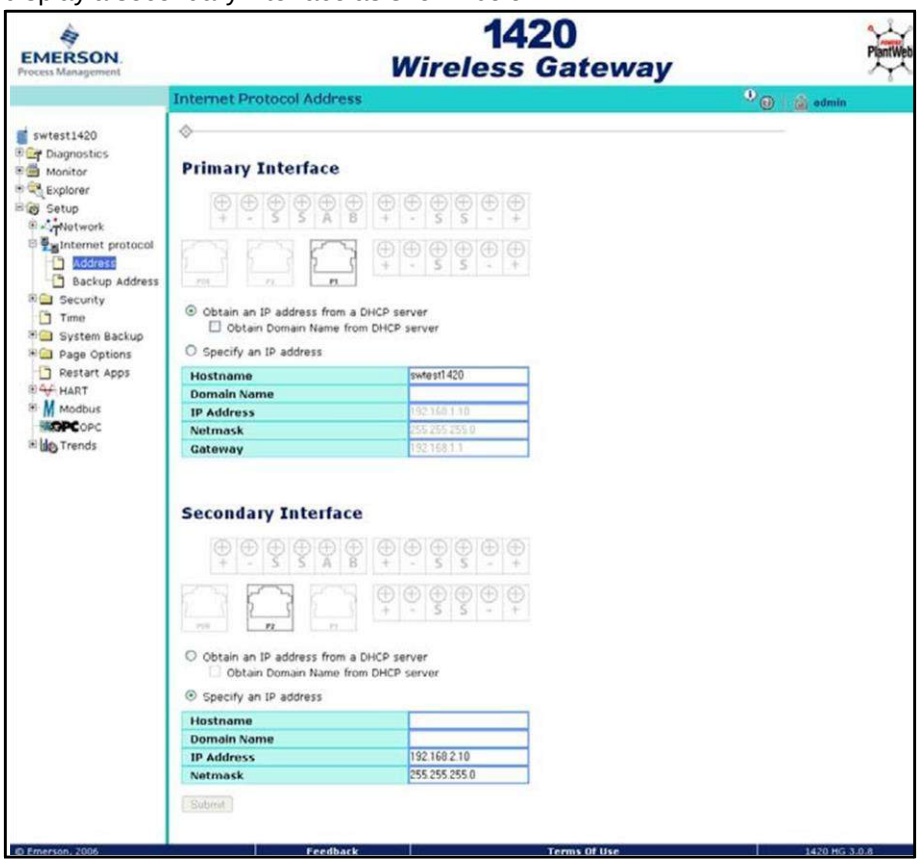
Redundant Ethernet Configuration

BEST PRACTICES

To protect against accidental misconfiguration of IP addresses, best practice is to change the IP address for Ethernet Receptacles P1 and P2 one at a time. If P1 is misconfigured, it can be reconfigured from P2.

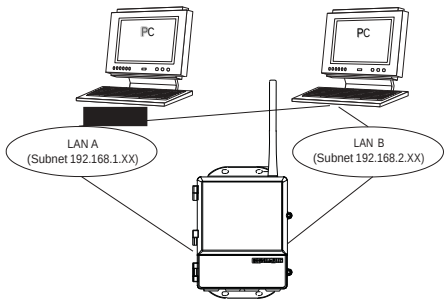
.

If the 1420 Wireless Gateway has been ordered with a redundant network interface, the network setup page (Setup>Internet Protocol>Address) will display a secondary interface as shown below.



The second network interface allows the 1420 to be accessed with two separate network addresses. The redundant interfaces provide the 1420 with a degree of fault tolerance to network failures. The network topology shown in Figure 2-1 is supported.

Figure 2-1. Redundant Ethernet Network Topology

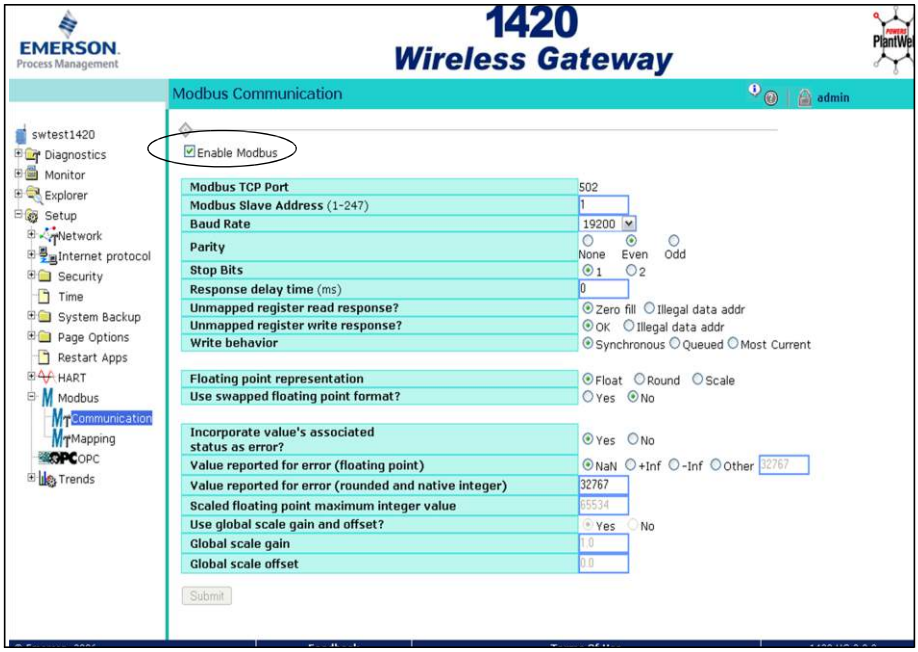


NOTE
The subnet numbers listed in the diagram are an example. Any valid network subnets are acceptable.

If you will be using the redundant ethernet feature, you may select to have the device obtain an IP address via DHCP or be statically assigned an IP for the secondary interface. Contact your network administrator if you are not sure which selection is appropriate.

Serial Connection Configuration:

1. Configure 1420 Serial Communication Settings
   a. Access the 1420 Web Interface with Administrator access
   b. Navigate to Setup>Modbus>Communication
   c. Click Enable Modbus



   d. Configure the 1420 Modbus Communication settings to match the Host Modbus settings

HINT/TIP
Modbus communications will fail if they are not configured identically on the Host and the 1420.

   e. Click Submit and proceed with restart

2. When configuration is completed, disconnect the PC/laptop from the 1420 and return the PC/laptop to its previous network settings.

RETURN PC/LAPTOP TO ORIGINAL SETTINGS

When initial configuration of the 1420 Wireless Gateway is complete, you may disconnect the PC/Laptop from the Gateway and return it to its original network settings. The 1420 Wireless Gateway should now be prepared for integration into the Information System.

Section 3 Mounting

OVERVIEW

This chapter will describe how to properly mount the 1420 Wireless Gateway.

Safety Messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Explosions could result in death or serious injury:

- Do not remove the transmitter from its mounting enclosure in explosive atmospheres when the circuit is live.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Electrical shock could cause death or serious injury. If the device is installed in a high-voltage environment and a fault condition or installation error occurs, high voltage may be present on transmitter leads and terminals.

- Use extreme caution when making contact with the leads and terminals. Failure to follow these installation guidelines could result in death or serious injury:
  - Make sure only qualified personnel perform the installation.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions: This device may not cause harmful interference, this device must accept any interference received, including interference that may cause undesired operation.

This device must be installed to ensure a minimum antenna separation distance of 20 cm from all persons.

General Considerations

The 1420 Wireless Gateway may be mounted in any General Purpose location. Be sure the covers are secured tightly to prevent exposure of the electronics to moisture and contamination.

The gateway should be mounted in a location that allows convenient access to the Information System, preferably at least three feet (1 meter) above any structures in the canopy (for example, above the roof of the control room). If this is not possible, place it near the closest wired integration point.

If outdoor mounting is not an option, connect the gateway to a remote omnidirectional antenna using a cable no longer than 50 feet (15 meters).

Consider the location of the wireless devices that will be routed through the 1420 Wireless Gateway as well to ensure robust network connectivity. Additional devices may be required to maintain optimal connectivity.

The 1420 Wireless Gateway is capable of handling networks of up to 100 transmitters. The closest transmitters should be at a maximum of 100 feet away from the 1420.

The gateway can be mounted to a support bracket on a wall or to a pipe.

MOUNTING CONSIDERATIONS

For highest signal quality, mount the 1420 Wireless Gateway outdoors. In this case, a minimum rating of Class I Div 2 or Zone 2 is required. Install the gateway at least three feet (1 m) above other structures.

If outdoor mounting is not an option, connect the gateway to a remote omnidirectional antenna using a cable no longer than 50 ft. (15 m).

Install the gateway first. Doing so allows you to check for proper operation of each device as it's added to the network and begins communicating with the gateway.

PHYSICAL INSTALLATION

For dimensional drawing information refer to Appendix A: Reference Data on page A-4.

The cast aluminum housing encloses the electronics and circuitry of the gateway. The front of the enclosure has two covers; an upper cover and a lower cover.

The upper cover provides access to the electronics assembly which includes the microprocessor. Normally the upper cover does not need to be opened. The lower cover provides access to the junction box which contains the terminals for the power supply, and Ethernet and Serial Modbus connections.

Mounting Procedure

Mounting the Gateway to a Support Bracket

The following hardware and tools are needed:

- Four $^{15}/_{16}$ inch bolts
- Mounting support bracket
- $^{3}/_{8}$ inch drill
- $^{1}/_{2}$ inch wrench

Mount the gateway by doing the following:

1. Drill four $^{3}/_{8}$ inch (9.525 mm) holes in the support bracket, corresponding with the holes on the 1420 housing.
2. Using a $^{1}/_{2}$ inch socket-head wrench, attach the module to the support bracket with four $^{15}/_{16}$ inch bolts.

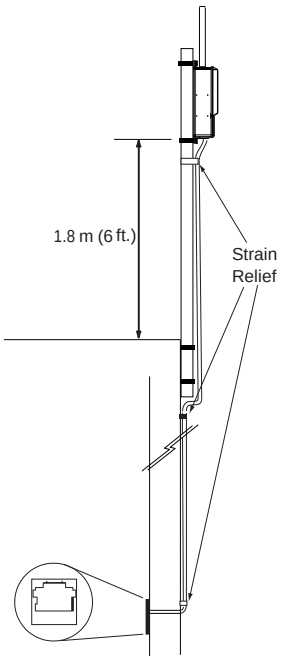
Mounting the Gateway to a Pipe

The following hardware tools are needed:

- Two 5/16 inch U-bolts
- 1/2 inch wrench

Mount the gateway by doing the following:

1. Insert one U-bolt around the pipe and through the top mounting holes of the pipe mount and the module and another U-bolt through the bottom mounting holes of the pipe mount and the module.
2. Using a 1/2 inch socket-head wrench, fasten nuts to the U-bolts.



Wiring the Module

Module wiring is done in the terminal block. For access to the terminal block, open the lower junction box cover. The terminal block label is located on the inside of the module junction box cover and is also found in Figure 3-1 on page 3-4.

Grounding the Module

If mounting the 1420 Wireless Gateway in the field, ground the module with a connection of 1 Ω or less leading from the external grounding lug to earth ground. If mounting the module in the control room, a cabinet ground is sufficient. In either location, follow local or plant electrical codes.

At the bottom of the junction box in 1/2 inch NPT conduit entries are four plastic plugs that were placed there at the factory. Four metal plugs were shipped with the module and are used to seal any unused ports.

The module case should always be grounded in accordance with national and local electrical codes. The most effective grounding method is a direct connection to earth ground with minimal impedance.

The internal Ground Connection located with the supply terminals is the Internal Ground Connection screw. This screw is identified by the following symbol:

NOTE
Grounding the module case via threaded conduit connection may not provide sufficient ground.

Module Input Power Connection

The module is designed to be powered by 24 V dc power. Use a power supply suitable for 185°F with sufficient capacity to power the module. The 1420 Wireless Gateway requires 500 mA of current. The positive and negative power terminals are found on the left side of the terminal block. A case ground is also found on the left hand side of the compartment.

The wiring should include an external power shut-off switch or an external circuit breaker. This device should be located near the module.

BEST PRACTICES

Use an uninterruptible power supply (UPS) to ensure that the network is still functional should there be a loss of power.

Figure 3-1. Terminal Wiring Diagram with Secondary Ethernet and POE Connection

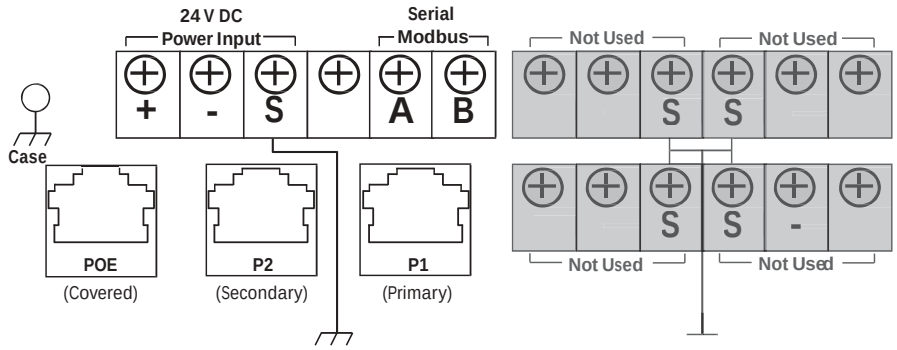
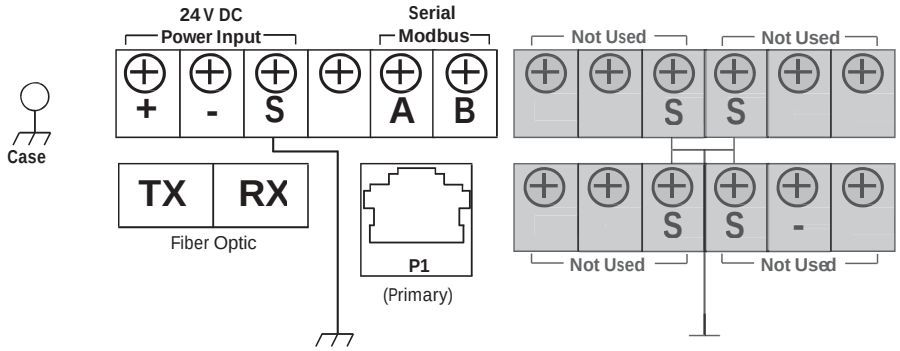


Figure 3-2. Terminal Wiring Diagram with Fiber Optic Connection



The Fiber Optic connection is an SC type connection. It should require no cleaning because the terminals should have remained covered from manufacturing through shipping.

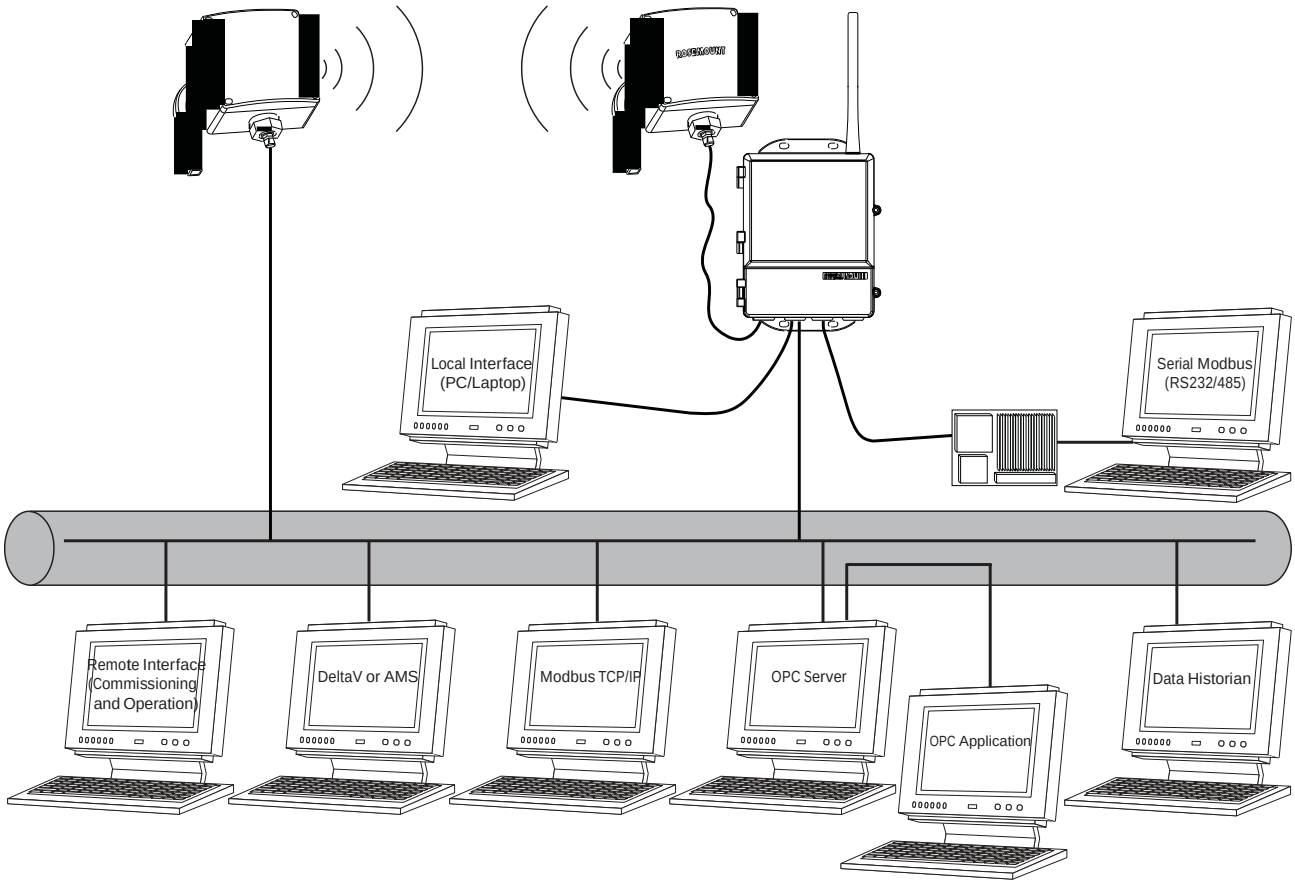
ATTACHING A REMOTE ANTENNA

A remote mount antenna is available (consult factory). It attaches to the 1420 Wireless Gateway via the antenna adapter on the top of the housing. This antenna is omnidirectional and includes a 50 foot long cable to allow for it to be mounted in an optimal location, even if the 1420 Wireless Gateway cannot.

CONNECTING THE GATEWAY

This section will describe how to connect the 1420 to a Serial Modbus (RS485) system, an Ethernet system or a Wireless Ethernet system. Some applications may require multiple connection types - for example, to support both a DCS and a data historian. The 1420 is able to support such applications.

Figure 3-3. 1420 Connection Options



Considerations for the Protocols

Ethernet

When installing an Ethernet connection, cabling will need to be run from the 1420 Wireless Gateway to an access point on the Ethernet Network. Be sure to consider the length of the cable and the availability of an access point.

Wireless Ethernet

When installing a Wireless Ethernet connection, a stable connection will need to be available between the 1420 and the Ethernet Network. Be sure to consider the constraints of such a connection.

Serial Modbus

When installing a Serial Modbus connection, cabling will need to be run from the 1420 Wireless Gateway to the Modbus PLC or DCS. Be sure to consider the length and location of this cable. Key information required by the administrator will be the number of Modbus registers required for integration. A good estimate for the number of registers is three registers for each data point so that the process variable and device status indicators can be remotely monitored.

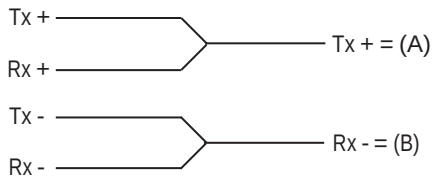
BEST PRACTICES

Typically, twisted shielded pair cable is used to wire the Serial connection. Standard practice is to ground the shield on the Serial Host side and leave the shield floating on the 1420 side. Be sure to insulate the 1420 shield to avoid grounding issues.

HINT/TIP

In most systems, A = Tx + and B = Rx -. In some systems, this is reversed. For 4-wire systems, see Figure 3-4.

Figure 3-4. Typical Full Duplex (4-wire) to Half Duplex (2-wire) Conversion Diagram



Confirm wiring configuration with host system documentation.

NOTE:
Do not open the 1420 electronics housing in an explosive atmosphere.

Ethernet

The 1420 Wireless Gateway is equipped with two 10/100 Base-T Ethernet interface receptacles on the left side of the terminal block (Figure 3-1 on page 3-4). When installing the gateway, you may connect the 1420 Wireless Gateway to an existing Ethernet Hub, Switch or Router.

The primary Ethernet port (P1) is used to connect to the Information System, specifically a Remote Interface Machine, an OPC Proxy Machine (and an OPC Application Machine), or a Modbus TCP Application Machine. This can be done over a non-encrypted Ethernet connection or over an encrypted Ethernet connection using the Security Setup application.

SECURITY

The most secure option is to connect over an encrypted Ethernet connection using the Security Setup application.

The second Ethernet port (P2) on the 1420 Wireless Gateway terminal block is an optional factory-configured redundant Ethernet port. (ordering option Output Code 2)

Wireless Ethernet

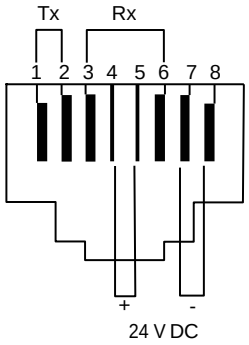
The 1420 Wireless Gateway is capable of communicating to the Information System via a Wireless Ethernet connection. This allows for greater flexibility in placement of the gateway with the same functionality as a standard Ethernet connection.

To install a wireless ethernet connection, simply mount the 1420 Wireless Gateway, then mount the wireless antenna. Remove the cap from the Power Over Ethernet (POE) receptacle and connect the antenna cable to the POE receptacle (Figure 3-1 on page 3-4).

WARNING
Connecting a standard wireless radio to the POE receptacle may result in damage to equipment.

HINT/TIP
To use a standard wireless radio, confirm that the radio is compatible with the 1420 Wireless Gateway's POE specifications, or use an externally powered radio connected to the P1 Ethernet port.

Figure 3-5. POE Specifications



The POE Port is 24 VDC, ± 4; 500 mA.

Compare to the standard wireless radio specifications and confirm that the radio is compatible with the POE Port before connecting.

When installing the gateway, you may connect the 1420 Wireless Gateway to an existing Ethernet Hub, Switch or Router. This connection is used to communicate with the Information System, specifically a Remote Interface Machine, an OPC Proxy Machine (and an OPC Application Machine), or a Modbus TCP Application Machine. This can be done over a non-encrypted Ethernet connection or over an encrypted Ethernet connection using the Security Setup application.

SECURITY
The most secure option is to connect over an encrypted Ethernet connection using the Security Setup application.

Modbus

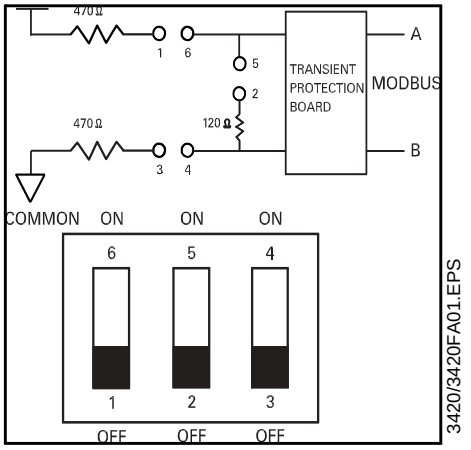
The Modbus interface terminals are located in the upper-middle of the wiring block next to the power input (Figure 3-1 on page 3-4). The Modbus interface is polarity sensitive. Connect the negative to the right-most Modbus terminal (B) and the positive to the center Modbus terminal (A). The left-most terminal is for the cable shield, if it is required.

Modbus Termination Setup

Modbus RTU is transmitted on an RS485 physical layer. Three dip-switches are provided to enable the RS485 circuitry with a network terminator. The switches are found inside the electronics housing on the RS485 communication board located in the top center of the housing. Switch 2 places a 120 ohm terminator on the bus. This would be used to match cable impedance if needed to dampen reflections on long cable runs. Its use will depend on the baud rate and cable length of the Modbus network.

Switches 1 and 3 are connected to pull-up and pull-down resisters on the Modbus network. These resisters are used to prevent noise from being interpreted as valid communications during periods when no communications are occurring on the network. Only one set is required on an RS485 network.

Figure 3-6. Modbus Setup

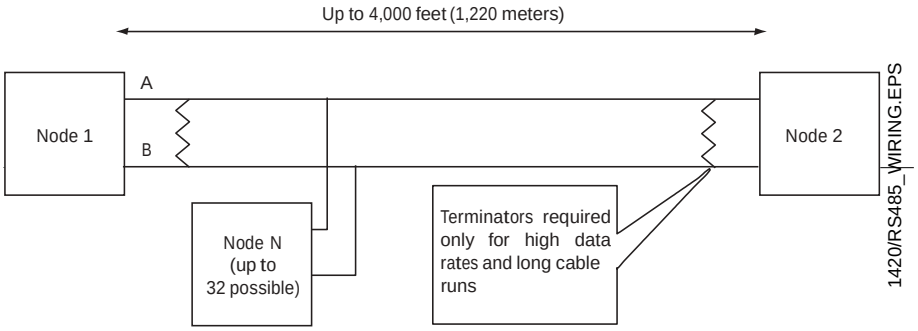


RS485 Serial Interface

The RS485 standard describes a balanced transmission line operating in a shared or multi-drop model. As many as 32 driver/receiver pairs can share a single network.

Figure 3-7 shows a typical two-wire multi-drop network such as used with the 1420 Wireless Gateway. The RS485 specifications indicate that the transmission line should be terminated at both ends of the network. However termination should only be used with high data rates above 115kbps and long cable runs so it should not be necessary with the transmission rates used by the 1420 Wireless Gateway.

Figure 3-7. Typical two-wire multi-drop network.



Section 4 Data Integration

Data Integration . . . . . page 4-1
Ethernet . . . . . page 4-1
Wireless Ethernet . . . . . page 4-6
Serial Modbus/RS485 . . . . . page 4-11

⚠WARNING

Explosions could result in death or serious injury:

- In an Explosion-Proof and Flame-Proof environment, do not open the 1420 Wireless Gateway electronic housing in an explosive atmosphere.
- Cover must be fully engaged to meet Explosion-Proof requirements.

DATA INTEGRATION

The 1420 Wireless Gateway is capable of integrating data from wireless measurement devices into a number of information systems. This chapter will describe how to integrate the data using the three available output protocols: Ethernet (TCP/IP), Wireless Ethernet (TCP/IP) and Serial/RS485.

ETHERNET

The 1420 Wireless Gateway integrates data to the information system via a wired Ethernet connection.

Begin by installing the software on the Information System.

Software Installation

To prepare the Information System to communicate with the 1420 Wireless Gateway, insert the Setup Assistant & Support Files CD that came with the 1420 Wireless Gateway. Follow the directions in the installation windows to install the desired components.

The data application administrator can determine where to install the required software.

At the Setup Type screen, select Complete or Custom depending on your specific needs. Custom setup allows you to choose whether to install the following options:

1420 User Interface	When this feature is selected, setup will install any additional software required to use this PC as a user interface for the 1420. This may include installing Microsoft Internet Explorer and Sun Microsystems Java Runtime.
1420 Reference Manual	When this feature is selected, setup will install an electronic copy of the 1420 Wireless Gateway Reference Manual (this manual) on the PC. This may include installing Adobe Acrobat Reader.
Network Assistant	When this feature is selected, setup will install Network Assistant, a program that automates network configuration changes to support 1420 configuration.
Security Setup	When this feature is selected, setup will install a security application that encrypts communications between the 1420 and AMS, Modbus, OPC, etc.

Once you have selected the desired options, continue with installation by clicking Next. Other selectable optional features include a desktop icon for the network assistant, and Security Setup.

Security

If the 1420 Wireless Gateway will be connected through a firewall, run the Security Setup application to allow the gateway to communicate with the Information System. The application requires the IP address of the 1420 Wireless Gateway and the firewall port through which the gateway will communicate with the network.

Verify Connectivity

Verify that the 1420 Wireless Gateway is connected to the Information System and that the data is propagating through correctly. Verification will vary depending on the type of information system being used. Refer to the respective documentation for verification instructions.

Add Wireless Devices

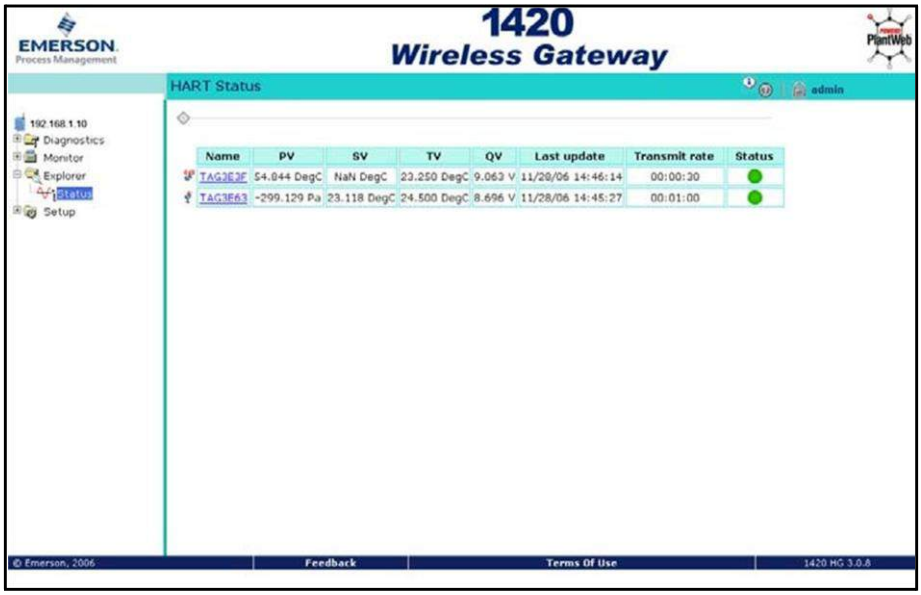
This is done by powering the 1420 Wireless Gateway first, then powering the wireless measurement devices in order of proximity beginning with the devices closest to the gateway. If the Network ID and Join Keys are properly entered, the gateway will automatically detect and organize the devices in the network. Device configuration and installation information is covered in the device manuals: Rosemount 648 Wireless Temperature Transmitter, 00809-0100-4648 and Rosemount 3051S Wireless Pressure Transmitter, 00809-0100-4802.

NOTE
This may take up to several hours depending on the update rate, number of devices and network paths. As devices are added, they will appear in the web interface at the Explorer>Status page.

The Diagnostics>Network>Overview pages display the following information about the network.

Data Type	Description
Wireless Device Count	Total count of wireless devices, regardless of state
Live	Devices that are connected and reporting data values
Late	Devices that are connected and have missed one or two scheduled data values
Stale	Devices that are connected and are no longer reporting data values
Joining	Devices that are joining the network
Unreachable	Devices that are no longer on the network
Unknown	Device whose state is not known, not communicating to the gateway
Conventional HART devices	Non-wireless HART devices connected to a wireless device router (WDR)
Devices with unknown tags	Devices whose tags have not been read yet
Devices with undefined tags	Devices with blank or uninitialized tags
Devices with duplicate tags	Devices with duplicate tags
Devices with invalid tags	Devices with tags containing invalid characters (a period or comma)
Devices with duplicated IDs	Devices with duplicate device IDs

Figure 4-1. Explorer Status



Map Application Data on the Gateway

Modbus

In the user interface, click Setup>Modbus to configure the Modbus Interface. This page is automatically redirected to Setup>Modbus>Communication. To enable Modbus, check the Enable Modbus box at the top of the page.

Communication

Click Setup>Modbus>Communication (Figure 4-7) to configure the Modbus Communication settings. The options on this page allow you to configure the Modbus communication settings. These settings should correspond to settings of the Modbus Master. Be sure to check the Enable Modbus checkbox at the top of the page.

The measured values can be represented as either a single register integer number, a scaled integer or a two-register (standard or swapped) floating point number. One common difference in Modbus Masters is the representation of a floating point number. The default used by the 1420 is a Standard Floating Point but this configuration page also allows you to use Swapped Floating Point which reverses the order in which the data in the floating point registers is sent. For more on scaled integers, see Appendix E: Integer Scaling on page E-1.

The Response delay time entry allows you to have the 1420 Wireless Gateway wait for a specified amount of time before it outputs its response to the master request. Some master devices may not be able to immediately receive the response due to receiver setup time. This setting accommodates those master devices.

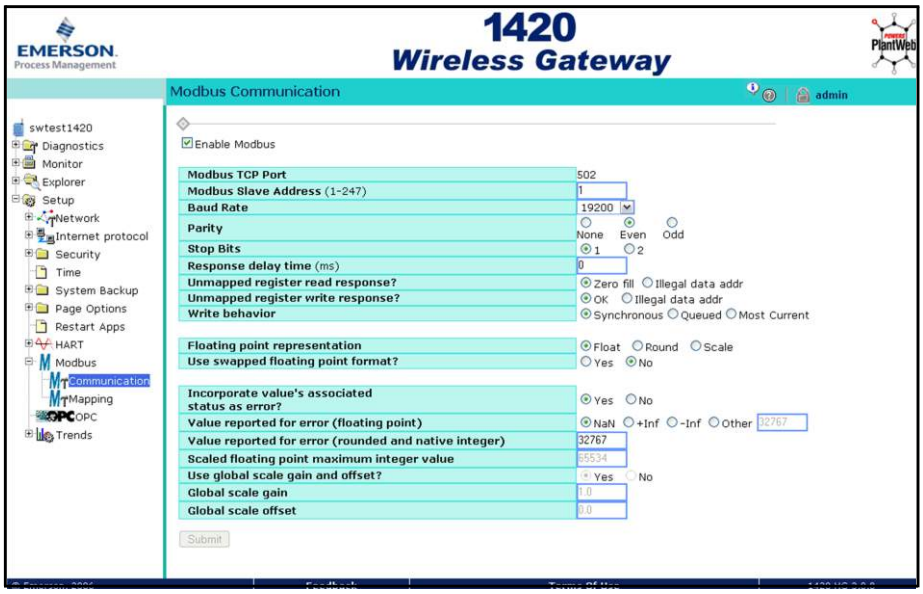
The unmapped register response setting allows the selection of the value entered into a register if no tag is assigned to it.

The Scaled Floating Point option allows the user to return values as a scaled integer rather than the direct integer. Using Gain and Offset, the values can show positive values, negative values or both.

For more on integer scaling, see Appendix E: Integer Scaling on page E-1.

For more information on Modbus, refer to the information system's documentation or http://www.modbus.org/specs.php.

Figure 4-2. Modbus Communication



Modbus Register Map

The Modbus Register Map page is located at Setup>Modbus>Mapping (Figure 4-8). On this page, Modbus Registers can be mapped to the measurement points. Please note that the registers in Table 4-3 are predefined.

To create a new entry, click the New Entry button. This will activate a row of text fields in the Modbus Register table. Begin by filling in the Register Number, then choose or type the Point Name. Be sure to click Submit to implement the changes.

Figure 4-3. Modbus Mapping

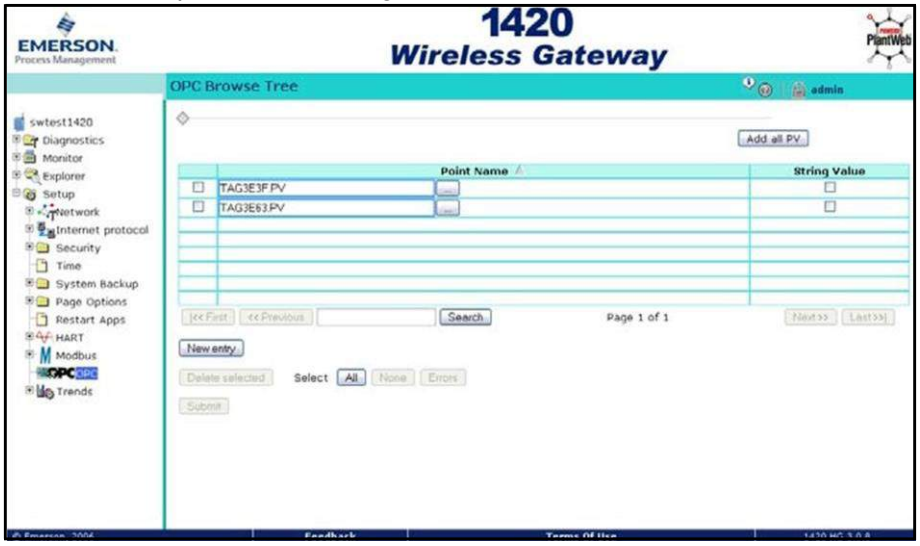
Table 4-1. Predefined Diagnostic Registers

Description	Register
Current Year (1)	49001
Current Month (1)	49002
Current Day (1)	49003
Current Hour (1)	49004
Current Minute (1)	49005
Current Second (1)	49006
Messages Received	49007
Corrupt Messages Received	49008
Messages Sent with Exception (error responses)	49009
Messages Sent Count	49010
Valid Messages Ignored (when in listen only mode)	49011

(1) Time is reported in GMT.

OPC

In the user interface, click Setup>OPC to configure the OPC Settings. To choose a new Point Name, click New Entry. This will open a text field in the point name table. Type the name of the point in the field or use the chooser to the right (pops up a new window) to select the name of the point. Click Submit to save and implement the changes.



Map Application Data on the Information System

Refer to your Information System's documentation for specific instructions regarding mapping application data using the TCP/IP protocol.

WIRELESS ETHERNET

The 1420 Wireless Gateway integrates data to the information system via a wired Ethernet connection.

Begin by installing the software on the Information System.

Software Installation

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The data application administrator can determine where to install the required software.

At the Setup Type screen, select Complete or Custom depending on your specific needs. Custom setup allows you to choose whether to install the following options:

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1420 Reference Manual	When this feature is selected, setup will install an electronic copy of the 1420 Wireless Gateway Reference Manual (this manual) on the PC. This may include installing Adobe Acrobat Reader.
Network Assistant	When this feature is selected, setup will install Network Assistant, a program that automates network configuration changes to support 1420 configuration.
OPC Client Runtime	When this feature is selected, setup will install software that will allow OPC clients running on this PC to access the 1420.
OPC Proxy Setup	When this feature is selected, setup will install the OPC Proxy Setup program to configure which 1420s will be accessed by OPC clients running on this PC
Security Setup	When this feature is selected, setup will install a security application that encrypts communications between the 1420 and AMS, Modbus, OPC, etc.

Once you have selected the desired options, continue with installation by clicking Next. Other selectable optional features include a desktop icon for the network assistant, a desktop icon for OPC Proxy Setup, and whether to start the OPC deviceCOM server automatically.

Security

If the 1420 Wireless Gateway will be connected through a firewall, run the Security Setup application to allow the gateway to communicate with the Information System. The application requires the IP address of the 1420 Wireless Gateway and the firewall port through which the gateway will communicate with the network.

Verify Connectivity

Verify that the 1420 Wireless Gateway is connected to the Information System and that the data is propagating through correctly. Verification will vary depending on the type of information system being used. Refer to the respective documentation for verification instructions.

Add Wireless Devices

This is done by powering the 1420 Wireless Gateway first, then powering the wireless measurement devices in order of proximity beginning with the devices closest to the gateway. If the Network ID and Join Keys are properly entered, the gateway will automatically detect and organize the devices in the network. Device configuration and installation information is covered in the device manuals: Rosemount 648 Wireless Temperature Transmitter, 00809-0100-4648 and Rosemount 3051S Wireless Pressure Transmitter, 00809-0100-4802.

NOTE
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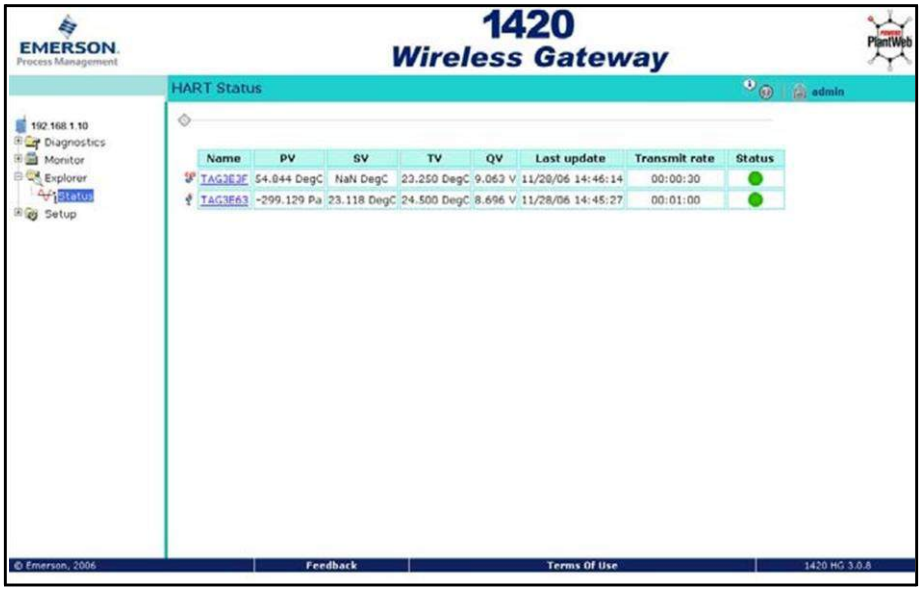
Devices with duplicate tags	Devices with duplicate tags
Devices with invalid tags	Devices with tags containing invalid characters (a period or comma)
Devices with duplicated IDs	Devices with duplicate device IDs

Figure 4-4. Explorer Status



Map Application Data on the Gateway

Modbus

In the user interface, click Setup>Modbus to configure the Modbus Interface. This page is automatically redirected to Setup>Modbus>Communication. To enable Modbus, check the Enable Modbus box at the top of the page.

Communication

Click Setup>Modbus>Communication (Figure 4-7) to configure the Modbus Communication settings. The options on this page allow you to configure the Modbus communication settings. These settings should correspond to settings of the Modbus Master. Be sure to check the Enable Modbus checkbox at the top of the page.

The measured values can be represented as either a single register integer number, a scaled integer or a two-register (standard or swapped) floating point number. One common difference in Modbus Masters is the representation of a floating point number. The default used by the 1420 is a Standard Floating Point but this configuration page also allows you to use Swapped Floating Point which reverses the order in which the data in the floating point registers is sent. For more on scaled integers, see Appendix E: Integer Scaling on page E-1.

The Response delay time entry allows you to have the 1420 Wireless Gateway wait for a specified amount of time before it outputs its response to the master request. Some master devices may not be able to immediately receive the response due to receiver setup time. This setting accommodates those master devices.

The unmapped register response setting allows the selection of the value entered into a register if no tag is assigned to it.

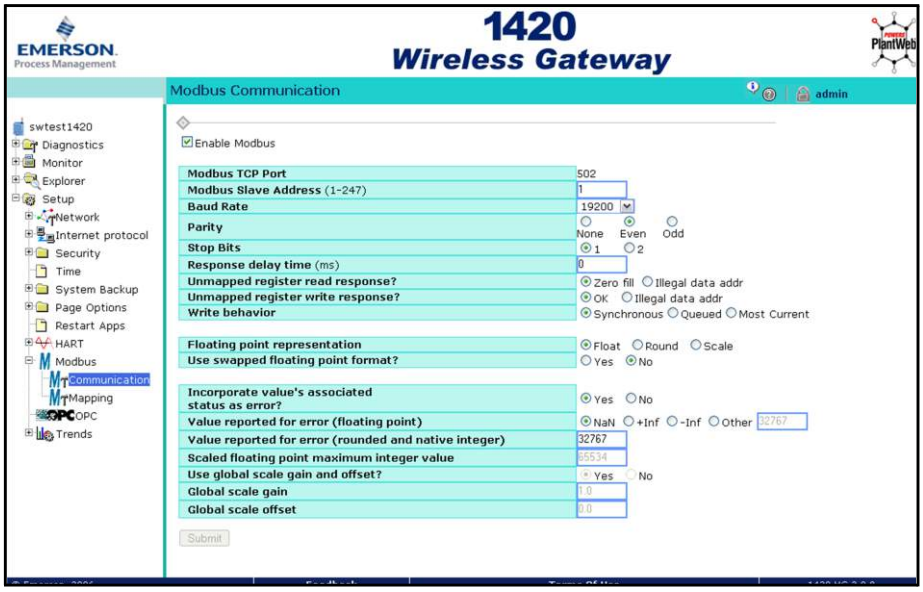
As an option you may elect to have a specified value replace the actual reading from the field device in the event of an error. This will allow a host to recognize an error condition without the need to read a separate set of registers containing the status indicators.

The Scaled Floating Point option allows the user to return values as a scaled integer rather than the direct integer. Using Gain and Offset, the values can show positive values, negative values or both.

For more on integer scaling, see Appendix E: Integer Scaling on page E-1.

For more information on Modbus, refer to the information system's documentation or http://www.modbus.org/specs.php.

Figure 4-5. Modbus Communication



Modbus Register Map

The Modbus Register Map page is located at Setup>Modbus>Mapping (Figure 4-8). On this page, Modbus Registers can be mapped to the measurement points. Please note that the registers in Table 4-3 are predefined.

To create a new entry, click the New Entry button. This will activate a row of text fields in the Modbus Register table. Begin by filling in the Register Number, then choose or type the Point Name. Be sure to click Submit to implement the changes.

Figure 4-6. Modbus Mapping

Table 4-2. Predefined Diagnostic Registers

Description	Register
Current Year (1)	49001
Current Month (1)	49002
Current Day (1)	49003
Current Hour (1)	49004
Current Minute (1)	49005
Current Second (1)	49006
Messages Received	49007
Corrupt Messages Received	49008
Messages Sent with Exception (error responses)	49009
Messages Sent Count	49010
Valid Messages Ignored (when in listen only mode)	49011

(1) Time is reported in GMT.

OPC

In the user interface, click Setup>OPC to configure the OPC Settings. This page is automatically redirected to Setup>OPC>Settings. To incorporate the value's associated status as OPC quality, click the Yes radio button, then click Submit.

Click Setup>OPC>Browse Tree to map the application data through the gateway. Use this page to choose the Point Name and whether to enable the String Value.

To choose a new Point Name, click New Entry. This will open a text field in the point name table. Type the name of the point in the field or use the chooser to the right (pops up a new window) to select the name of the point. Click Submit to save and implement the changes.

Map Application Data on the Information System

Refer to your Information System's documentation for specific instructions regarding mapping application data using the TCP/IP protocol.

SERIAL MODBUS/RS485

The 1420 Wireless Gateway supports Modbus RTU over the RS485 serial port.

Begin by adding the wireless devices. This is done by powering the 1420 Wireless Gateway first, then powering the wireless measurement devices in order of proximity beginning with the devices closest to the gateway. If the Network ID and Join Keys are properly entered, the gateway will automatically detect and organize the devices in the network. Device configuration and installation information is covered in the device manuals: Rosemount 648 Wireless Temperature Transmitter, 00809-0100-4648 and Rosemount 3051S Wireless Pressure Transmitter, 00809-0100-4802.

NOTE
This may take up to several hours depending on the update rate, number of devices and network paths. As devices are added, they will appear in the web interface at the Explorer>Status page.

The Diagnostics>Network>Overview pages display the following information about the network.

Data Type	Description
Wireless Device Count	Total count of wireless devices, regardless of state
Live	Devices that are connected and reporting data values
Late	Devices that are connected and have missed one or two scheduled data values
Stale	Devices that are connected and are no longer reporting data values
Joining	Devices that are joining the network
Unreachable	Devices that are no longer on the network
Unknown	Device whose state is not known, not communicating to the gateway
Conventional HART devices	Non-wireless HART devices connected to a wireless device router (WDR)
Devices with unknown tags	Devices whose tags have not been read yet
Devices with undefined tags	Devices with blank or uninitialized tags
Devices with duplicate tags	Devices with duplicate tags
Devices with invalid tags	Devices with tags containing invalid characters (a period or comma)
Devices with duplicated IDs	Devices with duplicate device IDs

In the user interface, click Setup>Modbus to configure the Modbus Interface. This page is automatically redirected to Setup>Modbus>Communication. To enable Modbus, check the Enable Modbus box at the top of the page.

Communication

Click Setup>Modbus>Communication (Figure 4-7) to configure the Modbus Communication settings. The options on this page allow you to configure the Modbus communication settings. These settings should correspond to settings of the Modbus Master. Be sure to check the Enable Modbus checkbox at the top of the page.

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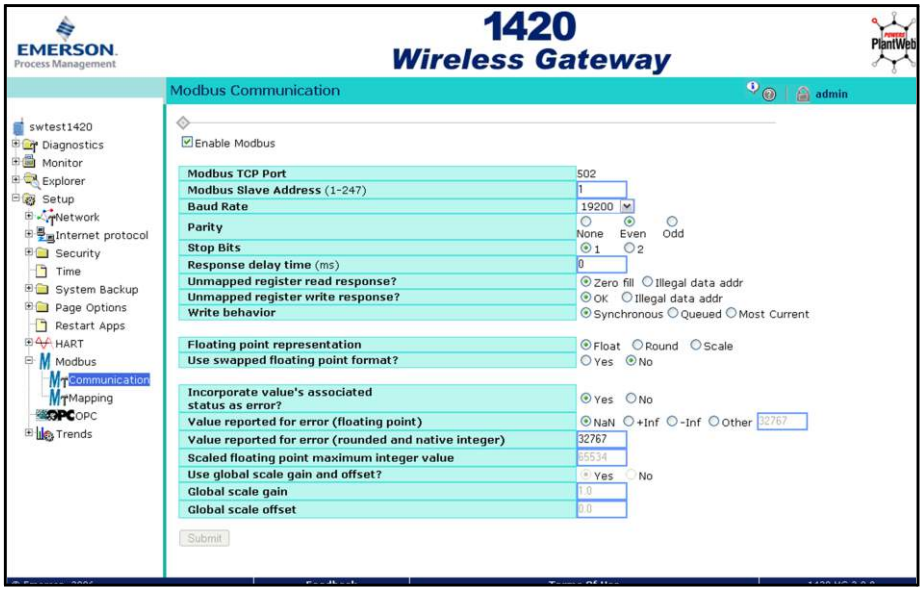
For more information on Modbus, refer to the information system's documentation or http://www.modbus.org/specs.php.

Figure 4-7. Modbus Communication



Modbus Register Map

The Modbus Register Map page is located at Setup>Modbus>Mapping (Figure 4-8). On this page, Modbus Registers can be mapped to the measurement points. Please note that the registers in Table 4-3 are predefined.

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Figure 4-8. Modbus Mapping

Table 4-3. Predefined Diagnostic Registers

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Current Month (1)	49002
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Messages Sent Count	49010
Valid Messages Ignored (when in listen only mode)	49011

(1) Time is reported in GMT.

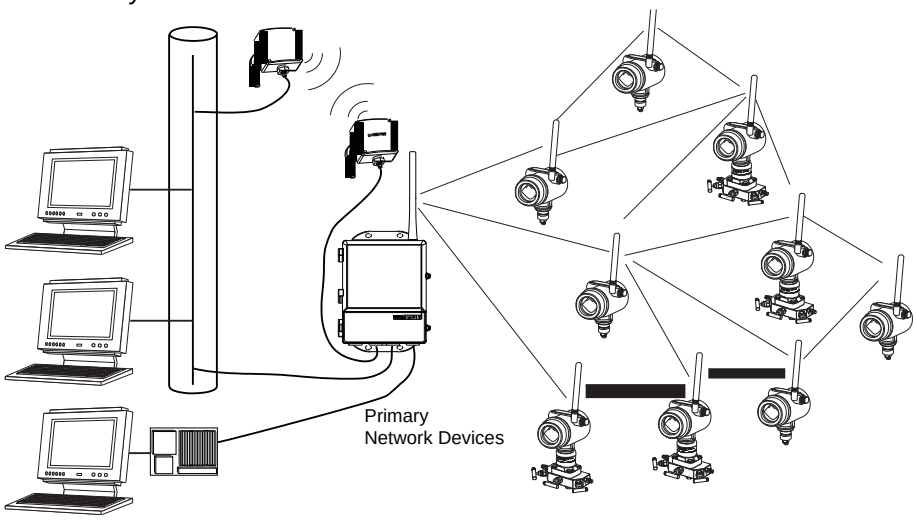
Section 5 Wireless Network Operation

Overview . . . . . page 5-1
Network Fortification . . . . . page 5-1
Security Features . . . . . page 5-4
Trends . . . . . page 5-5

OVERVIEW

This chapter will discuss ways to ensure good performance and security in the wireless network. Once the network is up and running, two simple steps will help ensure that the network is robust and reliable for the long term. These two steps are fortifying the network and identifying “pinch points.” Network expansion is also an easy process that not only broadens the reach of the network, but also increases robustness and reliability.

The second half of this chapter will lay out guidelines to increase and ensure the security of the network.



NETWORK FORTIFICATION

Verify Connections

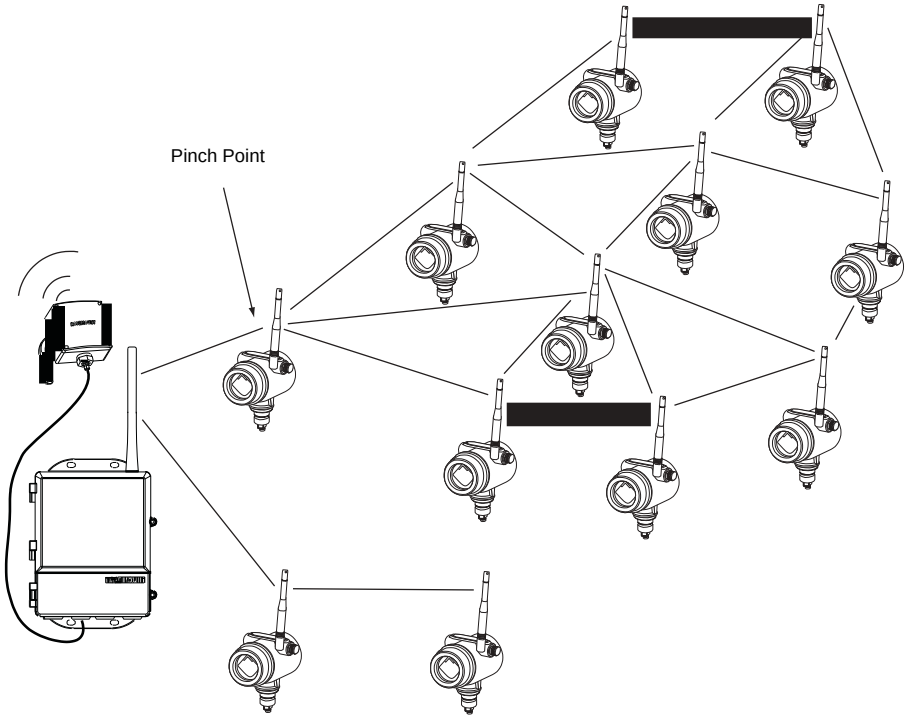
A fortified network allows the devices to communicate with the gateway in the most optimal configuration. First, verify that each device has joined the network and is communicating properly by checking the Explorer>Status page. If a communication link can’t be made, an additional device can be added to bridge the connection to the network.

A good connection should exhibit the following characteristics:

- Data Reliability > 99%
- Data Latency < 3 times update rate
- Battery Life > desired life span at fastest update rate
- Primary Network Connections
- Path Stabilities
- Radio Signal Strength Indication (RSSI) in the gateway diagnostics is good. This check is listed last because it can be misleading on its own (weak signals can still get through if the path is stable), but it can help identify a problem when it arises.

Identify Pinch Points

Next, identify “pinch points.” If messages from several devices must all pass through a single device at any point on their way to the gateway, the network becomes “pinched.” This pinch point then becomes a single point where failure can compromise the network’s long-term reliability.



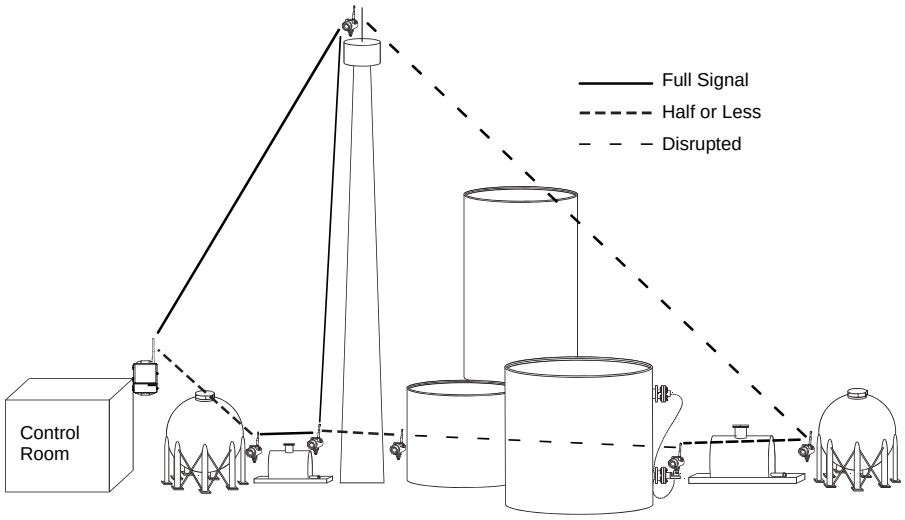
This doesn’t happen often because of the redundant communication paths in most self-organizing networks. The solution is simply to add additional devices near the pinch point to provide more communication paths. In general, for every ten devices, there should be a minimum of two connections to unique wireless devices.

HINT/TIP

Identification of pinch points should be performed 24 hours after all the devices have joined the network. This will allow the network to stabilize and optimize itself.

Impenetrables

A typical plant includes plenty of potential impenetrables, such as buildings, dense piping, concrete walls and long distances. The diagram below shows how impenetrables affect signal strength. There are three layers: floor, canopy, and emergent. Each layer has different potential impenetrables that can affect the network.



In this example, the floor layer - from ground to about 15-20 feet (5-6 m) - has very dense infrastructure that reduces signal range by 50% or more. This attenuation depends on the frequency of the radios, as well as the actual density of the environment.

Fortunately, the many potential measurement points in the floor layer mean there are likely to be many wireless devices. These devices provide many alternative communication paths around these impenetrables.

The canopy is the layer above the motors and pipe racks and below third floor stair decks. It's relatively open usually, but signals may be disrupted by tall structures.

The third layer is occupied by emergent structures such as distillation columns or exhaust towers that extend above the canopy. Emergent structures usually have minimal effect on radio signals unless they're part of a larger structure. Extensive testing has also shown that devices mounted in this layer can communicate with devices as far as approximately 160 feet (50 m) below in the canopy.

At any layer, increasing distance can also weaken signals. In general, if impenetrables disrupt direct transmission between wireless devices, simply add additional devices to provide alternate communication paths around the disruptions.

Expanding the Network

When it comes to self-organizing networks, bigger is better. In fact, the more wireless devices in the network, the easier it is to expand. That's because there are so many available paths for the additional communications to follow. The network simply senses that a device has joined the network, and routing algorithms in the devices and gateway automatically find the best route to the destination.

The existing network functions as a large antenna for any new device that is added to the periphery of the network, and a myriad of connections are available to devices added to the interior of the network. The only limitation is the amount of traffic that can be handled by each gateway and by the devices that provide the last “hop” to it. A high density of devices near the primary device level may cause pinch points.

This capability makes not only large-scale additions easy, but also allows the addition of single points to meet short-term needs. You can even install a temporary device to test whether a permanent installation would add value, or to do short-term monitoring for diagnostic purposes.

SECURITY FEATURES

The 1420 Wireless Gateway is shipped with the following usernames and passwords:

Table 5-1. Default Passwords

ID	PASSWORD
Executive (exec)	default
Operator (oper)	default
Maintenance (maint)	default
Administrator (admin)	default

Table 5-2. Access Table

Role	HTML Access	Explorer view Access
Executive (exec)	With the exception of factory settings (Setup/factory.html), can get any page (Read-Only access).	Read-only access.
Operator (oper)	No additional privileges	Same values as executive, but with read-write access.
Maintenance (maint)	• Can set device tags • Can configure Modbus communications • Can configure Modbus register map	All parameters (Read-Write).
Administrator (admin)	• Can configure network settings (address, default). • Can set passwords • Can set time settings • Can set home page options • Can restart applications	No additional privileges

These passwords should be changed periodically once the network is installed. Consult your local IT personnel or your network administrator for guidance when changing passwords.

WARNING
Use caution when changing the administrator password. If the administrator password is lost, you will not be able to operate the 1420 Wireless Gateway from the administrator role.

Network ID and Join Key

The Network ID and Join key work together to ensure that your network communicates only with itself. These two codes must be identical in the gateway and devices in order for them to communicate. The 1420 Wireless Gateway is capable of generating a random join key, or you may create your own custom Join Key using hexadecimal characters.

Encryption Key Rotation

Another security option in the 1420 Wireless Gateway is Encryption Key Rotation. To enable and configure Encryption Key Rotation, click Setup>Mesh.

TRENDS

Setting Up Trends

Setting up trends is a two part process. First the global Trend Settings need to be configured. This is done on the Setup>Trends>Settings page. On this page you will configure the Maximum series displayed, the Maximum initial samples, the Retained data duration (how long the gateway stores point data for trending), and the View port interval (how much time appears on the graph). When finished, click Submit to put the changes into effect.

New Trend

To begin collecting a trend, click Setup>Trends>Collections. Start by clicking the New Trend button. This will open a new page where the Name, Collection interval and Data retention period are entered. Next, click the New Entry button to select a Point Name. Select the point name from the list, then add a label if desired. This can help identify the measurement separate from just the HART Point Name. Repeat the above steps to add more measurement points to the trend. Click Submit to complete the trend setup.

Edit an Existing Trend

To edit an existing trend, click Setup>Trends>Collections. If there are any active trends, they will appear here. Click the Edit button to edit the trend settings, add or remove measurement points, or change a measurement point's Label. Click Submit when you are finished editing.

Delete a Trend

To delete a trend, click Setup>Trends>Collections. Click the Delete button next to the trend you wish to delete. A confirmation window will pop up. Click OK to delete the trend or cancel to return to the Trend Collections page. Click Return to form to return to the Trend Collections page.

Monitoring Trends

Trends may be monitored in one of two formats, an on-screen graph, or a generated report in Comma Separated Variable (CSV), Excel or XML format.

Graph

To view the graph of a trend, click Monitor>Trend>Graph. This will show the available trend graphs. Click the name of the trend you wish to view. The graph may be customized by zoom level, viewing mode, etc. These settings may be adjusted using the menus at the top of the graph page.

Report

To view a report of a trend, click Monitor>Trend>Report. Choose the trend to report, then select Local Time or Server Time, the Start and End times, and CSV, Excel, or XML format. To finish, click Generate Report.

ORDERING INFORMATION

Model	Product Description
1420	Wireless Gateway
Code	**Power Input**
A	24 VDC
Code	**Output**
1	RS485 + Ethernet
2	RS485 + Redundant Ethernet
3	RS485 + Fiber Optic Ethernet
Code	**Operating Frequency and Protocol**
A1	HART, Self Organizing Network - 2.4 GHz DSSS
A2	HART, Self Organizing Network - 900 MHz FHSS
Code	**RS-485 Communication**
N	No RS-485 Communication
A	Modbus RTU
Code	**Ethernet Communication**
0	Webserver and Modbus TCP/IP
1	OPC with Webserver and Modbus TCP/IP
2	AMS Ready Connectivity with Webserver and Modbus TCP/IP
4	AMS Ready Connectivity with OPC, Webserver and Modbus TCP/IP
Code	**Other Options**
	Software Configuration
C1	Custom Software Configuration
	Product Certifications
N5	FM Division 2, Dust Ignition-Proof
N6	CSA Division 2, Dust Ignition-Proof
N1	ATEX Type n
N7	IECEx Type n
NF	IECEx Dust Ignition-proof
ND	ATEX dust Ignition-proof
	Adapters
J1	CM 20 Conduit Adapter
J2	PG 13.5 Conduit Adapter

Typical Model Number: 1420 A 1 A2 1 N5

ANEXO "E"

BELT CONVEYORS

This data sheets has been revised as indicated below. Please destroy all previous revisions.

Rev. No.	Date	Originator's Name & Initials	Reviewed /Checked By Name & Initials	Description / Issue
A	22Nov05	LAR	WGC	IFR
B	23Jan06	LAR	WGC	IFA
C	10Feb06	LAR	WGC	IFQ
0	27Jun06	L. Arriagada /LAR	W. González/WGC	IFP
1		F. Riffo/ FRC	G. Gutierrez /GGL	IFP

APPROVALS	SIGNATURES	DATE
Lead Engineer:	Gerardo Gutierrez	
Engineering Manager:	Freddie Colón	
Project Manager:	F. M. Caichac	
Client Representative	Kim Hackney	

ISSUED FOR : ☐ Design ☐ Construction ☐ Other _____

Notes for Rev.1:

- Dust Suppression system in conveyor 1100-CV-12001 added
- Modification of pulleys shaft material for conveyor 1100-CV-12001
- Hardness and Thickness modification for some wear plates of 1100-CV-12001 feeding chutes
- Quantity and width modification of walkways

FLUOR

BELT CONVEYORS

DATA SHEET
"A"
Operational Requirements

BELT
CONVEYOR
1100-CV-12001

EQUIPMENT		CRUSHED ORE STOCKPILE FEED CONVEYOR
Quantity required:		One
Tag N°		1100-CV-12001
Service:		Heavy Duty
Design Capacity, dry t/h		1,500
Design Capacity, wet t/h		1,613
Maximum CEMA cross section, percentage		Max. 80%
Belt Speed, m/s		3.0
Belt Width, mm		1,200 (48")
Horizontal Centers Reference, m		Per conveyor drawing Belt Lift
Reference, m		Per conveyor drawing Idler trough angle,
degrees	35	
Belt Scale TAG N°		Not Applicable
Belt Scale accuracy		Not Applicable

MATERIAL CHARACTERISTICS

Description	Crushed gold ore, 93-97% quartz
Moisture content	7% by weight
Ore S.G., t/m3	2.3
Bulk Density, kg/m3	1,400
Maximum particle size, mm	200
Surcharge Angle, degrees	20

Operation Conditions|

Mill Location:	Outdoors
Ambient Temperature Range, °C: (min / max)	See General Site Conditions N° 2352-0000-55TS-001
Relative Humidity, %:	See General Site Conditions N° 2352-0000-55TS-001
Environment:	See General Site Conditions N° 2352-0000-55TS-001
Altitude Above MSL, m:	See General Site Conditions N° 2352-0000-55TS-001
Operating Schedule:	24 h/day - 365 Days/year – 75% Availability

Standard of Project

System of Units	SI Pipes
	Inches

Utilities

Electrical	See General Site Conditions N° 2352-0000-55TS-001, Section 7.1
Plant Air	See General Site Conditions N° 2352-0000-55TS-001, Section 7.2
Instrument	See General Site Conditions N° 2352-0000-55TS-001, Section 7.2

FLUOR

BELT CONVEYORS

DATA SHEET
"A"
Operational Requirements

BELT
CONVEYOR
1300-CV-12001

EQUIPMENT		MILL FEED CONVEYOR
Quantity required:		One
Tag N°		1300-CV-12001
Service:		Heavy Duty
Design Capacity, dry t/h		992
Design Capacity, wet t/h		1,066
Maximum CEMA cross section, percentage		Max. 80%
Belt Width, mm		1066 (42")
Horizontal Centers Reference, m		Per conveyor drawing Belt Lift
Reference, m		Per conveyor drawing Idler trough angle,
degrees	35	
Belt Scale TAG N°		1300-WS-12001
Belt Scale accuracy		+/- 0.25% using two scale idlers

MATERIAL CHARACTERISTICS	
Description	Crushed gold ore, 93-97% quartz
Moisture content	7% by weight
Ore S.G., t/m3	2.3
Bulk Density, kg/m3	1,400
Maximum particle size, mm	200
Surcharge Angle, degrees	20

Operation Conditions|	
Mill Location:	Outdoors
Ambient Temperature Range, °C: (min / max)	See General Site Conditions N° 2352-0000-55TS-001
Relative Humidity, %:	See General Site Conditions N° 2352-0000-55TS-001
Environment:	See General Site Conditions N° 2352-0000-55TS-001
Altitude Above MSL, m:	See General Site Conditions N° 2352-0000-55TS-001
Operating Schedule:	24 h/day - 365 Days/year – 92% Availability Minimum

Standard of Project	
System of Units	SI Pipes
	Inches

Utilities	
Electrical	See General Site Conditions N° 2352-0000-55TS-001, Section 7.1
Plant Air	See General Site Conditions N° 2352-0000-55TS-001, Section 7.2
Instrument	See General Site Conditions N° 2352-0000-55TS-001, Section 7.2

DATA SHEET
"B"
To be completed by Bidder

BELT CONVEYORS

SUPPLIER		CONVEYOR ENGINEERING				
CONVEYOR TAG No.		1100-CV-12001	1300-CV-12001	2200-CV-12001	2200-CV-12002	2200-CV-12003
1	Belt Conveyor Design					
	Capacity wet (MTPH)	1613	1066	248	248	248
	Belt Width (mm)	1220	1067	610	610	610
	Belt Trough Angle (degrees)	35	35	35	35	35
	Belt Speed (m/s)	3.0	2.09	1.63	1.63	1.63
	Horizontal Length (m)	173.7	159.3	27.5	57.3	27.5
	Material Vertical Lift (m)	37.4	11.0	4.4	10.3	3.0
	Calculated kW at drive shaft (kW)	215.4	77.4	8.1	15.0	7.1
	Type of Take-up	Gravity	Gravity	Screw	Gravity	Screw
	Take-up Travel (mm)	3500	3200	600	1150	550
	Amount of Counterweight (kg)	2400	2060	TBA	600	TBA
	Carrying Idler Spacing	1200	1200	1200	1200	1200
	Return Idler Spacing	3000	3000	3000	3000	3000
	Impact Idler Spacing	250	250	250	250	250
2	Drive Unit					
	Motor					
	Manufacturer	Toshiba	Toshiba	Toshiba	Toshiba	Toshiba
	Power (KW)	261	75	22	22	11
	RPM	1800	1800	1800	1800	1800
	Enclosure	TEFC	TEFC	TEFC	TEFC	TEFC
	Isolation class	F	F	F	F	F
	Frame	TBA	TBA	TBA	TBA	TBA
	Speed Reducer					
	Manufacturer	Sumitomo	Sumitomo	Sumitomo	Sumitomo	Sumitomo
	Reducer type	Parallel	Right Angle	Shaft Mounted	Shaft Mounted	Shaft Mounted
	Model Number	PHD9080	PHD9060	HSM307	HSM307	HSM307
	Ratio	20.054	28.6	25.24	25.24	25.24
	No. of reductions	3	3	2	2	2
	Pulley RPM	89.16	63	49	49	49
	Backstop					
	Type	External	External	Internal	Internal	Internal
	Manufacturer	Vulkan	Vulkan	Sumitomo	Sumitomo	Sumitomo
	Model	261-7	261-7	TBA	TBA	TBA
3	Couplings					
	High speed : Manufacturer / Type	Transfluid - Fluid Coupling	Transfluid - Fluid Coupling	Vulkan/ Flexible	Vulkan/ Flexible	Vulkan/ Flexible
	Low Speed : Manufacturer / Type	Vulkan/ Flexible	Vulkan/ Flexible	Vulkan/ Flexible	Vulkan/ Flexible	Vulkan/ Flexible

1

1

DATA SHEET
"B"
To be completed by Bidder

BELT CONVEYORS

SUPPLIER	CONVEYOR ENGINEERING					
CONVEYOR TAG No.	1100-CV-12001	1300-CV-12001	2200-CV-12001	2200-CV-12002	2200-CV-12003	
4 Pulleys						
Manufacturer	Precision	Precision	Precision	Precision	Precision	
Head pulley						
Pulley Diameter (mm)	762	610	610	610	610	
Pulley face width (mm)	1369	1217	710	710	710	
Lag Thickness (mm)	12	12	12	12	12	
Lag material	60 Shore A	60 Shore A	60 Shore A	60 Shore A	60 Shore A	
Shaft material specification	4140	1045	1045	1045	1045	1
Shaft diam. between hubs (mm)	215	171	86	95	90	
Shaft diameter at locking device (mm)	165	125	86	95	90	
Shaft diameter at bearings (mm)	165	125	86	95	90	
Bearing manufacturer	Linkbelt	Linkbelt	Linkbelt	Linkbelt	Linkbelt	
Bearing series	222	222	222	222	222	
Bearing size	165	125	86	95	90	
Bearing L10 life rating	100,000	100,000	100,000	100,000	100,000	
Seal type	TER SKF Taconite seals	TER SKF Taconite seals	TER SKF Taconite seals	TER SKF Taconite seals	TER SKF Taconite seals	
Pillow Blocks manufacturer	Precision	Precision	Precision	Precision	Precision	
Tail pulley						
Pulley Diameter (mm)	614	457	457	457	457	
Pulley face width (mm)	1369	1217	710	710	710	
Lag Thickness (mm)	10	10	10	10	10	
Lag material	45 Shore A	45 Shore A	45 Shore A	45 Shore A	45 Shore A	
Shaft material specification	4140	1045	1045	1045	1045	1
Shaft diam. between hubs (mm)	148	133	75	75	80	
Shaft diameter at locking device (mm)	148	133	75	75	80	
Shaft diameter at bearings (mm)	148	133	75	75	80	
Bearing manufacturer	Linkbelt	Linkbelt	Linkbelt	Linkbelt	Linkbelt	
Bearing series	222	222	222	222	222	
Bearing size	148	133	75	75	80	
Bearing L10 life rating	100,000	100,000	100,000	100,000	100,000	
Seal type	TER SKF Taconite seals	TER SKF Taconite seals	TER SKF Taconite seals	TER SKF Taconite seals	TER SKF Taconite seals	
Pillow Blocks manufacturer	Precision	Precision	Precision	Precision	Precision	
5 Belt Cleaners						
Primary head scraper						
Manufacturer	ASGCO	ASGCO	ASGCO	ASGCO	ASGCO	
Type	Skalper IV	Skalper IV	Skalper IV	Skalper IV	Skalper IV	

DATA SHEET
"B"
To be completed by Bidder

BELT CONVEYORS

SUPPLIER	CONVEYOR ENGINEERING				
CONVEYOR TAG No.	1100-CV-12001	1300-CV-12001	2200-CV-12001	2200-CV-12002	2200-CV-12003
Blade Material	Cast urethane	Cast urethane	Cast urethane	Cast urethane	Cast urethane
Can cleaner be readily removed for servicing?	Yes	Yes	Yes	Yes	Yes
Secondary head scraper Manufacturer	ASGCO	ASGCO	ASGCO	ASGCO	ASGCO
Type	Skalper IV	Skalper IV	Skalper IV	Skalper IV	Skalper IV
Blade Material	Cast urethane	Cast urethane	Cast urethane	Cast urethane	Cast urethane
Can cleaner be readily removed for servicing?	Yes	Yes	Yes	Yes	Yes
Return Belt Plow Manufacturer	ASGCO	ASGCO	ASGCO	ASGCO	ASGCO
Type	Hinged V-plow	Hinged V-plow	Hinged V-plow	Hinged V-plow	Hinged V-plow
Blade Material	Rubber	Rubber	Rubber	Rubber	Rubber
Can cleaner be readily removed for servicing?	Yes	Yes	Yes	Yes	Yes
6 Belting Manufacturer	Phoenix	Phoenix	Phoenix	Phoenix	Phoenix Type
	Polyflex Fabric	Polyflex Fabric	Polyflex Fabric	Polyflex Fabric	Polyflex Fabric
PIW Rating	1250/3	630/3	400/3	400/3	400/3
Length required (m)	353	328	62	124	54
Belt carcass specification	Fabric	Fabric	Fabric	Fabric	Fabric
Cover Specification	Grade Y (RMA I)	Grade Y (RMA I)	Grade Y (RMA I)	Grade Y (RMA I)	Grade Y (RMA I)
Top cover (mm)	5	5	5	5	5
Bottom cover (mm)	3	3	3	3	3
Maximum calculated tension (kN)	108.5	29.6	11.82	20.43	7.9
Breaking Strength (kN/m-width)	1250	630	400	400	400
Belt mass (kg/m)	TBA	TBA	9.1	9.1	9.1
Recommended Take-up Travel	2.0%	2.0%	2.0%	2.0%	2.0%
Recommended Splice Allowance (mm)	3450	2900	2650	2650	2650
7 Idlers Manufacturer	Goodman	Goodman	Goodman	Goodman	Goodman
Carrying Idlers					
Model No.	CSLB36350	CSLB36350	CSLB36350	CSLB36350	CSLB36350
CEMA series	C	C	C	C	C
Roll diameter (mm)	152.4	152.4	152.4	152.4	152.4
Angle of end rolls (degrees)	35	35	35	35	35
Number of rolls	3	3	3	3	3

DATA SHEET
"B"
To be completed by Bidder

BELT CONVEYORS

SUPPLIER	CONVEYOR ENGINEERING				
CONVEYOR TAG No.	1100-CV-12001	1300-CV-12001	2200-CV-12001	2200-CV-12002	2200-CV-12003
Bearing type	Tapered Roller	Tapered Roller	Tapered Roller	Tapered Roller	Tapered Roller
Impact Idlers					
Model No.	DSL36A353	CSL36A353	CSL36A353	CSL36A353	CSL36A353
CEMA series	D	C	C	C	C
Roll diameter (mm)	152.4	152.4	152.4	152.4	152.4
Angle of end rolls (degrees)	35	35	35	35	35
Number of rolls	3	3	3	3	3
Bearing type	Tapered Roller	Tapered Roller	Tapered Roller	Tapered Roller	Tapered Roller
Return Idlers					
Model No.	DSLB160	CSLB160	CSLB160	CSLB160	CSLB160
CEMA series	D	C	C	C	C
Roll diameter (mm)	152.4	152.4	152.4	152.4	152.4
Angle of end rolls (degrees)	N/A	N/A	N/A	N/A	N/A
Number of rolls	1	1	1	1	1
Bearing type	Tapered Roller	Tapered Roller	Tapered Roller	Tapered Roller	Tapered Roller
Transition Idlers					
Model No.	CSLB	CSLB	CSLB	CSLB	CSLB
CEMA series	C6	C6	C6	C6	C6
Roll diameter (mm)	152.4	152.4	152.4	152.4	152.4
Angle of end rolls (degrees)	20 to 35	20 to 35	20 to 35	20 to 35	20 to 35
Number of rolls	3	3	3	3	3
Bearing type	TBA	TBA	TBA	TBA	TBA
Training Carrying Idlers					
Model No.	CSLB36T350	CSLB36T350	CSLB36T350	CSLB36T350	CSLB36T350
CEMA series	C	C	C	C	C
Roll diameter (mm)	152.4	152.4	152.4	152.4	152.4
Angle of end rolls (degrees)	35	35	35	35	35
Number of rolls	3	3	3	3	3
Bearing type	Tapered Roller	Tapered Roller	Tapered Roller	Tapered Roller	Tapered Roller
Training Return Idlers					
Model No.	DSL163T	CSLB160T	CSLB160T	CSLB160T	CSLB160T
CEMA series	D	C	C	C	C
Roll diameter (mm)	N/A	N/A	N/A	N/A	N/A
Angle of end rolls (degrees)	1	1	1	1	1
Number of rolls	Tapered Roller	Tapered Roller	Tapered Roller	Tapered Roller	Tapered Roller
Bearing type	DSL163T	CSLB160T	CSLB160T	CSLB160T	CSLB160T

DATA SHEET
"B"
To be completed by Bidder

BELT CONVEYORS

SUPPLIER	CONVEYOR ENGINEERING					
CONVEYOR TAG No.	1100-CV-12001	1300-CV-12001	2200-CV-12001	2200-CV-12002	2200-CV-12003	
8 Electrical Safety Switches Pull cords						
Manufacturer	CCC	CCC	CCC	CCC	CCC	
Model	PCR(L)-2S & PCD-4S	PCR(L)-2S & PCD-4S	PCR(L)-2S & PCD-4S	PCR(L)-2S & PCD-4S	PCR(L)-2S & PCD-4S	
Enclosure (NEMA)	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	
Maximum rope length (m)	30	30	30	30	30	
Qty	14	14	4	4	4	1
Speed Transmitter						
Manufacturer	Ramsey	Ramsey	Ramsey	Ramsey	Ramsey	
Model	60-12C	60-12C	60-12C	60-12C	60-12C	
Enclosure (NEMA)	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	
Operating range	TBA	TBA	TBA	TBA	TBA	
Belt Misalignment Switches						
Manufacturer	CCC	CCC	CCC	CCC	CCC	
Model	TA-2	TA-2	TA-2	TA-2	TA-2	
Enclosure (NEMA)	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	
Qty	8	8	4	4	4	
Belt Rips						
Manufacturer	CCC	CCC	CCC	CCC	CCC	
Model	TBA	TBA	TBA	TBA	TBA	
Enclosure (NEMA)	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	
Qty (pair)	2	3	1	1	1	
Horns						
Manufacturer	Federal Signal	Federal Signal	Federal Signal	Federal Signal	Federal Signal	
Model	TBA	TBA	TBA	TBA	TBA	
Enclosure (NEMA)	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	
Qty	4	4	2	1	1	1
Lights						
Manufacturer	With Horn	With Horn	With Horn	With Horn	With Horn	
Model	TBA	TBA	TBA	TBA	TBA	
Enclosure (NEMA)	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	
Qty	3	3	2	1	1	1
Plugged Chute switches						
Manufacturer	CCC	CCC	CCC	CCC	CCC	
Model	CT-101	CT-101	CT-101	CT-101	CT-101	
Enclosure (NEMA)	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X	
Actuating angle	1	1	1	1	1	

DATA SHEET
"B"
To be completed by Bidder
BELT CONVEYORS

SUPPLIER	CONVEYOR ENGINEERING				
CONVEYOR TAG No.	1100-CV-12001	1300-CV-12001	2200-CV-12001	2200-CV-12002	2200-CV-12003
9 Belt Scale Equipment TAG N°					
Manufacturer	N/A	Thermo-Ramsey	N/A	Thermo-Ramsey	N/A
Scale System Accuracy		0.25%		0.25%	
Type		2 Idler Scale		2 Idler Scale	
Transmiter					
Model N°	N/A	2001	N/A	2001	N/A
Type		Microprocessor		Microprocessor	
Enclosure		NEMA 4X		NEMA 4X	
Mounting Type		Trunnion frictionless Pivots		Trunnion frictionless Pivots	
Local Indication		4x20 alphanumeric display		4x20 alphanumeric display	
Power Supply		110/120 VAC /50-60 Hz		110/120 VAC /50-60 Hz	
Output Signal		4-20 mA		4-20 mA	
Pulse Output		200,000 counts/hour		200,000 counts/hour	
Width Pulse		TBA		TBA Pulser	
TBA	TBA Temperature Sensitivity			TBA	
TBA					
Load Cell					
Quantity	N/A	2	N/A	2	N/A
Excitation Voltage Operating					
Temperature °C Overload					
Load Cell Construction		Stainless Steel		Stainless Steel	
Carriage					
Model N°	N/A	10- 17-2	N/A	10- 17-2	N/A
Type		Dual idler suspension		Dual idler suspension	
Weighbridge construction		4" x 6" mechanical tubing		4" x 6" mechanical tubing	
Speed Sensor					
Model	N/A	60-12C	N/A	60-12C	N/A
Type		Digital		Digital	

DATA SHEET ‘‘B’’
To be completed by Bidder

BELT CONVEYORS

SUPPLIER: CONVEYOR ENGINEERING

CONVEYOR TAG No.	1100-CV-12001	1300-CV-12001	2200-CV-12001	2200-CV-12002	2200-CV-12003
Mounting		Tail or bend pulley shaft		Tail or bend pulley shaft	
Housing		NEMA 4X		NEMA 4X	
Mounting Hardware		Included		Included	
Calibration					
Chain Weight	N/A	600	N/A	600	N/A
Chain Length		6.7		6.7	
Chain Winch Power		TBA		TBA	
10 Platework					
Lining					
Material	A-36	A-36	A-36	A-36	A-36
Chute and Skirtboard base plate thickness (mm)	10	10	6	6	6
Chute and Skirtboard liner thickness (mm)	32 and 50	30	20	20	20
Hardness (BHN)	500 and 650	500	500	500	500
Skirtboards length (m)	14	51	4	4	4
11 Weights					
Mechanical weight (kg)	29,765	20,460	4,363	5,695	2,693
Electrical weight (kg)	1,908	513	179	216	167
Steel weight (kg)	101,102	44,778	21,139	34,759	22,308
Total conveyor weight (kg)	132,774	65,751	25,680	40,670	25,168

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ANEXO “F”

SKF del Perú S.A.

Oficina principal: Av. República de Panamá 3545, of. 1002, San Isidro
Almacén: Av. Argentina N° 2427 Prov. Conts. Del Callao - **Teléfono:** +51 1 454-0146
Teléfono: +51 1 441-5222 **Fax** +51 1 441-5351 www.skf.com.pe

Numero de Proforma	Cliente	Fecha	Validez	Moneda	Condición de Pago
2013Q24612	19162	2013/01/29	2013/03/01	USD	30 Días fecha Factura US Dolar
	MINERA CHINALCO PERU S.A				
	LOGISTICA LIMA				
	Av. Santo Toribio 143. Lima 2				
	LIMA LIM				

Nro de Linea	Producto Designación	Cantidad	Precio Unitario.	Total Linea	Tiempo de Entrega
Diametro de 11	SDAFS 3160 KATX11	2.00	49000	98000.00	Disponible a 32 semana
	Caja de Chumacera				previa confirmacion
					salvo venta
	23160 CACK/W33	2.00	5926.08	11852.16	Disponible de 4 a 6 semanas
	Rodamiento de Rodillos				previa confirmacion
					salvo venta
	OSNP 3160X11	2.00	11456.47	22912.94	Disponible de 4 a 6 semanas
	Rodamiento de Rodillos				previa confirmacion
					salvo venta
	36053-157	2.00	1873.9	3747.80	Disponible de 6 a 8 semanas
	Anillo Guiador				previa confirmacion
					salvo venta
Diámetro 7.15/16	SAF 544	10.00	4393.81	43938.10	Disponible de 4 a 6 semana
	Caja de Chumacera				7 uni/ 3 restante en consulta
					con fabrica
					previa confirmacion
					salvo venta
	22244 CCK/W33	10.00	1942.62	19426.20	Disponible de 4 a 6 semanas
	Rodamiento de Rodillos				previa confirmacion
					salvo venta
	OSNW 44X7.15/16	10.00	2824.53	28245.30	Disponible 2 uni en stock
	Manguito para Rodamiento				saldo de 6 a 8 semanas
					previa confirmacion
					salvo venta
	TER 167	20.00	1221.73	24434.60	Disponible de 4 a 6 semanas
	Anillo Sellador				previa confirmacion
					salvo venta
Diámetro 5.15/16	SAF 534	14.00	1873.88	26234.32	Disponible de 4 a 6 semana
	Caja de Chumacera				6 uni/ 8 restante en consulta
					con fabrica
					previa confirmacion
					salvo venta
	22234 CCK/W33	14.00	897.93	12571.02	Disponible de 4 a 6 semanas
	Rodamiento de Rodillos				previa confirmacion
					salvo venta
	OSNW 34X5.15/16	14.00	1596.03	22344.42	Disponible de 4 a 6 semanas
	Manguito para Rodamiento				previa confirmacion
					salvo venta
	TER 140	28.00	1018.1	28506.80	Disponible de 6 a 8 semanas
	Anillo Sellador				previa confirmacion
					salvo venta

Diámetro 5.7/16	SAF 532	4.00	1527.91	6111.64	Disponible de 4 a 6 semana
	Caja de Chumacera				previa confirmacion
					salvo venta
	22232 CCK/W33	4.00	765.11	3060.44	Disponible en stock 2 uni
	Rodamiento de Rodillos				4 restante para 24/02/2013
					previa confirmacion
					salvo venta
	OSNW 32X5.7/16	4.00	1733.6	6934.40	Disponible 3 uni en stock
	Manguito para Rodamiento				saldo de 6 a 8 semanas
					previa confirmacion
					salvo venta
	TER 130	8.00	977.46	7819.68	Disponible de 10 a 12 semanas
	Anillo Sellador				previa confirmacion
					salvo venta
Diámetro 6.7/16	SAF 536	6.00	2653.41	15920.46	Disponible de 4 a 6 semana
	Caja de Chumacera				previa confirmacion
					salvo venta
	22236 CCK/W33	6.00	1002.75	6016.50	Disponible de 4 a 6 semanas
	Rodamiento de Rodillos				previa confirmacion
					salvo venta
	OSNW 36X6.7/16	6.00	1840.18	11041.08	Disponible de 4 a 6 semanas
	Manguito para Rodamiento				previa confirmacion
					salvo venta
	TER 148	12.00	1087.78	13053.36	Disponible de 4 a 6 semanas
	Anillo Sellador				previa confirmacion
					salvo venta
Diámetro 4.15/16	SAF 528	6.00	1119.81	6718.86	Disponible de 4 a 6 semana
	Caja de Chumacera				previa confirmacion
					salvo venta
	22228 CCK/W33	6.00	492.89	2957.34	Disponible de 4 a 6 semanas
	Rodamiento de Rodillos				previa confirmacion
					salvo venta
	OSNW 28X4.15/16	6.00	1093.78	6562.68	Disponible de 4 a 6 semanas
	Manguito para Rodamiento				previa confirmacion
					salvo venta
	TER 122	12.00	842.78	10113.36	Disponible de 10 a 12 semanas
	Anillo Sellador				previa confirmacion
					salvo venta
Diámetro 4.7/16	SAF 526	10.00	939.54	9395.40	Disponible de 4 a 6 semana
	Caja de Chumacera				previa confirmacion
					salvo venta
	22226 EK	10.00	379.5	3795.00	Disponible de 4 a 6 semanas
	Rodamiento de Rodillos				previa confirmacion
					salvo venta
	OSNW 26X4.7/16	10.00	978.92	9789.20	Disponible de 4 a 6 semanas
	Manguito para Rodamiento				previa confirmacion
					salvo venta
	TER 117	20.00	661.22	13224.40	Disponible de 10 a 12 semanas
	Anillo Sellador				previa confirmacion
					salvo venta
Diámetro 6.15/16	SAF 538	2.00	3126.39	6252.78	Disponible de 4 a 6 semana
	Caja de Chumacera				previa confirmacion

					salvo venta
	22238 CCK/W33	2.00	1282.26	2564.52	Disponible en stock
	Rodamiento de Rodillos				previa confirmacion
					salvo venta
	OSNW 38X6.15/16	2.00	2061.9	4123.80	Disponible de 4 a 6 semanas
	Manguito para Rodamiento				previa confirmacion
					salvo venta
	TER 155	4.00	1130.95	4523.80	Disponible de 4 a 6 semanas
	Anillo Sellador				previa confirmacion
					salvo venta
Diámetro 9.1/2	SDAFS 3152 KATX9.1/2	12.00	35500	426000.00	Disponible a 32 semana
	Caja de Chumacera				previa confirmacion
					salvo venta
	23152 CACK/W33	12.00	4718.49	56621.88	Disponible de 12 a 15 semanas
	Rodamiento de Rodillos				previa confirmacion
					salvo venta
	OSNP 3152X9.1/2	12.00	4817.98	57815.76	Disponible de 6 a 8 semanas
	Rodamiento de Rodillos				previa confirmacion
					salvo venta
	36053-114	12.00	1978.89	23746.68	Disponible de 12 a
	Anillo Guiador				previa confirmacion
					salvo venta
Diámetro	SDAFS 3184	2.00	122000	244000.00	Disponible a 32
	Caja de Chumacera				previa confirmacion
					salvo venta
	23184 CKJ/W33	2.00	16150.78	32301.56	Disponible a 22
	Rodamiento de				previa confirmacion
					salvo venta
	OSNP 3184X15.3/4	2.00	21962.67	43925.34	Disponible de 6 a 8
	Manguito para				previa confirmacion
					salvo venta
	36053-160	2.00	2611.13	5222.26	Disponible de 6 a 8
	Anillo Guiador				previa confirmacion
					salvo venta
Diámetro	SAFS 544	2.00	25160.95	50321.90	Disponible de 4 a 6
	Caja de Chumacera				7 uni/ 3 restante en

					con fabrica
					previa confirmacion
					salvo venta
	22244 CCK/W33	2.00	1942.62	3885.24	Disponible de 4 a 6
	Rodamiento de				previa confirmacion
					salvo venta
	OSNW 44X7.15/16	2.00	2824.53	5649.06	Disponible de 6 a 8
	Manguito para				previa confirmacion
					salvo venta
	TER 167	4.00	1221.73	4886.92	Disponible de 4 a 6
	Anillo Sellador				previa confirmacion
					salvo venta
Diámetro	SDAFS 30/500	10.00	115000	1150000.00	Disponible a 32
	Caja de Chumacera				previa confirmacion
					salvo venta
	230/500 CAK/W33	10.00	11668.35	116683.50	Disponible a 22
	Rodamiento de				previa confirmacion
					salvo venta
	OSNP	10.00	29720.47	297204.70	Disponible de 6 a 8
	Rodamiento de				previa confirmacion
					salvo venta
	36053-165	5.00	2680.98	13404.90	Disponible de 6 a 8
	Anillo Guiador				previa confirmacion
					salvo venta
Diámetro 12	SDAFS 3164	6.00	62000	372000.00	Disponible a 32
	Caja de Chumacera				previa confirmacion
					salvo venta
	23164 CACK/W33	6.00	6548.43	39290.58	Disponible de 4 a 6
	Rodamiento de				previa confirmacion
					salvo venta

	OSNP 3164X12.	6.00	9839.72	59038.32	Disponible de 6 a 8
	Manguito para				previa confirmacion
					salvo venta
	A 8970	6.00	2021.24	12127.44	Disponible de 6 a 8
	Anillo Guiador				previa confirmacion
					salvo venta
Grasa	LGGB 2/180	2.00	3483.03	6966.06	Disponible a 16
	Grasa				previa confirmacion
					salvo venta

ANEXO “G”

Miraflores, 21 de Febrero del 2013 VA-227-02-13

Sres. : MINERA CHINALCO

PERÚ S.A. Att. : Ing.

Aldo Cabanillas

Ref. : Cotización de Tx Wireless y RTDs

Estimados Señores:

En atención a su amable solicitud, adjunto encontrarán nuestra oferta, la misma que está sujeta a las siguientes condiciones comerciales:

	Pedido	**: Local**
	Lugar de entrega	: En sus Almacenes en Lima
	Tiempo de Entrega	: 06 Semanas, por confirmar con su O/C.
	Forma de Pago	: Factura a 30 Días
	Vigencia	: 30 Días
	Precios	: En Dólares Americanos
Nota:		
Nuestros proveedores no aceptan penalidades por lo que VAMSAC tampoco podrá aceptarlas en caso de que su O/C tenga esta cláusula por defecto, por favor enviar un e-mail dejándola sin efecto.		
Se adjunta T & C de VAMSAC.		

En caso de vernos favorecidos por su amable orden de compra, ésta deberá reflejar nuestras condiciones comerciales. Agradeceremos colocarla a:

VAMSAC
Calle Juan Alfaro #227
Miraflores - Perú

Sin otro particular de momento nos reiteramos de ustedes.

Atentamente,

Ing. Marybel Alférez
Dpto. Comercial
nk

LISTA DE EQUIPOS

<table>
<tr><th>Item</th><th>Cant</th><th>Descripción</th><th>P. Unitario US$</th><th>P. Total US$</th></tr>
<tr><td>1</td><td>1</td><td>
<table>
<tr><th>Qty</th><th>Equipos para Control de Temperatura
Descriptio</th></tr>
<tr><td>3</td><td>High Density Temperature Measurement Family
Model: 848TXNAS002WA3WK1B6HA2Q4
Wireless
ROSEMOUNT</td></tr>
<tr><td>3</td><td>Power Module to 848T Transmitter
ROSEMOUNT</td></tr>
</table>

<u>Complete description 848T:</u>
High Density Temperature Measurement Family
Model : 848TXNAS002WA3WK1B6HA2Q4
848T Product Description: High Density Temperature Measurement Family
X Communications Protocol: Wireless
NA Product Certification: No Approval
S002 Input Type: Input Type, RTD's, and 4-20 mA
WA3 Rate, Freq, Protocol: User Configurable Transmit Rate, 2.4GHz DSSS WirelessHART
WK1 Antenna and Power Options: Omnidirectional, Integral Antenna, Long Life Power Module Adaptor, Intrinsically Safe
B6 Mounting Kit Options: Mounting Bracket for 2-in. pipe mounting and for panel mounting -SST bracket and bolts
HA2 Enclosure Options: Aluminum with Conduit Entries (5 plugged holes, suitable for installing 1/2-in. NPT fittings)
Q4 Calibration Certification: 3 Point Calibration Certificate Provided
ROSEMOUNT

848T
No se incluye los RTD’s.
</td><td>22,649.00</td><td>22,649.00</td></tr>
</table>

EMERSON Process Management

SYSTEM CERTIFICATION ISO 9001 SGS

Item	Cant	Descripción	P. Unitario US$	P. Total US$
2	1	**Temperature Transmitter** **Model : 648DX1D1NAWA3WK1B5Q4XA** 648 Product Description: Temperature Transmitter D Transmitter Type: Wireless Field Mount X Output: Wireless 1 Measurement: Single-Sensor D Housing: Dual compartment housing Aluminum 1 Conduit_Threads: 1/2 -14NPT NA Certifications: No Approval WA3 Wireless Update Rate, Operatng Freq: User Configurable Update Rate, 2.4GHz DSSS, WirelessHART WK1 Antenna and SmartPower: Long Range, Integral Antenna, Long Life Power Module Adapter, Intrinsically Safe B5 Mounting Bracket: Universal "L" mounting bracket for 2-inch pipe mounting - SST bracket and bolts Q4 Calibration Certificate: Calibration Certificate (3-Point Calibration with Certificate) XA Sensor Options: Assemble to Transmitter, Sensor Specified Separately Include: - Power Module **Thin-Film Platinum RTD Sensor** **Model: 0068N21N00N040V1XA** 68 Product Description: Thin-Film Platinum RTD Sensor N Sensor Lead Wire Termination: Sensor Only with 6-inch; Teflon-insulated; 22-gauge lead wires 21 Sensor Type: Spring-Loaded Style N Extension (Extension Type; Material: None 0 Extension Length: 0.0 inches N Material: No Thermowell Required 40 Sensor Immersion Length (inches): 4.0 V1 V Calibration Option: Calibration Option:Callendar-van Dusen Constants 0 to 100 deg C (32 to 212 deg F) XA Assemble To Options: Assemble Conn. Head &/or Transmitter to Sensor Assy **ROSEMOUNT** 	3,912.00	3,912.00

ANEXO “H”

FOTOS DE MONTAJE

1.- Gateway Emerson 1420 A

Ubicación; Costado de Control Room
Planta Gold Mill
Minera Yanacocha

2.- Transmisor Wireless Rosemount 648 -Bridge

Ubicación: Ingreso Tunel de Faja 1300-CV-1201
Planta Gold Mill - Minera Yanacocha
TAG:TIT-131227

3.- Transmisor Wireless Rosemount 848

Ubicación: Ingreso Tunel de Faja 1300-CV-1201
Planta Gold Mill-Minera Yanacocha
TAGS:TIT-1312129,1312131,1312125

4.- Sensor de Temperatura Rosemount RTD 0068

Ubicación: Poleas de cola , cabeza,contrapeso y reductor de velocidad de faja 1300-CV-1201
Planta Gold Mill-Minera Yanacocha
TAGS:TE-1312129 (A,B,C,D)
TAGS:TE-13121131 (A,B,C,D)
TAGS:TE-13121125 (A,B)

EMERSON
Process Management

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